The Relationship Between Human Papillomavirus Vaccination and Socioeconomic Status of College Women

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Introduction

Human papillomavirus (HPV) is the most common sexually transmitted infection (STI) in the United States, encompassing a group of virus strains that infect epithelial tissue (Kasymova et al., 2019). HPV is primarily spread through vaginal, anal, and oral sex with an infected person, as well as through skin-to skin contact (Center for Disease Control [CDC], 2022). Common signs and symptoms of the virus are the development of genital warts, cervical dysplasia, and the presence of abnormal, precancerous cells on the cervix. However, most people with HPV will show no sign of symptoms but can still serve as agents of infection (CDC, 2022). More than 42 million Americans are infected with HPV, and around 13 million people, including teenagers, are diagnosed each year (CDC, 2022). New cases of HPV disproportionally affect adolescents and young adults (Walhart, 2012). Although young people between the ages of 15 to 24 comprise only 25% of the United States population, they represent nearly 50% of new HPV cases per year (Walhart, 2012).

Although HPV is prevalent in the United States, public knowledge about the virus remains low (Population Reference Bureau [PRB], 2023). Socioeconomic status (SES) factors have been correlated to disparities in HPV vaccination rates (Kasymova et al., 2019). Mother's education has been used as a SES marker in past studies, and has suggested differing knowledge levels, attitudes, and access to the vaccine (Vu et al., 2019). A mother's education level is correlated to her vaccine beliefs, which can influence those of her children (Kasymova et al., 2019). It has been shown that there is a gap in understanding of HPV knowledge in parents, especially regarding the age that children should be vaccinated (Walhart, 2012). In addition, barriers to vaccine access can be attributed to disparities in preventative care (Kurani et al., 2022). Starting in 2006, three vaccines became available in the United States, including Cervarix, Gardasil, and Gardasil 9, to target the most common strains of HPV (Kasymova et al., 2019). However, uptake of these vaccines starting at the recommended ages of 11 to 12 remains slow in the United States, with only 60% of adolescents from ages 13-17 having at least one dose of a vaccine (Kasymova et al., 2019). HPV vaccination rates continue to remain low at many colleges, including at a university in Georgia where only 43.3% of women were reported to have received full vaccine doses (Vu et al., 2019). This was lower than average nationwide rates of vaccination, which range between 46.0% and 68.9% (Vu et al. 2019). Young adults from

disadvantaged areas are less likely to have initiated vaccination due lack of resources in primary care practice and lack of vaccine data across diverse health systems (Kurani et al., 2022).

Young women are an important target group for HPV vaccine education and catch-up, particularly those from lower SES backgrounds (Lefkowitz et al., 2014). HPV vaccination has been proven to be a protective factor against common precancers and cancers in women, including cervical, vaginal, vulvar, oropharyngeal, and anal cancers in women (Kasymova et al., 2019). Cervical cancer is the third most common cancer worldwide and there has been a clear relationship established between HPV infection and development of cervical cancer later in life (Hu and Ma, 2018). Screening using the Papanicolaou, or Pap, smear has been effective in reducing 80% of cervical cancer mortalities (CDC, 2022). However, additional screening for high risk-HPV strains has detected 50% more high-grade lesions contributing for cervical cancer than the Pap smear (Okunade, 2019) Women with higher SES have higher economic security to support testing and seeking medical care for STIs and their resulting cancers (Ibragimov et al., 2019).

HPV infection is said to be highest in college aged women, ages 20-24 (Lefkowitz et al. 2014). This is due to increased rates of high-risk sexual behaviors, such as unprotected sex and higher numbers of sexual partners (Kasymova et al., 2019). Studies have also suggested that there are perceived knowledge barriers in college students about the prevalence of HPV infection. Previous research with university students has shown that there is a 35% prevalence of HPV among college women who perceived themselves to not be at risk. Furthermore, only 15% of these college students understood that most adults will acquire HPV within their lifetime, and there was a general underestimated lack of infection severity (Kasymova et al., 2019). The lack of knowledge regarding the prevalence of HPV infection contributes to its negative or "shameful" stigma especially among college-aged peers (Kasymova et al., 2019). Eliminating barriers to HPV knowledge and vaccine access could help mitigate this stigma (Kasymova et al., 2019).

