


# Examining barriers and facilitators of HPV vaccination in Nigeria, in the context of an innovative delivery model: a mixed-methods study

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**To cite:** Talabi O, Gilbert H, Fawzi MCS, *et al*. Examining barriers and facilitators of HPV vaccination in Nigeria, in the context of an innovative delivery model: a mixed-methods study. *BMJ Public Health* 2023;1:e000003. doi:10.1136/bmjph-2023-000003

► Additional supplemental material is published online only. To view, please visit the journal online (<http://dx.doi.org/10.1136/bmjph-2023-000003>).

Received 5 February 2023  
Accepted 14 June 2023



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## ABSTRACT

**Background** More than 80% of cervical cancer cases diagnosed globally are in low-income and middle-income countries. In sub-Saharan Africa, where treatment facilities are widely unavailable, it is a leading cause of cancer deaths in women. Human papillomavirus (HPV) vaccination, which is known to prevent almost 90% of cases of cervical cancer, has low uptake in this region, and little is known about the behaviour of those who have been offered the HPV vaccine. This knowledge is critical to guide policy-makers in sub-Saharan Africa on how best to roll out the vaccine and ensure successful and sustainable HPV vaccination programmes.

**Methods** To better understand uptake of the HPV vaccine among schoolgirls in Nigeria, we designed a mixed-methods convergent study, with a case-control quantitative arm that recruited caregivers of adolescent schoolgirls as cases (those who accepted vaccination) and controls (those who did not accept vaccination). For the qualitative study, we conducted 10 focus group discussions with of caregivers and 6 in-depth interviews with school administrators, vaccination sponsors and policy-makers.

**Results** Those with high awareness of HPV vaccination had three times the odds of uptake (adjusted OR (aOR) 2.6, 95% CI 1.54 to 4.31,  $p=0.002$ ). Giving HPV vaccines in school was also associated with uptake (aOR 3.1, 95% CI 1.54 to 6.43,  $p=0.002$ ). Being offered free HPV vaccination was significant in the bivariate analysis (aOR 1.67, 95% CI 1.03 to 2.70,  $p=0.039$ ) but was marginally significant in the multivariate analysis (aOR 0.63, 95% CI 0.37 to 1.06,  $p=0.086$ ). Qualitative themes supported these findings, demonstrating that effective awareness and convenience of vaccination could encourage uptake. Key barriers to uptake included lack of affordability and limited availability of vaccines.

**Conclusions** Effective awareness, administering HPV vaccines in school and subsidising HPV vaccination costs can improve uptake.

## INTRODUCTION

Low-income nations are home to the majority of cervical cancer diagnoses worldwide. More

## WHAT IS ALREADY KNOWN ON THIS TOPIC

⇒ While some barriers and facilitators of human papillomavirus (HPV) vaccination have been identified, little is understood about about HPV vaccine uptake among those who have been offered HPV vaccines.

## WHAT THIS STUDY ADDS

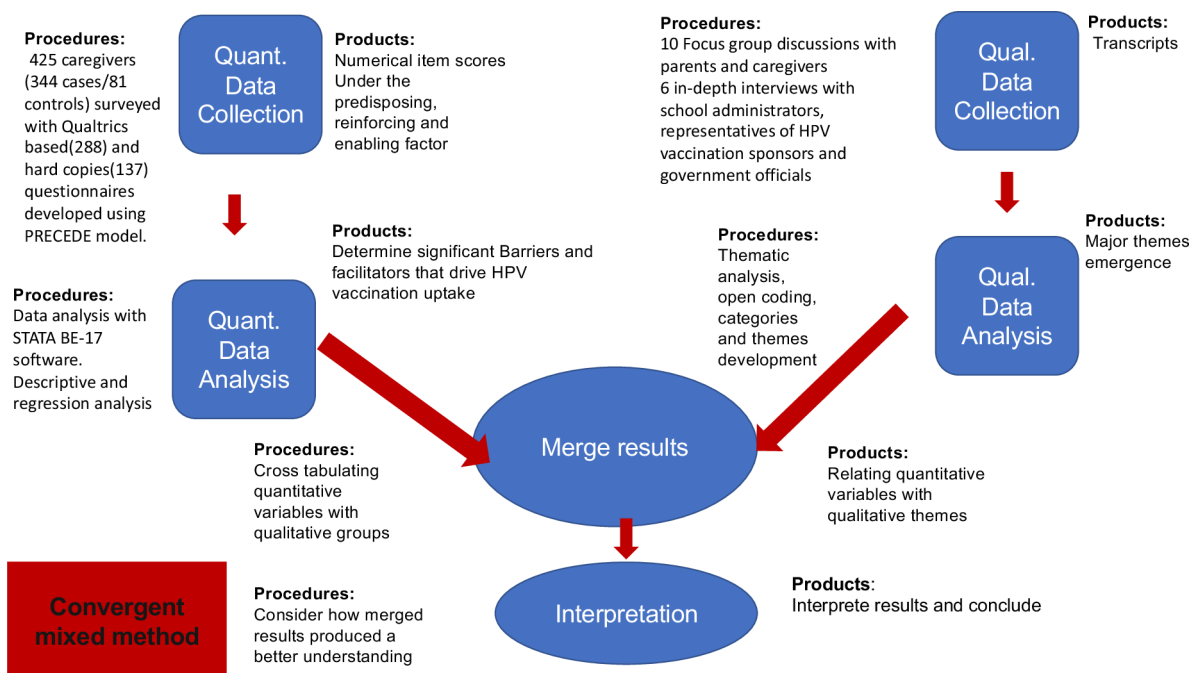
⇒ It adds to the knowledge of the way people are likely to behave when offered the HPV vaccination in a low resource setting and showed the possible barriers and facilitators.

