Comparing HPV Vaccination Rates Between Rural and Urban Female Undergraduate Students at the University of Tennessee, Knoxville

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Abstract

Human papillomavirus (HPV) is a common and highly transmissible infection that spreads through sexual contact. Since 2006, the CDC has recommended HPV vaccination for females aged 11-26 years old, but in 2015, only 40% of women aged 19-26 years reported receiving at least one dose of the HPV vaccine. Rural residents of the United States experience HPV-related cancer incidence and mortality at higher rates than their urban counterparts. An important reason for this disparity may be that the rate of HPV vaccination is lower among rural residents. The aim of this study was to determine if there is a disparity in HPV vaccine uptake between female college students in the Southeast from rural and urban areas and to identify factors that are associated with HPV vaccine uptake. A self-selected sample of female undergraduate students completed an online survey. Survey questions assessed personal demographics, sexual history, health care access, uptake of the HPV vaccine, and participant opinions regarding HPV and the HPV vaccine. Of 12,027 eligible female undergraduate students, 1,351 completed the survey. Respondents identified as Freshmen (25.9%), Sophomores (22.3%), Juniors (21.3%), and Seniors (30.5%), and 25.1% reported their hometown as rural, 62.4% suburban, 10% urban, and 2.4% do not know. About 70.2% of those who identified their hometown as rural received at least one HPV vaccine, compared to 71.0% of suburban residents and 71.1% of urban residents. Of the participants that reported receiving the HPV vaccine, 73.2% of rural residents, 74.6% of suburban residents, and 68.8% of urban residents received the entire course of the vaccine. This study found higher HPV vaccination rates than previous research; however, a disparity in HPV vaccine uptake and completion still exists between rural and urban areas. Educational efforts need to continue to target all areas but, special efforts need to be made to increase HPV vaccine uptake in rural areas.

Background

Human papillomavirus (HPV) is one of the most common and highly transmissible infections that is spread through sexual contact (St. Laurent et al., 2018). The Center for Disease Control (CDC) estimates that about 79 million Americans are infected with the virus. Between 2012-2016, an average of 34,800 HPV-attributable cancers were reported annually, and 92% of these cancers were caused by strains of HPV that the nonavalent HPV vaccine targets (Senkomago et al., 2019). In 2015, only 40% of women aged 19-26 years reported receiving at least one dose of the HPV vaccine (Williams et al., 2017).

HPV is a part of the Papillomaviridae family of DNA viruses, and it infects epithelial tissue in the skin, anogenital, and oral mucosa (St. Laurent et al., 2018), and the most common form of transmission of the virus is through vaginal or anal sex (CDC, 2019). Anyone who engages in sexual activity is at risk for contracting HPV, and 50-80% of all sexually active people will contract HPV within their lifetime (St. Laurent et al., 2018). Most people who contract HPV do not experience symptoms and therefore do not know they are infected. HPV infection often resolves itself—for most HPV infections, 90% of the virus has cleared or become dormant after 1-2 years (St. Laurent et al., 2018). Health problems related to HPV infection occur when the infection persists (CDC, 2019). However, HPV can be spread through sexual skin-to skin contact; therefore, all sexual activity contains some risk for contracting HPV. There is no set screening procedure for all people to test for HPV, but it is tested as part of a Pap smear examination. Women, therefore, are typically diagnosed with the infection after they have had a Pap smear, which is used to screen for cervical cancer, with abnormal results (CDC, 2019).

Contraction and persistent infection of HPV can eventually lead to certain cancers, most notably cervical cancer (Sundaram et al., 2016). According to the CDC, HPV infection can also

lead to genital warts as well as cancer of the vulva, vagina, penis, anus, throat, or base of the tongue and tonsils. Certain strains of the HPV virus tend to result in either genital warts or cancer. HPV16 and HPV18 are the strains that most often lead to cancer, while HPV6 and HPV11 are associated with the development of genital warts (Rahman et al., 2015). Some individuals only become aware that they are infected with HPV after they develop genital warts and/or cancer (CDC, 2019).

