UNIVERSITY OF OKLAHOMA

GRADUATE COLLEGE

HUMAN PAPILLOMAVIRUS (HPV) KNOWLEDGE, BELIEFS, AND VACCINE UPTAKE AMONG UNITED STATES AND INTERNATIONAL COLLEGE STUDENTS

A THESIS

SUBMITTED TO THE GRADUATE FACULTY

in partial fulfillment of the requirements for the

Degree of

MASTER OF SCIENCE

By

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Norman, Oklahoma

2020

HUMAN PAPILLOMAVIRUS (HPV) KNOWLEDGE, BELIEFS, AND THE VACCINE UPTAKE AMONG UNITED STATES AND INTERNATIONAL COLLEGE STUDENTS

A THESIS APPROVED FOR THE

DEPARTMENT OF HEALTH AND EXERCISE SCIENCE

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Abstract

Introduction: Human Papillomavirus (HPV) infection is the most common sexually transmitted infection worldwide and is associated with different types of cancer in both men and women (CDC, 2016). Nearly all sexually active individuals who has not had the HPV vaccine will get the HPV infection at least once in their lifetime (CDC, 2016). HPV vaccination is the primary prevention strategy for HPV-related infections and cancers. The HPV vaccination rate among male and female adults aged 22-26 years is 13.5% and 46.6% respectively (CDC, 2018e). The purpose of this study was to compare knowledge about HPV and HPV vaccine, beliefs of college students towards HPV, and HPV vaccine uptake between US and International college students studying in the US.

Methods: The study was conducted among 588 graduate and undergraduate students in a University setting. The study measures included demographics, HPV and HPV vaccine awareness, HPV knowledge, HPV vaccine knowledge, HPV beliefs, and HPV vaccine uptake. HPV knowledge scale and HPV belief scale were derived from previously validated measures and HPV vaccine knowledge was adapted from other studies. Data was collected via an online survey using Qualtrics. The survey link was sent to students at a Southwestern University with active email addresses via campus-wide email. Participants who chose to enter an incentive drawing were randomly selected, and 30 participants received an e-gift card or check. Data were collected between November 2019 to January 2020. After checking descriptive statistics and differences between completed and missing responses, independent sample t-test, chi-square test, logistic regression and multiple regression were performed in SPSS.

Results: A significant difference was found in HPV awareness, HPV vaccine awareness and HPV vaccine uptake between the US and international college students. HPV and HPV vaccine

awareness and HPV vaccine uptake were higher among US college students than international college students. However, there was no difference in HPV knowledge, HPV vaccine knowledge and HPV beliefs between US and international college students. US students, females, and sexually active persons were more likely to have heard about HPV. Similarly, females, White (compared to Asian), and people with higher age were predicted to score higher in the HPV knowledge scale. Females and people scoring higher in HPV knowledge scale were more likely to have heard about the HPV vaccine. People with a higher HPV knowledge were predicted to score higher in the HPV vaccine knowledge scale. People with higher HPV and HPV vaccine knowledge scale were predicted to score higher in perceived benefit of HPV vaccine scale and score lower in perceived barrier to get HPV vaccine scale. Females, people with higher HPV knowledge, and people with less perceived barrier belief were more likely to have received the vaccine.

Conclusion: This study aimed to compare the HPV knowledge, beliefs and vaccine uptake among the US and international college students. Unlike many other studies conducted among college students about HPV, this study has particularly considered international students studying in the US. College students are an important target population for HPV and HPV vaccine. This study showed the existing disparities between US and international college students regarding HPV and HPV vaccine awareness, and HPV vaccine uptake. Every year, there are thousands of international students admitted to Universities in US from around the world. College health centers could play a crucial role in raising awareness of HPV and HPV vaccination by organizing various intervention programs. This study found the higher level of HPV knowledge was associated with HPV vaccine uptake. Thus, it is important to raise HPV

awareness and knowledge to reduce HPV-associated infections and cancers that take thousands of lives every year.

Chapter 1

Introduction

Introduction

Human Papillomavirus (HPV) infection is the most common sexually transmitted infection worldwide and is associated with different types of cancer in both men and women (Centers for Disease Control and Prevention [CDC], 2016). HPV is a group of more than 100 types of viruses, of which fourteen high-risk types can cause multiple cancers and two types cause genital warts (World Health Organization [WHO], 2019). HPV is sexually transmitted and is transmitted by skin-to-skin contact from one person to another (WHO, 2019). The use of a condom during sexual intercourse can lower the chance of getting the HPV infection, but it does not fully prevent transmission since the virus can infect areas that are not covered by a condom (CDC, 2017). Nearly all sexually active individuals who has not had the HPV vaccine will get the HPV infection at least once in their lifetime (CDC, 2016). In most cases, a HPV infection does not cause any health issues; however, some infections persist for years and may cause genital warts or cancers (CDC, 2016). People can transmit the virus even when they do not have any signs and symptoms of HPV (CDC, 2016). HPV can cause cervical, vaginal and vulvar cancer in women; penile cancer in men; and oropharyngeal cancer and anal/rectal cancer in both men and women (CDC, 2016). Among these, cervical cancer is the most common HPV-associated cancer in women and oropharyngeal cancer is the most common HPV-associated cancer in men (CDC, 2018a).

More than 90% of all cervical and anal cancer cases can be attributable to HPV. Similarly, 70% of cancers in the vagina and vulva, and 60% of penile cancers are thought to be caused by HPV (CDC, 2018b). Though oropharyngeal cancer has long been considered to be

caused by alcohol and tobacco products, recent studies have shown that almost 70% of all the oropharyngeal cancer cases were attributed to HPV (CDC, 2018b).

HPV vaccination is the primary prevention strategy for HPV-related infections and cancers. The Food and Drug Administration (FDA) has approved three vaccines against HPV namely: Gardasil®, Gardasil®9 and Cervarix®. All these vaccines prevent infection from HPV types 16 and 18; viruses responsible for more than 70% of cervical cancer cases and other HPV-related cancers. In addition, Gardasil® vaccine prevents HPV type 6 and 11, viruses which cause most of the genital warts. Moreover, Gardasil®9 prevents from additional 5 types of HPV (31,33, 45,52 and 58) (National Cancer Institute [NCI], 2015).

The FDA first approved the HPV vaccine in 2006 (CDC, 2018c). The HPV vaccine is recommended by the Advisory Committee on Immunization Practices (ACIP) for the age group of 11 to 12 years; however, the vaccine can be given as early as the age of nine years. For those who initiate vaccination before the age of 15, two doses of the vaccine are recommended, and the vaccines should be administered within 6-12 months of each other. For those who are vaccinated after the age of 15, three-doses of the vaccine are recommended, the first two doses should be administered within 1-2 months, and the third dose should be administered after six months of administering the first dose (NCI, 2015).

ACIP also recommends catch-up vaccination for males and females through age 22 years and 26 years respectively, if they have not taken the vaccine earlier (NCI, 2015). Recently, the US FDA approved the vaccine (Gardasil9) to both men and women aged 27-45 years (CDC, 2018c). As the HPV vaccine is recommended for adolescents, parents are responsible for the personal and medical decisions of their adolescent children at this age (Thompson et al., 2017). In contrast, college-aged individuals are at a stage of life where they make medical decisions

themselves. Hence, targeting college students to receive catch-up HPV vaccination would help increase the vaccination rate by vaccinating those who missed the vaccine during early adolescence (Barnard, George, Perryman, & Wolff, 2017).

A national level survey in US reported around 70% of female adolescent aged 13-17 years have received at least one dose of HPV vaccine, among which 54% have taken all the recommended doses and 66% of male adolescents aged 13-17 years have received at least one dose of HPV vaccine, among which 54% have received all the recommended doses (Walker et al., 2018). In 2016, the HPV vaccination rate among female adults aged 19-21 years was 51.6 and female adults aged 22-26 years was 46.6.%. Similarly, the HPV vaccination rate among male adults aged 19-21 years was 21.2% and male adults aged 22-26 years was 13.5% (CDC, 2018e). Most of the population of this age group represents college students. HPV-related knowledge and perception to getting the vaccine among college students are positively associated (Kasymova, Harrison, & Pascal, 2018). Lack of HPV related knowledge, low perceived risk of getting HPV infection and high level of shame associated with HPV may hinder the efforts for the prevention of HPV infection and HPV vaccine uptake among college students (Kasymova et al., 2018). Their HPV and HPV vaccine knowledge and beliefs may play an important role in their decision of getting the vaccine. Therefore, it is crucial to assess their knowledge and beliefs and how it affects their vaccination decisions.

College students in the US are diverse and represent different races, ethnicities, and cultures. One group of particular interest regarding HPV vaccination is international students. International students come from countries around the world that have various access, policies and program for HPV vaccination. A majority of international students in the US are from China, India, South Korea, and Saudi Arabia. Literature shows that college students in China, India,

Turkey, Vietnam, Cyprus, etc. have a low HPV vaccination rate and less HPV and HPV vaccine knowledge (Farazi, Siahpush, Michaud, Kim, & Muchena, 2018; Kamimura et al., 2018; Koc, 2015; Rashid, Labani, & Das, 2016; Choi, Wong, Lau & Fong, 2018). A study conducted in China among college students (mean age of 20.1 years) showed that the HPV vaccine rate was 27.6% (Choi et al., 2018). Similarly, a study conducted among female college students aged 16-26 years in India showed the HPV vaccination rate was 7%. Being a sexually transmitted infection, the HPV vaccine is sometimes linked with the culture of sexual practices (Allen et al., 2010). People representing different countries and cultures may have different beliefs on HPV and HPV vaccine. A better understanding of the difference in HPV and HPV vaccine knowledge and beliefs among US and international college students is crucial to increase overall vaccination rates and to decrease the transmission of HPV infection.

Significance of the study

Cervical cancer is the most common cancer caused by the HPV virus (WHO, 2019). Worldwide, it is the fourth most common type of cancer in women and the second most common cancer prevalent in women living in less developed countries (WHO, 2019; WHO, 2018). In 2018, approximately 570,000 new cases of cervical cancer were diagnosed, and 311,000 women died of cervical cancer around the world (WHO, 2019). In the US, nearly 43,000 cases of HPV-related cancers are diagnosed each year (CDC,2018a). About 12,000 cervical cancer cases are diagnosed in women and it results in 4,000 deaths every year (CDC, 2017). About 14,800 cases of oropharyngeal cancer are diagnosed in men each year and about 70% of these cancer cases can be linked to HPV (CDC, 2018d).

One out of a hundred sexually active people in the US have genital warts (CDC, 2017). An estimated 360,000 people were affected by HPV-related genital warts every year, before the

introduction of the HPV vaccine (CDC, 2017). Almost 80 million people in the US are infected with HPV. Most of these individuals are in their late teens or early twenties (CDC, 2017). Also, each year 14 million people in the US get infected by HPV among which half of the infection occurs in the age group 15-24 years (Barnard et al., 2017). This age group is at higher risk of getting the HPV infection because of their engagement in risky sexual behaviors which include having multiple sexual partners and practicing unsafe sex (Kasymova et al., 2018).

Despite being the most common sexually transmitted infection worldwide, the HPV vaccination program has not been adopted or given priority throughout the world because of the country's policies and the high cost associated with the vaccine. Not every college-aged individual in the US was raised in a place where there is a HPV vaccination program. Therefore, assessing the awareness and knowledge level on HPV and HPV vaccine and HPV vaccine beliefs among college students, including international college students could help to design a comprehensive intervention program to increase the overall vaccination rates and thereby reduce the prevalence of HPV-associated infections and cancers.

Purpose of the study

Healthy people 2020 targets to raise the HPV vaccination rate among 13-15 years aged population to 80% in the US (U.S. Department of Health and Human Service, 2019). The current HPV vaccination status of adolescents is less than this target (CDC, 2018e). Although there are many studies conducted in US on HPV knowledge and beliefs among college students, to the best of our knowledge, only a few have taken into consideration international students. The findings from this study may help generate information to design interventions to improve the knowledge about HPV and HPV vaccine and to raise the overall HPV vaccine uptake.

The purpose of this study was to compare knowledge about HPV and HPV vaccine, beliefs of college students towards HPV, and HPV vaccine uptake between US and International college students studying in the US.

Research Questions

The research questions for this study include:

1. Is there a significant difference in HPV awareness between the US and International college students?
2. Is there a significant difference in knowledge of HPV between the US and International college students?
3. Is there a significant difference in HPV vaccine awareness between the US and International college students?
4. Is there a significant difference in the HPV vaccine knowledge between the US and International college students?
5. Are there significant differences in HPV beliefs among the US and International college students?
6. Is there a significant difference in HPV vaccine uptake among the US and International college students?

Hypothesis

The hypothesis for this study includes:

1. **Hypothesis 1**
    - Null Hypothesis 1: There is no difference in HPV awareness among the US and International college students.

Research Hypothesis 1: There is a significant difference in HPV awareness among the US and International college students.

2. **Hypothesis 2**
    - Null Hypothesis 2: There is no difference in HPV knowledge among the US and International college students.
    - Research Hypothesis 2: There is a significant difference in HPV knowledge among the US and International college students.
3. **Hypothesis 3**
    - Null Hypothesis 3: There is no difference in HPV vaccine awareness among the US and International college students.
    - Research Hypothesis 3: There is a significant difference in HPV vaccine awareness among the US and International college students.
4. **Hypothesis 4**
    - Null Hypothesis 4: There is no difference in HPV vaccine knowledge among the US and International college students.
    - Research Hypothesis 4: There is a significant difference in HPV vaccine knowledge among the US and International college students.
5. **Hypothesis 5**
    - Null Hypothesis 5: There is no difference in HPV beliefs among the US and International college students.
    - Research Hypothesis 5: There is a significant difference in HPV beliefs among the US and International college students.
6. **Hypothesis 6**

- Null Hypothesis 6: There is no difference in HPV vaccine uptake among the US and International college students.
- Research Hypothesis 6: There is a significant difference in HPV vaccine uptake among the US and International college students.

Delimitations of the study

The delimitations for this study include:

- The study was conducted among students at the University of Oklahoma, Norman campus who had an active OU email address.
- The participants were both male and female graduate and undergraduate students aged 18-30 years.
- Non-probability convenience sampling was used to recruit the participants in the study.
- The online-based survey using Qualtrics was used to collect data.
- Data collection was done on November-January 2019/2020.

Assumptions of the study

The assumptions for this study include:

- Participants understood the survey questions, written in the English language.
- Participants answered the questions honestly and truthfully.
- Participants correctly self-reported the HPV vaccination status.
- Participants were representative of the study population.

Operational Definitions

The operational definitions for this study include:

Human Papillomavirus (HPV): "Human papillomavirus is a member of family Papillomaviridae having a double-stranded DNA genome" (Cohen, Powderly, & Opal, 2017).

HPV vaccine: FDA approved vaccines namely: Gardasil®, Gardasil®9 and Cervarix® (NCI, 2015).

HPV awareness: Heard about Human Papillomavirus.

HPV vaccine awareness: Heard about HPV vaccine.

HPV knowledge: Information about what HPV can cause, how HPV is transmitted, how HPV is diagnosed and how HPV can be prevented.

HPV vaccine knowledge: Information about recommended timing of administration and doses of vaccine, and vaccine effectiveness.

HPV beliefs: HPV beliefs are the; perceived susceptibility of the HPV infection and HPV-associated cancer, perceived seriousness of HPV infection and HPV associated cancers, perceived benefits of the HPV vaccine and perceived barrier of getting the vaccine (Juntasopeepun, Davidson, Chang, Suwan, Phianmongkhol & Srisomboon, 2011).

