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Human Papillomavirus Vaccine Uptake and Its Associated Factors among Adolescent Girls in Kaduna North LGA, Nigeria: A Mixed-Methods Study

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Abstract

Introduction: Cervical cancer, primarily attributed to persistent human papillomavirus (HPV), remains a critical public health concern globally, particularly in low- and middle-income countries like Nigeria. Despite the availability of an effective vaccine and its integration into the national immunization program, uptake continues to be low in Nigeria. Therefore, this study was designed to assess HPV vaccine uptake and its associated factors among adolescent school girls in Kaduna North LGA.

Methods: A mixed-methods cross-sectional study design was employed, targeting adolescent girls aged 10–19 years enrolled in public and private secondary schools within Kaduna North LGA. Using a multistage sampling approach, 418 respondents were systematically selected. Data, collected through a structured, pre-tested electronic questionnaire, were analyzed using SPSS version 25 and thematic content analysis.

Results: The results revealed that while 65.1% of respondents reported having heard of HPV, only 42.3% had adequate knowledge of the virus and its vaccine. Alarmingly, only 7.5% of the respondents had received at least one dose of the HPV vaccine. Bivariate analysis showed statistically significant associations between vaccine uptake and parental willingness to vaccinate, awareness of the vaccine's existence, cultural attitudes toward vaccination, and prior awareness of HPV-related health risks. Multivariate logistic regression confirmed these factors as independent predictors of uptake. The primary barriers to vaccination identified included misinformation, fear of adverse effects, parental disapproval, sociocultural misconceptions, and inadequate access to vaccination points. Qualitative data provided further insights into community perceptions, suggesting that mistrust of the health system, religious myths, and inadequate engagement with school authorities were major deterrents.

Conclusion: This study concludes that HPV vaccine uptake among adolescent school girls in Kaduna North LGA is significantly low and recommends multi-pronged strategies, including community-based sensitization, religious and parental engagement, school-based vaccination drives, and consistent communication through trusted channels. These measures are essential for improving coverage and contributing to cervical cancer prevention and eventual elimination.

Keywords: HPV, cervical cancer, vaccine uptake, adolescent girls, Nigeria, Kaduna North, health behavior, barriers, awareness, parental influence, immunization, public health strategy.

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Introduction

Cervical cancer is a significant public health issue globally, particularly affecting women in low- and middle-income countries. It is the fourth most common cancer in women worldwide, with approximately 660,000 new cases and 350,000 deaths reported in 2022 (WHO, 2024). The disease primarily arises from persistent infection with high-risk types of the human papillomavirus (HPV), a common sexually transmitted infection. HPV is a group of more than 100 related viruses, with over 40 types that can infect the genital areas,

mouth, and throat (CDC, 2024). The HPV vaccine is highly effective in preventing infections with the most dangerous HPV types and has significantly reduced the prevalence of HPV infections and related diseases in vaccinated populations (CDC, 2024). HPV vaccination is a proven, cost-effective strategy to prevent HPV infections and, subsequently, cervical cancer. The World Health Organization (WHO) recommends that girls aged 9–14 receive the HPV vaccine before they are exposed to the virus. The introduction of HPV vaccination programs has been instrumental in reducing the incidence of HPV-related diseases in many countries (WHO, 2018).

In Nigeria, cervical cancer remains the second most common cancer among women, with an estimated 14,943 new cases and 10,403 deaths annually (GLOBOCAN, 2020). Despite the availability of HPV vaccines, uptake in the country has historically been low due to factors such as lack of awareness, cultural misconceptions, socio-economic barriers, and limited access to healthcare (Brown & Folayan, 2015; Onyema & Oparanma, 2023). Until 2023, the HPV vaccine was not included in Nigeria's national routine immunization program, which likely contributed to lower uptake rates as access was primarily limited to private healthcare settings. In October 2023, Nigeria incorporated the HPV vaccine into its routine immunization schedule, targeting 7.7 million girls in what represents the largest single-round HPV vaccination effort in the African region (WHO, 2023). Increasing public awareness of the link between HPV and cervical cancer and promoting the vaccine as a safe and effective method of prevention may help to improve uptake (Okoka et al., 2023).

Kaduna North, one of the Local Government Areas (LGAs) in Kaduna State, serves as the state capital with its administrative center in Doka. The area covers 72 square kilometers and has the postal code 800 (Manpower, 2025). The LGA is bordered by Kaduna South, Igabi, and Chikun LGAs. Towns, districts, and villages in Kaduna North LGA include Kawo, Unguwan Dosa, Malali, Abakpa, Kabala, Sabon Kawo, Kwaru, and Hayin Banki (Statoids, 2025). This region faces similar challenges in achieving high HPV vaccine uptake among adolescent girls (Dike-Ndudim et al., 2022). Understanding the factors influencing vaccine acceptance and addressing barriers at multiple levels are critical for the success of vaccination programs.