## HOW THIS STUDY MIGHT AFFECT RESEARCH, PRACTICE OR POLICY

⇒ The study examined four possible outcomes after vaccine introduction, which will help predict the behaviour of the source population and similar populations when offered HPV vaccines. These findings provide important guidance to governments in low-resource settings on the best ways to roll out HPV programmes in order to achieve maximum uptake and cost-effectiveness.

than 80% of the nearly half million diagnoses that occur each year are in the developing world.<sup>1–3</sup> In sub-Saharan Africa, where diagnostic tools and treatment facilities are widely unavailable,<sup>4–6</sup> cervical cancer is the second most common cancer<sup>1</sup> and a leading cause of cancer-related deaths in women.<sup>7 8</sup> In Nigeria alone, 250 per 100 000 women are diagnosed with cervical cancer annually,<sup>9</sup> and 8 out of every 10 of these women will present at advanced stages of the disease<sup>10</sup> when little can be done to treat them.

Human papillomavirus (HPV) has been linked to more than 90% of cases of cervical cancer.<sup>11 12</sup> The HPV vaccine was developed to prevent infection and thereby reduce the incidence of cervical cancer.<sup>13 14</sup> The vaccine is more than 88% effective in preventing HPV infection,<sup>15 16</sup> but is not accessible to most



**Figure 1** Mixed-methods convergent study (Dawadi *et al*).<sup>50</sup> HPV, human papillomavirus.

women in the very regions with the highest burden of cervical cancer.<sup>17–19</sup> The HPV vaccine has been introduced in fewer than 27% of low-income countries.<sup>20</sup>

Key barriers and facilitators to HPV vaccination in sub-Saharan Africa have been identified,<sup>21</sup> and notably include lack of affordability<sup>22</sup> both on the part of the governments, which are unable to fund free vaccinations,<sup>23</sup> and the citizens who are unable to pay for the vaccine due to poverty and structural violence.<sup>24–26</sup> There are little data on the actual behaviour of individuals who have been offered the HPV vaccine. This knowledge is critical to guide policy-makers in sub-Saharan Africa on how best to initiate effective and sustainable HPV vaccination programmes.

We undertook a mixed-methods study to understand the factors that affect the actual behaviour of individuals who have been offered the HPV vaccine by examining a school-based, low-cost HPV vaccination programme (online supplemental appendix D) administered by a private organisation in Nigeria (Prettyhealth Care) in order to identify factors associated with the uptake of vaccines.

## METHODS

### Study design

We designed a mixed-methods convergent study (figure 1), where the qualitative provided elaboration and explanation for the quantitative findings. The quantitative component was a case-control study that compared caregivers who accepted the vaccine (cases) versus those who did not (controls). The survey (online supplemental appendix G) was created using the PRECEDE model, a health promotion model developed by Green and Kreuter<sup>27</sup> (online supplemental appendix C) that looks at

internal and external factors influencing individuals' behaviours by exploring the predisposing, reinforcing, enabling and policy factors associated with HPV uptake. The qualitative study employed focus group discussions (FGDs) and in-depth interviews to provide more in-depth information regarding how these factors shape uptake. The results of the quantitative and qualitative components of the study were then merged.

### Study setting

Participants were drawn from six schools in the southwest state of Nigeria; four schools were located in Lagos state and two in Ogun state. Lagos is a cosmopolitan city-state and the economic capital of Nigeria with a mixed rural-urban population of about 20 million people in the low to high income group range. Ogun state is contiguous to Lagos and shares some key socioeconomic characteristics. The population of Ogun state is just one-third of Lagos state. The predominant ethnic group in the two states is Yoruba, but virtually all of Nigeria's ethnic groups are represented in these two states.

### Study participants

Our study had two main participant groups: those who accepted the vaccine and those who did not accept the vaccine. These were further stratified into those who paid for the vaccine (unsupported) and those who were offered it for free (supported). Between June and December 2021, we enrolled four groups of participants table 1 in the quantitative study: caregivers who were asked to pay for the vaccine and accepted (A), those that were asked to pay for the vaccine and rejected (B), those that were offered free and accepted (C) and those that were offered free but rejected the vaccine (D). Caregivers were selected from a group of those introduced to the

**Table 1** (A) Groups of study participants and (B) descriptive characteristics of caregivers of girls who accepted or did not accept HPV vaccination (cases and controls) (n=425\*)