Student status: Category of student as either US student or international student.

US student: Student who reported themselves as a US student at OU or student who is not enrolled in OU as an international student.

International student: Student who reported themselves as an international student at OU or student who is enrolled in OU as an international student.

HPV uptake: At least one dose of any HPV vaccine (Gardasil®, Gardasil®9 and Cervarix®) (NCI, 2015).

Chapter 2

Literature Review

The purpose of this study was to compare differences between US and international college student's knowledge about HPV and HPV vaccine, beliefs towards HPV, and HPV vaccine uptake. This chapter consists of a review of the literature related to HPV knowledge, HPV vaccine knowledge, HPV beliefs, HPV vaccine beliefs, HPV uptake, methodologies, and theories used in studies, and gaps in research findings conducted among college students in the US and around the world.

Literature Review

For the literature review, articles were searched from university library databases: PubMed, CINAHL, and PsycINFO. These articles were published in the English language between 2014 to 2019. All the studies were conducted among college students; some employed only male or only female samples, while others included both male and female students in their sample. The keywords used for the literature search were HPV knowledge, HPV beliefs, HPV vaccine uptake, and college students. A total of 15 articles are reviewed in this chapter. Seven studies were conducted in different places in the US, seven were conducted outside the US and one study was conducted both in the US and Vietnam. Those studies which were based on the interventions on HPV vaccination or evaluation of interventions are excluded from this review.

HPV and HPV vaccine awareness

HPV and HPV vaccine awareness are the most important determinants of HPV vaccine uptake (Oz et al., 2018). Studies show that the higher awareness level of HPV and HPV vaccine is directly associated with the person's intention of getting the HPV vaccine and not having enough awareness is linked with not getting the vaccine (Oz et al., 2018). Besides, for HPV

vaccination programs to be successful, awareness and acceptance of the HPV vaccine are believed to be required (Zou et al., 2016).

A study conducted in Mississippi showed a majority of female participants (92.4%) had heard about HPV compared to male participants (82.9%) (Barnard et al., 2017). Similar to this finding, a study conducted in South Carolina also indicated that most of the participants (95.3%) and (90.6%) were aware of the HPV and HPV vaccine (Kasymova et al., 2018). However, Jones et al., (2017) revealed that 25% of the ethnically diverse male and female college students aged 18-64 years did not know that men also get infected by HPV (Jones et al., 2017). Findings from a study conducted only among male college students showed that 79.5% of the participants knew about HPV but only 55.8% of the participants knew about the HPV vaccine (Cooper et al., 2018).

In contrast to the findings from studies conducted in the US, in a study conducted among Turkish college students, only 43.7% of the participants had heard about HPV (Oz et al., 2018). Among participants, a comparatively higher number of female students (51%) had heard about the HPV than the male students (33.5%). In addition, only 32.8% of females and 18% of the male students had heard about the HPV vaccine (Oz et al., 2018). A study conducted in India also showed relatively low awareness about HPV and HPV vaccine. Only 45.61% and 44% of the female participants had knowledge and awareness about HPV and HPV vaccine respectively. However, most of the female participants (82.45%) knew about cervical cancer. These numbers were higher compared to the male participants of the study (Rashid et al., 2016). The result from the study conducted in Lebanon showed a good number of participants (36.5%) had not ever heard about HPV before the study (Dany, Chidiac, & Nassar, 2015).

In Turkey, only 12% of the participants from one study had heard about HPV and 10% of the participants responded to HPV as the risk factor for cervical cancer. Moreover, most of the participants (90.9%) did not know the measure to protect themselves from HPV (Koc, 2015). In a study conducted in Cyprus, the majority (91%) of the students reported that they had heard about HPV (Farazi et al., 2018). The findings from the study conducted among the female college students in Nepal revealed that 71.7% of the participants had the knowledge about HPV however, only 51.8% of the students knew about the HPV vaccine (Sathian et al., 2017). Studies conducted in the US have found moderate to higher HPV and HPV vaccine awareness level whereas studies conducted outside the US showed low HPV and HPV vaccine awareness level (Barnard et al., 2017; Kasymova et al., 2018; Cooper et al., 2018; Koc, 2015; Sathian et al., 2017).

HPV and HPV vaccine knowledge

Knowledge of HPV and HPV vaccine can increase the success of HPV vaccination programs (Oz et al., 2018). Moreover, the lack of HPV knowledge is associated with the increase in the risk of transmission of HPV infection (Kasymova et al., 2018). Insufficient knowledge of HPV and HPV vaccine can also be linked to low vaccination rates (Zou et al., 2016).

To measure the HPV and HPV vaccine knowledge different studies have used different knowledge scales. However, most studies have used a certain number of statements to access the participant's knowledge. For every correct statement, a participant would get one point, and the overall scale score is calculated via the average score of a knowledge test among the participants.

A recent study conducted in South Carolina measured the HPV and HPV vaccine knowledge of college students on an eighteen-point scale. It showed a moderate level of knowledge (8.9/18) about overall HPV among the participants. In the same study, the knowledge

level among the female participants (9.2/18) was significantly higher than the knowledge level of male participants (7.2/18) (Kasymova et al., 2018). In contrast, Barnard et al., (2017) did not find any significant difference in the knowledge level about HPV among male and female participants. Female and male participants had the mean knowledge score of 11.87/18 and 11.99/18 respectively when measured by an 18-point knowledge scale, the higher score representing higher knowledge level (Barnard et al., 2017).

Dany et al., (2015) study conducted among female college students in Lebanon which showed the overall knowledge of the participants about HPV and HPV vaccine was poor to moderate (52.7/100) (Dany et al., 2015). A study conducted in India found that the female participants had more knowledge about HPV, HPV vaccine and cervical cancer than the male participants (Rashid et al., 2016). In contrast to this result, the result from the study conducted in Turkey indicated that the mean knowledge score about HPV among the male participants was higher (7.9/15) than the female students (7.1/15). However, the mean knowledge score about the HPV vaccine was higher in female participants (3.6/9) than male participants (3.4/9) (Oz et al., 2018). Another study conducted in Turkey indicated that the majority of the participants (85.8%) did not know when to get the HPV vaccine. Also, 37.5% of the participants reported not having enough knowledge about the HPV vaccine (Koc, 2015). A cross-sectional study conducted in Cyprus among 178 students found most participants have moderate knowledge about HPV (23.32/33), cervical cancer (8.12/13) and HPV vaccine (9.25/14) (Farazi et al., 2018). A study conducted to compare the knowledge and belief of Vietnam and US college students found that the Vietnamese students had a lower level of knowledge about HPV compared to the U.S students (Kamimura et al., 2018).

Findings from different studies conducted among college students revealed that knowledge of HPV and HPV vaccine is commonly low to moderate, which acts as a barrier to vaccine uptake. Vaccination campaigns should seek to increase participant's knowledge about HPV and HPV vaccine in order to raise vaccination rates.

HPV Beliefs

A positive attitude towards the HPV vaccine and higher perceived susceptibility of HPV infection is associated with the person's intention of getting the vaccine. Low perceived risk of getting the HPV infection is considered as a barrier to HPV vaccine uptake (Kasymova et al., 2018).

Jones et al., (2017) conducted a study among minority college students in the US. They found that most of the participants (54%) believed that they did not have a risk of getting HPV. Moreover, the majority of the participants (71%) believed that condom use can prevent the transmission of the HPV virus (Jones et al., 2017). Likewise, another study also found that the majority of the participants had low perceived susceptibility of getting an HPV infection. Less than a quarter of participants only, reported that they are at risk of acquiring HPV during their lifetime. Most of the male participants (90%) reported that they had not seriously thought about getting the HPV vaccine (Barnard et al., 2017). A study showed that a majority of the participants believed that they would feel shame if they get an HPV infection (Kasymova et al., 2018). Another study revealed that the majority of the participants (66.8%) reported that the HPV vaccine is highly important. However, most of them (71%) responded that they do not intend to get the vaccine (Cooper et al., 2018). Similar to this finding, a study result indicated that the majority of the participants (65%) would take the vaccine if all doses of the vaccine were free of cost (LaJoie, Kerr, Clover, & Harper, 2018).

In the study conducted in Lebanon, more than half of the participants (59.8%) did not believe that they are susceptible to getting the HPV infection. However, most of the participants (62.1%) believed that female college students are susceptible to getting HPV and so, they should get the HPV vaccine. Also, the mean attitude score of 2.47+/-0.05 reflects the positive attitude of participants towards HPV and HPV vaccine (Dany et al., 2015). Study results showed that only 24.5% of the participants believed that cervical cancer could be prevented. Surprisingly, most of the participants (91.7%) did not believe that vaccine can prevent cervical cancer. Also, 20% of the participants responded that vaccine might have an adverse effect on their health so, they do not want to get the vaccine (Koc, 2015). Another study conducted in India indicated that a significant number of female participants (73.24%) showed a positive attitude towards mandatory HPV vaccine for girls and 63.58% of the male participants also responded positively (Rashid et al., 2016). Findings from the study conducted in Turkey revealed that majority of the participants (54.9%) were willing to get the HPV vaccine (Oz et al., 2018). Studies showed that some students have a low perceived susceptibility of getting the HPV infection which may hinder HPV vaccine uptake among this population. However, most of the studies showed a positive attitude of students towards the HPV vaccine.

HPV vaccine uptake

The HPV vaccine is an important strategy to prevent HPV associated morbidities and mortalities. Despite this fact, the HPV vaccination rate is still low among adolescents and adults in the US (CDC, 2018e).

A study conducted among 18-32 years female undergraduate students showed more than half of the participants (57.5%) had taken at least one dose of the HPV vaccine. Among those who had taken at least one shot of the vaccine, almost three-fourths (72.6%) of them had

completed all the three-dose of the HPV vaccine. However, a good number of participants (42.5%) had not received even a single dose of vaccine (Winger, Christy, & Mosher, 2016). Similarly, Rohde et al., (2018) found that about 60% of both male and female college students aged 19-26 years had taken at least one shot of the HPV vaccine and 40% of the participants had not taken the vaccine. Among those who had taken the vaccine, almost half (49%) had completed all the three-dose of the vaccine (Rohde et al., 2018). The findings from the study conducted among minority college students revealed that many male participants (72%) had not received the HPV vaccine compared to the female participants (61.6%). However, among those who had taken the vaccine only 20% have completed the three-dose series of the vaccine (Jones et al., 2017). A recent study conducted in South Carolina found that majority of both male and female participants aged 18-31 years (64.1%) had taken at least one dose of the HPV vaccine (Kasymova et al., 2018). The study conducted among 383 participants showed lower HPV vaccination uptake. Most of the male participants (84.2%) had not taken the HPV vaccine and most female participants (52.7%) had not taken the HPV vaccine (Barnard et al., 2017). Another similar study showed that 46% of the participants had taken all three doses of the HPV vaccine (LaJoie et al., 2018).

In contrast to the studies conducted in the US, those studies which were conducted outside the US reported a lower vaccination rate. The study conducted among the 1180 Turkish college students aged 18-30 years showed a very low HPV vaccination rate among both males (0.4%) and female (1.5%) students (Oz et al., 2018). Dany et al., (2015) revealed that the majority of the participants (83.5%) had not taken the HPV vaccine. The results from the study conducted in India reported that only 7% of the female participants aged 16-26 years had taken the HPV vaccine (Rashid et al., 2016). Another study conducted in Turkey found that 99.7% of

the participants (mean age 20.4 years) had not received the HPV vaccine (Koc, 2015). In the cross-sectional study conducted in China among 888 male and female college students (mean age =20.1; SD=1.5), only 27.6% of the participants had received the HPV vaccine (Choi et al., 2018). A study conducted among US students and Vietnamese students found that the vaccination uptake among Vietnamese students was much lower (7.5%) than those of the US students (42%) (Kamimura et al., 2018).

The HPV vaccination rates reported in the studies conducted in the US are consistent with the national average of HPV vaccination rate. The HPV vaccination rate is not satisfactory, and it needs to be increased in a considerable amount to ensure the fall in HPV associated mortality and morbidity. However, studies conducted outside the US still have a very low vaccination rate and efforts are needed to increase the vaccination rate in this population.

International students and HPV

Literature is scarce about HPV knowledge and beliefs of international students in the US (Oz et al., 2018). A recent study conducted among 449 Chinese college students (mean age 23.3 years; SD=3.4) studying in the US showed that 38% of the participants had received at least one dose of the HPV vaccine and 22% had received all three doses of vaccine. Among those who had received the vaccine, 92.4% had received the vaccine in the US (Tung, Lu, Qiu & Ervin, 2019). The study conducted among male undergraduate students in the US found an insignificant relation of international student status (predisposing factor) to vaccine completion (Lee, Lust Vang & Desai, 2018). Similarly, the study conducted among Asian American Pacific Islander undergraduate students also revealed that being born in the US was a significant predictor of HPV vaccine uptake (Lee, Kwon, Vang, DeWolfe, Kim, Lee & Yeung, 2015).

The HPV vaccination rates of many developing and low-income countries is low (Oz et al., 2018). WHO report indicates that by March 2017 only 71 countries around the world had introduced the HPV vaccine for girls in their national immunization programs and only a few i.e. eleven countries had for boys also (WHO, 2017). This means many countries around the world still do not have HPV vaccination program even though HPV-associated infections and cancers are prevalent throughout the world. Though the HPV vaccine is recommended in the US, there is no mandatory vaccination policy for US students. However, some states have their own policy of vaccine requirements for school students (Henry J Kaiser Family Foundation [KKF], 2018). For international students in the US, there is no mandatory vaccination policy for HPV as they have for Diphtheria, Pertussis, Tetanus, Hepatitis B, and other vaccines. As a result, international students may not request the HPV vaccine even when the recommended vaccination cost is covered by many private health insurance plans (NCI, 2018).

Use of Theory in Literature

Among the 15 studies that are reviewed here, all but three have not mentioned the use of any health behavior theory in their study (Barnard et al., 2017; Cooper et al., 2017; Kasymova et al., 2018). A cross-sectional study conducted among undergraduate students had mentioned the use of the Precaution Adoption Process Model (PAPM) to explore the knowledge of the participants about HPV and HPV vaccine and to identify associated factors for the vaccine uptake (Barnard et al., 2017). They claimed it was the first study to use the PAPM model in exploring the status of decision making about HPV vaccination among college students. The findings from this study suggested that majority of those participants who had not taken the vaccine were in stage I (unaware) and stage II (unengaged) of the PAPM (Barnard et al., 2017). A study conducted to assess awareness about HPV, sexual behaviors and HPV vaccination

intention of male college students used a previously developed instrument for their survey (Cooper et al., 2017). They have mentioned that the survey instruments which were previously developed were based on the constructs from Health Belief Model (HBM) and Social Cognitive Theory (SCT) however, they have not pointed out which constructs of these theories were used in developing the survey (Cooper et al., 2017). In the study conducted in South Carolina, the importance of HBM constructs in understanding the behavior of college students is highlighted however it is not clear from the article whether they have used the theory in their study or not (Kasymova et al., 2018).