HPV infection can be prevented. The HPV vaccine is the best method for primary prevention of HPV infection. There are currently three HPV vaccines that target 2, 4, or 9 HPV variants, and each vaccine has been proven effective in randomized trials (St. Laurent et al., 2018). Since 2006, the CDC has recommended HPV vaccination for females aged 11-26 years old and since 2011, has expanded that recommendation to include males aged 13-21 years old (LaJoie et al., 2018). In 2018, only half of adolescents aged 13-17 years old had received the full course of the HPV vaccine (Senkomago et al., 2019).

If a person is sexually active, the National Institute of Health recommends that they correctly use latex condoms to prevent the spread of the virus. Even though HPV is an extremely common infection, it is important that people are aware of ways in which they can prevent the contraction and spread of the virus.

As of 2016, the Advisory Committee on Immunization Practices (ACIP) from the CDC recommends that adolescents aged 9-14 receive two doses of the HPV vaccine, and they recommend three doses of the vaccine for people aged 15-26 and those who are immunocompromised (Meites et al., 2019). In 2010, the Department of Health and Human Services released the Healthy People 2020 goals for improving health outcomes and disparities

across the United States. The Healthy People 2020 goal for HPV vaccine uptake is 80% of adolescents aged 13-18.

In 2018, 51.1% of adolescents aged 13-17 years had completed the HPV vaccine series, and 68.1% had received at least one dose of the HPV vaccine (Walker et al., 2019). Because the vaccine rates are suboptimal, there is a catch-up process in place for those who did not receive the vaccine before the age of 13. Recent research, however, indicates that this catch up process may not be effective at preventing some forms of cervical cancer if the catch-up takes place after age 20; therefore, the best method to prevent cervical cancer is by receiving complete HPV vaccination at the recommended age of 11-12 years (Silverberg et al., 2018).

When discussing HPV vaccine rates, it is important to understand the barriers that prevent people from receiving the vaccine on time and completely. One barrier preventing vaccination is the perception that the vaccine and its protection against a sexually transmitted infection (STI) will lower sexual inhibitions of the adolescents that receive it. In a study by Schuler et al. (2011), 16% of parents believed that the vaccine would make it more likely that their teenage daughters would engage in sexual activity. Parents that believed the vaccine would cause sexual disinhibition were more likely to be politically conservative and/or older (Schuler et al., 2011). Schuler et al. (2011) also compared the effects of religion and political conservatism on parental beliefs in sexual disinhibition and found that political conservatism was a larger factor in this belief than religion. Importantly, Schuler et al. (2011) found that parents who knew more about the HPV vaccine were less likely to believe the vaccine would lead to sexual disinhibition. Education prevents people from fearing sexual disinhibition because of HPV vaccination; therefore, it improves HPV vaccine uptake. Education is also important for those that do engage in riskier sexual behavior, so they are aware of the potential consequences.

Dillard and Spear (2010) demonstrated a connection between poor education on HPV and riskier sexual behavior; they found that female college students who have multiple sexual partners and did not use condoms were not well-informed on HPV. They concluded that those most at risk for contracting HPV were not armed with the education needed to protect themselves against the infection.

This study chose to focus on HPV vaccine rates across the rural-urban continuum because rural residents of the United States experience HPV-related cancer incidence and mortality at higher rates than their urban counterparts. One reason for this disparity is that HPV vaccination is lower among rural residents. The completion rate for girls in small, rural towns was about 30% compared to a rate of 36% among girls in urban areas (Swiecki-Sikora et al., 2019). Mohammed et al. (2018) analyzed data from the Health Information National Trends Survey from 2013, 2014, and 2017. They found that rural residents were less aware of HPV and the HPV vaccine than urban residents, and fewer people from rural areas knew about the connection between HPV and cervical cancer and that the infection is sexually transmitted. Even when controlling for high poverty rates, adolescents from urban areas were more likely to initiate and complete the vaccine than adolescents in rural areas (Swiecki-Sikora et al., 2019).