<b>A</b>			
	<b>Asked to pay</b>	<b>Offered free</b>	<b>Total</b>
Accepted vaccination	217 (A)	127(C)	344
Did not accept vaccination	41 (B)	40 (D)	81
Total	258	167	425
<b>B</b>			
<b>Sociodemographic characteristics</b>	<b>N (%) or mean (range)</b>		
Gender (n=293)			
Female	236 (80.55)		
Male	57 (19.5)		
Age (n=423)			
31–40	98 (23.17)		
41–50	82 (19.39)		
>50	240 (56.74)		
Don't know	3 (0.71)		
Current marital status (n=379)			
Married	367 (96.9)		
Not married	12 (3.1)		
Can you read and write? (n=180*) skipped logic applied			
Yes	171 (95)		
No	9 (5)		
What is your level of education (n=425)			
Primary school	18 (4.20)		
Secondary school	76 (17.76)		
Vocational training	14 (3.27)		
University graduate	150 (35.05)		
Post university (postgraduate)	170 (39.72)		
What is your main occupation (n=421)			
None	18 (4.28)		
Farming	7 (1.66)		
Petty trader	31 (7.36)		
Artisan (mechanic, tailor, etc)	20 (4.75)		
Housewife	8 (1.90)		
Professional (teacher, nurse...)	166 (39.43)		
Self-run business	145 (34.44)		
Others	26 (6.18)		
Where are you currently living (n=409)			
Lagos	373 (91.2)		
Ogun	36 (8.8)		
Estimated monetary income spent on food for household (n=367)			

Continued

**Table 1** Continued

<b>B</b>	
<b>Sociodemographic characteristics</b>	<b>N (%) or mean (range)</b>
Little income spent on food	152 (41.4)
Half income spent on food	105 (28.6)
Most income spent on food	86 (23.4)
All income spent on food	24 (6.6)
How old was the child when asked to be vaccinated? Age (n=252)	
Mean age in years (range)	14.1 (10–18)
*Variables with the highest response has n=425; other variables less than that are due to missing data or the use of skipped logic.	

HPV vaccination programme in their respective schools between the years 2016 and 2020. While the school HPV programme began in 2014, we purposely selected the time period from 2016 and 2020 to ensure that the girls had completed their doses, but had not graduated from the school. Attempts were made to reach all participants who completed their doses and were still enrolled in the schools. Nearly 600 girls met this criteria; we were only able to reach the caregivers of 400. Out of these, 344 representing 86% agreed to participate. To achieve a 1:1 ratio of cases and controls, we approached 400 caregivers in a similar category but whose children did not take the vaccine (controls) and only 81 (21%) agreed to participate in the study. We suspect this was influenced by this group's initial reluctance to accept the original offer of vaccination; aside being reluctant to participate in the study. The overall response rate was 63%.

From our sample size calculation on STATA, assuming a 27% uptake rate (derived from the HPV programme intervention), 80% power, and 95% CI, we needed a minimum of 76 participants. Final figures satisfied our desired sample size.

For FGDs, a subset of caregivers was purposely selected from groups A, B, C and D stated above (table 5). In addition, in-depth interviews were conducted with key informants, including school administrators in charge of vaccination, representatives of an NGO sponsoring HPV vaccination and a policy-maker (online supplemental appendix B). Caregivers and parents who took their vaccination outside the school programme were excluded. Caregivers whose wards enrolled outside of the period covering the years 2016–2020 were also excluded.

### Patient and public involvement

Patients were not involved in this study. Field work for this research was discussed with various stakeholders including school administrators and Non Governmental Organizations (NGOs) involved in HPV programmes. Feedback sessions were held with caregivers at school-based parent forums prior to beginning data collection for the purposes of eliciting input on approaches to data collection. Consultations

with these community members continued throughout the study duration.

### Quantitative data collection

Three schools were selected from the unsupported group and three schools were selected from the supported group whose vaccinations were sponsored by an NGO (Rotary Club International, District 9110 Nigeria). Four of the schools were in Lagos, and two were in Ogun state. For all groups, caregivers were informed by the school about the research through parents–teachers’ meetings, newsletters, through the students, or via emails and WhatsApp groups. For groups A and B, consent forms were sent to caregivers’ email and consent was obtained electronically. Subsequently, a survey was designed on the software Qualtrics and participant accessed it electronically. For groups C and D, consent forms were given to caregivers directly or through the schools, and a hard copy of the survey was distributed. This was completed and returned by respondents.

### Qualitative data collection

We conducted 10 FGDs with parents and caregivers of schoolgirls who participated in the HPV vaccination programme. To ensure variation in terms of both uptake and financial support, we used purposeful sampling to identify participants from across all four groups: group A (unsupported, accepted vaccine), group B (unsupported, rejected vaccine), group C (supported, accepted vaccine) and group D (supported, rejected vaccine). Six FGDs were conducted with parents whose children paid for the vaccine (unsupported). To ensure social distancing and to accommodate the limited schedules of these caregivers, these FGDs were held virtually via Zoom. Participants were admitted to the FGD only after they had been verified in the waiting room and cross-checked against a list of invited participants. FGD sessions were recorded with permission. Four FGDs were conducted with parents who were offered the HPV vaccines free of charge. These families had limited access to technology, therefore, FGDs were held in person at a quiet location on the premises of their children’s schools while observing the existing COVID-19 national policies. In-person FGDs were audiorecorded with permission.

All FGDs were conducted primarily in English; Yoruba was used for the unsupported FGDs as requested by participants. FGDs were conducted by OT, a male physician who had prior experience participating in school-based HPV programmes in the region. He was neither known to the participants nor the participants known to him before the study. A female research assistant was present to take notes and assist with logistics. FGDs lasted an average of 45–60 min and followed an FGD guide (online supplemental appendix F) which covered the following key topics: HPV vaccination knowledge, educational experiences, acceptability and ideas for improving uptake.