Methodology of previous studies

Most of the literature reviewed here used a cross-sectional study design. A self-administered online and paper-based survey had been used for data collection. All the studies were conducted in university settings among college students except one which was conducted in the community setting with undergraduate college students. They conducted a face-to-face interview for the data collection process (Sathian et al., 2017). Five studies used a paper-based self-administered questionnaire to collect the data (Koc, 2015; Rashid et al., 2016; Kasymova et al., 2018; Farazi et al., 2018; Kamimura et al., 2018). Six studies used an online-based self-administered questionnaire for data collection (Barnard et al., 2017; Oz et al., 2018; Dany et al., 2015; LaJoie et al., 2018; Winger et al., 2016; Rohde et al., 2018). Three studies did secondary data analysis from the large project for their study purpose (Jones et al., 2017; Choi et al., 2018; Cooper et al., 2018). Nine of the studies were conducted among both male and female college students. Five were conducted only among female college students (Koc, 2015; Dany et al., 2015; Winger et al., 2016; Sathian et al., 2017). Only one study was conducted among male college students (Cooper et al., 2018). The total sample sizes of these studies ranged from 190 to

1580 participants (Cooper et al., 2018; Rashid et al., 2016). Most of the studies used non-probability convenience sampling for the data collection purpose.

Gaps in research findings

Based on the literature reviewed here, there is not much literature available on student knowledge, perception, and uptake of HPV and HPV vaccine conducted outside the US specifically between 2014-2019. Also, there is not enough literature available that is conducted among international students studying in US. College students need educational intervention to increase their knowledge and belief about HPV and HPV vaccine. Moreover, interventions should be planned in college settings to increase HPV vaccination uptake.

Summary

The studies conducted among college students in the US showed that most of the participants had heard about the HPV followed by the HPV vaccine. Also, the studies found that the participants had moderate knowledge when they calculated the mean value of the knowledge score of the participants. However, studies conducted outside the US found a relatively lower level of knowledge and in some studies, many participants had not heard about HPV and HPV vaccine prior to the study. In comparison to male and female participants in the studies reviewed here, comparatively majority of the female had heard about HPV and HPV vaccine in all studies. Also, female participants had a higher mean score for knowledge. Not surprisingly, female participants also had higher HPV vaccination rate than the male participants. The HPV vaccine uptake rate varied in different studies; in some studies, conducted in the US majority of the participants had taken at least one dose of the vaccine whereas in others majority of the participants had not taken even a single dose of the vaccine. In contrast, studies conducted outside the US showed that the HPV vaccination status outside the US is comparatively poor, as

low as 0.4% (Kamimura et al., 2018). Many studies showed that the perceived susceptibility of the students to getting the HPV infection was low which might act as a barrier to getting the vaccine. Most of the studies reviewed here did not use any health behavior theory in their study. Most of the studies were based on the cross-sectional study design where they have either had used a paper-based self-administered questionnaire or web-based self-administered questionnaire. Only one study conducted a face-to-face interview for data collection (Sathian et al., 2017).

Chapter 3

Methodology

The primary purpose of this study was to compare the findings between US and international college students regarding knowledge about HPV and HPV vaccine, HPV beliefs, and HPV vaccine uptake. This chapter includes an overview of the methodology that was used in this study including sample, sample size, sampling technique, research design, data collection tools and techniques, data collection procedures, data management, and analysis techniques.

Sample

The sampling frame for this study were students of the University of Oklahoma (OU), Norman campus. The OU Norman campus had a total of 26,605 students including 20,436 undergraduate students enrolled in spring 2019 (The University of Oklahoma [OU], 2019). In Spring 2018, there were 1804 international students enrolled at OU Norman and Tulsa campus combined. Among these, the highest number of students were from China followed by India, South Arabia, South Korea, and Iran (OU, 2018). The total sample for this study were 588; 488 U.S students and 100 international students. Both male and female students were participated in this study. Non-probability convenience sampling was used to recruit the participants in the study. The inclusion criteria for this study were; student having an active OU email and between 18-30 years of age. Studies conducted in the similar setting had also recruited participants aged 18-30 years in their studies (Kamimura et al., 2018; Oz et al., 2018). OU Norman campus students who did not have an active OU email and students aged less than 18 years or more than30 years were excluded from the study.

Data collection tools

The data collection for this study was done by the web-based survey using Qualtrics. The data collection tool consisted of measures including socio-demographic variables, HPV awareness, HPV knowledge, HPV vaccine awareness, HPV vaccine knowledge, HPV belief, and HPV uptake. The measures for some study variables were taken from previously conducted studies in similar settings and for one, the measure was adapted combining the tools used by a few other studies. A brief description of a measure for each variable are described below:

Socio-demographic measure:

The socio-demographic measure consisted of age, gender (male and female), race (White, African American, American Indian, Asian, Others), education level (undergraduate and graduate), student status (US and International) and sexual history (yes and no). (See Appendix A)

HPV Awareness:

HPV awareness was measured by asking if the participants had heard about the Human Papillomavirus. (See Appendix B).

HPV knowledge:

HPV knowledge was measured using a small addition in the previously developed HPV knowledge scale (Kasymova et al., 2018). The scale was used in a study conducted in South Carolina among college students. They used this scale among 256 participants (male and female college students), the scale showed strong internal consistency in their study (α=.79) (Kasymova et al., 2018).

The original scale consisted of 18 items which included information about what HPV can cause, how HPV is transmitted, how HPV is diagnosed and how HPV can be prevented. (See

Appendix C). The original scale did not mention information about penile and oropharyngeal cancer. Thus, for this study, two more statements were added to measure the knowledge about penile and oropharyngeal cancer. Therefore, the HPV knowledge scale consisted of 20 items. Each item of the scale was responded as either “true” or “false”. The correct response was given one point. Thus, the score for HPV knowledge ranged from 0-20. Higher score in the scale indicated higher level of HPV vaccine knowledge.

HPV vaccine awareness:

HPV vaccine awareness was measured by asking participants if they had heard about the HPV vaccine. (See Appendix D).

HPV vaccine knowledge:

The HPV vaccine knowledge measure was developed by combining the measures used by three studies which were conducted in a similar setting with a few changes (Kamimura et al., 2018; Oz et al., 2018; Dany et al., 2015). This tool consisted of eight items. (See Appendix E). Six items in this scale were taken from Kamimura et al., (2018) study, one statement was taken from Dany et al., (2015) study and the remaining one was taken from Oz et al., (2018) study (See Appendix E). Kamimura et al., (2018) study developed the scale using the information available on the Centers for Disease Control and Prevention (CDC) which measured both HPV and HPV vaccine knowledge. For this study, only those items related to the HPV vaccine were taken. The items included information about HPV vaccine dose, vaccine effectiveness, recommended age and gender for vaccination. Participants responded to each item as either "true" or "false". One point was assigned for each correct response on the scale. Thus, the HPV vaccine knowledge score ranged from 0-8. Higher score in the scale represented higher level of HPV vaccine knowledge.

HPV Beliefs:

A 12-item scale was used to measure the HPV beliefs (See Appendix F). This scale was taken from the study conducted among the Thai womens (Juntasopeepun et al., 2011). They developed this scale based on the four constructs of the HBM: perceived susceptibility, perceived severity, perceived benefits and perceived barriers (Juntasopeepun et al., 2011).

Health Belief Model (HBM), developed in the 1950s, has widely been used in HPV related researches (Glanz et al., 2015). HBM constructs predict people action in preventing and detecting health issues. People are likely to change their behavior if they perceive that they are susceptible to a condition (perceived susceptibility), if they know that the condition could have serious effect (perceived severity), if there are known benefits of performing a behavior (perceived benefits), if the benefits of performing a behavior overweighs the barriers to perform a behavior (perceived barrier) and if there is a way to perform a behavior (cues to action) (Glanz et al., 2015).

A few changes were made on the scale to use in this study. Some of the items in the scale were focused only on cervical cancers but HPV also causes many other types of cancers. The cervical cancer statements in the original scale was replaced by HPV-associated cancers. The HPV belief scale was categorized into four factors; perceived benefits, perceived severity, perceived barriers, and perceived susceptibility. The first 4 items in the scale measured perceived benefits belief, the second three items in the scale measured perceived severity belief, the third four items in the scale measured perceived barrier beliefs, and the last two items in the scale measured perceived susceptibility. Each of the items in the scale was responded on a five-point Likert scale ranging from strongly disagree (1), disagree (2), not-sure (3), agree (4) and strongly agree (5). Thus, HPV beliefs score on each item in the scale ranged from 1-5. The score

on the items in each factor were summed to calculate the total belief score in each factor. The scores in these factors ranged from 3-15 (perceived benefits), 3-15 (perceived severity), 4-20 (perceived barriers), and 2-10 (perceived susceptibility). A higher score in the scale represented stronger belief.

HPV Uptake:

The HPV vaccine uptake was measured by asking if the participants had received the HPV vaccine. This also included the number of doses the participant had received. Also, for international students, they were asked to respond if they had received the vaccine in their home country or in the US (See Appendix G).

Research Design

The study used a descriptive cross-sectional design. There were neither any control group in the study, nor it manipulated any of the independent variables in the sample population as it did not intend to explore the cause-and-effect relationship. This study intended to describe the existing condition in the sample population at a point in time. It aimed to compare the current knowledge and beliefs about HPV and HPV vaccine, and HPV vaccine uptake among US and international college students. Hence, a descriptive cross-sectional study design was a best choice in answering the research questions of this study. Other studies conducted on HPV among college students had also used a descriptive cross-sectional study design (Rashid et al., 2016; Farazi et al., 2018; Dany et al., 2015; Sathian et al., 2017).

In this study, one of the possible threats to internal validity was selection. Since participants in this study were recruited using non-probability convenience sampling, the participants could not be the representative of the population. Next, the study relied on the self-reported data, thus, there might be the chance of recall bias.

IRB approval & Pilot testing

The study was approved by the Institutional review board (IRB), the University of Oklahoma, in November 2019. After IRB approval, pilot testing was conducted in November 2019. The pilot test was a paper-based survey. A total of ten participants responded to the pilot survey. The survey was modified based on the feedback received from the survey. First, the HPV beliefs were measured by using a 4-point Likert scale which was later changed to a 5-point Likert scale after the pilot study. Second, student status was assessed by asking the country of citizenship and many responded having dual citizenship, thus, one question was added to ensure if the participant was an international student at OU or not.

Data collection

A survey was developed in Qualtrics (See Appendix H). The data collection was conducted using an online-based survey on Qualtrics between November 2019 to January 2020. Convenience sampling was used to recruit the participants in the study. The principal investigator sent out the survey link two times via mass email to graduate and undergraduate students of the University of Oklahoma, Norman campus. The responses received from the first email, which was sent in November 2019, did not get enough representation from international students as required thus, a second mass email was sent in December 2019. The total responses collected from both attempts was not enough to meet the desired sample for international student hence, the research team coordinated with International Student Services (ISS) to send the survey link to international students only. ISS sent the survey link to the international students in January 2020 and after getting the desired sample the survey was closed in the Qualtrics in January 2020. Upon completing the survey, participants were asked if they want to enter for a drawing. Those who consent for the drawing were sent a separate link to participate for a

drawing to receive one of 30 $15 e-gift card/check. A total of 30 participants selected from the random drawing were provided either $15 Amazon e-gift card or check.

Data Management and Analysis

The data collected by using Qualtrics was exported to statistical package for social science (SPSS) version 24 and stored in the password-protected computer. All the data analysis was conducted on SPSS using descriptive statistics and statistical analysis.

For the socio-demographic measures, the mean and standard deviation was computed for the variable age. Frequencies were calculated for other variables: gender, student status, race, education and sexual history.

For HPV awareness, frequencies were computed for those who had heard about HPV. A chi-square test was computed to find the relationship between HPV awareness and student status. The alpha-level was set at .05. A logistic regression was also computed with outcome variable (HPV awareness) and a set of predictors (sex, age, gender, race, education level, sexual history, and student status).

For the HPV knowledge variable, frequencies were computed for correct responses in each item on the scale. The mean and standard deviation of HPV knowledge score was calculated for each item in the scale and also for the overall HPV knowledge. An independent sample t-test was performed to test the mean differences in HPV knowledge scores among the US and international students. The alpha level was set at 0.05. In addition, a multiple regression model was computed with the outcome variable (HPV knowledge) and predictor variables (age, gender, student status, race, sexual history, and education level).

For HPV vaccine awareness, frequencies were computed for those who had heard about HPV vaccine. A chi-square test was performed for the relationship between HPV vaccine

awareness and student status. The alpha-level was set at .05. A logistic regression was performed with outcome variable (HPV vaccine awareness) and a set of predictors (age, gender, race, education level, student status, sexual history, and HPV knowledge).

For HPV vaccine knowledge, frequencies were computed for correct responses in item on the scale. The total mean and standard deviation of the scores of each item on the scale was computed. An independent sample T-test was performed to test the mean difference in HPV vaccine knowledge between US and international students. The alpha level was set at .05. A multiple regression was computed with the outcome variable (HPV vaccine knowledge) and a set of predictor variables (age, gender, education level, student status, race, sexual history, and HPV knowledge).

For the HPV belief variable, which was measured by the 5-point Likert scale, the frequencies were computed for each item on the scale indicating the number of participants who responded as either 'strongly disagree', 'disagree', 'not-sure', 'agree' and 'strongly agree'. The total mean score and standard deviation for each item on the HPV belief scale was also computed where the score in each item ranged from 1-5. Higher mean value represented the higher belief of participants towards HPV. The items in the scale was categorized into four factors; perceived benefits, perceived severity, perceived barriers and perceived susceptibility. An independent sample t-test was computed to test the mean difference on each of these factors between the US and international college students. The alpha level was set at .05. Multiple regressions were computed for each of these four factors separately. The dependent variable was each of these factors and set of predictors for all models were age, sex, race, education level, student status, sexual history, HPV knowledge, and HPV vaccine knowledge.

Similarly, for HPV vaccine uptake, the frequencies were computed to find out the percentage of participants who had taken at least one dose of the vaccine and participants who had completed all the series of the HPV vaccine. A chi-square test was used to compare the relationship between HPV vaccine uptake and student status. A logistic regression model was performed with the outcome variable (HPV uptake) and predictor variables (age, gender, race, education, student status, sexual history, HPV knowledge, HPV vaccine knowledge, perceived benefits, perceived severity, perceived barriers, perceived susceptibility).

Chapter 4

Results

The primary purpose of this study was to access the difference in Human Papillomavirus (HPV) knowledge, HPV vaccine knowledge, HPV beliefs, and the HPV vaccine uptake among US and international college students. This chapter includes the outcomes from various descriptive and statistical analysis of all study variables.

Data export and cleaning

After closing the survey in Qualtrics, the responses were exported to the SPSS for data analysis in a password protected computer. There was a total of 662 responses recorded, out of which, five did not agree to participate in the survey. Two responses recorded had not responded to any of the survey items. Twenty participants agreed to participate in the survey but did not respond to any of the items in the survey. There was a screening question in the survey, 'Have you heard about the HPV vaccine?' If a participant responded 'no' to this question the survey would end there. Twenty-four participants responded 'Yes' to this question but did not continue further. Thus, after removing these responses, the total recorded responses in the survey was 611.