Healthy People 2030 outlines several goals related to HPV prevention (US Dept. of Human and Health Services, 2023). These include increasing the proportion of adolescents who receive recommended doses of the vaccine, reducing infections of HPV prevented by the vaccine in young adults, and increasing the proportion of women who are screened for cervical cancer

(US Dept. of Human and Health Services, 2023). To develop interventions to achieve these goals, a socio-ecological approach can be taken to assess HPV risk factors attributed to health behaviors.

Theory

Many of the leading causes of disease in the United States can be related to various health behaviors (Painter et al., 2008). To guide behavior-based investigations and interventions, theories can be used to assess the psychological and structural determinants of behavior (Painter et al., 2008). Theories utilized to understand the relationship between HPV vaccination and socioeconomic status of college women in the United States are the socio-ecological model (SEM), the Theory of Planned Behavior, and the Health Belief Model (Vu et al., 2019; Lefkowitz et al., 2014).

Socio-Ecological Model

Factors affecting vaccine uptake in college women span across multiple domains. The objective of the socio-ecological model (SEM) is to assess factors that influence health behaviors at multiple levels, including the interpersonal, intrapersonal, organization, community, policy, institutional, and/or environmental factors (Vu et al., 2019).

In the SEM, the intrapersonal level includes factors such as individual demographics, knowledge, attitudes, and the developmental history of the individual. Stunted SES has been perpetuated in black Americans through institutional and cultural racism which reduces access to societal resources and health opportunities (Williams et al., 2016). As a result, black college students have been documented by previous studies to have lower vaccination rates than white students (Vu et al., 2019). Perceived high costs and a distrust of the medical system within this racial group contribute to these lower rates (Vu et al. 2019). Further self-reported correlates of HPV vaccination behavior can be analyzed using the socio-ecological model, including friend and family norms, religious influences, and perceived benefits (Vu et al. 2019).

The interpersonal level of the SEM references the social influence from friends, family, and social network norms (Kumar et al., 2011). These relationships play a major role in health behaviors such as consulting a medical professional and cancer screenings (Kumar et al., 2011) A doctor recommendation has been shown to increase HPV vaccination rates in college students (Vu et al., 2019). Among both male and female college students, factors associated with a

doctor's recommendation included higher parental education, a marker for SES, and attendance of private schools (Vu et al., 2019).

The organizational level of the socio-ecological model has been used to assess the impact that institutions, such as health centers and campus settings, have had on rates of HPV vaccination in college students (Vu et al., 2019). Students attending technical colleges with more limited access to HPV vaccination resources have traditionally lower SES that those enrolled in public or private universities (Vu et al., 2019).

The socio-ecological model is an important tool implemented to develop research questions and assess behaviors in a variety of studies (Vu et al., 2019). It can be used to generate cost effective interventions that best improve health outcomes for a studied population (Kumar et al., 2011).

Theory of Planned Behavior

The Theory of Planned Behavior is a framework focusing on behavioral intent, or the willingness of an individual to exhibit a behavior at a specific place and time (Boston University, 2022). It also aims to explain performance through perceived behavioral control, which is shaped by attitudes, self-efficacy, and subjective norms (Catalano et al., 2017). This theory has been used to guide questions in interview-based studies investigating college student HPV vaccination rates (Hirth et al., 2018). Community colleges normally have a higher proportion of students from lower SES than public or private universities (Hirth et al., 2018). Student attending community colleges felt they had barriers to healthcare information about the HPV vaccine, such as locations to receive the vaccine, transportation, lack of knowledge of negative side effects, and the general negative stigma surrounding the vaccine (Hirth et al. 2018). They also demonstrated a lack of motivation to receive the vaccine due to self-reported laziness, fear of needles and side effects, and lack of free time (Hirth et al., 2018). This evidence suggests that SES influences barriers to healthcare and attitudes towards HPV vaccination in college students (Hirth et al., 2018). The Theory of Planned Behavior helps investigators to understand motivations and challenges for voluntary health behaviors, which is a crucial step in developing an effective intervention (Hirth et al., 2018).