Semistructured interviews (online supplemental appendix E) were conducted with key informants. Purposeful sampling was used to ensure participants with

a rich and varied experience with school-based HPV vaccination campaigns. This included three school representatives who oversaw the HPV vaccination in their schools, two representatives of the HPV vaccination sponsoring NGO and one public official. Three interviews were held via zoom, and three were held in person, according to the participants’ preference. Interviews were conducted in English by OT, and the research assistant assisted with logistics. Interviews lasted an average of 45–60 min and followed an interview guide that addressed the following themes: knowledge related to HPV vaccination and source of information, their roles and experiences with the HPV vaccination programme and their views on barriers and facilitators of uptake.

### Quantitative data analysis

Quantitative data were organised using Excel and subsequently exported to STATA. Analysis was done using STATA V.BE 17. Demographic characteristics, such as age and gender, were analysed in addition to socioeconomic variables such as income and occupation. Then the predisposing, reinforcing, enabling and policy-related factors were analysed to determine their influence on the outcome variable—whether HPV vaccination was accepted—(HPV vaccine uptake).  $\chi^2$  statistics were used to determine the associations between HPV vaccine uptake and barriers and facilitators. The measure of association used was the OR.

Using logistic regression, we conducted a bivariate analysis to analyse the association of independent variables with the outcome variable (uptake of vaccine), while multivariate analysis was done to adjust for confounding. Variables were considered to be confounding if a priori they were potentially associated with the outcome (ie, HPV vaccine uptake) and independently associated with the main predictor of interest in each of the models. The confounding variables for each model can be found in the second column in table 4, since they were variables that were included in addition to the main predictor. Variables were dichotomised for logistic regression analysis. For example, ‘awareness’ was defined as ‘how well did you understand the health education message about HPV’; those who answered ‘very well’ and ‘a good amount’ were classified as having ‘high awareness’, and those who answered ‘a little bit’ or ‘not at all’ were classified as having ‘low awareness’.

### Qualitative data analysis

Qualitative data analysis was done using an inductive content analytic approach<sup>28</sup> to examine key factors influencing uptake of HPV vaccination. Recordings from the FGDs and semistructured interviews were transcribed, and where necessary, translated into English. Following a thorough review of the entire dataset, OT open-coded a subset of transcripts from both key informants and caregivers to identify a set of emerging concepts which were defined and supported with evidence from the data. These concepts were reviewed and revised with HG and developed by OT into a draft codebook which was piloted and finalised. The final codebook contained 36 codes. The entire dataset was coded with the



resultant codebook, using Dedoose qualitative data management software. All authors provided continuous oversight of the coding process to ensure accuracy. Using an inductive analytical approach, OT examined the coded data to formulate an initial set of thematic categories that represented participants' views and experiences on HPV vaccination uptake. Each category was defined and supported with evidence from the data. Using an iterative approach, OT, TR and HG reviewed the initial categories, and revisited the dataset to add additional descriptive detail. Initial categories were grouped into four overarching thematic categories.

### Mixed data analysis

Finally, quantitative and qualitative results were integrated by using a joint display technique.<sup>29</sup> This highlighted the interconnected themes emerging from the two data strands. Table 6 illustrates the factors that influence the uptake of the HPV vaccination by study population and identifies key points of convergence with the qualitative findings.

## RESULTS

### Quantitative results

Table 1B shows the descriptive characteristics of participants in the study. While over 80% of participants are females, most are above 50 years of age (56.74%). More than 90% of participants are married and reside in Lagos.

Table 2 shows the descriptive characteristics of the outcome variable and other relevant variables in the survey. A total number of 344 participants (80.9%) accepted the vaccine (cases), while the remaining 81 (19.1%) did not accept (controls). Of those who accepted, 217 paid for the vaccination (group A), while 127 were offered free (group C). Among the controls, 41 were asked to pay (group B), and 40 were provided the vaccine free of charge (group D).

Almost half of the participants (48.4%) only heard of the HPV vaccine after enrolling their children in school. The greatest concern parents had before accepting or rejecting vaccination was safety (65.5%), followed by long-term side effects (21.1%), and cost (6.3%). More than half of respondents (52.1%) did not give HPV vaccine to their wards before the school vaccination programme because they did not know about it (33.9%) or they did not know where to get it (18.2%). About half (47.9%) also saw health education (31.8%) and not having to make repeated visits for subsequent doses (16.1%) as the significant advantages of the school vaccination programme. More than 88% agreed that giving the vaccine in schools is better than elsewhere. When asked who was likely to convince them to take HPV vaccines, most respondents (68%) chose their Doctors or nurses. In terms of awareness generation by the government, almost 40% of participants had never heard of such announcements, while another 28% only heard it a few times.

We ran a bivariate analysis on STATA by using the  $\chi^2$  command (table 3). Our outcome variable is the uptake

of HPV vaccination. In our bivariate analysis, we identified various factors that were associated with the uptake of HPV vaccines and significantly differentiated cases (those who accepted) from controls (those who did not accept). High awareness was one of the most positively associated variables ( $p=0.000$ ), as well as 'giving HPV vaccines in schools' ( $p=0.001$ ). Other variables positively associated with uptake are 'being married' ( $p=0.001$ ) and willingness to take the COVID-19 vaccine ( $p<0.001$ ). Our study found that cost (being offered the HPV vaccine free of charge) was comparatively less significant ( $p=0.039$ ).