Cervical cancer remains a significant public health issue in Nigeria. The country records thousands of new cases and deaths annually, indicating that effective prevention strategies are needed (Otorkpa et al., 2024). It is crucial to determine the prevalence of HPV infection among young girls to monitor the effectiveness of the HPV vaccine, decide the optimal age for vaccine introduction, and understand factors contributing to persistent high-risk HPV infection (a necessary cause of cervical cancer). While many studies have addressed HPV vaccine uptake globally, very few have focused on local contexts within Nigeria. This study addresses a critical gap by examining HPV vaccine uptake specifically among adolescent school girls in Kaduna North LGA. While previous research has identified general barriers to HPV vaccination in Nigeria and similar contexts, this study will provide a detailed analysis of the unique socio-economic, cultural, and healthcare-related factors influencing vaccine uptake in Kaduna North. The localized insights gained will be essential for designing targeted public health interventions and policies to improve vaccination coverage in this community.

Therefore, this study aimed to determine the level of HPV vaccine uptake among adolescent school girls in Kaduna North LGA and to identify the factors associated with that uptake. It specifically assessed the level of awareness and knowledge of HPV infection, the proportion of HPV vaccine uptake among adolescent school girls in Kaduna North LGA, the factors associated with HPV vaccine uptake, and recommended strategies for increasing HPV vaccine uptake among adolescent school girls in Kaduna North LGA. It was unique to fill existing gaps providing both quantitative and qualitative evidence with integration of multivariate analysis, highlighting private-school disparities.

Materials and Methods

Design and Study Population

This study employed a cross-sectional descriptive design to assess HPV vaccine uptake and associated factors among adolescent school girls in Kaduna North LGA. This design was appropriate for measuring the prevalence of vaccine uptake and examining relationships between uptake and explanatory variables at a single point in time (Althubaiti, 2022).

The study was conducted in Kaduna North LGA, the administrative capital of Kaduna State, Nigeria. The area included both urban and semi-urban communities and comprised several public and private secondary schools. Figure 1 below presents a detailed map of Kaduna North LGA, highlighting key zones and landmarks within the area.

The target population consisted of adolescent girls aged 10–19 years enrolled in secondary schools within Kaduna North LGA. This age group aligns with the WHO's recommended age range for HPV vaccination (WHO, 2017).

Sample Size Determination

The sample size for this study was determined using the Cochran formula for estimating sample size in a descriptive cross-sectional study (Althubaiti, 2022):

$$\mathrm{n} = \frac{Z^2 \times p \times q}{d^2}$$

Where:

n = required sample size

Z = standard normal deviate (1.96 for 95% confidence level)

p = estimated proportion of HPV vaccine uptake (0.5 used when unknown, for maximum sample size)

q = 1 –

d = margin of error (0.05)

Substituting the values:

$$\mathrm{n} = \frac{(1.96)^2 \times 0.5 \times 0.5}{0.05^2} = 384.16$$

Rounding up, the minimum sample size is 384. To account for potential non-response or incomplete data, an additional 10% was added:

$$384 + 38.4 = 422.4$$

Thus, the final sample size was approximately 422 adolescent school girls.

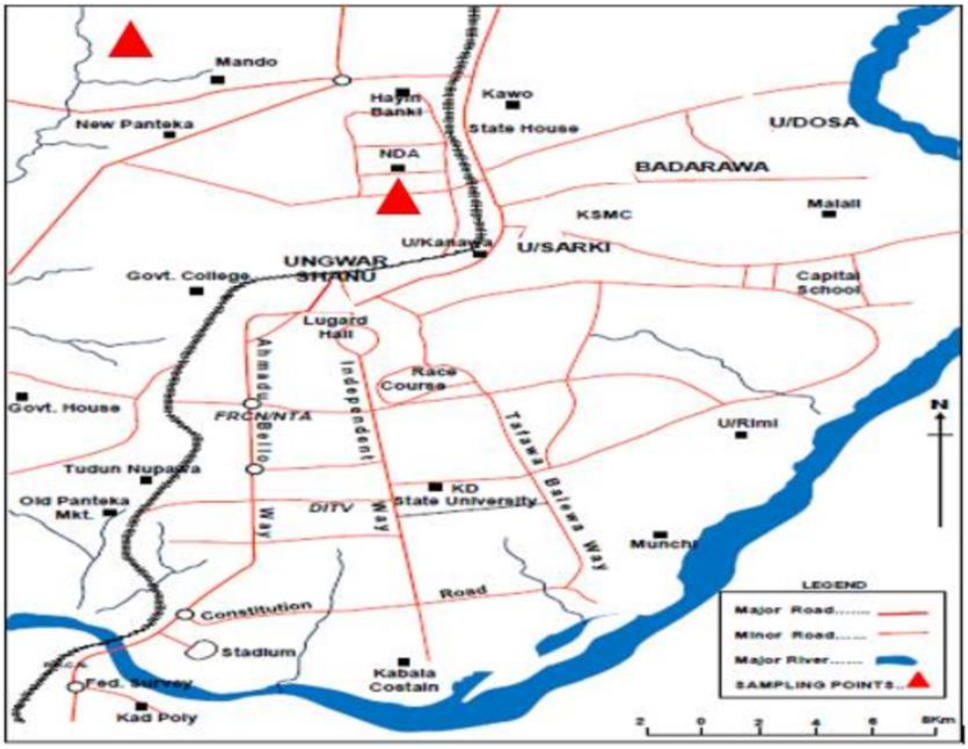

Figure 1: Map of Kaduna North LGA showing populated zones and landmarks (Source: KASU GIS, 2023).