Health Belief Model

The Health Belief Model (HBM) is a widely used theory that states that several constructs influence health behavior (Vu et al., 2019). It utilizes several general constructs to

assess the "why" behind health behavior: risk susceptibility and severity, benefits and barriers to action, self-efficacy, and cues to action (Vu et al., 2019). The HBM has been used in studies to assess factors influencing outcomes of HPV vaccination and intrapersonal factors such as perceived susceptibility, seriousness, vaccine benefit, and barriers (Vu et al., 2019). In a study conducted at a college in Georgia, it was found that only 13.2% of college women believed themselves to be susceptible to contracting HPV, although many understood the potential severity of the virus (Vu et al., 2019). In another study implementing the HBM, college students were asked to rank their level of agreement towards statements such as "I do not believe in vaccines generally" or "I do not have confidence that the HPV vaccine is safe" (Donadiki et al., 2014). These survey statements were phrased to assess participants' beliefs and perceptions about vaccine effectiveness. The HBM's focus on perceived barriers, benefits, severity, and susceptibility of the HPV vaccine all for addressing of misconceptions through targeted educational interventions (Donadiki et al., 2014).

Intrapersonal Factors

A range of intrapersonal factors can influence a college woman's decision to receive the HPV vaccine, such as demographic factors, vaccine beliefs, knowledge, attitudes, and developmental history. In terms of demographic factors, marginalized racial groups historically lack societal resources and health opportunities that racial groups with more privilege may have access to (Williams et al., 2016). For example, black college students have been documented by previous studies to have lower vaccination rates than white students (Vu et al., 2019). The knowledge that HPV causes cervical cancer has been reported as significantly lower in African American women in a study investigating racial disparities in HPV-related knowledge (Ojeaga et al., 2019). This can be seen in the cervical cancer mortality data, as African American women have a 41% higher incidence and are twice as likely to die from cervical cancer compared to non-Hispanic white women (Ojeaga et al., 2019).

Individual characteristics such as a woman's sexual activity may be correlated to vaccine behavior after the age of 18 (Lefkowitz et al. 2014). Higher rates of sexual activity have been correlated to higher vaccination rates due to the perceived risk in college students (Lefkowitz et al., 2014). However, disparities in educational performance tend to increase the prevalence of unprotected sexual behavior in college students. Past studies have demonstrated that SES can

influence student grades (Johnson et al., 2008). It has been shown that young adults with lower grade point averages (GPAs) are more likely to participate in sexual health risk behaviors compared to those with higher GPAs (Lefkowitz et al., 2014). This could cause less engagement in vaccine uptake as a protective behavior (Lefkowitz et al., 2014).

Vaccine beliefs, attitudes, and knowledge levels influenced college students' rate of HPV vaccination (Vu et al., 2019). Studies have shown that reasons for the initiation yet incompletion of vaccine doses in college students result from perceived scheduling inconvenience, perceived high cost, lack of motivation, and forgetfulness (Vu et al., 2019). Low perceived risk, limited knowledge, and high perceived likelihood of shame are further intrapersonal barriers to increasing HPV vaccine uptake in college students (Grandahl et al. 2017).

Interpersonal Factors

Interpersonal factors have been used in investigations to demonstrate a relationship between rates of HPV vaccination and socioeconomic status in college women. Firstly, a doctor's influence has been shown to play a pivotal role in the rates of vaccine uptake for women attending college (Vu et al., 2019). A cohort study conducted with 3418 women ages 18-25 from seven colleges and universities in Georgia revealed higher parental education, a marker of SES, is a substantial predictor of doctor's recommendation to receive the HPV vaccine. A doctor's recommendation in turn reinforces a higher perceived seriousness of HPV and effectiveness of the vaccine (Vu et al. 2019). These conclusions point to possible socioeconomic disparities in patient-provider communication about the HPV vaccine (Vu et al., 2019).

Provider attitudes have additionally been considered as interpersonal influences on vaccine uptake, including confidence in discussing the HPV vaccine and the sexual health of their patients. Reviews have shown that vaccines for Tdap and meningitis are more focused on in the clinic with patients, potentially due to the stigma surrounding HPV (Vu et al., 2019). Providing sexual education and background on the HPV vaccines before women of lower SES are sexually active is reported to be an important step for healthcare providers (Vu et al., 2019).