Missing Data

There were a few missing values in the recorded 611 responses. Thus, a new dichotomous variable was computed, and the 611 responses were categorized as either missing data (1) or complete data (0). The missing data included cases that had at least one missing value and complete data included all such cases which were complete. There were 23 cases with at least one missing value and 588 complete cases. To find out if there was any difference between the missing data and complete data; an independent sample t-test was performed to compare the mean age between missing and complete data, the test result did not show a significant result

t(607)= -.762, *p*= .446, a chi-square test was performed to find the relationship between gender and data type (complete and missing), the test result was not significant $\chi 2(1, N= 609)= .001$, *p*= .971, a chi-square test was performed to find the relationship between race and data type (complete and missing), the test result was not significant $\chi 2(4, N= 611)= 7.902$, *p*= .095, and a chi-square test was performed to find the relationship between education level and data type (complete and missing), the test result was not significant $\chi 2(1, N= 608)= .996$, *p*= .318.

A logistic regression was performed with the dependent variable data type (complete and missing) and a set of predictors (gender, age, race, and education) (see Table 1). The model containing the full set of predictors did not show a significant improvement of fit than a null model, $\chi 2(7)= 7.84$, *p*= 0.347. The Pseudo R-square vale in Cox and Snell R-square and Nagelkerke R-square indicated that the model containing the full set of predictors explained 1.3% and 5.9% of the variance. None of the predictor was significant in the model. Gender (*OR*= 0.20; *CI*= 0.02-1.58), age (*OR*= 0.91; *CI*= 0.71-1.17), race; African American vs. White (*OR*= 3.88; *CI*= 0.75-20.07), American Indian vs. White (*OR*= 0; *CI*= 0), Asian vs. White (*OR*= 1.66; *CI*= 0.43-6.34), and others vs. White (*OR*= 2.04; *CI*= 0.42-9.85) and education (OR= 1.71; *CI*= .31-9.49) were not significantly associated with data type. Hence, these 23 cases with at least one missing value were excluded for further analysis. Thus, 588 samples were included in the data analysis.

Table 1: Parameter estimates from logistic regression predicting data type (complete and missing)

Variables	B	S.E.	Wald	df	Sig.	Odds Ratio	95%CI
Gender Male vs. Female	-1.57	1.04	2.29	1	.129	.206	.027-1.587
Age	-.090	.127	.505	1	.477	.914	.713-1.172
Race							
African American vs. White	1.357	.838	2.62	1	.105	3.88	.752-20.069

American Indian vs. White	-17.34	9604.9	.000	1	.999	.000	.000
Asian vs. White	.507	.684	.550	1	.458	1.66	.435-6.342
Other vs. White	.714	.803	.791	1	.374	2.042	.423-9.851
Education level	.538	.874	.378	1	.538	1.712	.309-9.493
Graduate vs. Undergraduate							
Constant	-1.834	2.557	.514	1	.473	.160	

Reference group: Female, Undergraduate, & White

Participant's Demographic characteristics

A descriptive analysis was computed with all the study variables (see Table 2). A majority of the participants in the survey were female (76.5%) and 23.5% of the participants were male. Most of the participants were white (69.9%) followed by Asian (14.5%). The mean age of the participants was 21.43 years (SD = 3.12). Within the sample, 79.3% were undergraduate students and 20.7% were graduate students. Eighty-three percent of the participants were US college students and 17% of the participants were international college students. A majority of the participants were sexually active or were sexually active before (72.8%) and 27.2% of the participants were never sexually active. A majority of the participants (91.5%) had heard about the HPV and 8.5% of the participants had not heard about HPV and these participants did not continue the survey. About 84% of the participants had also heard about the HPV vaccine and 16.2% had not heard about the HPV vaccine. Most of the participants (53.5%) reported that they had received the HPV vaccine, 9.5% reported they might have taken the vaccine, and 37% reported that they probably had not received the vaccine or had not received the vaccine. Among those who reported that they had received the vaccine, majority (67.4%) had received three doses of vaccine, 18.1% had received two doses of the vaccine, and 14.6% had received one dose of the vaccine. A majority of the participants (93.1%) who had received the vaccine had received the vaccine in the US.

Table 2: Demographic characteristics of the participants (N=588)

Variables	Number (%)
Age (M, SD)	21.43 (3.117)
Gender	
Male	138 (23.5)
Female	450 (76.5)
Race	
White	411 (69.9)
Black or African American	23 (3.9)
American Indian or Alaska Native	17 (2.9)
Asian	85 (14.5)
Other	52 (8.8)
Education	
Undergraduate	466 (79.3)
Graduate	122 (20.7)
Student status	
US students	488 (83)
International students	100 (17)
Sexual history	
Yes	428 (72.8)
No	160 (27.2)
Have you heard about HPV?	
Yes	538 (91.5)
No	50 (8.5)
Have you heard about the HPV vaccine?	(N=538)
Yes	451 (83.8)
No	87 (16.2)
HPV vaccine Uptake	(N=538)
Yes	288(53.5)
May be	51(9.5)
No + Probably not	199 (37)
Number of vaccine dose	N=288
One	42(14.6%)
Two	52(18.1%)
Three	194(67.4%)
Place of vaccination	N=288
US	268(93.1)
Home country	20(6.9%)
HPV knowledge score (M, SD)	14.8 (2.25)
HPV vaccine knowledge score (M, SD)	7.19 (.84)

HPV Awareness

HPV Awareness statistical analysis

Among 488 US students, 465 (95.28%) had heard about the HPV and among 100 international students, 73 (73%) had heard about the HPV. A chi-square test was performed to access the relationship between the student status and HPV awareness (see Table 3). The test showed a significant relationship between these variables $\chi^2(1, N= 588)= 52.98$, $p < 0.001$. US students (95.28%) were significantly more likely to have heard about HPV than international students (73%).

Table 3: HPV Awareness and Student Status differences

Variables	US student N= 488	International student N=100	*p*-value
	No (%)		
HPV awareness			
Heard about HPV	465 (95.28)	73 (73)	< .001
Had not heard about HPV	23 (4.72)	27 (27)	

A logistic regression was performed with dependent variable HPV awareness and a set of predictors (gender, age, education level, race, student status, and sexual history) (see Table 4). The HPV awareness was binary coded (1= heard about HPV, 0= not heard about HPV). The omnibus test result indicated that the model containing a full set of predictors rejected the null model, $\chi2(9)= 76.72$, $p < .001$. The Hosmer and Lemeshow test result also indicated a good model fit ($p= .77$). The Pseudo R-square vale in Cox and Snell R-square and Nagelkerke R-square indicated that the model containing the full set of predictors explained 12.2% and 27.7% of the variance. Gender (*OR*= 0.32; *CI*= 0.16-0.61) significantly predicted HPV awareness when controlling for other variables in the model. The odds ratio indicated that the odds of having heard about HPV among females was three times more than that of males. Age was not a

significant (*OR*= 1.04; *CI*= 0.88-1.24) predictor of HPV awareness in the model. Education level was also not a significant (*OR*= 1.09; *CI*= 0.31-3.81) predictor of HPV awareness in the model. The comparison between Asian and White only was the significant (*OR*= 0.35; *CI*= 0.16-0.77) predictor of HPV awareness among race. The odds ratio indicated that the odds of having heard about HPV among White participants was approximately three times more than Asian participants. Student status negatively (*OR*= 0.14; *CI*= 0.06-0.31) predicted HPV awareness when controlling for other variables in the model. The odds ratio indicated that the odds of having heard about HPV among US students was seven times more than that of international students. Sexual history also significantly (*OR*= 0.42; *CI*= 0.21-0.83) predicted HPV awareness when controlling for other variables in the model. The odds ratio indicated that the odds of having heard about HPV among sexually active participants was more than two times of those who were not sexually active.

Table 4: Estimates from Logistic regression predicting HPV Awareness

Variables	B	S.E.	Wald	df	Sig.	OR	95% CI
Gender							
Male vs. Female	-1.14	.334	11.71	1	**.001**	.318	0.16-0.61
Age	.041	.088	.216	1	.642	1.042	0.877-1.236
Education							
Graduate vs. Undergraduate	-.083	.640	.017	1	.897	1.086	0.310-3.806
Race							
African American vs. White	19.07	7837.4	.000	1	.998	1916109 88.7	0
American Indian vs. White	-1.6	.821	3.830	1	.050	.200	0.040-1
Asian vs. White	-1.05	.402	6.82	1	**.009**	.350	0.159-0.77
Other vs. White	-.439	.521	.712	1	.399	.645	0.232-1.78
Student status							
International student vs. US student	-1.95	.406	23.20	1	**<0.001**	.142	.064-.314
Sexual history							
	-.871	.350	6.186	1	.013	.419	0.211-0.831

Not sexually active vs. sexually active	

Reference group: Female, White, Undergraduate, US student, Sexually active
[a] Bold value represents significance

HPV Knowledge

HPV Knowledge Descriptive Analysis

Only those participants who had heard about HPV responded to the HPV knowledge scale. There were 20 items on the scale. Participants responded to each item on the scale as True/False. For each correct response, one-point was assigned. The table presents the number and percentage of participants who correctly responded to each item on the scale and the difference between US and international students (see Table 5). A majority of the participants (98%) correctly responded that certain types of HPV can lead to cervical cancer in women. About 98% of the participants correctly responded that HPV can lay dormant in the body for years without symptoms. About 29% of the participants indicated that there is no screening that is commonly used to test males for HPV. A majority (91.8%) of the participants were aware that a person's chance of getting the HPV increases with the number of sexual partners they have. Only 42.4% of the participants responded correctly that nearly all sexually active men and women will contract HPV at some point, 68% correctly responded that HPV can cause penile cancer, 68.2% correctly responded that HPV can cause anal cancer, and 66.9% correctly responded that HPV can cause oropharyngeal cancer. Although 83.3% responded that HPV can cause genital warts, only 42.6% responded that HPV does not cause genital herpes.

A chi-square test was performed to find out the relationship between HPV knowledge item accuracy on each item on the scale and student status (see Table 5). The results indicated that the knowledge score in five items on the scale was significantly different among the US and international college students. The knowledge that there is no cure for HPV was significant, χ^2(1,

N= 538)= .12.926 $p < 0.001$, and higher among US students (m= 0.62, SD= 0.49) than international students (m= 0.80, SD= 0.40). The knowledge that HPV is a very common virus, was significant, χ^2(1, N= 538)= 4.248 p= .039, and higher among US students (m= 0.92, SD= 0.27) than international students (m= 0.85, SD= 0.36). The knowledge that 'HPV infection does not cause genital herpes' was also significant, χ^2(1, N= 538)= 9.449 , p= .002, and higher among US students (m= 0.45, SD= 0.5) than international students (m= .26, SD= 0.44). The knowledge about 'HPV can lay dormant in the body for years without symptoms' was significant, χ^2(1, N= 538)= 6.011, p= .014), and higher among US students (m= .98, SD= 0.14) compared to international students (m= 0.93, SD= 0.25). The knowledge that most people with HPV do not have visible signs and symptoms of the infection, was significant, χ^2(1, N= 538)= 4.049, p=.044, and higher among US students (m= 0.90, SD= 0.30) than international students (m= 0.82, SD= 0.39).

Table 5: HPV knowledge scale correct score of each item

Items (Correct response)	US Student N=465	International student N=73	Total N=538	*p*-value
	Correct response No (%)			
1.Human Papillomavirus… (True)	439 (94.40)	70 (95.89)	509 (86.4)	.602
2.There is a… (False)	374 (80.43)	45 (61.64)	419 (77.9)	**<.001**
3.Having one type of… (False)	451 (96.98)	71 (97.26)	522 (97)	.899
4.There is a….(False)	131 (28.17)	27 (36.98)	158 (29.4)	.124
5.An abnormal pap…(True)	427 (91.82)	63 (86.30)	490 (91.1)	.124
6.Most genital HPV…(False)	158 (33.97)	23 (31.50)	181 (33.6)	.678
7.A person usually…. (False)	399 (85.80)	61 (83.56)	460 (85.5)	.613
8.HPV is not…(False)	429 (92.25)	62 (84.93)	491 (91.3)	**.039**
9.HPV infection can…(True)	388 (83.44)	60 (82.19)	448 (83.3)	.790
10.HPV infection can… (False)	210 (45.16)	19 (26.02)	229 (42.6)	**.002**
11.Certain type of…(True)	455 (97.84)	72 (98.63)	527 (98)	.661
12.HPV can lay…(True)	456 (98.06)	68 (93.15)	524 (97.4)	**.014**
13.A person's chances of…(True)	428 (92.04)	66 (90.41)	494 (91.8)	.636
14.Most people with…(False)	419 (90.10)	60 (82.19)	479 (89)	**.044**
15.Genital warts can…(False)	250 (53.76)	41 (56.16)	291 (54.1)	.702
16.Condom are not…(False)	357 (76.77)	63 (86.30)	420 (78.1)	.067
17.HPV can cause…(True)	321 (69.03)	45 (61.64)	366 (68)	.208

18.HPV can cause…. (True)	321 (69.03)	46 (63.01)	367 (68.2)	.305
19.HPV can cause…(True)	307 (66.02)	53 (72.60)	360 (66.9)	.267
20.Nearly all sexually…(True)	196 (42.15)	32 (43.83)	228 (42.4)	.786

[a] Bold value represents significance

HPV Knowledge Statistical Analysis

The HPV knowledge score ranged from 0-20. The HPV knowledge score of those who had heard about HPV was moderate (m= 14.8, SD= 2.25). An independent sample T-test was performed to compare HPV knowledge among the US and international college students (see Table 6). The t-test result showed that there was no significant difference, t(536)=-1.871, *p*=.062, in the overall HPV knowledge score among US students (m= 14.87, SD= 2.21) and international students (m= 14.34, SD= 2.46).

Table 6: HPV knowledge mean score and student status differences

Variable	**US students**	**International students**	**Total**	***p*-value**
		Mean (SD)		
Total HPV knowledge mean score	14.87 (2.21)	14.34 (2.46)	14.8 (2.25)	.062

A multiple regression was performed to test whether a set of behavioral and demographic variables predict HPV knowledge among college students (see Table 7). HPV knowledge was used as a dependent variable and age, gender, race, education level, sexual history, and student status were used as a set of predictors. The results from the multiple regression model indicated that the set of variables accounted for 5.1% of the variance in the HPV knowledge variable (R^2=.051, $F_{(9,528)}$ = 3.17, p = 0.001). Three of the predictors in the model were a significant predictors of HPV knowledge. Gender was a significant (β= -.52, S.E.= .23, *p*= .027) predictor of HPV knowledge in the model. The result indicated that females were predicted to score higher on HPV knowledge compared to males. Education level was not a significant (β= .05, S.E.= .33,

p= .886) predictor of HPV knowledge in the model. Student status also was not significant (β= -.55, S.E.= .30, *p*= .074) predictor of HPV knowledge in the model. Sexual history was not a significant (β= .009, S.E.= .22, *p*= .966) predictor of HPV knowledge in the model. Only Asian vs. White comparison among Race was a significant predictor of HPV knowledge in the model (β= -.68, S.E.= .31, *p*= .027) indicating that White participants were predicted to score higher on HPV knowledge than Asian participants in the model. Similarly, Age was also a significant (β= .11, S.E.= .043, *p*= **.**010) predictor of HPV knowledge in the model. This indicated that higher age predicted higher HPV knowledge score.