In a multivariate analysis of the outcome variable (uptake of HPV vaccine) with various other variables, having high awareness (adjusted OR, aOR 2.6, 95% CI 1.54 to 4.31,  $p=0.002$ ) and wanting HPV to be given in school (aOR 3.1, 95% CI 1.54, 6.43,  $p=0.002$ ) remained strong predictors of HPV uptake (table 4).

Being offered the HPV vaccine for free, which was significant in the bivariate analysis, became not significant in most of the multivariate analysis models except in the model that had a high percentage of income spent on food, high awareness and wanting HPV to be given in school (aOR 0.52, 95% CI 0.30 to 0.90,  $p=0.019$ ). However, the OR in this last model suggested a negative correlation. Other variables with positive associations such as 'being married' and 'being educated' lost their significance.

### Qualitative results

There was a total of 10 male participants and 37 female participants (table 5). Though the specific age of participants was not obtained, participants were categorised by general age group based on observation and participants' statements. Thirty-eight participants were classified as young (<60 years), and nine were classified as old (>60 years). There were 27 participants in group A (paid, accepted vaccine), 3 in group B (asked to pay, rejected vaccine), 14 from group C (offered free, accepted vaccine) and 3 from group D (offered free, rejected vaccine).

Our study identified two main facilitators and one main barrier to HPV vaccination uptake. Facilitators include convenience, and awareness- which must be trusted, timed, thorough, tailored and at least 'two ways'. An important barrier to uptake is lack of accessibility, which comprises lack of affordability and lack of availability of the HPV vaccine (figure 2)

### Themes

#### 5Ts awareness

##### Trusted awareness

The study respondents explained that they were inclined to agree to vaccination when vaccine information came from a trusted source. For many, a trusted source was defined as a credible, independent member of society, often a doctor or nurse. Credible sources could exist outside the medical profession as well.

If you have credible, independent personalities who should be knowledgeable about these things, credible persons, even if they are not even scientists or doctors, people that

**Table 2** Descriptive statistics of the outcome variable and other variables (cases and controls) (n=425\*)

Variable characteristics	N (%)
Predisposing factors (knowledge and attitude)	
(A) The first time you heard about HPV vaccine (n=413)	
Before enrolling your child	213 (51.6)
After enrolling your child	59 (38.5)
I do not know about such vaccine	29 (7.0)
I do not know what cervical cancer is	12 (2.9)
(B) Greatest concern before accepting or not (n=213)	
Safety	146 (65.5)
Long-term side effects	47 (21.1)
Cost	14 (6.3)
Others	16 (7.1)
(C) How well did you understand the message (n=253)	
Very much or a good amount	232 (91.7)
A little bit or not at all	21 (8.3)
Enabling factors	
(A) Why not give HPV vaccine prior to school programme (n=336)	
Didn't know about it	114 (33.9)
Child less than 9 years	57 (17.0)
Didn't know where to get it	61 (18.2)
Couldn't afford it then	14 (4.2)
Other reasons (thought child too young', 'too busy', 'fear of side effects', etc.	90 (26.8)
(B) Significant advantage of the school vaccination (n=217)	
Reduced cost	22 (10.1)
Health education	69 (31.8)
Reminders	6 (2.8)
No repeated trips for subsequent doses	35 (16.1)
Assurance of vaccine safety	3 (1.4)
Full payment upfront	45 (20.7)
Not having to think of when next dose due	2 (0.9)
Assurance of completion	7 (3.2)
Other reasons	28 (12.9)
(C) Giving the vaccine in school is better than elsewhere (297)	
Strongly agree or agree	263 (88.5)
Disagree or strongly disagree	34 (11.5)
Reinforcing factors	
(A) Likely to be convinced to accept HPV by (n=387)	
My doctor or nurse	263 (68.0)
Government announcement	37 (9.6)
Family member	9 (2.3)
Friends	2 (0.5)
Online info and social media	28 (7.2)
One whose daughter has taken	20 (5.2)
Others	28 (7.2)
(B) Trust in the school makes me accept (n=287) (*skipped logic: answered by only those who accepted HPV vaccine)	
Strongly agree	140 (48.8)
Agree	112 (39.0)
Neither agree nor disagree	22 (7.7)

Continued

**Table 2** Continued

Variable characteristics	N (%)
Disagree	11 (3.8)
Strongly disagree	2 (0.7)
Policy factors	
If government cannot afford to give HPV free, they should (n=385)	
Allow people to buy it	30 (7.79)
Subsidise to make it affordable to most	199 (51.69)
Look for money to make it free for all	50 (12.99)
Not allowed into the country	4 (1.04)
Subsidise for some and free for others	82 (21.30)
Can't say	18 (4.68)
Other	2 (0.52)
How many times have you heard about the HPV vaccine from government announcements? (n=393)	
Many times	65 (16.54)
Few times	113 (28.75)
Once or twice	37 (9.41)
Never heard of it	154 (39.19)
Don't know	24 (6.11)

\*Variables with the highest response has n=425; other variables less than that are due to missing data or the use of skipped logic.  
HPV, human papillomavirus.

we normally hold up as responsible, trustworthy people, you know, maybe they can help to drive the conversation and make people trust it a bit more -FGD 006, Participant #10, male caregiver, unsupported uptake group

#### Tailored awareness

Respondents also indicated that to be effective awareness must be tailored to the environment. School was considered by participants to be a good place to receive information about vaccines for adolescents, though they acknowledge that this school-based approach may not be

applicable to other regions of the country, where there are many out-of-school children.