Two of the most frequently identified barriers to vaccine uptake is knowledge about HPV infection and its consequences as well as doubts surrounding the safety and efficacy of the vaccine. According to one survey of college students, the reason why most female students, about 58%, did not receive the vaccine was because they were not having sex and thought that they did not need it (Ragan et al., 2018). Other barriers to vaccine uptake include concerns about vaccine safety/efficacy and little knowledge of HPV and its association with certain genital warts (LaJoie et al., 2018). In one study, 38% of those who chose not to be vaccinated against HPV

expressed concern about the safety of the vaccine compared to 26% of vaccinated individuals (LaJoie et al., 2018).

Dillard and Spear (2010) also sought to better understand female college students' knowledge of both HPV and the HPV vaccine in order to determine what barriers prevented complete vaccination against the virus. They found that 96% of female students knew about HPV and even more (98%) knew about the HPV vaccine. Moreover, this study also identified an important gap in students' knowledge about the effects of the infection itself— two-thirds of the surveyed students did not know that HPV infection can cause genital warts. In order to assess barriers against vaccination, Dillard and Spear (2010) asked non-vaccinated students about their beliefs on the HPV vaccine and why they chose not to receive it. They found that the most common belief among the unvaccinated group was that they did not believe there was enough research to prove that the vaccine was effective at preventing HPV infection. Another important misconception identified in this study was that those who deemed themselves protected against infection, either by refraining from sexual activity or being in a monogamous relationship, did not think it was necessary for them to get the HPV vaccine.

Factors that do lead to higher rates of HPV vaccine uptake and completion include parental age and beliefs, cost of the vaccine, and uptake of other vaccinations. Lai et al. (2016) found that parents under the age of 35 were more likely to initiate and complete the vaccine compared to parents over the age of 45. Parental desire for vaccination is another strong indicator for vaccine uptake (LaJoie et al., 2018). The cost of the vaccine also impacts uptake, and LaJoie et al. (2018) found that a free HPV vaccine would almost double the likelihood of vaccination. Receiving other adolescent vaccines such as the influenza, TDAP, and meningitis vaccines also predicted higher rates of HPV vaccine uptake (Lai et al., 2016).

Previous research indicates that both physician recommendation and parental approval also lead to higher rates of HPV vaccine uptake (Ragan et al., 2018). However, the impact of a physician recommendation to receive the HPV vaccine on female college students is contradicted in the literature. LaJoie et al. (2018) found that a physician's recommendation was the least influential in vaccine uptake compared to parental influence and the student's own ideas. Dillard and Spear (2010), however, found that the recommendation of a physician helped to reduce the perceived barriers to vaccination; people were less likely to feel it was unsafe or unnecessary to receive the vaccine.

The disparities in rural and urban HPV vaccination rates could be caused by many factors. As described by Swiecki-Sikora et al. (2019), the HPV vaccine required three doses until 2016, so multiple trips to a healthcare provider can pose a challenge for those living far away from clinics. Because of the scarcity of primary care providers in many rural areas, there is also a higher chance of families and adolescents not receiving a physician's recommendation to receive the HPV vaccine. Those living in rural areas are also more likely to be politically conservative, which Schuler et al. (2011) described as a reason they may choose not to vaccinate their children against HPV. Swiecki-Sikora et al. (2019) also theorized that the higher prevalence of community health centers and vaccine programs in urban areas also lead to this disparity. Education about HPV and access to health care systems are likely important factors in lower HPV vaccination rates in rural areas.

The purpose of this study was to determine if there is a disparity in HPV vaccine uptake between students at a research-one, state university in the Southeast from rural and urban areas and to identify factors that are associated with HPV vaccine uptake. Studies have determined HPV vaccination rates of young women, and they have looked at vaccination disparities along

the rural-urban continuum among female adolescents. This attempts to see what disparity may still exist between young women, over the age of 18, from rural and urban areas.

Methods

Study Design and Sample

A cross-sectional study design was used. Eligible participants were undergraduate students who self-identified as female and were enrolled in an undergraduate program at a state, research one university in the Southeast United States during the fall semester of 2019. Potential participants were recruited via university email. The institution review board approved all study materials.