Table 7: Estimates from Multiple regression predicting HPV knowledge

Variables	B	S.E.	Beta	t	Sig.	95% CI
Constant	12.719	.893		14.236	.000	10.964-14.474
Gender						
Male vs. Female	-.523	.236	-.095	-2.222	**.027**	-.986--.061
Education level						
Graduate vs. Undergraduate	.047	.328	.008	.143	.886	-.597-.691
Student status						
International student vs. US student	-.549	.307	-.083	-1.787	.074	-1.153-.054
Sexual history						
Not sexually active vs. sexually active	-.009	.226	-.002	-.042	.966	-.453-.434
Race						
African American vs. White	-.124	.490	-.011	-.252	.801	-1.087-.839
American Indian vs. White	.026	.586	.002	.044	.965	-1.125-1.177
Asian vs. White	-.687	.311	-.099	-2.213	**.027**	-1.298--.077
Other vs. White	-.399	.354	-.049	-1.126	.261	-1.095-.297
Age	.111	.043	.153	2.599	**.010**	.027-.196

Reference group: Female, White, Undergraduate, US student, & Sexually active
[a] Bold value represents significance

HPV Vaccine Awareness

HPV vaccine awareness statistical analysis

Among 465 US students, 397 (85.37%) had heard about the HPV vaccine and among 73 international students, 54 (73.97%) had heard about the HPV vaccine. A chi-square test was performed to access the relationship between a student status (US and international students) and HPV vaccine awareness (see Table 8). The test showed a significant relationship between these variables, $\chi^2(1, N= 538)= 6.05$, $p= .014$. US students (85.37%) were more likely to have HPV vaccine awareness than international students (73.97%).

Table 8: HPV vaccine awareness and student status

Variable	US student N=465	International student N=73	*p*-value
		No (%)	
HPV vaccine awareness			
Heard about the HPV vaccine	397 (85.37)	54 (73.97)	**.014**
Had not heard about the HPV vaccine	68 (14.63)	19 (26.03)	

A binary logistic regression was performed with HPV vaccine awareness as a dependent variable and a set of predictors (gender, age, education, race, student status, sexual history, and HPV knowledge score (see Table 9). The dependent variable HPV vaccine awareness was binary coded (1= heard about the HPV vaccine, 0= not heard about HPV vaccine). The omnibus test result indicated that the model including the set of predictors was significant ($\chi2[10] = 37.849$, $p < 0.001$) over the null model. The Hosmer-Lemeshow test result also indicated a good model fit ($p= .234$). The Pseudo R-square value in Cox and Snell R-square and Nagelkerke R-square indicated that the model containing the full set of predictors explained 6.8% and 11.6% of the variance. Gender was a significant (*OR*= 0.353; *CI*= .213-.586) predictor of HPV vaccine

awareness in the model. The odds ratio indicated that the odds of having heard about HPV vaccine among females was approximately three times more than of males. Age (*OR*= 1.06; *CI*= .944-1.188) and education level (*OR*= .94; *CI*= .393-2.260) were not significant predictors of HPV vaccine awareness in the model. None of the comparison between various races were significant in the model; African American vs. White (*OR*= 0.58; *CI*= .199-1.683), American Indian vs. White (*OR*= 0.39; *CI*= .112-1.377), Asian vs. White (*OR*= 0.63; *CI*= .319-1.263) and Others vs. White (*OR*= 1.09; *CI*= .444-2.697). Student status (*OR*= 0.53 *CI*= .269-1.065) and sexual history (OR= 1.05; *CI*= .603-1.837) were also not a significant predictors of HPV vaccine awareness in the model. HPV knowledge score was a significant (*OR*= 1.16; *CI*= 1.048-1.296) predictor of HPV vaccine awareness in the model. The odds ratio indicated that for every one-unit increase in the HPV knowledge score, the odds of hearing about the HPV vaccine changed by the factor of 1.166.

Table 9: Estimates from Logistic regression predicting HPV vaccine awareness

Variables	B	S.E.	Wald	df	Sig.	Odds Ratio	95%CI
Gender							
Male vs. Female	-1.041	.259	16.180	1	**<.001**	.353	.213-.586
Age	.057	.059	.957	1	.328	1.059	.944-1.188
Education							
Graduate vs. Undergraduate	-.060	.446	.018	1	.894	.942	.393-2.260
Race							
African American vs. White	-.546	.544	1.007	1	.316	.579	.199-1.683
American Indian vs. White	-.937	.641	2.134	1	.144	.392	.112-1.377
Asian vs. White	-.455	.351	1.680	1	.195	.634	.319-1.263
Other vs. White	.090	.460	.039	1	.844	1.095	.444-2.697
Student status							
International student vs. US student	-.625	.351	3.174	1	.075	.535	.269-1.065
Sexual history							

Not sexually active vs. Sexually active	.051	.284	.032	1	.857	1.052	.603-1.837
HPV knowledge score	.153	.054	7.995	1	**.005**	1.166	1.048-1.29

Reference group: Female, White, Undergraduate, US student, & Sexually active
[a] Bold value represents significance

HPV Vaccine Knowledge

HPV Vaccine Knowledge Descriptive Analysis

Only those participants who had heard about the HPV vaccine responded to this scale in the survey. A total of 451 participants responded to the items on the HPV vaccine scale. There were eight items on the scale. Each item in the scale was responded as either True/False. For each correct response, the participant received one-point. The table presents the number and percentage of participants who correctly responded to the items in the HPV vaccine scale, the mean score of the item in the scale, and the difference between US and international college students (see Table 10). A majority of the participants (99.3%) correctly responded that the HPV vaccine is offered not only to sexually active people. Twenty-two percent of the participants indicated that the HPV vaccine is given only for women and girls, and the HPV vaccine is given as a single shot. Ninety-five percent of participants responded that it is best to receive HPV shots before being sexually active.

A chi-square test was computed to compare the difference in HPV vaccine knowledge score of each item in the HPV vaccine scale among the US students and international students. The test result indicated that none of the items in the scale were significantly different among US and international college students.

Table 10: HPV vaccine knowledge score and correct responses

Items (Correct response)	**US Student N=397**	**International students N=54**	**Total N=451**	***p*-value**
	Correct response No (%)			
1. The HPV vaccine… (False)	313 (78.84)	38 (70.37)	351 (77.8)	.160

2. The HPV vaccination… (False)	330 (83.12)	48 (88.88)	378 (83.8)	.280
3. The HPV vaccine… (False)	307 (77.32)	43 (79.62)	350 (77.6)	.704
4. It is best to… (True)	379 (95.46)	51 (94.44)	430 (95.3)	.738
5. It is too late… (False)	389 (97.98)	54 (100)	443 (98.2)	.293
6. If a woman has… (False)	391 (98.48)	53 (98.14)	444 (98.4)	.849
7. The HPV vaccine… (False)	352 (88.66)	48 (88.88)	400 (88.7)	.961
8. HPV vaccine is… (False)	394 (99.24)	54 (100)	448 (99.3)	.522

HPV Vaccine Knowledge Statistical Analysis

The HPV vaccine knowledge score could range from 0-8. The HPV vaccine knowledge score of those who had heard about the HPV vaccine was high (m=7.19; SD=.84). An independent sample T-test was performed to compare the HPV vaccine knowledge among the US and international college students (see Table 11). The t-test result showed that there was no significant difference; t(449)=.100, *p*=.921, in the overall HPV knowledge score among US students (m=7.19, SD=.858) and international students (m=7.20, SD=.786).

Table 11: HPV vaccine knowledge and student status t-test

Variable	**US students**	**International students**	**Total**	***p*-value**
	Mean (SD)			
Total HPV vaccine knowledge mean score	7.19 (0.86)	7.20 (0.79)	7.19 (0.85)	.921

A multiple regression was performed to test whether the set of demographic and behavioral variables predict the HPV vaccine knowledge among college students (see Table 12). Gender, education level, student status, sexual history, race, age, and HPV knowledge were included as a set of predictors. The result from the multiple regression model indicated that the set of predictors accounted for 4.9% variance in the model, $F_{(10,440)}= 2.27$, $p= .013$. Among the set of predictors, HPV knowledge was the only variable that was a significant (β= .08, S.E.= .02, $p < .001$) predictor of HPV vaccine knowledge in the model. This indicated that higher score of HPV knowledge predicted higher score of HPV vaccine knowledge. Gender (β= .13, S.E.= .10,

p= .195), education level (β= .05, S.E.= .13, *p*= .688), student status (β= .08, S.E.= .13, *p*= .549), sexual history (β= -.12, S.E.= .09, *p*= .182), all comparison of races and age (β= -.02, S.E.= .02, *p*= .183) were not significant predictors of HPV vaccine awareness in the model.

Table 12: Estimates from multiple regression predicting HPV vaccine knowledge

Variables	B	S.E.	Beta	t	Sig.	95% CI
Constant	6.494	.431		15.084	.000	5.648-7.340
Gender						
Male vs. Female	.136	.105	.061	1.297	.195	-.070-.342
Education level						
Graduate vs. Undergraduate	.054	.135	.026	.402	.688	-.212-.320
Student status						
International student vs. US student	.082	.137	.032	.600	.549	-.187-.352
Sexual history						
Not sexually active vs. Sexually active	-.126	.094	-.065	-1.337	.182	-.310-.059
Race						
African American vs. White	-.025	.216	-.006	-.115	.908	-.450-.400
American Indian vs. White	.049	.258	.009	.189	.850	-.458-.555
Asian vs. White	.038	.138	.014	.276	.783	-.233-.309
Other vs. White	-.023	.018	-.007	-.146	.884	-.308-.365
Age	-.023	.018	-.086	-1.315	.189	-.058-.011
HPV knowledge	.079	.018	.210	4.394	**<.001**	.044-.114

Reference group: Female, Undergraduate, US student, Sexually active, & White
[a] Bold value represents significance

HPV Beliefs

HPV Beliefs Descriptive Analysis

Participants who had heard about HPV responded to the HPV Beliefs scale. A total of 538 participants responded to the HPV belief scale. There were 12-item on the scale and each item on the scale was responded on a 5-point Likert scale ranging from strongly disagree to strongly agree. The table presents how participants responded to each item on the scale (see Table 13). Majority of the participants responded ‘agree’ to the items on the scale which were

categorized as ‘perceived benefits’ of getting the HPV vaccine; 52.6% agreed to the statement, ‘The HPV vaccine will protect from getting HPV associated cancers’, 60.8% agreed to the statement, ‘The HPV vaccine will be effective in preventing HPV infection’, 43.3% agreed to the statement, ‘Getting HPV vaccine will benefit my health’. Similarly, majority of the participants responded 'agree' to the items in the scale which were categorized as 'perceived severity' of the HPV infection; 37.4% agreed to the statement, ‘If I have a HPV infection, it will be disruptive to my health’, 33.1% agreed the statement, ‘If I have an HPV-associated cancer, it would threaten the relationship with my boyfriend/girlfriend, husband/wife, or partner', and 45% agreed to the statement, 'HPV associated cancer is a life-threatening disease'. Majority of the participants responded ‘strongly disagree’, ‘disagree’ and ‘not sure’ to the items in the scale which were categorized as ‘perceived barrier’ for getting the vaccine; 42.9% strongly disagreed the statement, ‘I think the HPV vaccine is unsafe’, 52.4% strongly disagreed the statement, ‘I feel embarrassed to get an HPV vaccine because it is for a sexually transmitted infection’, 34.8% responded ‘not sure’ to the statement, ‘It is hard to find a provider or clinic that has the vaccine available’, and equal number of participants (31.6%) responded ‘disagree’ and’ not sure’ to the statement, ‘I am concerned that the HPV vaccine costs more than my parents, or I can pay’. Majority of the participants responded ‘disagree’ and ‘not sure’ to the items in the scale which were categorized as ‘perceived susceptibility’ of getting the HPV infection and cancers; 25.7% disagreed the statement, ‘I am at risk of contracting HPV’, and 29.9% responded ‘not sure’ to the statement, ‘I am at risk of getting HPV associated cancer’.

Table 13: Participant’s HPV Beliefs

Items	Strongly Disagree	Disagree	Not sure	Agree	Strongly Agree
			No (%)		
1. The HPV vaccine…	12	40	131	283	72

	(2.2)	(7.4)	(24.3)	(52.6)	(13.4)
2. The HPV vaccine will…	8	13	72	327	118
	(1.5)	(2.4)	(13.4)	(60.8)	(21.9)
3. Getting the HPV vaccine…	11	16	79	233	199
	(2.0)	(3.0)	(14.7)	(43.3)	(37.0)
4. If I have a HPV….	26	53	98	201	160
	(4.8)	(9.9)	(18.2)	(37.4)	(29.7)
5. If I have an HPV…	30	87	138	178	105
	(5.6)	(16.2)	(25.7)	(33.1)	(19.5)
6. HPV associated…	0	24	94	242	178
	(0)	(4.5)	(17.5)	(45.0)	(33.1)
7. I think the HPV…	231	182	96	21	8
	(42.9)	(33.8)	(17.8)	(3.9)	(1.5)
8. I feel embarrassed…	282	177	45	29	5
	(52.4)	(32.9)	(8.4)	(5.4)	(0.9)
9. It is hard…	145	172	187	25	9
	(27.0)	(32.0)	(34.8)	(4.6)	(1.7)
10. I am concerned…	105	170	170	69	24
	(19.5)	(31.6)	(31.6)	(12.8)	(4.5)
11. I am at risk…	111	138	137	113	39
	(20.6)	(25.7)	(25.5)	(21.0)	(7.2)
12. I am at risk of…	103	153	161	100	21
	(19.1)	(28.4)	(29.9)	(18.6)	(3.9)

HPV Beliefs Statistical Analysis

There were 12-items in the HPV beliefs scale and all the items were categorized into 4 factors: perceived benefits, perceived severity, perceived barriers, and perceived susceptibility. The mean scores were calculated for each of these factors. The table presents the mean score for each of the factors and comparisons between US and international college students (see Table 14). The higher mean score in each factor represents a higher belief towards the factor. The score ranged from 3-15 (perceived benefits), 3-15 (perceived severity), 4-20 (perceived barriers), and 2-10 (perceived susceptibility). The total mean score in each factor indicated higher perceived benefits (m= 11.75, SD= 1.98) of HPV vaccine, higher perceived severity (m= 11.29, SD= 2.18) of HPV infection and cancer, moderate-low perceived barriers (m= 8.30, SD= 2.10) towards

getting the vaccination, and moderate perceived susceptibility (m= 5.3, SD= 2.2) of getting HPV infection and HPV-associated cancers.

An independent sample t-test was performed to compare the HPV beliefs (perceived benefits, perceived severity, perceived barriers, and perceived susceptibility) between US and international college students. The t-test result showed a significant difference in the perceived barriers belief (t [536]= 2.146, *p*= .032), among US (m= 8.2, SD= 2.73) and international college students (m= 8.93, SD= 2.55). However, there was not a significant difference in the perceived benefits belief (t [536]= .708, *p*= .479), perceived severity belief (t [536]= .056, *p*= .955), and perceived susceptibility belief (t [536]= .028, *p*= .794) between US and international college students.