Where is the place you can almost surely meet them? That is when they are in school, and that is why we chose the school-based program, and we've been quite successful in that. It has its own drawbacks because yes, maybe when we go north [northern Nigeria], if we decide to expand the program, you have a lot of people that are out of school.— Key informant #2, male

**Table 3** Bivariate analysis showing association of HPV uptake with relevant variables

Variables	All (n=425)*	Accepted vaccine (n=344)		Did not accept vaccine (n=81)		P value†
	N	N	(%)	N	(%)	
Age (older than 50)	259	219	−63.7	40	−49.4	0.018
Gender (female)	261	221	−64.2	40	−49.4	0.724
Marital status (married)	351	294	−85.5	57	−70.3	0.001
Literacy (can read or write)	179	120	−96	50	−92.6	0.521
Level of education (have graduate education)	322	270	−78.4	52	−62.4	0.007
High percent income spent on food	179	143	−41.6	36	−44.4	0.637
Have high paying job	347	289	−84	58	−71.6	0.009
Offered HPV Free	167	127	−36.9	40	−49.4	0.039
High level of awareness	230	202	−58.7	28	−34.6	0
Will take COVID-19 vaccine	232	191	−55.5	41	−50.6	0
HPV vaccine is better given in school	260	224	−65.1	36	−44.4	0.001

\*n<425 due to missing values.  
†p values were calculated using the  $\chi^2$  test.  
HPV, human papillomavirus.

**Table 4** Logistic regression analysis of the association of HPV vaccination uptake and influencing factors among caregivers of secondary school girls in Nigeria (n=425)

	Univariate analysis			Multivariate analysis		
	OR	95% CI	P value	OR	95% CI	P value
High awareness						
High awareness	2.69	(1.62 to 4.46)	0	2.53	(1.51 to 4.20)	0
Give HPV in school	–	–	–	2.38	(1.43 to 3.90)	0.001
Were you offered HPV free	–	–	–	0.55	(0.33 to 0.91)	0.022
Level of education (having graduate education)						
Grad education	2.03	(1.21 to 3.42)	0.008	0.98	(0.39 to 2.43)	0.964
Give HPV in school	–	–	–	3.49	(1.68 to 7.22)	0.001
High paying job	–	–	–	2.8	(1.15 to 6.89)	0.024
Age	–	–	–	2.05	(1.00 to 4.17)	0.047
Gender	–	–	–	0.81	(0.32 to 2.02)	0.646
Were you offered HPV free (cost)						
Were you offered HPV free	1.67	(1.03 to 2.70)	0.039	0.63	(0.37 to 1.06)	0.086
High awareness	–	–	–	2.32	(1.37 to 3.09)	0.002
Give HPV in school (convenience)	–	–	–	2.43	(1.46 to 4.06)	0.001
Married	–	–	–	1.96	(1.06 to 3.62)	0.031
Giving HPV in school is better than elsewhere						
Give HPV in school	2.33	(1.43 to 3.81)	0.001	3.14	(1.54 to 6.43)	0.002
Were you offered HPV free	–	–	–	1.52	(0.68 to 3.41)	0.306
Married	–	–	–	1.64	(0.66 to 4.11)	0.29
Age	–	–	–	2.25	(1.11 to 4.56)	0.025
Gender	–	–	–	0.86	(0.35 to 2.13)	0.684
High percentage of income spent on food						
High spend on food	0.89	(0.55 to 1.44)	0.637	1.16	(0.68 to 2.00)	0.583
Were you given HPV free	–	–	–	0.52	(0.30 to 0.90)	0.019
High awareness	–	–	–	2.55	(1.52 to 4.27)	0
Give HPV in school	–	–	–	2.39	(1.44 to 3.98)	0.001
Marital Status						
Married	2.48	(1.41 to 4.30)	0.002	1.28	(0.51 to 3.20)	0.602
Give HPV in school	–	–	–	3.03	(1.48 to 6.21)	0.002
Age	–	–	–	2.2	(1.08 to 4.40)	0.029
Gender	–	–	–	0.9	(0.36 to 2.20)	0.824
Will you take COVID-19 vaccine						
Will you take COVID-19 vaccine	3.61	(1.92 to 6.77)	0	2.62	(1.33 to 5.17)	0.005
High awareness	–	–	–	2.51	(1.37 to 4.58)	0.003
Grad edu	–	–	–	2.12	(1.02 to 4.39)	0.043
Age	–	–	–	1.82	(0.99 to 3.31)	0.051
High paying job	–	–	–	1.29	(0.58 to 2.83)	0.534

HPV, human papillomavirus.

**Timed awareness**

Awareness must also be well timed. Respondents explained that they were more likely to accept vaccination when they saw other parents vaccinating their children at the same time.

So I think the organization should work hand in hand with the school, especially on the day of orientation when the parents gather. You will be able to spare a few minutes to enlighten the parents on reasons why they should take the vaccine. I think you will get more turnout when you do it that way—FGD 005 Participant #9, female caregiver, unsupported non-uptake group



**Table 5** Descriptive characteristics of focus group participants (N=47)

	(N=47) n (%)
<b>Demographic</b>	
Age, (in years)	
<60	38 (80.9)
>60	9 (19.1)
Gender	
Female	37 (78.7)
Male	10 (21.3)
<b>Caregiver groups</b>	
Group A (unsupported, accepted vaccine)	27 (57.4)
Group B (unsupported, rejected vaccine)	3 (6.4)
Group C (supported, accepted vaccine)	14 (29.8)
Group D (supported, rejected vaccine)	3 (6.4)

**Two-way awareness**

When parents were able to express their concerns, seek clarifications and receive vetted information in two-way discussions with knowledgeable individuals, they tend to accept vaccination.