Thirdly, family and friend influences play a notable role in HPV vaccination rates of college women (Vu et al., 2019). Of 580 college women attending a Georgia university, 70 reported that they had not initiated vaccine uptake due to discouragement from their immediate family (Vu et al., 2019). Studies have suggested that a higher maternal education level is

associated with more favorable familial attitudes towards vaccination, and a higher likelihood of daughters initiating and receiving all doses of the vaccine (Vu et al., 2019). Maternal education level also functions as a marker of SES in college students in past studies (Vu et al., 2019). In a study conducted at a university in the southern United States surveying 1,725 students, 53% of participants did not respond "yes" to being vaccinated, and these responses were evenly split among "no" and "I don't know." Parental awareness of their child's medical history, as well as their ability to communicate with their child about their past vaccinations, is a predictor of college students' awareness of their HPV vaccination status (McLendon et al., 2020). For students to make informed health decisions, it is necessary for their parents to be informed as well in passing down students' health history (McLendon et al., 2020). The influence of friends has also been evaluated as an interpersonal influence. During interviews with 19 students at a community college, it was found that most would want to know about side effects that their vaccinated friends experienced before receiving the HPV vaccine (Hirth et al. 2018). A broad range of interpersonal factors can be used in analyzing trends in vaccine uptake in college women.

Organizational, Community, Environment, and Policy Factors

Organizational, community, environmental, and policy efforts can greatly influence the decision of a woman in college with a lower socioeconomic status (SES) to receive the HPV vaccine. Parental education can serve as a marker of SES and has an influence on the attitudes, access, and knowledge levels of college women regarding HPV vaccination (Vu et al., 2019). Based on this, research suggests continued vaccine education should be encouraged at the organizational level, such as within universities, especially among college populations with lower SES (Lefkowitz et al., 2014). Narrative-based interventions implemented on college campuses have proven to be effective in increasing vaccination rates in college women (Lefkowitz et al., 2014). The findings of a study conducted in 2008 on a college campus concluded that a four-minute combined peer-health care provider message nearly doubled the vaccination initiation rate in participants (Hopfer, 2012). Because HPV vaccination received before a woman is sexually active is more effective, universities should begin vaccine education with students when they first enroll (Lefkowitz et al., 2014).

Another common initiation barrier for the HPV vaccine is lack of doctor recommendation. At the organizational level, a physician's recommendation is a strong predictor of initiation and/or completion of HPV vaccination in male and female college students (Vu et al., 2019). Promoting conversations about HPV vaccination in routine healthcare visits as well as in reproductive health organizations could potentially reduce this disparity (Lefkowitz et al., 2014). Combining healthcare system and community interventions can serve as an effective strategy in increasing vaccination coverage. The Community Preventive Services Task Force develops guidelines for community efforts to increase vaccination rates (Carter-Pokras et al., 2020). Evidence supports the application of this force's recommendations specifically for provider assessment and feedback regarding HPV vaccination (Oliver et al., 2016).

College campuses can provide varying levels of accessibility to the HPV vaccine for their female students depending on the institution type. The context of a student's geographical location is correlated to rates of vaccine uptake. For example, Georgia falls behind other states in regard to HPV vaccination rates in adolescents due to limited school-based interventions and access to primary care, and Georgia technical colleges lack on-campus health centers (Vu et al., 2019). Research has also demonstrated that historically black colleges/universities (HBCUs) are less likely to offer the HPV vaccine and Pap tests to students compared to non-HBCUs (Vu et al., 2019). Community colleges have been shown to have higher proportions of students from lower SES who face more healthcare barriers than students attending 4-year universities (Hirth et al., 2018). Women attending technical colleges or state universities have also been shown to have lower odds of a doctor recommendation for the vaccine compared to those attending private institutions (Vu et al., 2019). These barriers are augmented through a lack of onsite clinics and healthcare resources at community colleges (Vu et al., 2019). A study based on interviews with students ages 18-26 attending a Southeast Texas community college showed that lack of awareness, transportation, and associated negative stigma of vaccinations were all barriers to receiving the HPV vaccine. Results also revealed that having a vaccine clinic on campus or nearby would be a motivator for HPV vaccination (Hirth et al. 2018).

Data collected at the national level can be used to detect levels of HPV vaccination in college populations and how these levels correlate to desired outcomes expressed in policy such as Healthy People. For example, the National College Health Assessment is a nationally renowned survey that collects information about college student health habits, behaviors, and

perceptions (American College Health Association, 2021). Data from this assessment collected from 2009-2013 showed that HPV vaccination coverage increased from 44.7% to 68.9% in college women. This data was then compared to goals in the Healthy People 2020 Law and Health Policy Project (Vu et al., 2019). Development of immunization policy can lead to successful interventions resulting in a measurable public health impact regarding HPV vaccination (Carter-Pokras et al., 2021).