Table 14: HPV Beliefs factor score and student status differences

Variables	US students N=465	International students N=73	Total N=538	*p*-value
	Mean (SD)			
Perceived Benefits	11.75 (1.95)	11.92 (1.68)	11.75 (1.98)	.479
Perceived Severity	11.29 (2.17)	11.30 (2.25)	11.29 (2.18)	.955
Perceived Barriers	8.20 (2.73)	8.93 (2.55)	8.30 (2.71)	**.032**
Perceived Susceptibility	5.29 (2.27)	5.22 (1.90)	5.28 (2.22)	.794

[a] Bold value represents significance

A multiple regression model was performed to test whether a set of predictors predict the perceived benefits beliefs (see Table 15). The outcome variable was perceived benefits beliefs and the predictors were gender, education level, student status, sexual history, race, age, HPV knowledge, and HPV vaccine Knowledge. The result from multiple regression model indicated that the model containing the given set of predictors accounted for 5% of variance in the model, $F_{(11,439)}$= 2.10, *p*= .019. Among eight predictors, two were significant predictors of perceived benefit beliefs in the model. Gender (β= .31, S.E.= .23, *p*= .179), education level (β= .33, S.E.= .29, *p*= .268), student status (β= .21, S.E.= .30, *p*= .472), sexual history (β= -.09, S.E.= .20, *p*=

.641), all of the comparison between races and age (β= -.06, S.E.= .04, *p*= .10) were not a significant predictor of perceived benefit belief in the model. HPV knowledge was a positive and a significant (β= .09, S.E.= .04, *p*= .02**)** predictor of perceived benefit belief in the model. The positive regression coefficient indicated that for every-one standard score unit increase on HPV knowledge, there was a predicted increase in the perceived benefit belief of .09 raw score units. The HPV vaccine knowledge was also a positive and a significant (β= .27, S.E.= .10, *p*= **.**01**)** predictor of perceived benefit belief in the model. The positive regression coefficient indicated that for every-one standard score unit increase in the HPV vaccine knowledge, there was a predicted increase in the perceived benefit belief of .27 raw score units.

Table 15: Estimates from multiple regression predicting perceived benefit beliefs

Variables	B	S.E.	Beta	t	Sig.	95% CI
Constant	9.924	1.162		8.544	.000	7.641-12.207
Gender						
Male vs. Female	.309	.230	.063	1.345	**.**179	-.143-.760
Education level						
Graduate vs. Undergraduate	.329	.296	.071	1.109	.268	-.254-.911
Student status						
International student vs. US student	.217	.301	.038	.720	.472	-.374-.808
Sexual history						
Not sexually active vs. Sexually active	-.096	.206	-.023	-.467	.641	-.501-.309
Race						
African American vs. White	-.430	.474	-.044	-.908	.364	-1.362-.501
American Indian vs. White	.127	.565	.011	.225	.822	-.983-1.237
Asian vs. White	.179	.302	.030	.593	.554	-.415-.773
Other vs. White	-.453	.319	-.068	-1.420	.156	-1.080-.174
Age	-.063	.039	-.107	-1.644	.101	-.139-.012
HPV knowledge	.094	.040	.114	2.337	**.020**	.015-.173
HPV vaccine knowledge	.272	.104	.124	2.601	**.010**	.066-.477

Reference group: Female, Undergraduate, US student, Sexually active, & White

[a] Bold value represents significance

A multiple regression model was performed to test whether a set of predictors predict perceived severity beliefs (see Table 16). The outcome variable was perceived severity belief and the predictors were gender, education level, student status, sexual history, race, age, HPV knowledge and HPV vaccine knowledge. The result from multiple regression model indicated that the model containing the set of the predictors accounted for 2.1% of the variance but it was not significant ($F_{(11,439)}$= .874, *p*= .566).

Table 16: Estimates from multiple regression predicting Perceived severity beliefs

Variables	B	S.E.	Beta	t	Sig.	95% CI
Constant	11.263	1.413		7.972	.000	8.486-14.039
Gender						
Male vs. Female	-.161	.279	-.027	-.576	**.**565	-.710-.388
Education level						
Graduate vs. Undergraduate	.647	.361	.116	1.794	.074	-.062-1.356
Student status						
International student vs. US student	-.072	.366	-.011	-.197	.844	-.791-.647
Sexual history						
Not sexually active vs. Sexually active	-.088	.251	-.017	-.351	.726	-.581-.405
Race						
African American vs. White	-.314	.576	-.027	-.545	.586	-1.447-.819
American Indian vs. White	.647	.687	.045	.942	.347	-.703-1.997
Asian vs. White	.637	.368	.089	1.731	.084	-.086-1.359
Other vs. White	.127	.388	.016	.326	.745	-.636-.889
Age	-.055	.047	-.077	-1.167	.244	-.147-.037
HPV knowledge	.025	.049	.025	.511	.610	-.071-.121
HPV vaccine knowledge	.088	.127	.034	.695	.487	-.161-.338

Reference group: Female, Undergraduate, US student, Sexually active, & White

A multiple regression model was performed to test whether the set of variables predict perceived barrier belief (see Table 17). The outcome variable was perceived barrier belief and

predictors were gender, education level, student status, sexual history, race, age, HPV knowledge, and HPV vaccine knowledge. The result form multiple regression model indicated that the model containing the full set of predictors accounted for 13.2% variance in the model, $F_{(11,439)}= 6.081$, $p < .001$. Among eight predictors, three variables and one comparison between races were significant predictors of perceived barrier belief in the model. Gender (β= .51, S.E.= .3, p= .095), education level (β= -.56, S.E.= .39, p= .154), student status (β= .12, S.E.= .39, p= .757), and sexual history (β= .09, S.E.= .27, p= .725) were not significant predictors of perceived barrier belief in the model. Age was a positive and a significant (β= .101, S.E.= .051, p= .048) predictor of perceived barrier belief in the model. The positive regression coefficient indicated that for each one unit increase in age the perceived barrier belief increased by .10 standard score units. HPV knowledge was a negative and a significant (β= -.18, S.E.= .053, p= .001) predictor of perceived barrier belief in the model. The negative regression coefficient indicated that for every-one standard score unit increase in the HPV knowledge, the perceived barrier beliefs decreased by .18 standard score units. The HPV vaccine knowledge was a negative and a significant (β= -.74, S.E.= .14, $p < .001$) of perceived barrier beliefs in the model. The negative regression coefficient indicated that for every-one unit increase in standard score of HPV vaccine knowledge, the perceived barrier belief decreased by a .736 standard score units.

Table 17: Estimates from multiple regression predicting Perceived Barrier belief

Variables	B	S.E.	Beta	t	Sig.	95% CI
Constant	13.491	1.535		8.788	.000	10.474-16.508
Gender						
Male vs. Female	.509	.304	.075	1.676	.095	-.088-1.105
Education level						
Graduate vs. Undergraduate	-.560	.392	-.087	-1.429	.154	-1.330-.210
Student status						
International student vs. US student	.123	.397	.016	.309	.757	-.658-.904
Sexual history						

Not sexually active vs. Sexually active	.096	.272	.016	.352	.725	-.440-.631
Race						
African American vs. White	1.347	.626	.100	2.150	**.032**	.116-2.578
American Indian vs. White	.398	.746	.024	.533	.594	-1.069-1.865
Asian vs. White	.667	.400	.081	1.670	.096	-.118-1.453
Other vs. White	-.343	.422	-.037	-.814	.416	-1.172-.486
Age	.101	.051	.124	1.987	**.048**	.001-.201
HPV knowledge	-.179	.053	-.157	-3.370	**.001**	-.283-.074
HPV vaccine knowledge	-.739	.138	-.244	-5.355	**<.001**	-1.010--.468

Reference group: Female, Undergraduate, US student, Sexually active, & White
[a] Bold value represents significance

A multiple regression model was performed to test whether a set of variables predict the perceived susceptibility belief (see Table 18). The outcome variable was perceived susceptibility was set of predictors were gender, education level, student status, sexual history, race, age, HPV knowledge, and HPV vaccine knowledge. The result form regression model indicated that the model containing the full set of predictors accounted for the 17% of variance in the model, $F_{(11,439)}= 8.165$, $p < .001$. Among eight predictors, two were a significant predictors of perceived susceptibility belief in the model. Gender (β= -.07, S.E.= .26, *p*= .795), education level, (β= -.63, S.E.= .34, *p*= .064), student status (β= -.29, S.E.= .34, *p*= .393), age (β= .004, S.E.= .04, *p*= .933), and HPV vaccine knowledge (β= -.16, S.E.= .12, *p*= .181) were not a significant predictor of perceived susceptibility belief in the model. Sexual history was a negative and a significant (β= -1.78, S.E.= .24, *p* <.001) predictor of perceived susceptibility in the model. The negative regression coefficient indicated that sexually active people scored higher in the perceived susceptibility scale than people who were not sexually active. Similarly, HPV knowledge was also a negative and a significant (β= .14, S.E.= .05, *p*= .003) predictor of perceived susceptibility belief in the model. The positive regression coefficient indicated that for each one unit increase in HPV knowledge, the perceived susceptibility belief changed by a factor of .14.

Table 18: Estimates from multiple regression predicting Perceived Susceptibility Belief

Variables	B	S.E.	Beta	t	Sig.	95% CI
Constant	4.726	1.330		3.553	.000	2.112-7.340
Gender						
Male vs. Female	-.069	.263	-.011	-.261	.795	-.586-.448
Education level						
Graduate vs. Undergraduate	.630	.339	.111	1.856	.064	-.037-1.297
Student status						
International student vs. US student	-.294	.344	-.042	-.855	.393	-.971-.382
Sexual history						
Not sexually active vs. Sexually active	-1.777	.236	-.341	-7.527	**<.001**	-2.241-1.313
Race						
African American vs. White	-.457	.543	-.038	-.842	.400	-1.524-.610
American Indian vs. White	.646	.647	.044	.999	.318	-.625-1.917
Asian vs. White	.308	.346	.042	.889	.374	-.373-.988
Other vs. White	.274	.365	.034	.751	.453	-.444-.992
Age	.004	.044	.005	.084	.933	-.083-.090
HPV knowledge	.135	.046	.134	2.942	**.003**	.045-.225
HPV vaccine knowledge	-.160	.120	-.060	-1.340	.181	-.395-.075

Reference group: Female, Undergraduate, US student, Sexually active, & White
[a] Bold value represents significance

HPV Vaccine Uptake

HPV vaccine uptake statistical analysis

The table shows the HPV vaccination uptake status of US and international college students. A chi-square test was performed to access the relationship between a student status (US and international) and HPV vaccine uptake (see Table 19). The chi-square test result showed a significant relation, $\chi 2(3, N=538)= 12.429$, $p= .006$, between these variables; indicating US college students (55.91%) are more likely to get the HPV vaccine than the international college students (38.35%). Those participants who responded that they had received the vaccine, were

asked the number of doses they had received. Majority of the international students (85.71%) responded that they had received three doses of HPV vaccine, and 65.38% of the US students had received three doses of HPV vaccine. A chi-square test was performed to access the relationship between student status and the number of HPV vaccine doses. The result showed not a significant relationship between these variables, $\chi^2(3, N=288)= 5.056$, $p= .080$. Among 28 international students who had received the HPV vaccine, 32.14% had received the vaccine in the United States and 67.85% had received the vaccine in their home country.

Table 19: Participant's HPV vaccination status

Variables	US students N=465	International Students N=73	Total N=538	*p*-value
		No (%)		
HPV vaccine uptake	260 (55.91)	28 (38.35)	288 (53.53)	**.006**
Vaccine Doses (N= 288)				
One	41 (15.77)	1 (3.57)	42 (14.58)	.080
Two	49 (18.85)	3 (10.71)	52 (18.05)	
Three	170 (65.38)	24 (85.71)	194 (67.36)	
Vaccination place (N= 288)				
US	260 (100)	9 (32.15)	269 (93.40)	
Home country		19 (67.85)	19 (6.60)	

A logistic regression was performed with outcome variable HPV vaccine uptake and a set of variables (age, gender, race, education, sexual history, student status, HPV knowledge, HPV vaccine knowledge, perceived benefit belief, perceived severity belief, perceived barrier belief, and perceived susceptibility belief) (see Table 20). The Omnibus test result indicated that the model containing the full set of predictors was a significant (χ^2 [15]= 156.828, $p < .001$) improvement in fit over the null model only. The Hosmer and Lemeshow test result also indicated a good model fit, $\chi^2(8)= 14.608$, $p= .067$. The Pseudo R-square vale in Cox and Snell R-square and Nagelkerke R-square indicated that the model containing the full set of predictors

explained 29.4% and 40.1% of the variance. Among twelve predictors in the model, three variables were a significant predictor of HPV vaccine uptake in the model. Gender was a positive and a significant (*OR*= 0.45; *CI*= .244-.816) predictor of probability of HPV vaccine uptake in the model. The odds ratio indicated that the odds of receiving the vaccine among females was more than 2 times than of females. HPV vaccine knowledge was a positive and a significant (*OR*= 2.23; *CI*= 1.646-3.030) predictor of HPV vaccine uptake in the model. The OR indicated that for every one-unit increase in the HPV vaccine knowledge, the odds of taking the HPV vaccine increased by a factor of 2.23. Perceived barrier belief was a negative and a significant (*OR*= 0.641; *CI*= .573-.717) predictor of HPV vaccine uptake in the model. The OR indicated that for every one-unit increase in the perceived barrier belief, the odds of taking HPV vaccine decreased by a factor of 0.641.

Table 20: Estimates from Binary Logistic regression predicting HPV vaccine uptake

Variables	B	S.E.	Wald	df	Sig.	OR	95% CI
Gender							
Male vs. female	-.807	.308	6.877	1	**.009**	.446	.244-.816
Age	.039	.054	.502	1	.479	1.039	.934-1.156
Race							
African American vs. White	.252	.608	.172	1	.678	1.287	.391-4.236
American Indian vs. white	-.015	.778	.000	1	.985	.986	.215-4.525
Asian vs. White	.123	.408	.091	1	.763	1.131	.509-2.514
Other vs. White	-.576	.430	1.796	1	.180	.562	.242-1.305
Education level							
Graduate vs. undergraduate	-.183	.412	.196	1	.658	.833	.371-1.869
Sexual history							
	-.365	.295	1.524	1	.217	.694	.389-1.239

Not sexually active vs. sexually active							
Student status							
International student vs. US student	-.433	.391	1.222	1	.269	.649	.301-1.397
HPV knowledge	.007	.056	.016	1	.899	1.007	.902-1.125
HPV vaccine knowledge	.803	.156	26.644	1	**.000**	2.233	1.646-3.030
Perceived benefit belief	.045	.068	.436	1	.509	1.046	.916-1.195
Perceived severity belief	-.068	.055	1.497	1	.221	.935	.839-1.042
Perceived barrier belief	-.445	.057	60.648	1	**<.001**	.641	.573-.717
Perceived susceptibility belief	.015	.059	.063	1	.802	1.015	.904-1.139
Constant	-2.033	1.995	1.038	1	.308	.131	

Reference group: Female, Undergraduate, US student, Sexually active, & White
[a] Bold value represents significance

Summary of results

A significant difference was found in HPV awareness and HPV vaccine awareness between US and international college students. However, there was no difference in HPV knowledge and HPV vaccine knowledge between US and international college students. This might be because the HPV knowledge and HPV vaccine knowledge scale were responded only by those who had heard about HPV and HPV vaccine respectively. There was a significant difference only in perceived barrier belief between US and international college students. Unlike this, there was no difference in all remaining three factors: perceived severity, perceived benefits, and perceived susceptibility beliefs between US and international college students. There was a significant difference in HPV vaccine uptake between US and international college students. US students, females, and sexually active persons were more likely to have heard about HPV. Similarly, females, White (compared to Asian), and people with higher aged were predicted to

score higher in HPV knowledge scale. Females and people scoring higher in HPV knowledge scale were more likely to have heard about HPV vaccine. People scoring higher in HPV knowledge scale were predicted to score higher in HPV vaccine knowledge scale. People scoring higher in HPV knowledge and HPV vaccine knowledge scale were predicted to score higher in perceived benefit of HPV vaccine scale and score lower in perceived barrier to get HPV vaccine scale. Sexually active people were predicted to score higher in perceived susceptibility scale and people with higher HPV knowledge were predicted to score higher is perceived susceptibility scale. Females, people with higher HPV knowledge, and people with less perceived barrier belief were more likely to have received the vaccine.