Inform parents... through the PTA [parents teachers association] meetings, through circulars, take home circulars, through Whatsapp messages. If there is a need to clarify, call some [parents] and then put them through to the doctor in charge or the nurses for further information.—Key informant #1, female

**Thorough awareness**

Participants suggested that in order to avoid misunderstandings or negative information, it is important for awareness campaigns to deliver communications about the HPV vaccine that is clear, unambiguous and thorough. This is particularly important in this context, where awareness of the HPV vaccine is uneven.

I must confess that that announcement wasn't elaborate and the information was also limited. Its only those that have already had good knowledge about HPV and what it can cause will be able to reconcile that announcement and

decide to take a decision to vaccinate their girl,... If extensive information was passed along, I believe that more and more parents would have elected to vaccinate their girls. -FGD 006, Participant #4, male caregiver, unsupported uptake group

**Convenience**

Convenience played a central role in participants' willingness to accept the vaccine. Participants stated that school-based vaccination was an important way to ensure this convenience. Caregivers who intended to vaccinate noted that if the process of vaccination is not convenient they may delay vaccine initiation, procrastinate or forget to take subsequent doses of the vaccine.

It's good [giving it in school], and it is easier. For example... let us go to the General Hospital, I would not have had 'chance' [time to go]. Number one, you queue. You will take a number, and they will talk to you [rudely].—FGD 009, participant #3, female caregiver, uptake group, supported

**Lack of accessibility****Lack of affordability**

A common refrain among respondents who were asked to pay for the vaccine was that the cost of the vaccine made it inaccessible. Participants who received the vaccine for free acknowledged that they would never have been able to afford the vaccination without the financial support provided, because they had to prioritise immediate daily needs such as providing food and other basic needs for their families.

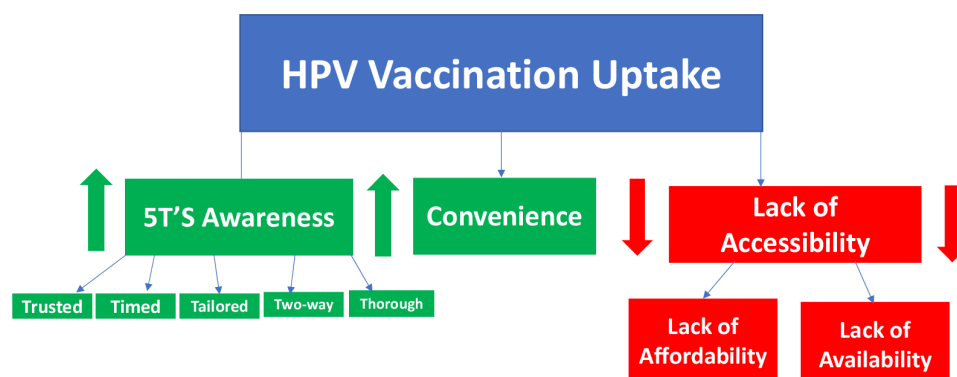
R: The vaccine, they may not be able to afford to pay for it, and because of that, some of them may just decide that they may think of other things first before thinking of such a thing, you understand, the attitude may be different.

I: Other things like?

R: Feeding of the children.—Key Informant #4, female

**Lack of availability**

Participants explained that families living in hard-to-reach areas who were motivated to vaccinate their children often could not access vaccines. Vaccines are primarily

**Figure 2** Qualitative themes. HPV, human papillomavirus.

**Table 6** Joint display (qualitative and quantitative findings)

Qualitative themes	Qualitative subthemes	Quantitative results	Interpretation
Awareness (5Ts)	Trusted awareness	High awareness	The quantitative finding revealed high awareness as a strong predictor of HPV vaccination uptake. Qualitative findings identified the features of awareness that are considered high and effective including trust, timing and thoroughness.
	Timed awareness	OR 2.69	
	Thorough awareness	95% CI (1.62 to 4.46)	
	Tailored awareness	p=0.000	
	Two-way awareness	(aOR 2.58, 95% CI (1.54 to 4.31) p=0.000)	
Convenience		Give HPV in school OR 2.33 95% CI (1.43 to 3.81) p=0.001 (aOR 3.14, 95% CI (1.54 to 6.43) p=0.002)	The domain that was identified as a preference for HPV vaccination to take place in school was a strong predictor of uptake. The qualitative study identified the theme of 'convenience,' in which caregivers spoke about how school-based vaccinations avoided the hassle of pursuing vaccines at a hospital or clinic.
Lack of accessibility	Lack of affordability	HPV offered free OR 1.67 95% CI (1.03 to 2.70) p=0.039 (aOR 0.63, 95% CI (0.37 to 1.06) p=0.086)	In the quantitative study, 'Offering HPV free' was significant in predicting uptake of the HPV vaccine. However, this was no longer significant when tested against other factors such as demographic characteristics and awareness. This is confirmed in the qualitative component, where respondents noted that they were willing to pay for the vaccine, the high cost of the vaccine made it unaffordable.

aOR, adjusted OR; HPV, human papillomavirus.

centralised in large urban areas, making access extremely difficult for families living in smaller towns and villages.