Sampling Technique

A multistage sampling technique was employed as follows:

Stage 1: Public and private secondary schools within Kaduna North LGA were listed, and a random selection was conducted to ensure proportional representation of both categories in line with their distribution in the area.

Stage 2: Within each selected school, students were stratified by class level (JSS1–SS3).

Stage 3: Proportional allocation and random selection of students within each stratum were carried out to preserve representativeness across class levels.

Refusals or non-responses were addressed by replacing the selected student with the next eligible student on the randomization list for that stratum and school, ensuring that the sample size target was maintained.

To ensure that the study targeted the appropriate population and maintained methodological rigor, specific inclusion and exclusion criteria were established.

Inclusion Criteria:

The study included adolescent girls between the ages of 10 and 19 years who are enrolled in selected public and private secondary schools within Kaduna North LGA. Eligible participants were provided informed assent, and for those below 18 years, parental or guardian consent was obtained before participation.

Exclusion Criteria:

Students who are not present during the period of data collection were excluded from the study. In addition, any student or parent/guardian who declined to give consent or assent for participation was excluded.

Data Collection Tools and Procedures

Data were collected using a structured, pretested questionnaire administered via a Microsoft Form. The form contained both closed-ended and open-ended questions covering the following sections: socio-demographic characteristics; knowledge and awareness of HPV and the HPV vaccine; attitudes and beliefs toward HPV vaccination; vaccine uptake status; and barriers and facilitators to vaccine uptake.

The questionnaire was designed based on insights from prior studies on HPV knowledge and behavioral theory, including the Health Belief Model (Brewer *et al.*, 2017), and incorporates evidence-based contents used in educational interventions (Fu *et al.*, 2014). The form was shared digitally with participants through school authorities, who facilitated access via computer labs or students' personal mobile devices. This online format ensured anonymity, faster data aggregation, and improved data quality through required fields and skip logic. The form was pretested in a non-selected school to ensure clarity and reliability of the instrument.

Data Analysis

Collected data was downloaded from Microsoft Forms into Microsoft Excel and exported to SPSS version 25 for analysis. Quantitative analysis, at p-value < 0.05 and 95% level of significance, included descriptive statistics (frequencies, percentages, means) to summarize respondents' characteristics and vaccine uptake and inferential statistics (chi-square tests) to examine associations between categorical independent variables and HPV vaccine uptake. Additionally, a multivariable logistic regression model was fit to estimate adjusted odds ratios (aORs) and 95% confidence intervals for independent predictors of HPV vaccine uptake, including awareness, parental willingness, socio-demographics, and cultural acceptability.

Finally, qualitative analysis was conducted on the open-ended responses using thematic content analysis to identify recurring suggestions and perceptions regarding HPV vaccine uptake.

The responses were manually reviewed and coded into themes such as awareness creation, school programs, and parental involvement, providing contextual depth to the quantitative findings.

Ethical Considerations

The main ethical consideration for this study was ensuring that the rights, dignity, and welfare of all participants were respected in accordance with ethical guidelines for research involving human subjects. Ethical approval was obtained from the Ministry of Health, Kaduna State (MOH/ADM/744/VOL.1/1110045 dated 14/07/2025). Informed consent was obtained from parents/guardians and assent from participants aged below 18. Participation was voluntary, and confidentiality was strictly maintained. The Microsoft Form did not collect names or identifiable information to ensure anonymity.

Limitations of the Study

The use of online forms limited participation among students with limited digital access. Additionally, self-reported data were affected by recall bias or social desirability bias. Furthermore, the cross-sectional design of the study limited the ability to infer causality. Self-selection bias may also have been present if schools or students more open to discussing HPV were more likely to participate. Efforts were made to address these limitations by ensuring that access was facilitated through schools and that questions were phrased clearly and objectively. The logistic regression analysis was conducted on complete cases only (n = 397), excluding respondents with missing data. If the pattern of missing data was not random, it could lead to biased estimates. Finally, the study was geographically limited to Kaduna North LGA. While this focus allowed for in-depth contextual analysis, it limits the generalizability of the findings. Sociocultural, religious, and educational dynamics vary considerably across Nigeria, and factors influencing HPV vaccine uptake in one locality may not apply uniformly elsewhere.