Chapter 5

Discussion

The purpose of this study was to explore HPV knowledge, beliefs and vaccine uptake among US and international college students. Among many studies conducted about knowledge, attitude, and practice of HPV among college students in US, only a few have accounted for international students. This study focused on the comparison of these variables between US and international college students. This chapter includes the summary and interpretation of the results, comparison of results to previously conducted studies, limitations of the study, and conclusion.

HPV Awareness

Null hypothesis 1: There is no difference in HPV awareness among US and international college students.

Research hypothesis 1: There is a significant difference in HPV awareness among US and international college students.

This hypothesis was tested using a chi-square test. The association between HPV awareness and student status was significant; US students were more likely to have heard about HPV than international students. Therefore, we rejected the null hypothesis as HPV awareness was higher among US students than international students.

Among 488 US students who participated in the survey, 95.28% had heard about human papillomavirus. This finding was consistent with a few studies conducted in the US which had also shown that more than 90% of the participants had heard about HPV (Barnard et al., 2017; Kasymova et al., 2018). A study that compared the HPV awareness of people among the US, UK and, Australia also reported that the HPV awareness was higher among the participants from the

US (Marlow, Zimet, McCaffery, Ostini, & Waller, 2013). Among 100 international students who participated in the survey, 73% had heard about human papillomavirus. In contrast to a few studies conducted outside the US that reported low HPV awareness (Oz et al., 2018; Rashid et al., 2016; Koc, 2015), this study found that more than 70% of the international student had heard about HPV. This might be because this study has included international students from around the globe, unlike those studies which had included students only from one country. White students were more likely to have heard about HPV than Asian students, sexually active students were more likely to have heard about HPV than students who were not sexually active, and females were more likely to have heard about HPV than males. Some other studies had also reported that more females had heard about HPV compared to males (Oz et al., 2018; Rashid et al., 2016). Overall, 8.5% of the total participants reported not having heard about the HPV. HPV is the most common sexually transmitted virus around the world, and it impacts the lives of thousands of people around the world by various HPV-associated infections and cancers (CDC, 2016). This study found many people had never even heard about HPV. This indicates the need to increase awareness among the students. Moreover, to meet the Healthy People 2020 objective for HPV vaccination, which aims to reach 80% total HPV vaccination rate (US Department of Health and Human Services, 2019), awareness is a crucial strategy.

HPV knowledge

Null hypothesis 2: There is no difference in HPV knowledge among the US and international college students.

Research hypothesis 2: There is a significant difference in HPV knowledge among US and international college students.

This hypothesis was tested by using the independent sample t-test by comparing the mean knowledge between US and international college students. The test result did not show a significant difference in HPV knowledge between US and international college students. Thus, we retained null hypothesis (i.e., there is no difference in HPV knowledge among the US and international college students). However, the result from the multiple regression model indicated that females compared to males, US students compared to international students, and older participants compared to younger participants had a higher level of HPV knowledge.

The overall HPV knowledge mean score was 14.8 (range = 0-20), which indicated moderate-high HPV knowledge level among college students. The mean HPV knowledge score of US students was 14.87 and of international students was 14.34. The HPV knowledge scale was completed only by those students who had heard about HPV. Thus, the results could have been different if this scale was completed by all the participants instead of only those who had heard about HPV. A few other studies conducted in US have also reported a moderate-high level of HPV knowledge among college students (Kasymova et al., 2018; Barnard et al., 2017). Kasymova et al. (2018) reported the HPV knowledge mean score 8.9 on an 18-point scale. Similarly, Barnard et al. (2017) reported the HPV knowledge mean score 11.93 (out of an 18-point scale). In contrast to a few studies conducted outside the US, which reported a low-moderate level of HPV knowledge, the HPV knowledge of international students in this study was moderate-high (Dany et al., 2015; Koc, 2015; Kamimura et al., 2018). Also, a study conducted in the US among Chinese students reported the mean HPV knowledge score 40.87, SD = 26.60 (out of a 100-point scale), indicating a low-moderate level of HPV knowledge (Tung et al., 2019). Although the HPV knowledge scale used by all of these studies were different, all these tested the knowledge about HPV screening for male and female, treatment of

HPV, HPV related infection and cancer, and preventive measures. A study conducted among US and Vietnamese students reported a significant difference in both HPV and HPV vaccine knowledge among US and Vietnamese students (Kamimura et al., 2018). However, in the present study there was no significant difference in HPV knowledge among the US and international college students. This might be due to the low vaccination rate in Vietnam (Kamimura et al., 2018). and also, the study included students only from Vietnam in contrast to the present study which included students from around the world. However, this study did not categorize international students into different sub-groups. Future studies could consider categorizing international students into sub-groups like developing and developed countries and see the differences.

Although the overall HPV knowledge among those who had heard about HPV was moderate-high, many participants reported they were unaware of some key issues related to HPV. Many students did not know that there was no cure for HPV. This implies that many were unaware of the severity of an HPV infection. Similarly, the majority of the participants did not know how common HPV is and at least once in a lifetime a sexually active person can contract the virus. HBM theory states people are likely to change their behavior if they feel they are susceptible to the condition and understand the severity it might cause (Glanz et al., 2015). In addition, studies have also shown the relationship between HPV knowledge and HPV vaccine uptake and the importance of HPV knowledge in increasing the HPV vaccination rate. In this study, a majority of the participants had shown poor knowledge regarding how common the infection is and its consequences although there was a high-moderate knowledge about HPV in general. Thus, intervention measures should be focused on improving the knowledge regarding key issues related to HPV in order to raise the HPV vaccination uptake.

HPV vaccine awareness

Null hypothesis 3: There is no difference in HPV vaccine awareness among US and international college students.

Research hypothesis 3: There is a significant difference in HPV vaccine awareness among US and international college students.

A chi-square test was performed to test this hypothesis. The test result indicated a significant relationship between HPV vaccine awareness and student status indicating a significantly higher number of US students were aware of the HPV vaccine than international students. Hence, we rejected the null and accepted the research hypothesis. Thus, there is a significant difference in HPV vaccine awareness among US and international college students and higher among US students.

Among the participants who had heard about HPV, about 80% of the participants had heard about the HPV vaccine in this study. Similar to this finding a study also reported 79.1% HPV awareness among those who had heard about HPV (Marlow et al., 2013). Among 465 US students who had heard about HPV, 85.37% of the participants had heard about HPV vaccine. A similar study conducted in the US reported that 90.6% of the participants were aware about the HPV vaccine (Kasymova et al., 2018). Another study conducted among male college students reported that only 55.8% of the participants were aware about the HPV vaccine. Among 73 international students who had heard about HPV, only 73.97% had heard about HPV vaccine. In contrast to the findings from this study, a few studies had reported a low HPV vaccine awareness level among participants. A study conducted among Turkish college students reported that only 32.8% and 18% of male and female college students respectively had heard about HPV vaccine

(Oz et al., 2018). A study conducted in India reported 44% of the female participants had heard about HPV vaccine.

This study found females were more likely to be aware of HPV vaccine than males and participants. Also, those with a higher level of HPV knowledge were more likely to have heard about HPV vaccine than participants with a lower level of HPV knowledge. This is consistent with few other studies which indicated HPV vaccine awareness was higher among females than males (Marlow et al., 2013; Barnard et al., 2017; Cooper et al., 2018; Oz et al., 2018). Although a majority of the participants had heard about HPV vaccine in this study, 20% of those participants (i.e., 1 in 5 participants who had heard about HPV had not heard about HPV vaccine). This number could be higher because those who had never heard about HPV were not asked to respond whether they had heard about HPV vaccine or not. HPV vaccine was first approved about 13 years ago; however, 16% participants in our study had not even heard about the vaccine. For an individual to make a decision about taking a vaccine, he/she must know the importance of vaccine or at least know about the existence of the vaccine. Thus, HPV vaccine-related information could be disseminated during the routine immunization schedule and also by other intervention strategies to increase the HPV vaccine awareness which possibly help to increase the HPV vaccination rate.

HPV vaccine knowledge

Null hypothesis 4: There is no difference in HPV vaccine knowledge among the US and international college students.

Research hypothesis 4: There is a significant difference in HPV vaccine knowledge among US and international college students.

This hypothesis was tested using an independent sample t-test. The mean HPV vaccine knowledge score of US students and international students was compared. The test result showed that there was no significant difference in HPV vaccine knowledge among US and international college students. Hence, we failed to reject the null hypothesis. Thus, this indicates that there is no difference in HPV vaccine knowledge among US and international college students. The result from a study conducted among US, UK and Australian people, which also did not find any difference in HPV vaccine knowledge mean scores across all three countries, was consistent with the findings from this study (Marlow et al., 2013). The finding from this study was opposed to a finding from a study which compared the HPV vaccine knowledge among US and Vietnamese student, which showed a significant difference in HPV vaccine knowledge among US and Vietnamese students (Kamimura et al., 2018). Findings from this study also suggested that individuals scoring higher on HPV knowledge scale were more likely to score higher on the HPV vaccine scale. This study also did not find any difference in HPV vaccine knowledge among males and females as a few previous studies did (Rashid et al., 2016; Oz et al., 2018). As HPV knowledge, HPV vaccine knowledge scale was only responded by those who had heard about HPV vaccine. The overall HPV vaccine knowledge mean score was 7.19 (on an eight-point scale) indicating a higher level of HPV vaccine knowledge. The HPV knowledge mean score of US students was 7.19 and of international students was 7.20. In comparison to the HPV knowledge, the overall HPV vaccine knowledge was higher among the study participants. A majority of the participants responded correctly for most of the items on the HPV vaccine scale. In contrast to a study conducted in Lebanon that showed poor-moderate HPV vaccine knowledge, this study found higher HPV vaccine knowledge among both US and international college students who had heard about HPV vaccine. Another study conducted in Cyprus also

found the HPV vaccine knowledge mean score 9.25 (on a 14-point scale), which indicated moderate knowledge of HPV vaccine among college students (Farazi et al., 2018). However, this result does not indicate that the knowledge of HPV vaccine is high among students in general because in this study only those students who had heard about HPV and HPV vaccine had responded to this scale. Future studies should consider exploring the HPV vaccine knowledge among all students.

HPV Beliefs

Null hypothesis 5: There is no difference in HPV beliefs (perceived benefits, perceived severity, perceived barrier, and perceived susceptibility) among the US and international college students.
Research hypothesis 5: There is a significant difference in HPV beliefs (perceived benefits, perceived severity, perceived barrier, and perceived susceptibility) among US and international college students.

The HPV belief was measured by categorizing the beliefs into four different factors: perceived benefits, perceived severity, perceived barriers and perceived susceptibility. An independent sample t-test was performed to compare the mean difference in each of these factors between US and international college students. The test result showed there was a significant difference only in the perceived barriers belief between US and international college students. The perceived barrier to getting the HPV vaccine was higher among international college students than US college students. Hence, we failed to reject the null in three other factors. However, we rejected the null for the perceived barrier factor. Thus, there is a significant difference in Perceived barrier belief among US and international college students. Overall, the perceived barrier among the participants was 8.30 (out of 20). Perceived barrier belief was measured by asking the availability of the vaccine, cost associated with the vaccine, social norms

about the vaccine, and vaccine safety. Though the perceived barrier among all participants was considered moderate-low, international students reported higher perceived barrier to getting the vaccine than US students. Concerned authorities should address this issue by covering the cost of the vaccine, by clearing the misconception and stigma related to HPV vaccine and by facilitating to reach the health center to take the vaccine.

About 20% of the participants strongly disagreed and around 25% disagreed that they were at risk of getting HPV infection and HPV associated cancers. The mean perceived susceptibility score was 5.28 (out of 10), indicating moderate susceptibility of getting the HPV infection and HPV associated cancers. The mean perceived severity score was 11.29 (out of 15), indicating a moderate-high perceived severity of HPV-associated infection and cancer. This shows that a majority of participants do not believe that they could get the HPV infection and cancers when, in fact, every sexually active person could get the virus at least once in their lifetime. Studies have shown the relationship between perceived susceptibility of getting the HPV infection and cancer and intention of getting the HPV vaccine (Kasymova et al., 2018). In addition, HBM also implies that a person is likely to change behavior if they perceive that they are susceptible to getting an infection and know the severity it can cause. Hence, the moderate perceived susceptibility found in this study demonstrates the need to increase students' awareness that they are at risk of getting an HPV associated infection which could lead to cancer. Thus, necessary preventive measures should be adopted to prevent this condition. This result is consistent with the result from a study conducted among minority college students in US, which found that the majority (54%) of participants did not believe that they were at risk of getting HPV (Jones et al., 2017). Also, a study conducted among Chinese college students in US found

only one-fifth of the participants agreed they were susceptible to get the HPV infection (Tung et al.,2019).

The mean perceived benefits score was 11.75 (out of 15), indicating moderate-high belief for benefits of the HPV vaccine. The study conducted among the Thai women using the same HPV belief scale used in this study also found similar results; the mean perceived susceptibility 4.26 (out of 10), perceived seriousness 10.00 (out of15), perceived benefits 9.67 (out of 15) and perceived barriers 10.64 (out of 20) (Juntasopeepun et al., 2011).

HPV vaccine uptake

Null hypothesis 6: There is no difference in HPV vaccine uptake among the US and international college students.

Research hypothesis 6: There is a significant difference in HPV vaccine uptake among the US and international college students.

This hypothesis was tested by performing the chi-square test. The test result showed a significant relationship between student status and HPV vaccine uptake. US students were more likely to have received the HPV vaccine compared to international students. Hence, we rejected the null hypothesis. Thus, there is a significant difference in HPV vaccine uptake among the US and international college students.

The total HPV vaccine intake was 53.53%, among the total 538 participants. This included all those who had received at least one dose of the vaccine. This result was consistent with a study conducted among college students in US which found 57.5% HPV vaccine uptake (Winger et al., 2016). Rohde et al. (2018) also found 60% HPV vaccine uptake among college students. Among 288 participants who had received the vaccine, 67.36% had received three doses of the vaccine. In contrast to the finding from a study which reported only 20% had

received three doses of vaccine among those who had received the vaccine (Jones et al., 2017), a majority of those who had received the vaccine had received all three doses in this study. In this study among 465 US students, the HPV vaccine uptake was 55.91% and among 73 international students, the HPV vaccine uptake was 38.35%. In contrast, a study conducted among US and Vietnamese students reported a 7.5% HPV vaccine rate among Vietnamese college students (Kamimura et al., 2018). Similarly, many studies that were conducted among the college students outside the US had reported very low vaccination rates (Oz et al., 2018; Rashid et al., 2016; Koc, 2015). A study conducted among Chinese college students in US reported that among the participants who had received the vaccine 92.4% had received in US (Tung et al., 2019). However, this study found that among those international students who had received the vaccine, only 32.15% had received the vaccine in the US. The regression model result suggested that gender was a predictor of HPV vaccine uptake and females are more likely to receive the HPV vaccine than males. This is consistent with a few studies which reported that HPV vaccine uptake was higher among females than males (Oz et al., 2018; Jones et al., 2017; Barnard et al., 2017). Similarly, people having higher HPV knowledge and lower perceived barrier belief to get the vaccine were more likely to have received the HPV vaccine. The HPV vaccination uptake found in this study is very low than the Healthy people 2020 objective (USDHHS, 2019) which aims to reach the HPV vaccination rate to 80%. To meet this objective, a great effort is also required in a university setting. Many students still have not ever heard about HPV and HPV vaccine. College health centers could thus play a crucial role in uplifting this rate during the student's visit or by organizing HPV and HPV vaccine awareness campaigns. Moreover, HPV vaccine could be also be offered to international students as many other vaccines like Measles and Diphtheria, Pertusis, & Tetanus (DPT). which is mandated to international students in many

Universities in US, to reduce the disparities between US and International students. Future studies could identify the barriers for low HPV vaccination among college students in general and international college students studying in the US in particular. By identifying the barriers that are hindering students to get the vaccine, strategical interventions, such as covering the vaccination cost by insurance, incentives for vaccination, etc. could be implemented to increase this number and help meet the Healthy People 2020 objective.