The environment created by economic policy within the United States may powerfully influences STI rates in general (Ibragimov et al., 2019). In recent years, research has explored structural factors act at the population level that propagate STI rates (Ibragimov et al., 2019). Poverty, income inequality, and low wages are structures that can contribute to STI risk factors in an environment by creating high-risk partner pools, undermining sexual agency of women, and promoting transactional sex (Ibragimov et al., 2019).

Suggestions for Intervention

A useful intervention strategy for promoting HPV vaccination in college students is to focus on preventative measures. Overall, interventions should focus on making HPV vaccine information more accessible and overcoming barriers to vaccination (Vu et al., 2019). Information that should be stressed in educational interventions are the opportune timing to receive the vaccine and the different ways exposure to HPV can occur (Vu et al., 2019). Ideally, the vaccine should be received when one is sexually inactive, and it should be emphasized that sexual activity is not the only way one can be exposed to HPV (Vu et al., 2019). As another preventative measure, patient-provider communication barriers regarding the HPV vaccine should be addressed to lessen disparities between college students of different SES (Vu et al. 2019). Continued vaccine education has been an effective strategy particularly among lower SES populations in increasing vaccine uptake (Lefkowitz et al., 2014)

Another way to increase effectiveness of interventions for HPV vaccination in college women is through increasing the convenience of vaccine delivery (Vu et al., 2019). Forgetfulness and inconveniences with scheduling have been prominent barriers for college women attempting to receive the vaccine (Vu et al., 2019). Future interventions should focus on creating a more convenient option for these students and arranging a system of patient-provider reminders to check in about vaccine status (Lefkowitz et al., 2014). Increasing vaccine accessibility through

mobile clinics and other low-cost vaccination programs could be beneficial (Lefkowitz et al. 2014). Additionally, easing fears through a continuity of patient-provider conversation would help address many of the common misconceptions that college women have about the HPV vaccine (Vu et al. 2019). Combining convenience and interactive methods is an ideal strategy for increasing HPV vaccination in college women (Vu et al., 2019). Such interactive methods can also be used for targeting a geographic location with a vaccine uptake disparity, such as in the southern United States (Kasymova et al. 2019).

Healthy People 2030 lists several potential interventions related to their HPV vaccination uptake goals for this decade (US Dept. of Human and Health Services, 2023). The first intervention is the 1-2-3 Pap Initiative to deliver the Pap test to clinical, home, and school settings to rural women between ages 19 and 39 (US Dept. of Human and Health Services, 2023). Secondly, DOSE HPV is an intervention to enhance development of education of healthcare providers who serve patients in rural, suburban, and urban areas (US Dept. of Human and Health Services, 2023). Finally, Give Teens Vaccines would be targeted towards youth of ages 11-18 in suburban and urban areas (US Dept. of Human and Health Services, 2023).

Improvements for future interventions regarding HPV vaccination in college students can be made through research incentives. Interventions that only address knowledge or intent, such as standardized questionnaires, may not be sufficient in changing vaccination rates in college populations (Cho et al., 2020). Rather, theory-based interventions that assess vaccine uptake behavior across psychosocial, healthcare, and cultural disciplines are ideal in creating future interventions (Cho et al., 2020). A holistic, multi-component intervention that has been effective in past studies included healthcare team training activities, distribution of patient education materials, and technology-based HPV vaccination reminders for young adult patients (Kepka et al., 2021). Studies have also suggested that focusing on patient-provider communication barriers at the clinical and policy level could prove beneficial in combatting perceived vaccine complexity, scheduling ambivalence, and confusion surrounding vaccine timelines (Vu et al., 2019). A current gap in the literature is the lack of information on the father's role in parent clinical-making decisions, as the mother is usually considered as an SES marker and the gatekeeper of a child's clinical information (Walhart, 2012).

There are several future work ideas that could continue the investigation of HPV vaccination rates in college students. Further assessment of the impact of educational

performance on HPV vaccination in young adults (Lefkowitz et al., 2014). This work would further the investigation of SES and its impact on vaccine rates (Lefkowitz et al., 2014). Another future study idea would be targeted at the organizational and policy level of the SEM (Ibragimov et al., 2019). Studying policies as primary indicators of HPV vaccination rates enhances public health by directly informing legislation, promoting literature on the social determinants of health, and promotes a policy focus towards vaccine education (Ibragimov et al., 2019). Detailing the relationship between policy reforms and SES would be useful in future studies to guide large-scale interventions to raise HPV vaccination rates (Ibragimov et al., 2019).

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