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Abstract

Human Papillomavirus (HPV) is the most common sexually transmitted infection. In 2018, 43 million cases of HPV were recorded in the United States, mostly afflicting young adults in their late teens and early twenties. Gardasil-9, the HPV vaccine currently distributed in the U.S., protects against nine HPV types that cause genital warts and cancers, such as cervical, penile, and oropharyngeal cancer. There is an urgent need for widespread pre-exposure vaccination against HPV among adolescents to prevent the spread of the disease and the future development of associated cancers. This study aims to identify barriers- including lack of knowledge or access, relationship with a provider, and sociocultural factors- to HPV vaccination, to understand the complex motivations behind HPV vaccination and hesitancy to improve vaccine uptake and the health of the community. By identifying these interpersonal and systemic barriers, we can begin to understand what contributes to the lower vaccination rates in low-income, medically underserved communities and what is needed to address them. Data for this analysis was drawn from a quantitative survey and qualitative narratives compiled from key informant interviews (KIIs). Data suggested that receipt of a provider recommendation is associated with vaccine uptake, and greater knowledge of HPV is significantly associated with vaccination. The KIIs revealed that COVID-19 strengthened existing beliefs about vaccination generally, indicating that individuals prone to vaccine hesitancy grew more hesitant while proponents of vaccination pre-pandemic became more supportive after COVID-19. In conclusion, data suggested that increasing the frequency of provider recommendations for HPV vaccination and awareness of HPV would positively impact uptake and result in higher vaccination rates nationwide. Further studies are needed to assess the impact of additional factors, such as medical mistrust, vaccine hesitancy, and stress stemming from COVID-19 on HPV vaccination.

Keywords: human papillomavirus, vaccine, hesitancy, barrier

1. Introduction

Pre-exposure vaccination is one of the most effective interventions for preventing the transmission of disease, particularly for Human Papillomavirus (HPV).[1] Providing vaccines as primary prevention is crucial for maintaining and protecting public health. HPV is the most common sexually transmitted infection and 70% of cervical cancers are caused by HPV types 16 and 18, both of which are protected against by Gardasil-9, the HPV vaccine currently distributed in the US. [1,2,3,4] Globally, vaccines have reduced the burden of vaccine-preventable diseases such as polio and smallpox, and with widespread coverage, this could be possible for HPV as well.[2,3]

Since its initial Food and Drug Administration (FDA) approval for females in 2006 and males in 2009, the HPV vaccine has been surrounded by misinformation and controversy. Many misconceptions persist about the purpose of the HPV vaccine for males. Some believe that HPV and cervical cancer are synonymous, leading them to falsely believe that HPV is solely a women's health issue.[5] Physicians are also less likely to recommend the HPV vaccine to males, which could be attributed to the 3-year delay in FDA approval for males and the resulting misconception that it is not necessary for males.[6] Additionally, there are fears about safety and efficacy as well as concerns that it would promote premature sexual activity in pre-teens who receive the vaccine.[7,8] There is consistent evidence that the relative novelty of and misinformation regarding the vaccine contribute to increased vaccine refusal by parents, which leads us to hypothesize that these two factors are associated with lower vaccination rates.[7,8,9] Vaccine refusal refers to a parent's decision to not vaccinate their child, while vaccination rate refers to the proportion of children who have received the vaccine and can be measured by analyzing the number of eligible children who have and have not been vaccinated in a given population. The lack of widespread and comprehensive HPV vaccine mandates has also contributed to the reduced uptake of the HPV vaccine. Only three states and Washington, D.C. require the HPV vaccine. Some of those mandates were implemented as recently as 2021, so they have not yet been able to have a significant impact on vaccination rates.[10] Such myths and missteps with the HPV vaccine rollout have contributed to the slow and reluctant acceptance of the vaccine in the U.S.