Results and Discussion

Descriptive Statistics

The majority of the 418 participants were aged 15–19 years (83.3%, 95% CI: 79.4% – 86.7%), while 16.7% (95% CI: 13.3% – 20.6%) were aged 10–14. Over half (57.9%, 95% CI: 53.1% – 62.6%) were in SSS1. The sample was predominantly Muslim (93.8%, 95% CI: 91.1% – 95.9%) and of Hausa ethnicity (69.4%, 95% CI: 64.9% – 73.6%). In terms of parental education, 52.4% (95% CI: 47.6% – 57.1%) of mothers and 69.6% (95% CI: 65.1% – 73.8%) of fathers had attained tertiary education.

HPV Vaccine Uptake, Awareness and Knowledge of HPV

Only a small proportion of respondents (7.4%) reported receiving at least one dose of the HPV vaccine, 27.8% (95% CI: 23.7%–32.2%) of respondents had heard of HPV before the survey, and 26.6% (95% CI: 22.5%–30.9%) had heard of the HPV vaccine (Table 1). Knowledge of HPV-related disease and transmission was limited: fewer than one-third correctly identified cervical cancer as the disease caused by HPV, and only about one-fifth knew that HPV is mainly spread by sexual contact. Over half of respondents (54.1%, 95% CI: 49.3%–58.8%) were aware that a vaccine exists, though most were unsure of the recommended age for vaccination. Nevertheless, 55.3% (95% CI: 50.5%–60.0%) believed that vaccination could prevent cervical cancer.

Table 1: HPV Uptake, Awareness and knowledge of HPV (N = 418)

HPV Vaccine Uptake	**Vaccination status**	**Frequency**	**Percentage (%)**
	Vaccinated (≥1 dose)	31	7.4
	Not vaccinated	387	92.6
	Total	418	100.0
Awareness and Knowledge of HPV			
Item	**Response**	**Frequency**	**Percentage (%)**
Heard of HPV	Yes	116	27.8
	No	302	72.2
Heard of HPV vaccine	Yes	111	26.6
	No	307	73.4
Knows HPV causes cervical cancer	Correct	114	27.3
	Incorrect	33	7.9
	Don't know	271	64.9
Knows how HPV spreads	Correct (sexual contact)	89	21.3
	Incorrect	43	10.3
	Don't know	286	68.4
Knows a vaccine exists	Yes (correct)	226	54.1
	Incorrect	8	1.9
	Don't know	184	44.0
Believes vaccine prevents cervical cancer	Yes	231	55.3
	No	26	6.2
	Not sure	144	34.4

Associations Using Chi-Square Test

As shown in Table 2, there was a significant relationship between awareness of the HPV vaccine and actual uptake. Girls who were aware were significantly more likely to be vaccinated (17.1%) than those who were not (3.9%) - $p < 0.001$. The strength of this association was weak to moderate (Cramér's V = 0.22). However, even among the aware group, uptake remained under 20%, suggesting that awareness is necessary but not sufficient. The relationship between knowledge of the vaccine's existence and uptake was also statistically significant ($p = 0.026$). The strength of this association was weak to moderate (Cramér's V = 0.23). Girls

who knew that the HPV vaccine exists were more than twice as likely to be vaccinated (9.3%) compared to those who were unsure or unaware (4.3%). A statistically significant association was also found between awareness of HPV infection and vaccine uptake (p = 0.014). The strength of this association was weak (Cramér's V = 0.12). Girls who were aware of HPV were more than twice as likely to be vaccinated (12.9%) compared to those who were unaware (5.3%).

Additionally, there was a statistically significant association between parental willingness and HPV vaccine uptake (p = 0.001), emphasizing the gatekeeping role of parents in adolescent health decisions. The strength of this association was weak (Cramér's V = 0.15). However, even among those with willing parents, uptake remained under 20%, suggesting that willingness alone may not overcome barriers like access or misinformation. Finally, the analysis revealed a statistically significant association between cultural attitudes and vaccine uptake (p = 0.045). The strength of this association was weak (Cramér's V = 0.11). Respondents who disagreed or strongly disagreed with the statement that their religion or culture discourages HPV vaccination had notably higher uptake (up to 13.8%) compared to those who agreed (2.9%) or were unsure (4.3%). While the strength of this association was weak, the findings suggest that cultural acceptability can either enable or hinder vaccination behavior.