Online Survey

The online, one-time survey questions assessed personal demographics, sexual history, health care access, and uptake of the HPV vaccine, and participant opinions regarding the HPV and the HPV vaccine. The survey comprised of seven sections, and it consisted primarily of questions adapted from validated questionnaires. Questions from the 2018 Behavioral Risk Factor Surveillance System (BRFSS) were used to assess demographics, health care access, and cervical cancer screening behaviors. Also, questions from the 2017 Medical Expenditure Panel Survey were used to assess health care access. Sexual history questions were adapted from the 2019 Youth Risk Behavior Surveillance System and its Guide to Taking a Sexual History for health care providers. The HPV immunization questions came from the 2018 BRFSS, the 2011 National Health and Nutrition Examination Survey, and a survey developed by Dillard and Spear (2010). Sets of True/False questions to assess knowledge of HPV and the HPV vaccine and to

assess barriers and attitudes regarding the HPV vaccine were adapted from Dillard and Spear (2010). Participants were also given the opportunity to describe their thoughts and beliefs regarding the vaccine and asked if their views had changed since beginning college.

The survey was created and delivered through the QuestionPro online survey software, and participants were able to complete the survey on a personal computer or mobile device. The survey was anonymous, and participants could refuse to answer questions and were able to drop out of the survey up until completion. To recruit participants, an invitation was sent three times to all female undergraduate students. Those who completed the survey were eligible to enter a drawing for one of three $50 university store gift cards.

Analysis

Data were analyzed using SPSS version 26. Incomplete responses were removed from the data set. Descriptive statistics such as frequencies, percentages, and means were used to analyze data. Chi-square analysis was also performed to compare HPV vaccine uptake and completion among students from urban, suburban, and rural areas, and it was used to analyze HPV vaccination uptake and suspected barriers against vaccination.

Results

Of 1,486 surveys initiated, 1,351 complete responses were used for this study. The majority of participants were cis-gender female (97.9%, n=1321), white (88.1%, n=1187), heterosexual (83.3%, n=1124), and sexually active (74.4%, n=1003). Only 23.5% of participants (n=315) were first-generation college students, and 56.7% (n=767) reported an annual household income of $50,000 or more. Respondents identified as Freshmen (25.9%, n=349), Sophomores

(22.3%, n=301), Juniors (21.3%, n=287), and Seniors (30.5%, n=411). The mean age of participants was 20.48 years old. Those who work part time (<35 hours/week) made up 55.2% (n=745) of participants, 5.4% (n=73) work full time (35= hours/week), and 39.3% (n=530) do not work. Participants were asked to identify if they and their parents are religious. About half of participants (59.5%, n=803) said they themselves are religious, and more participants (75.6%, n=1020) reported that their parents are religious. When asked if they use some form of protection (e.g. condom, finger cot, dental dam) during sexual contact, 32.7% (n=430) of participants reported doing so all or most of the time.

For HPV vaccine uptake, 70.5% (n=947) received at least one dose of the HPV vaccine, 22.4% (n=301) had not, 7.1% (n=95) did not know if they had, and 0.1% (n=1) reported their doctor had refused when asked. Of those who initiated the HPV vaccine sequence—they received at least one dose—73.5% (n=695) completed the full course of the vaccine. The average age when participants received the first dose of the HPV vaccine was 15.34 years old. Students who were first generation college students were vaccinated less often; 65.7% (n=207) of first-generation students initiated the vaccine, compared to 71.9% (n=733) of non-first-generation students. Students that work full-time, 35+ hours a week, also initiated the vaccine less often (57.7%, n=41) than those that work part-time or not at all (71.2%, n=529 and 71.5%, n=377). Participants were also asked to identify who was most important in making the decision on whether or not to be vaccinated against HPV. Those who considered it a shared choice between them and their doctor consisted of 18.7% (n=250) of participants, 23.2% (n=310) said themselves, 5.4% (n=72) said their doctor, 43.5% (n=583) said their parents or guardians, and 9.3% (n=124) selected not applicable. Most participants reported that their parents (61.8%, n=828) and doctors (75.9%, n=1016) encouraged them to be vaccinated against HPV.

Table 1.