Low vaccination rates can also be attributed to socioeconomic barriers such as access to a provider recommendation, one of the most significant indicators of whether a child will be vaccinated.[11] For uninsured families that do not regularly see a provider or families that have been mistreated by the medical system, a provider recommendation is challenging to obtain or holds little value. Parents who do not regularly interact with healthcare environments due to proximity to the nearest provider or insurance status might be unaware of HPV, the vaccine, and how to access information. This lack of awareness and access would inhibit vaccine acceptance

and receipt. Financial barriers, such as concerns about the cost to vaccinate their child with or without insurance or being unable to afford traveling and taking time off of work to take their child to a doctor's office may also significantly impact vaccination rates. Asking parents about their experiences with these barriers or what they know and think about the vaccine can help determine where gaps in access and knowledge exist and attempt to fill them. Our target populations come from low-income, underserved communities. Being uninsured, undocumented, concerned about cost, or hesitant to trust healthcare professionals are important factors parents grapple with when deciding whether to have their children vaccinated against HPV. By conducting the surveys and key informant interviews, we can determine which factors weigh most heavily on parents' minds and work to mitigate those barriers to increase HPV vaccination rates in target communities.

Healthy People 2030, a U.S. Department of Health and Human Services initiative, set a goal of having 80% of adolescents up-to-date on their HPV vaccination, which has not been reached in any of the states included in the study.[12] According to 2019 data, the most recently published data for the catchment areas, only 75.5% of males and females in Washington, D.C, 68.9% in Maryland, and 51.4% in New Jersey were up-to-date on their HPV vaccinations, demonstrating that many regions, and all of those included in this study, are falling short of vaccination goals.[13] A November 2021 study found that the Cervarix HPV vaccination reduced cervical cancer incidence rates by 87% when comparing girls who received the vaccine at ages 12 or 13 to those who did not receive it.[2] These findings quantify the effectiveness of the vaccine in preventing HPV and the impact that reducing HPV infection rates has on cervical cancer rates. This underscores the importance of understanding the complex motivations behind HPV vaccination to better target interventions that can improve vaccine uptake and ensure lasting community health.

This study seeks to characterize individual, familial, and systemic barriers to HPV vaccination among low-income, underserved children 10-17 years of age in the greater Washington, D.C. and Hackensack, NJ metropolitan areas to better understand the factors that influence a parent or guardian's decision to vaccinate a child against HPV or not. We hypothesized that barriers such as inadequate knowledge (defined as limited or incorrect knowledge of HPV and the HPV vaccine), financial hardship, lack of access, medical mistrust, and greater stress due to COVID-19, would be associated with low vaccine uptake in this sample.

2. Methods

2.1 Design

This IRB-approved study was conducted from May 2021 to January 2022. A mixed methods approach, consisting of a quantitative survey and qualitative Key Informant Interviews (KII) conducted with parents of children 10-17 years of age in the catchment area, was used to assess the barriers to accessing and receiving the HPV

vaccine. Data was collected via an online survey through the Lombardi Comprehensive Cancer Center's Cancer Prevention and Control Program at Georgetown University. Participants completed a 46-item survey administered online through the REDCap platform. The survey was adapted from existing measures such as the Hopkins Medical Mistrust Index, Vaccine Hesitancy Scale, and the SARS-CoV-2-related worry (CoV-Wo) scale and included the HPV Vaccine Knowledge & Beliefs scale and items assessing awareness and intent.[8,14,15,16] Summary scores were calculated for each measure with higher scores indicating greater knowledge, mistrust, hesitancy, and COVID-19 stress.

2.2 Participants

Parents of children 10-17 years of age living in the catchment area (Washington, D.C., Prince George's and St. Mary's Counties in Maryland, and Bergen, Hudson, and Passaic Counties in New Jersey) were eligible to participate. Using Facebook's advertising platform, parents were targeted by selecting an audience with interests such as parenting and family and narrowing to users 25-55 years of age living in the catchment area. Between May and September 2021, across Facebook and Instagram platforms, the advertisements reached over 57,000 individuals from the high-risk target populations. The survey was also advertised on flyers in community settings, such as primary care offices, starting in July 2021. A total of 29 participants completed the survey and 3 elected to participate in an optional follow-up key informant interview. The key informant interviews (KII) were conducted between November 2021 and January 2022 and lasted approximately 20 minutes.