Limitations

There are several limitations of this study. This study relied on self-reported data. There is a chance of recall bias related to HPV vaccine uptake. Future studies could use a measure for HPV vaccine uptake rather than relying on self-reported data. Even though the scales used in this study were taken from the previous studies which had showed good internal consistency, some of the scales used in the study shown poor internal consistency. Future studies should consider selecting validated scale for measuring variables in the study. This study aimed to compare the HPV knowledge, beliefs and vaccine uptake among US and international college students; however, only around 20% of the total participants were international students. However, compared to the proportion of US students and international student at the University, the proportion of the US students and international student in the study is consistent. The international student group was not categorized based on geographical representation to see the in-group difference. Future studies can include this as well in analysis. The income level was not assessed, the income level may impact the HPV vaccine status. Future studies should consider measuring these variables as well. This study recruited participants using non-probability convenience sampling in a University; thus, the findings from this study might not be generalizable to the population with different backgrounds.

Conclusion

This study aimed to compare the HPV knowledge, beliefs and vaccine uptake among US and international college students. Unlike many other studies conducted among college students about HPV, this study particularly considered international students studying in the US. A significant difference was found in HPV awareness, HPV vaccine awareness, perceived barrier belief and HPV vaccine uptake between US and international college students. There was no difference in HPV knowledge, HPV vaccine knowledge, perceived benefit beliefs, perceived severity beliefs, and perceived susceptibility belief between US and International college students. College students are an important target population for HPV and HPV vaccine. Not only they are at a stage of life when they can decide about getting the vaccine without parental permission, but also because they are in an age group with higher rates of risky sexual behaviors (Kasymova et al., 2018). Since HPV is sexually transmitted, it is important to raise awareness among all. This study showed the existing disparities between US and international college students regarding HPV and HPV vaccine awareness, and HPV vaccine uptake. Every year, there are thousands of international students admitted to Universities in US from around the world. College health centers could play a crucial role in raising awareness of HPV and HPV vaccination by organizing various intervention programs. This study also found the higher level of HPV knowledge was associated with HPV vaccine uptake. Thus, it is important to raise HPV awareness and knowledge to reduce HPV-associated infections and cancers that take thousands and thousands of lives every year.

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Appendix A: Socio-Demographic Measures

S.N	Measures	Options
1.	Age	……years
2.	Sex	1. Male 2. Female
3.	Race	1. White 2. Black or African American 3. American Indian or Alaska Native 4. Asian 5. Native Hawaiian or Pacific Islander 6. Others……
4.	Country of citizenship	……
5.	Are you an international student in the University of Oklahoma?	1. Yes 2. No
5.	Are you or have you ever been sexually active?	1. Yes 2. No

Appendix B: HPV Awareness

S.N	Measures	Options
1.	Have you heard about Human Papillomavirus?	1. Yes 2. No → Skip whole survey.

Appendix C: HPV Knowledge Scale

1. HPV is a sexually transmitted infection. (True)
2. There is a cure for HPV. (False)
3. Having one type of HPV means that you cannot acquire new types. (False)
4. There is a screening that is commonly used to test males for HPV. (False)
5. An abnormal Pap smear may indicate that a woman has HPV. (True)
6. Most genital HPV infections do not clear up on their own. (False)
7. A person usually has symptoms when infected with HPV. (False)
8. HPV is not a very common virus. (False)
9. HPV infection can cause genital warts. (True)
10. HPV infection can cause genital herpes. (False)
11. Certain types of HPV can lead to cervical cancer in women. (True)
12. HPV can lay dormant in the body for years without symptoms. (True)
13. A person's chances of getting HPV increase with the number of sexual partners they have. (True)

14. Most people with HPV have visible signs or symptoms of the infection. (False)

15. Genital warts can cause cervical cancer. (False)

16. Condoms are not effective in preventing HPV. (False)

17. HPV can cause penile cancer. (True)

18. HPV can cause anal cancer. (True)

19. HPV can cause oropharyngeal cancer. (True)

20. Nearly all sexually active men and women will contract HPV at some point. (True)

(Kasymova et al., 2018)

Appendix D: HPV Vaccine Awareness

S.N	Measure	Options
1.	Have you heard about HPV vaccine?	1. Yes 2. No → Skip the HPV vaccine knowledge scale.

Appendix E: HPV Vaccine Knowledge Scale

1. The HPV vaccination is recommended only for women and girls. [a] False

2. The HPV vaccination is often associated with serious side-effects. [a] False

3. The HPV vaccine is given as a single shot. [a] False

4. It is best to receive the HPV shot before being sexually active. [b] True

5. It is too late for teenagers who already had sex to have the HPV vaccine. [a] False

6. If a woman has obtained HPV vaccination, she will not need to do the pap smears. [a] False

7. The HPV vaccine will prevent all causes of HPV associated cancers. [a] False

8. HPV vaccine is offered only to sexually active people. [c] False

[a] =Kamimura et al., 2018.

[b]=Dany et al., 2015.

[c]=Oz et al., 2018.

Appendix F: HPV Beliefs

S.N	Statements	Strongly disagree	Disagree	Not sure	Agree	Strongly agree
1.	The HPV vaccine will protect from getting HPV associated cancers.					
2.	The HPV vaccine will be effective in preventing HPV infection.					
3.	Getting an HPV vaccine will benefit my health.					
4.	If I have an HPV infection, it would be disruptive to my health.					
5.	If I have HPV-associated cancer, it would threaten the relationship with my boyfriend, husband, or partner.					

6.	HPV-associated cancer is a life-threating disease.
7.	I think the HPV vaccine is unsafe.
8.	I feel embarrassed to get an HPV vaccine because it is for a sexually transmitted infection.
9.	It is hard to find a provider or clinic that has the vaccine available.
10.	I am concerned that the HPV vaccine costs more than my parents or I can pay.
11.	I am at risk of contracting HPV.
12.	I am at risk for getting cervical cancer.

Juntasopeepun et al., 2011

Appendix G: HPV vaccine Uptake

S.N	Measures	Options
1.	Have you received HPV vaccine?	1. Yes 2. May be 3. Probably not

		4. No
2.	How many doses of the HPV vaccine have you received?	1. One 2. Two 3. Three 4. Don't know
3.	Where did you take the vaccine?	1. US (Only for international students) 2. Home country

Appendix H: Survey

Unsigned consent to participate in the study

Would you like to be involved in research at the University of Oklahoma?

I am Ishu Karki, a graduate student from the Department of Health and Exercise Science working under the mentorship of Dr. Sarah Maness and I invite you to participate in my research project entitled "Human Papillomavirus (HPV) knowledge, beliefs and the vaccine uptake among United States (US) and International college students". This research is being conducted at the University of Oklahoma, Norman campus. You were selected as a participant because you are a student at OU Norman campus and between 18-30 years. You must be at least 18 years of age to participate in this study.

Please read this document and contact me to ask any questions that you may have BEFORE agreeing to take part in my research.

What is the purpose of this research?

The purpose of this study is to explore the difference in Human Papillomavirus (HPV) knowledge, HPV vaccine knowledge, HPV beliefs and HPV vaccine uptake among US and International college students.

How many participants will be in this research?

In this study, 300 students both graduate and undergraduate will participate among which, 150 participants will be US students and 150 participants will be International students.

What will I be asked to do?

If you agree to be in this research, you will respond to an online survey. You will respond to the questions and statements regarding demographics, Human Papillomavirus (HPV) knowledge, HPV vaccine knowledge, HPV beliefs and HPV vaccine uptake.

How long will this take?

Your participation will take approximately 15-30 minutes.

What are the risks and/or benefits if I participate?

There are no anticipated risks and no benefits from being in this research.

Will I be compensated for participating?

Upon completing the survey, you will get an opportunity to enter to a drawing to win one of a thirty (30) $15 e-gift cards or checks.

Who will see my information?

In research reports, there will be no information that will make it possible to identify you. Research records will be stored securely and only approved researchers and the OU Institutional Review Board will have access to the records. Data are collected via an online survey system that has its own privacy and security policies for keeping your information confidential.

What will happen to my data in the future?

Data from this study will be destroyed following study completion and publication of findings.

Do I have to participate?

No. If you do not participate, you will not be penalized or lose benefits or services unrelated to the research. If you decide to participate, you don't have to answer any question and can stop participating at any time.

Who do I contact with questions, concerns or complaints?

If you have questions, concerns or complaints about the research or have experienced a research-related injury, contact Ishu Karki at ishu.karki-1@ou.edu or Dr. Sarah Maness (Advisor) at 405-325-4984 or smaness@ou.edu. You can also contact the University of Oklahoma-Norman Campus Institutional Review Board (OU-NC IRB) at 405-325- 8110 or irb@ou.edu if you have any questions about your rights as a research participant, concerns, or complaints about the research and wish to talk to someone other than the researcher(s) or you cannot reach the researcher(s).

Please print this document for your records. By providing information to the researcher(s), I am agreeing to participate in this research.

This research has been approved by the University of Oklahoma, Norman Campus IRB.

IRB Number: 11306 Approval date:10/30/2019

- ⭘ I agree to participate
- ⭘ I do not want to participate [Thank you for your participation]

Section 1: Socio-demographic Variables

S.N.	Measures	Options	Feedback
1.	Sex	1. Male 2. Female	
2.	Age	…….Years	
3.	Ethnicity	1. White 2. Black or African American 3. American Indian or Alaska Native 4. Asian 5. Native Hawaiian or Pacific Islander 6.Others……	
4.	Education level	1. Undergraduate 2. Graduate	
5.	Country of citizenship	……	
6.	Are you an international student in the University of Oklahoma?	1. Yes 2. No	
7.	Are you or have you been sexually active?	1. Yes 2. No	

Section 2: Human Papillomavirus (HPV) Awareness

S.N	Measures	Options	Feedback
1.	Have you heard about Human Papillomavirus (HPV)?	1. Yes 2. No (Skip the whole survey).	

Section 3: HPV Knowledge

S.N.	Measures	Options
1.	Human Papillomavirus (HPV) is a sexually transmitted infection.	1. True 2. False
2.	There is a cure for HPV.	1. True 2. False
3.	Having one type of HPV means you cannot acquire new types.	1. True 2. False
4.	There is a screening that is commonly used to test males for HPV.	1. True 2. False
5.	An abnormal pap smear may indicate that a woman has HPV.	1. True 2. False
6.	Most genital HPV infections do not clear of their own.	1. True 2. False

7.	A person usually has symptoms when infected with HPV.	1. True 2. False
8.	HPV is not a very common virus.	1. True 2. False
9.	HPV infection can cause genital warts.	1. True 2. False
10	HPV infection can cause genital herpes.	1. True 2. False
11	Certain type of HPV can lead to cervical cancer in women.	1. True 2. False
12	HPV can lay dormant in the body for years without symptoms.	1. True 2. False
13	A person's chances of getting HPV increase with the number of sexual partners they have.	1. True 2. False
14	Most people with HPV have visible signs and symptoms of the infection.	1. True 2. False
15	Genital warts can cause cervical cancer.	1. True 2. False
16	Condom are not effective in preventing HPV.	1. True 2. False
17	HPV can cause penile cancer.	1. True 2. False

18	HPV can cause anal cancer.	1. True 2. False
19	HPV can cause oropharyngeal cancer.	1. True 2. False
20	Nearly all sexually active men and women will contract HPV at some point.	1. True 2. False

Section 4: HPV vaccine awareness and knowledge

S.N.	Measures	Options
1.	Have you heard about HPV vaccine?	1. Yes 2. No **[Skip this section]**
2.	The HPV vaccine is recommended only for women and girls.	1. True 2. False
3.	The HPV vaccination is often associated with serious side-effects.	1. True 2. False
4.	The HPV vaccine is given as a single shot.	1. True 2. False
5.	It is best to receive HPV shot before being sexually active.	1. True 2. False
6.	It is too late for the teenagers who already had sex to have the vaccine.	1. True 2. False

7.	If a woman has obtained HPV vaccination, she will not need to do the pap smears.	1. True 2. False
8.	The HPV vaccine will prevent all causes of HPV associated cancers.	1. True 2. False
9.	HPV vaccine is offered only to sexually active people.	1. True 2. False

Section 5: HPV Beliefs

S.N.	Measures	Options
1.	The HPV vaccine will protect from getting HPV associated cancers.	1. Strongly disagree 2. Disagree 3. Not sure 4. Agree 5. Strongly agree
2.	The HPV vaccine will be effective in preventing HPV infection.	1. Strongly disagree 2. Disagree 3. Not sure 4. Agree 5. Strongly agree
3.	Getting HPV vaccine will benefit my health.	1. Strongly disagree 2. Disagree 3. Not sure

	4. Agree 5. Strongly agree
4. If I have a HPV infection, it will be disruptive to my health.	1. Strongly disagree 2. Disagree 3. Not sure 4. Agree 5. Strongly agree
5. If I have an HPV-associated cancer, it would threaten the relationship with my boyfriend/girlfriend, husband/wife, or partner.	1. Strongly disagree 2. Disagree 3. Not sure 4. Agree 5. Strongly agree
6. HPV associated cancer is a life-threatening disease.	1. Strongly disagree 2. Disagree 3. Not sure 4. Agree 5. Strongly agree
7. I think the HPV vaccine is unsafe.	1. Strongly disagree 2. Disagree 3. Not sure 4. Agree 5. Strongly agree

8.	I feel embarrassed to get an HPV vaccine because it is for a sexually transmitted infection.	1. Strongly disagree 2. Disagree 3. Not sure 4. Agree 5. Strongly agree
9.	It is hard to find a provider or clinic that has the vaccine available.	1. Strongly disagree 2. Disagree 3. Not sure 4. Agree 5. Strongly agree
10	I am concerned that the HPV vaccine costs more than my parents, or I can pay.	1. Strongly disagree 2. Disagree 3. Not sure 4. Agree 5. Strongly agree
11	I am at risk of contracting HPV.	1. Strongly disagree 2. Disagree 3. Not sure 4. Agree 5. Strongly agree
12	I am at risk of getting HPV associated cancer.	1. Strongly disagree 2. Disagree 3. Not sure

		4. Agree 5. Strongly agree

Section 6: HPV vaccine uptake

S.N.	Measures	Options
1.	Have you received HPV vaccine?	1. Yes 2. Maybe 3. No 4. Probably not **(End survey if YES is Not selected)**
2.	How many doses of vaccine have you received?	1. One 2. Two 3. Three
3.	Where did you take the HPV vaccine?	1. U.S. 2. Others……

Thank you for your participation!