Demographics		
Race	Percent (%)	Number (n)
White	88.1	1187
Black or African American	3.9	52
American Indian or Alaska Native	0.2	3
Asian	4.7	63
Pacific Islander	0.1	2
Other	2.8	38
Hispanic/Latin Origin		
Yes	4.6	62
Sexual Orientation		
Straight	83.3	1124
Gay	1.7	23
Bisexual	11.9	160
Something else	2.1	28
Year in School		
Freshman	25.9	349
Sophomore	22.3	301
Junior	21.3	287
Senior	30.5	411
Hometown		
Rural	25.1	339
Suburban	62.4	842
Urban	10	135
Employment		
Full time: 35+ hrs/week	5.4	73
Part-time: <35 hrs/week	55.2	743
No	39.3	527
Annual Household Income		
Less than $25,000	17.1	231
$25,000-$35,000	6.5	87
$35,000-$50,000	8.9	120
$50,000-$75,000	10.6	143
Greater than $75,000	46.1	622
First-generation college student		
Yes	23.5	317
Live in college housing		
Yes	48.1	649

To assess participants' knowledge about HPV and the HPV vaccine, they were asked to answer ten True/False statements (Table 2). Most of the respondents knew that genital HPV is the most common STI in the United States (75.6%, n=714 of vaccinated and 77.1%, n=232 of unvaccinated. Also, most knew that HPV causes genital warts (65.1%, n=615 of vaccinated and 69.8%, n=210 of unvaccinated.) These differences were not significant via chi-square analysis (p=0.271 and p=0.415, respectively.) Few participants knew that HPV is the only cause of cervical cancer, 21.3% (n=201) of vaccinated versus 16.3% (n=49) of unvaccinated (p= 0.034), or that it is only spread through sexual contact, 36.9% (n=348) of vaccinated versus 43.9% (n=132) of unvaccinated (p= 0.038). Participants did know that the HPV vaccine does not prevent other STIs (82.2%, n=775 of vaccinated and 77.4%, n=233 of unvaccinated; p= < 0.001) and does not provide a cure for HPV (96.9%, n=916 of vaccinated and 96.3%, n=290 of unvaccinated; p=0.001).

Table 2.

Participant Knowledge of HPV and the HPV vaccine	Vaccinated	Unvaccinated
correct answer in parentheses	% Correct	
Genital HPV is the most common sexually transmitted infection in the United States. (T)	75.6	77.1
HPV is the cause of genital warts. (T)	65.1	69.8
HPV is the only known cause of cervical cancer. (T)	21.3	163
The only means of HPV transmission is sexual contact. (T)	36.9	43.9
A woman who has been vaccinated against HPV no longer needs to get Pap tests. (F)	98.8	97.3
The vaccination protects against HPV and genital warts. (T)	68.9	69.1
The HPV vaccination can prevent sexually transmitted infections such as Chlamydia. (F)	82.2	77.4
If someone is currently infected with HPV, the vaccination provides a cure. (F)	96.9	96.3
The HPV vaccination is administered in just one injection. (F)	91.6	71.8
The HPV vaccination is almost 100% effective in preventing all types of HPV infection. (F)	47.7	49.8

Participants identified their hometown as rural, suburban, or urban. Of the completed responses, 25.1% (n=339) reported their hometown as rural, 62.4% (n=842) suburban, 10% (n=135) urban, and 2.4% (n=33) did not know. Healthcare coverage was dissimilar across the

different areas. Most women (86.1%, n=291) from rural areas reported having some form of health insurance, compared to 92.1% (n=774) of suburban women, and 87.4% (n=118) of urban women. This difference was determined to be significant via chi-square analysis (p= 0.010). The majority of respondents (90%, n=1200) reported that travel time to their physician's office was less than an hour, and 86.6% (n=1038) of those reported travel time to be less than 30 minutes. Most women (60%, n=201 and n=81) from rural and urban areas said their parents encouraged them to be vaccinated against HPV, compared to 63% (n=529) of suburban women.