2.3 Instruments

Demographic data collected included race/ethnicity, education, and income (Table A1). Awareness of the HPV vaccine (whether the participant had ever heard of it or not) and the HPV vaccination status of the respondent were also recorded. Family Composition was determined by asking participants how many 10-17-year-old children are in the household as well as the age, gender, ethnicity, and race of each child. Participants were asked to complete the remainder of the survey with one child in mind. For participants with two or more children 10-17 years of age, one child was randomly selected to be considered for the survey. Child HPV Experience/Intentions was determined by asking whether the child had received any doses of the HPV vaccine and if so, how many. If the child had not received any doses, they were asked to specify the main reason behind the child's vaccination status. Intent to vaccinate and physician recommendation were also assessed. Additional data was obtained using the following instruments (Table A2).

The 8-item HPV Vaccine Knowledge & Beliefs scale was adapted from the Group-Based Medical Mistrust Scale and was used to determine what participants know or believe to be true about the HPV vaccine and if greater HPV knowledge was correlated with vaccination.[14]

The 7-item Hopkins Medical Mistrust Index measures the level of medical mistrust to determine the extent to which mistrust of healthcare providers, organizations, and health systems may have contributed to HPV vaccine hesitancy.[17]

The 9-item Vaccine Hesitancy Scale measures a person's level of vaccine hesitancy.[16] It was used to examine how hesitancy regarding childhood vaccines, in general, may have impacted a parents' decision to vaccinate against HPV.

The 6-item SARS-CoV-2- related worry (CoV-Wo) Scale measures how stressed a person is regarding COVID-19 and related issues such as financial strain or health concerns.[18] This scale was used to determine if there was a correlation between increased "worry" about COVID-19 and HPV vaccination.

The Key Informant Interviews (KII) were conducted via Zoom and lasted approximately 20 minutes. They were recorded and transcribed for data analysis. Participants were asked 12 questions about their knowledge of and opinions regarding HPV and the HPV vaccine to assess beliefs, experience, barriers to access, and hesitancy. To prevent implicit biases from influencing the KIIs, the interview was conducted without video, and the questions were purposefully framed to avoid stigmatizing language.

2.4 Data Analysis

Statistical analyses were prepared in Microsoft Excel and were conducted using an online statistical calculator.[19] Descriptive statistics were used to compare vaccinated and unvaccinated groups. One-tailed student's t-tests were used to compare the means of each of the four dependent variables between the parents of vaccinated and unvaccinated children (Table A3).

3. Results

In this sample, 29 parents of 43 children completed the survey. 20 out of 29 (69.0%) parents reported vaccinating their children against HPV, seven (24.14%) reported not vaccinating their children against HPV, and two (6.90%) were unsure of their child's vaccination status. There were 29 vaccinated children, 12 unvaccinated children, and 2 children with unknown vaccination status recorded. None of the seven parents who did not vaccinate their children against HPV reported receiving a physician recommendation.

Parents in this sample with greater HPV knowledge were more likely to have their children receive the vaccine (Table A3, $p = 0.0044$). Lesser vaccine hesitancy was shown to have a marginally significant association with vaccination (Table A3, $p = 0.094$). Among other barriers to vaccination that were assessed in this sample, no significant findings emerged.

All three KII participants attributed their decision to vaccinate to a provider recommendation. They were also all generally proponents of vaccination and expressed that COVID-19 has strengthened their existing beliefs in vaccines. They all reported that wanting to protect their child from potentially contracting HPV or developing associated cancers was their primary motivation for

choosing to vaccinate their child against HPV. All three KII participants reported employing a cost-benefit analysis of vaccination, ultimately deciding that the protection conferred by the HPV vaccine outweighed any possible side effects.

4. Discussion

Our results show a relationship between knowledge and awareness of both HPV and the HPV vaccine, vaccine hesitancy, provider recommendation, and HPV vaccination status, findings that are consistent with prior literature. Parents with greater knowledge and awareness and lesser vaccine hesitancy who receive a provider recommendation are more likely to vaccinate their children. This emphasizes the importance of increasing public knowledge of HPV as well as encouraging provider recommendations, particularly for medically underserved populations such as this sample.