Table 2: Significant predictors of HPV Vaccine Uptake Using X^2 Test

Relationship between Awareness of HPV Vaccine and HPV Vaccine Uptake				
Awareness of HPV Vaccine	Not Vaccinated	Vaccinated	Total	
Not Aware	241 (96.1%)	10 (3.9%)	251 (100.0%)	$X^2 = 34.9^a \ df = 1 \ p < 0.001$
Aware	138 (82.9%)	29 (17.1%)	167 (100.0%)	
Total	379 (90.7%)	39 (9.3%)	418 (100.0%)	
Relationship between Knowledge of Vaccine Existence and HPV Vaccine Uptake				
Knowledge Vaccine Exists	Not Vaccinated	Vaccinated	Total	
No / Unsure	261 (95.7%)	12 (4.3%)	273 (100.0%)	$X^2 = 4.9^a \ df = 1 \ p = 0.026$
Yes	118 (90.7%)	27 (9.3%)	145 (100.0%)	
Total	379 (90.7%)	39 (9.3%)	418 (100.0%)	
Relationship between Awareness of HPV Infection and HPV Vaccine Uptake				
Awareness of HPV Infection	Not Vaccinated	Vaccinated	Total	
Not Aware	277 (94.7%)	16 (5.3%)	293 (100.0%)	$X^2 = 6.0^a \ df = 1 \ p = 0.014$
Aware	102 (87.1%)	15 (12.9%)	117 (100.0%)	
Total	379 (90.7%)	39 (9.3%)	418 (100.0%)	
Relationship between Parental Willingness and HPV Vaccine Uptake				
Parental Willingness	Not Vaccinated	Vaccinated	Total	
Willing	193 (84.7%)	35 (15.3%)	228 (100.0%)	$X^2 = 10.3^a \ df = 2 \ p = 0.001$
Not Willing	92 (93.9%)	6 (6.1%)	98 (100.0%)	
Unsure	94 (96.0%)	4 (4.0%)	98 (100.0%)	
Total	379 (90.7%)	39 (9.3%)	418 (100.0%)	
Relationship between Cultural Attitudes and HPV Vaccine Uptake				
Cultural Belief About HPV Vaccine	Not Vaccinated	Vaccinated	Total	
Agree (A)	34 (97.1%)	1 (2.9%)	35 (100.0%)	$X^2 = 9.75^a \ df = 4 \ p = 0.045$
Disagree (D)	56 (86.2%)	9 (13.8%)	65 (100.0%)	
Not Sure (NS)	111 (95.7%)	5 (4.3%)	116 (100.0%)	
Strongly Agree (SA)	62 (95.4%)	3 (4.6%)	65 (100.0%)	
Strongly Disagree (SD)	77 (89.5%)	9 (10.5%)	86 (100.0%)	
Total	340 (93.7%)	27 (6.3%)	367 (100.0%)*	

** Note: Table 2 includes only 367 respondents out of the total sample of 418 because 51 participants did not respond to the cultural attitude question: "My religion or culture is against me getting the HPV vaccine." This missing data may reflect uncertainty, reluctance to answer culturally sensitive questions, or simple non-response.*

Multivariable Analysis of Factors Associated with HPV Vaccine Uptake

To identify and validate the independent predictors of HPV vaccine uptake, a multivariable logistic regression model was fitted with uptake (received ≥1 dose: Yes = 1, No = 0) as the dependent variable. Variables included in the model were awareness of the HPV vaccine (Yes/No), age group (15–19 years vs 10–14 years), school type (Private vs Public), mother's highest education (Tertiary vs ≤Secondary), cultural acceptability ("Religion or culture is against me getting the HPV vaccine": Disagree/Strongly disagree vs Agree/Strongly agree/Not sure), and parental willingness (Not willing / Not sure vs Willing). A complete-case analysis was used (n = 397). The model showed acceptable fit (McFadden pseudo-R^2 = 0.153, p < 0.001) and good discrimination (AUC = 0.80). The results (Table 3) indicated that awareness of the HPV vaccine (AOR 2.83, 95% CI -1.19 – 6.73, p = 0.019) and cultural acceptability (AOR 2.46, 95% CI -1.02 – 5.94, p = 0.046) were positively associated with uptake after adjusting for other factors. Attending a private school was independently associated with lower odds of uptake. Maternal tertiary education was positively associated with uptake but was marginally non-significant at the 5% level. Girls attending private schools had significantly lower odds of receiving the vaccine (AOR 0.35, 95% CI - 0.13 – 0.95, p = 0.04), while those whose mothers had tertiary education showed a trend towards higher uptake but it was not statistically significant (p = 0.074). Parental indecision was associated with lower uptake compared to those whose parents were willing. These findings suggest that increasing awareness, addressing cultural concerns, and engaging parents particularly in private school settings, could enhance uptake rates.

Table 3: Multivariable logistic regression of predictors of HPV vaccine uptake

Predictor	Adjusted OR	95% CI	p-value
Heard of HPV vaccine (Yes vs No)	2.83	1.19 – 6.73	0.019
Age 15–19 years (vs 10–14 years)	2.12	0.57 – 7.95	0.264
School type: Private (vs Public)	0.35	0.13 – 0.95	0.040
Mother's education: Tertiary (vs ≤Secondary)	2.50	0.91 – 6.84	0.074
Disagrees religion/culture is against HPV vaccine (vs agree/strongly agree/not sure)	2.46	1.02 – 5.94	0.046
Parents not willing (vs willing)	0.47	0.15 – 1.49	0.200
Parents not sure (vs willing)	0.31	0.11 – 0.89	0.030

Note: *Outcome = received ≥1 dose (Yes/No). Complete-case logistic regression. McFadden pseudo-R^2 = 0.153; AUC = 0.80. n = 397 reflects only participants with complete data for all predictors in the model (awareness, age group, school type, mother's education, cultural acceptability, and parental willingness). Respondents missing any of these values were excluded from the regression.*

Barriers to HPV Vaccine Uptake

Among the 387 non-vaccinated respondents, Table 4 summarized the main reasons reported for not receiving the HPV vaccine. Lack of information was by far the most common reason. Other reasons included safety concerns, the belief that vaccination is unnecessary for girls who are not yet sexually active, parental disapproval, lack of opportunity, access/availability issues and religious/cultural objections.