About 70.2% (n=236) of those who identified their hometown as rural received at least one dose of the HPV vaccine, compared to 71.0% (n=596) of suburban residents and 71.1% (n=96) of urban residents. This difference was determined to be significant via chi-square analysis (p= < 0.01). Of the participants that reported receiving the HPV vaccine, 73.2% (n=172) of rural residents, 74.6% (n=444) of suburban residents, and 68.8% (n=66) of urban residents received the entire course of the vaccine. Unlike initiation of the HPV vaccine sequence, the difference between people receiving the entire course of the vaccine and where they are from was not statistically significant according to chi-square analysis (p= 0.851).

Factors that have previously been identified as barriers or influences on HPV vaccination were compared to HPV vaccine initiation in this study. When initiation was compared to parent religion, 70.1% (n=714) of those who reported their parents are religious received at least one dose of the HPV vaccine compared to 72.1% (n=207) of those whose parents are not religious. This difference was not significant according to chi-square analysis (p= 0.470). Of the participants who indicated that they had not seen a doctor in the past 12 months due to cost, 67.9% (n=163) initiated the HPV vaccine, and 71.1% (n=761) of those who did not also initiated the vaccine (p= 0.167). Participants who reported they were not sexually active initiated the HPV

vaccine less often (67.8%, n=234) than those who were sexually active (71.4%, n=713); however, this was not statistically significant (p= 0.426). Those who have not yet been sexually active also completed the entire course of the HPV vaccine less often (68.2%, n=159 versus 75.3%, n=536; p=0.203).

Table 3.

Statements to gauge opinions of the HPV vaccine		
Vaccinated Population	TRUE	FALSE
There has been enough research to justify getting the vaccine.	91.80%	8.10%
I'm convinced that the vaccine is really effective.	91.50%	8.50%
I'm not sexually active, but I know I need to get the vaccine.	49.10%	50.90%
I can afford it.	88.80%	11.20%
I'm comfortable discussing the vaccine with my parents.	87.60%	12.40%
I trust pharmaceutical companies.	64.90%	35.10%
I only have sex with one person, but I know I need to get the vaccine.	63.50%	36.50%
I make smart decisions about sex (e.g. use condom), but I know I am still at risk.	85.00%	15.00%
I do not want to risk spreading the infection to a sexual partner.	92.00%	8.00%
I'm already sexually active, but it's not too late for me to get the vaccine and have it be effective.	62.50%	37.50%
Unvaccinated Population		
There hasn't been enough research done yet to justify getting the vaccine.	35.10%	64.90%
I'm not convinced that the vaccine is really effective.	30.00%	70.00%
I'm not sexually active, so I don't need to get the vaccine.	21.80%	72.20%
I can't afford it.	12.90%	87.10%
I'm not comfortable discussing the vaccine with my parents.	22.30%	77.70%
I don't trust pharmaceutical companies.	12.90%	87.10%
I only have sex with one person, so I don't need to get the vaccine.	24.10%	75.90%
I make smart decisions about sex (e.g. use condom), so I'm not at risk.	25.50%	74.50%
Only people who are sleeping around are at risk for HPV: That's not me.	16.30%	83.70%
I'm already sexually active, so it's too late for me to get the vaccine and have it be effective.	13.60%	86.40%

In order to assess participants' attitudes of the HPV vaccine, they were asked to answer True/False statements about the HPV vaccine (Table 3). Those who were vaccinated for HPV were more likely to think the vaccine was sufficiently researched (91.8%, n=854) and effective (91.5%, n=851) than those who were not vaccinated (64.9%, n=192 and 70.0%, n=205, respectively). The majority of both groups reported being able to afford the vaccine (88.8% of

vaccinated, n=826 versus 87.1% of unvaccinated, n=257), but vaccinated women said they were comfortable discussing the vaccine with their parent more often than unvaccinated women (87.6%, n=815 versus 77.7%, n=230). The unvaccinated population reported a higher level of trust in pharmaceutical companies than the vaccinated population (84.4%, n=248 versus 64.9%, n=604).