There is consistent evidence in the literature that provider recommendation is a significant predictor of vaccination, which is supported by sentiments expressed by all KII participants and the finding that none of the parents who chose not to vaccinate their children against HPV reported receiving a provider recommendation.[11] In line with hypotheses and literature, this suggests that receipt of a recommendation from a trusted provider is a crucial predictor of vaccination and emphasizes how impactful a provider recommendation can be for a parent deciding whether to vaccinate their child against HPV. Providers can contribute to raising awareness and knowledge of the HPV vaccine, and a trusted recommendation can be the determining factor for vaccine uptake. This underscores the need for providers to make HPV vaccine recommendations a priority to improve the health and well-being of their communities.

Limited knowledge of HPV and the HPV vaccine is shown to be a significant barrier in this sample, consistent with hypotheses and existing literature. This finding suggests that there is a need for increased awareness and education so that parents are not only aware of HPV, but also understand the importance of vaccination to prevent infection and the development of associated cancers. Correcting widespread misinformation by providing credible data and facts about HPV and the vaccine could have a significant, positive impact on vaccination rates. For populations who do not have a primary care provider or accessible, accurate health information, limited knowledge hinders widespread vaccination.

Results also indicate that lesser vaccine hesitancy is marginally associated with vaccination in this sample. Hesitancy was expected to be a key barrier to HPV vaccination because of the many myths and fears that have persisted since the initial vaccine rollout in 2006. There was fear about the vaccine's safety and efficacy and hesitancy stemming from fear of encouraging premature sexual activity, and many of the reasons for hesitancy remain significant factors in parents' decisions to vaccinate their children today. These findings emphasize the overlap between knowledge and hesitancy

and suggest that, with improved knowledge of HPV and the HPV vaccine, hesitancy could decrease, and vaccine uptake could increase. Knowledge and hesitancy are closely related, and addressing both barriers is necessary to increase vaccination rates in medically underserved communities.

It was expected that lesser medical mistrust would be associated with vaccination, but no significant findings emerged. Mistrust and hesitancy often go hand-in-hand, particularly amongst low-income, medically underserved communities, so further research is needed to fully elucidate the relationship between medical mistrust and HPV vaccine hesitancy among vulnerable populations.[15,20]

4.1 Limitations

The small sample size (n=29) was a limitation of this study, with a greater proportion of participants having vaccinated their children. This could have influenced findings by excluding the proportion of more at-risk, medically underrepresented parents and children who are less likely to vaccinate. Similarly, all three KIIs were conducted with parents who vaccinated their children against HPV, also omitting the unvaccinated population that we aimed to target. While all three KIIs were conducted with parents who vaccinated their children, understanding the factors that lead parents to vaccinate their children highlights gaps for parents who choose not to vaccinate and suggests where interventions should be focused. Since the relationship with a provider was revealed to be so important, interventions should focus on providers as facilitators of HPV vaccine information and recommendation.

5. Conclusions

The intersections of awareness, knowledge, hesitancy, and trust in providers are emphasized by these findings as all these barriers are shown to influence HPV vaccination among the sample. Not only does this data contribute to a better understanding of the barriers and motivations for HPV vaccination among low-income, underserved parents, but it also indicates what interventions would be most effective for increasing HPV vaccination rates in these communities. The small sample size is a limitation. However, there is value in the consistent nature of the KIIs and all findings being consistent with previous literature. Despite this limitation, these findings have contributed to a better understanding of factors that influence parents' decision to vaccinate their children against HPV and the gaps that exist which prevent parents from choosing to do so. Consequently, the findings provide information that can be used to address barriers and improve HPV vaccination rates in medically underserved communities. In the future, studies should aim to obtain a greater sampling from these communities to capture the diversity of experiences, opinions, and beliefs parents have regarding HPV and the HPV vaccine for their children. This study contributes to an expanding line of research to better understand barriers and facilitators of HPV vaccination in children from vulnerable communities.

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Appendix

Table A1. Characteristics of HPV Survey Respondents (n=43). Demographic data are presented as a percentage (%) of the total and as the number (n) of participants who responded to each category.