Qualitative Insights on Promoting HPV Vaccine Uptake

The responses to the question 'In your opinion, what could be done to encourage more girls like yourself to receive the HPV vaccine?' were thematically analyzed. Almost half left this blank or said they did not know. Among substantive responses, the dominant theme was the need for awareness and education, including more information in schools and communities. Respondents also called for the vaccine to be made easily available at schools and clinics, for health workers to provide clear information and for parents to be engaged and supportive. Table 5 below presented the identified themes, their frequencies, and representative quotes from participants

Table 4: Barriers to HPV Vaccination (non-vaccinated n = 387)

Barrier	Frequency	Percentage (%)
Lack of information	194	50.1
Safety/side-effect concerns	26	6.7
Not sexually active	23	5.9
Plan to get but no opportunity	20	5.2
Parental disapproval	11	2.8
Access/availability	3	0.8
Religious/cultural beliefs	3	0.8
Other	2	0.5

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Table 5: Thematic Analysis of Suggestions to Encourage HPV Vaccination

Theme	Frequency	Sample Quotes
Increase Awareness and Education	95	"I cant say anything for now because i dont know about HPV vaccine"; "I dont know at all"
School-Based Outreach	19	"Creating more awareness of the vaccine in schools and neighbourhood and enlightening people about it."; "Talk more about it in schools and gatherings"
Parental Involvement	9	"I think it's important for schools and health centres to organise talks to educate girls and their parents. Also making the vaccine affordable or free, especially in rural areas, would help alot"; "Teach parents and teachers about the HPV vaccine, make it affordable for people"
Healthcare Access and Availability	16	"Go to the hospital to process check for the vaccine and ask doctors to give you some dose for it"; "Go hospital to prose check for the hpv vaccine and as doctors to give you some dose for it"

Discussion

Low Uptake of the HPV Vaccine

The study revealed that only 7.4% of adolescent girls had received at least one dose of the HPV vaccine. This figure is far from the WHO global immunization strategy, which aims to have 90% of girls fully vaccinated against HPV by the age of 15 (WHO, 2020). This gap between the global benchmark and the findings of this study indicates the ongoing structural and sociocultural challenges that hinder vaccine access and acceptance. This trend is consistent with other sub-Saharan African contexts. For example, Adepoju *et al.* (2021) also reported low HPV vaccine uptake in Nigeria, and attributed this to poor public health communication, low awareness and poor vaccine distribution, especially in rural and underserved communities. In addition, studies by Ezeanochie and Olagbuji (2014) and Ngcobo *et al.* (2021) also highlight the role of poor education campaigns, distrust in government health interventions, and cultural misconceptions about HPV and cervical cancer in worsening the situation. The low coverage observed in this study is a serious public health concern, especially considering that cervical cancer is one of the most preventable yet most lethal cancers affecting women in low and middle income countries (WHO, 2024). The region is likely to continue experiencing high rates of HPV-related illnesses and death unless there are substantial efforts to expand awareness and improve vaccine availability. These findings highlight the need for coordinated strategies that strengthen vaccine delivery systems and engage communities through culturally relevant and gender-responsive health education. Achieving global targets and reducing the burden of HPV-associated diseases will require national immunization policies to be aligned with WHO recommendations, while addressing local barriers.

Awareness, Knowledge and Uptake

The study found that only 27.8% of girls had heard of HPV and 26.6% had heard of the HPV vaccine. Despite this limited awareness, vaccine uptake was significantly higher among those who were aware of the vaccine (17.1%) than those unaware (3.9%), with $p < 0.001$. Furthermore, knowledge that a vaccine exists was also positively associated with uptake (9.3% vs. 4.3%, $p = 0.026$). The findings indicate awareness and knowledge play a crucial role in determining health seeking behavior especially in the context of HPV prevention

among adolescents. This finding is supported by existing literature, including Ezeanochie and Olagbuji (2014), who reported that Nigerian mothers with higher awareness of HPV and its vaccine were significantly more likely to express willingness to vaccinate their daughters. The study showed that knowledge acts as both an enabling factor and a motivational factor by enhancing the perceived benefits of the vaccine and decreasing the psychological barriers that include fear and misinformation. According to Asgedom *et al*. (2024), adolescent girls in sub-Saharan Africa who have a good understanding of HPV were more than three times more likely to be vaccinated indicating that informational programs can lead to improved vaccination rates.