Discussion

Participants for this study were recruited from a state, research one university—The University of Tennessee, Knoxville. In Fall 2019, 23,290 undergraduate students were enrolled, and 80% of those undergraduate students were from the state of Tennessee. Females students made up 52% of all students, and 23% identified as non-white. The goal of this study was to determine if any disparities existed in the uptake and completion of the HPV vaccine between college women from rural and urban areas. Secondarily, the study attempted to identify the level of knowledge of HPV and the HPV vaccine as well as barriers and uptake predictors for HPV vaccination.

This study found that 70.5% (n=947) of college women have received at least one dose of the HPV vaccine, which is below the CDC's Healthy People 2020 goal of 80%. Fewer have completed the full course of the vaccine (n=695). Even though HPV vaccination rates remain suboptimal, this study reports a higher uptake of the vaccine rate than Williams et al. (2017) previously reported (40% of women aged 19-26.) This rate may be higher in part because this study focused only on college women. According to this study, most women are or become sexually active during college (74.4%, n=1003); therefore, educational efforts to increase HPV vaccination should still target college women. This is especially important since this study also

found that only 32.7% (n=430) of participants reported using some form of protection (e.g. condom, finger cot, dental dam) during sexual contact all or most of the time.

In accordance with previous research, fewer women from rural areas (70.2%, n=236) initiated the HPV vaccine than their urban counterparts (71.1%, n=96). This difference was significant (p= <0.001) and shows that educational efforts need to continue to target this population. However, this study also found that women from urban areas completed the HPV vaccine sequence less often than women from rural areas (68.8%, n=172 versus 73.2%, n=66), so programs also need to promote completion of the HPV vaccine across all geographical areas.

This study found that there was not a clear knowledge gap on HPV and the HPV vaccination between those who initiated the HPV vaccine and those that did not. Overall, the study population better understood the HPV vaccine than HPV itself. However, for most of the knowledge questions, a greater proportion of the vaccinated population answered the questions correctly. Vaccine programs and healthcare professionals should educate people about why it is important to prevent HPV infection. Because there seems to be a lack of understanding of HPV itself, they focus on informing people about the mechanisms and the consequences of HPV infection. If people understand why HPV is directly harmful to their health, it may encourage more people to be vaccinated.

This study also looked at previously described barriers to HPV vaccination, including parental religious beliefs and healthcare costs. Similar to previous research, a greater proportion of those who were not vaccinated reported their parents were religious (72.1%, n=714 versus 70.1%, n=207). Cost may also have served as a barrier against vaccination for this population because the unvaccinated group was more likely to have indicated that they had not seen a doctor in the past 12 months due to cost (67.9%, n=163 versus 71.1%, n=761). Parental religion and

cost continue to appear as barriers against HPV vaccination, and programs should acknowledge this issue.

The attitudes regarding the HPV vaccine were not widely different between the vaccinated and unvaccinated populations. This indicates that believing the vaccine is safe and effective is not a sufficient motivator for some people to choose to be vaccinated. The same reason why one person may be encouraged to be vaccinated—for example, thinking the vaccine safe and being willing to discuss it with their parents—may not convince another person to vaccinate themselves against HPV. Future research should attempt to identify what other opinions affect vaccination decisions; other factors could include medical misinformation or a preference for a natural lifestyle.

Limitations

This study utilized self-reporting, and recall bias may have limited the significance of the results; for example, participants may have mislabeled their hometown as suburban instead of urban, or they may have inaccurately recalled how many doses of the HPV vaccine they received. A relatively small number of participants were from urban areas (n=135), so the effect of comparisons between rural and urban populations may be limited; however, this small percentage of students from urban areas could be indicative of the university's student population.

Conclusion

According to this study, a disparity in the initiation of the HPV vaccine does exist between college women from rural and urban areas. Young college women from rural areas have

been vaccinated against HPV less often than their urban counterparts, but it is not completely understood why this disparity exists. Access to healthcare, cost, and parental influence and religion do play a role in limiting HPV vaccination rates, but other personal ideas and philosophies may also contribute to lower vaccination rates. More research needs to be done to better understand what these factors are and how they influence the disparity in HPV vaccination rates across the rural-urban continuum. In order to improve HPV vaccination rates, programs and healthcare providers must continue to address the existing geographical disparity and known barriers preventing vaccination.

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