Demographics	n	%
Race/Ethnicity (n=43)		
American Indian/Alaskan Native	n=4	9.30%
Asian	n=1	2.33%
Black or African American	n=10	23.26%
Native Hawaiian or Other Pacific Islander	n=0	0.0%
White	n=14	32.56%
Other	n=4	9.30%
Hispanic/Latinx	n=10	23.26%
Education (n=30)		
Less than high school	n=1	3.33%
High school/GED	n=10	33.33%
Two year degree/some college	n=7	23.33%
Bachelor's degree	n=3	10.0%
Professional degree	n=9	30.0%
Annual Household Income (n=30)		
Less than $30,000	n=10	33.33%
$30,000 to $59,000	n=5	16.67%
$60,000 to $99,000	n=6	20.0%
$100,000 or more	n=9	30.0%
Child gender (n=43)		
Female	n=22	51.16%
Male	n=21	48.84%
Child vaccinated (n=43)		
Yes	n=29	67.44%
No	n=12	27.91%
Unsure	n=2	6.90%
Number of children/respondent (n=29)		
One child	n=17	58.62%
Two children	n=10	34.48%
Three children	n=2	6.90%

Table A2. Survey Instruments. Items included in the survey from the HPV Vaccine Knowledge & Beliefs Scale, Hopkins Medical Mistrust Index, Vaccine Hesitancy Scale, and SARS-CoV-2- related worry (CoV-Wo) Scale.

Survey Measure	Items
HPV Vaccine Knowledge & Beliefs Scale	1. "The HPV vaccine can prevent certain types of genital warts." 2. "Men can get HPV." 3. "The HPV vaccine can protect against certain types of cervical cancer." 4. "The HPV vaccine is available for males and females between 9 and 26 years old." 5. "You can't get the HPV vaccine if you had HPV." 6. "The HPV vaccine does not protect against every type of HPV." 7. "The HPV vaccine protects against anal cancer." 8. "The HPV vaccine will cure cervical cancer."
Hopkins Medical Mistrust Index	1. "You'd better be cautious when dealing with health organizations." 2. "Patients have sometimes been deceived or misled by health care organizations." 3. "When health care organizations make mistakes they usually cover it up." 4. "Health care organizations are more concerned about making money than taking care of people." 5. "Health care organizations don't always keep your information totally private." 6. "Sometimes I wonder if health care organizations really know what they are doing." 7. "Mistakes are common in health care organizations."
Vaccine Hesitancy Scale	1. "Childhood vaccines are important for my child's health." 2. "Childhood vaccines are effective." 3. "Having my child vaccinated is important for the health of others in my community." 4. "All childhood vaccines offered by the government program in my community are beneficial." 5. "New vaccines carry more risks than older vaccines." 6. "The information I received about vaccines from the vaccine program is reliable and trustworthy." 7. "Getting vaccines is a good way to protect my child/children from diseases." 8. "Generally I do what my doctor or health care provider recommends about vaccines for my child/children." 9. "I am concerned about serious adverse effects of vaccines."
SARS-CoV-2- related worry (CoV-Wo) Scale	1. "I am worried about getting the coronavirus." 2. "I am worried about my family/friends getting the coronavirus." 3. "I am very worried about giving someone else the coronavirus." 4. "I am worried about money because of the coronavirus." 5. "I am worried about having enough food because of the coronavirus." 6. "I am worried about medical bills if I get sick because of the coronavirus."

Table A3. Associations between Barriers to Vaccination and Vaccination Status (n=27). Correlational data was calculated between HPV knowledge, medical mistrust, vaccine hesitancy, COVID stress, and vaccination status using an online statistical calculator. Higher scores indicate greater knowledge, mistrust, hesitancy, and COVID stress.
* Correlation is significant ($p < 0.05$)

Measure	Mean	SD	T-value	P-value
HPV Knowledge (n=27)	5.04	2.24	2.84	0.0044*
Vaccinated (n=21)	5.62	1.75		
Unvaccinated (n=6)	3.00	2.76		
Medical Mistrust (n=25)	17.92	5.36	0.72	0.24
Vaccinated (n=20)	18.35	4.97		
Unvaccinated (n=5)	16.40	7.06		
Vaccine Hesitancy (n=25)	17.72	4.65	-1.36	0.094
Vaccinated (n=20)	17.10	4.62		
Unvaccinated (n=5)	20.20	4.32		
COVID stress (n=25)	19.76	6.65	-0.31	0.38
Vaccinated (n=20)	19.55	7.08		
Unvaccinated (N=5)	20.60	5.18		

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