However, the relationship between knowledge and behavior was not absolute. Even among those aware, uptake remained under 20%. This indicates that awareness is necessary but not sufficient to ensure vaccine uptake. According to the Health Belief Model (Champion & Skinner, 2008), health behavior is influenced not only by knowledge but also by perceived susceptibility, perceived severity, and perceived barriers.

Age differences in awareness were not statistically significant ($p = 0.550$), suggesting that current communication efforts reach early (10–14) and late (15–19) adolescents similarly. Nonetheless, given that younger girls are closer to the recommended age for vaccination, tailored strategies targeting this group could enhance impact.

Influence of Parental Willingness and Cultural Acceptability

Parental willingness had a strong and statistically significant association with uptake ($p = 0.001$). Adolescents with willing parents were more than twice as likely to be vaccinated (15.3%) compared to those with unwilling (6.1%) or unsure (4.0%) parents. This emphasizes the gatekeeping role parents play in adolescent health decisions. Cultural acceptability also emerged as an important factor. Uptake was highest among respondents who disagreed (13.8%) or strongly disagreed (10.5%) with the belief that their religion or culture opposed vaccination. Those who agreed or were unsure had uptake rates as low as 2.9% and 4.3%, respectively ($p = 0.045$). These findings are consistent with studies in Nigeria that emphasize parental consent and sociocultural beliefs as critical determinants of HPV vaccine uptake. Yusuf *et al*. (2024) reported that cultural and informational barriers were major reasons for Kano State's hesitation to accept the HPV vaccine. The study by Adesina *et al.* (2018) revealed that mothers in Ilorin had low acceptance of the vaccine because of their moral objections and incorrect beliefs. According to the study, health communication strategies that involved parents through community outreach programs and educational meetings enhanced vaccine acceptance. In similar fashion, Okagbue *et al.* (2025) demonstrated that positive parental perception and knowledge strongly predicted willingness to vaccinate in a multi-state Nigerian study.

These results support the Socio Ecological Model which emphasizes the role of interpersonal and community-level influences in shaping health behaviors. Parents play a significant role in adolescent health decision-making because adolescent girls lack medical authority in such situations. Parental unwillingness to have their daughters vaccinated because of cultural beliefs and misinformation or religious beliefs acts as a barrier to access preventive services like HPV vaccination. The current findings demonstrate that cultural resistance does not exist as a single entity. Respondents who rejected the idea that their religion or culture prohibits HPV vaccination were more likely to be vaccinated, indicating that norms are contested and can evolve, especially when exposed to credible and culturally sensitive information. This presents a valuable opportunity for targeted advocacy, particularly involving religious leaders, community elders, and teachers, to challenge harmful myths and encourage acceptance.

Barriers to Vaccination

Among non-vaccinated respondents, the most frequently cited barrier was lack of information (50.1%), followed by concerns about side effects (6.7%) and misconceptions that the vaccine is only necessary for sexually active girls (5.9%). These findings are consistent with the results of Okunowo *et al*. (2021), who examined barriers to HPV vaccination among women in Lagos, Nigeria. In their study, major obstacles included fear of side effects, limited healthcare provider recommendations, inaccessibility, and a significant lack of awareness about the vaccine's benefits and availability. Okunowo *et al.* (2021) found that while 29% of urban Nigerian women had received the HPV vaccine, many remained uninformed or misinformed. Being unmarried, knowing someone with cervical cancer, and having positive exposure to vaccine messaging were important predictors of uptake. Other barriers included cost, lack of provider endorsement and limited knowledge.

These findings demonstrate that awareness gaps and access limitations exist as part of a broader systemic problem. The availability of the vaccine does not guarantee success because people need proper information and clear guidance. Thus, tailored health communication strategies and provider engagement are essential to close knowledge gaps, allay safety fears, and improve logistical access to vaccination services.

Qualitative Insights

The thematic analysis of open-ended survey responses highlighted three main facilitators to HPV vaccine acceptance: awareness creation, school-based vaccination programs, and parental involvement. These findings closely mirror the qualitative themes in the mixed-methods study by Talabi *et al.* (2023), which included 10 focus groups with caregivers and in-depth interviews with school administrators and policymakers in Nigeria. Participants emphasized the practical importance of health education campaigns, the convenience and effectiveness of school-based delivery, and the role of parental support and consent in shaping vaccine uptake (Talabi *et al.*, 2023). Caregivers often linked insufficient or inaccurate information about HPV and cervical cancer to hesitancy, while school officials supported vaccination within school settings for its ease and peer-driven encouragement. They further indicated that involving parents in sensitization sessions reiterated trust and consent, undercutting resistance rooted in misinformation (Talabi *et al.*, 2023).

The qualitative themes show that awareness creation combined with school delivery platforms and parent-targeted

engagement creates an effective strategy to increase vaccine uptake in areas where services are accessible but uptake remain low.

Independent Predictors from Multivariate Analysis

To assess the independent effects of awareness, parental willingness, school type, and socio-demographic variables, a multivariable logistic regression model was conducted using complete cases (n = 397). The model demonstrated acceptable goodness-of-fit (McFadden pseudo-$R^2 = 0.153$) and strong discriminative ability (area under the ROC curve = 0.80). Awareness of the HPV vaccine remained a significant independent predictor of uptake after adjusting for other variables (aOR = 2.83, 95 % CI: 1.19–6.73). Respondents who disagreed that their religion or culture opposed vaccination had significantly higher odds of receiving the vaccine (aOR = 2.46, 95 % CI: 1.02–5.94), highlighting the critical role of cultural acceptability. Attendance at a private school was associated with reduced odds of uptake (aOR = 0.35, 95 % CI: 0.13–0.95), while maternal tertiary education showed a positive but statistically non-significant association (aOR = 2.50, 95 % CI: 0.91–6.84). Parental indecision—characterized by uncertainty rather than opposition—was associated with significantly lower uptake (aOR = 0.31, 95 % CI: 0.11–0.89). These findings refine the bivariate results by isolating the relationships that persist after controlling for potential confounders.

Interpreting these effect sizes in practical terms: transitioning from unawareness to awareness nearly triples the odds of vaccination, emphasizing the impact of sustained public education campaigns. Cultural concerns, if effectively addressed through engagement with religious and community stakeholders, could similarly double the likelihood of uptake. The lower odds observed among students in private schools suggest systemic gaps in vaccine delivery or communication, calling for targeted interventions such as on-site vaccination days and structured parental engagement. Parental uncertainty, rather than outright refusal, also emerged as a barrier, underscoring the need for proactive, dialogic counselling strategies tailored to address specific concerns.

These patterns are consistent with findings from other regions. For instance, in a mixed-methods study conducted across Abuja, Nasarawa, and Adamawa States, exposure to HPV vaccine messaging was associated with a seven-fold increase in uptake (aOR = 6.87, 95 % CI: 6.20–7.61), and caregivers with no formal education were nearly three times more likely to vaccinate compared to those with tertiary education (NPHCDA & Gavi, 2023). Similarly, a parental survey in Kano State found that individuals who had never heard of HPV were significantly more likely to be hesitant about the vaccine (OR = 2.86, 95 % CI: 1.28–6.40), and that fathers exhibited higher levels of hesitancy than mothers (Yusuf *et al.*, 2024). Together, these findings reinforce the central role of awareness, cultural context, and parental engagement in shaping HPV vaccine uptake across Nigeria.

Conclusion

HPV vaccination among adolescent girls in Kaduna North remains markedly low, signaling a disconnect between policy-level efforts and on-the-ground realities. While the national introduction of the HPV vaccine represents a critical step toward cervical cancer prevention, the data reveal that implementation gaps persist at multiple levels. This study highlights that vaccination decisions are not merely the outcome of individual awareness or willingness, but the product of intersecting influences that span the household, community, and health system. Cultural narratives, parental gatekeeping, institutional readiness, and logistical access all interplay to either enable or obstruct vaccine uptake.

The finding that parental indecision, rather than outright refusal, significantly suppresses uptake suggests a widespread lack of confidence or clarity around the vaccine, likely driven by inconsistent messaging and limited engagement with trusted community figures. Similarly, the lower uptake observed among private school students—despite assumptions of greater access to resources—points to communication gaps in settings that may not be integrated into public health outreach channels. These insights underscore the need for tailored, context-sensitive strategies that move beyond generic health promotion and actively engage with the social realities of vaccine delivery.

Without a deliberate recalibration of HPV vaccination campaigns to address these layered barriers, national coverage goals will remain out of reach. The implications extend beyond Kaduna North; they reflect broader systemic challenges in translating vaccination policy into equitable public health outcomes across Nigeria.

Recommendations

In light of the study's findings, the following recommendations are proposed to improve HPV vaccine uptake among adolescent girls in Kaduna North LGA:

- Design and implement sustained, age-appropriate HPV education campaigns in both schools and community settings to increase awareness of HPV, cervical cancer, and the benefits of vaccination. Tailor messaging to local languages and sociocultural beliefs.
- Establish regular school-based vaccination programs in partnership with the Ministry of Health and Education to enhance accessibility and convenience for eligible adolescents. Schools offer the most efficient platform for reaching adolescent girls in a structured, trusted setting.
- Collaborate with influential religious figures and community stakeholders to address sociocultural misconceptions and build trust in the vaccine through culturally sensitive messaging.
- Provide targeted training for healthcare providers on effective HPV vaccine communication, with emphasis on addressing parental concerns and debunking myths during routine care and outreach.
- Ensure sustainable vaccine access and affordability by working with state-level immunization programs to integrate HPV vaccines into the routine immunization schedule and ensure cost is not a barrier. Explore subsidies or donor support where necessary.

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