They said it is not even available, so we had to get one of our friends in Lagos to get the vaccine for us... we had to put it in a cooler filled with ice blocks to keep it cold, the common ones [vaccines] all those oral ones they are free... are easily accessible. But the very expensive ones which are very important are actually scarce, common people don't have access to them.—FGD 004, participant #8, Female Caregiver, unsupported uptake group

### Quantitative and qualitative study integration

Table 6 highlights the interconnected themes emerging from the two data strands. It illustrates the factors that influence the uptake of the HPV vaccination by study population and identifies key points of convergence with the qualitative findings.

### DISCUSSION

Our study found that effective awareness is the most important factor associated with the uptake of HPV vaccination. Participants classified as being highly aware had a threefold likelihood of being vaccinated with HPV. This is consistent with previous social mobilisation studies<sup>30</sup> and similar studies in Nigeria<sup>31</sup> that demonstrated a high intent to vaccinate over the baseline when there was a >70% increase in the knowledge of the HPV vaccine. Our findings were also consistent also with a study conducted

in Italy by Icardi *et al*<sup>32</sup> (2020) which demonstrated that lower participation in an HPV education programme and lower perception of HPV vaccine benefits<sup>33</sup> can be a barrier to uptake.

Previous studies in Nigeria have shown low awareness,<sup>34</sup> with awareness levels of 40%,<sup>35</sup> 59.7%<sup>36</sup> and 40%–80% (general population/healthcare providers).<sup>37</sup> Studies have also demonstrated high intent to vaccinate,<sup>17</sup> 94%<sup>35</sup> and >59%<sup>38</sup> if participants are made aware of vaccination benefits.

The qualitative arm of the study contextualised awareness and suggest that in order for awareness of the vaccine to truly affect uptake, it must come from trusted sources and be delivered in a trusted environment. In our quantitative study, health providers ranked high (68%) as those people can trust with vaccine information. This was described by Cunningham *et al*<sup>38</sup> as 'cues to action' that healthcare providers can provide to encourage vaccination. Previous studies have also reported that parents consistently cited health professionals' recommendations as one of the most important factors in encouraging them to vaccinate.<sup>39–41</sup> Our study found that these trusted sources are not limited to health professionals. Participants highlighted that sources could be trusted as long as they were credible and well-regarded members of society. Other qualities that must be contained in what we call the 5Ts of awareness are timing (appropriate), thoroughness, two-way (at least) and tailored (to the target group).

For instance, other studies, including those in other West African nations, Agyei-Baffour *et al.*<sup>42</sup> Coleman *et al.*<sup>35</sup> have demonstrated that schools and television are often the most preferred way of educating the public on HPV vaccination, suggesting that the awareness must be tailored to different audiences. Our study also identified schools as a particularly trusted source for caregivers, where caregivers feel comfortable receiving information about HPV vaccination. We found that two-way communication between caregivers and health educators was also facilitated in the school-based setting. Participants noted that including parent-to-parent communication as a kind of 'three-way approach' was also an effective way to inform caregivers and avoid misinformation. Schools can be a rallying point to connect various stakeholders in the vaccination process<sup>43</sup> and represent an important resource in improving HPV vaccination uptake.

Furthermore, our study revealed a lack of accessibility which we defined as a lack of affordability for the low-income group and a lack of availability for the high-income group who are willing to pay but found it difficult to access. Accessibility was also identified as a barrier to HPV vaccination in another Nigeria-based study.<sup>22</sup> This study revealed that awareness (39%), accessibility (39%) and cost (13%) were barriers to HPV vaccination uptake. Our study found that cost was a recognised barrier for just 13% of participants, and while cost was minimally significant (low OR) in our bivariate analysis, it lost its significance when adjusted for demographics and socioeconomic status of respondents in our multivariate analysis. Furthermore, the aOR seemed to suggest that cost had a negative correlation with uptake. We can only speculate about the causal pathway of this, but one explanation is that more people in the high-income group participated in the study. Even for caregivers of girls in public schools who are expected to be in the low-income group, we found that a significant number of caregivers were not biological parents of the girls. They were mostly elderly retirees whom the girls served as maids. Therefore, caregivers in this study tend to be wealthier, educated and less influenced by cost. Our findings may, therefore, underestimate the effect of cost. However, the low effect of cost, as demonstrated in the Nguyen study, is in keeping with other studies that have demonstrated a high intent to vaccinate even among the low-income group, where more than 50% of them were willing to pay for the vaccine.<sup>31 44</sup> In our study, we found that even when the vaccine was offered free, awareness was as important and more significant than cost in influencing vaccination, as some of those offered free rejected the vaccination.

In terms of convenience, which our study found to be an important facilitator of vaccination, most parents (88%) in our study wanted the vaccine to be given in school. This percentage is higher than 70% found by Adejimi *et al.*<sup>37</sup> and 74% in a study by DiAngi *et al.*<sup>45</sup> Choosing the school as the site of vaccination may thus be a likely contributor to convenience, accessibility and uptake.

## Limitations and strengths

Our study had some limitations. We were unable to recruit as many low-income people as the high income for our quantitative study, resulting in selection bias, as participants were likely to be older and wealthier. This was due to the COVID-19 pandemic that limited our ability to physically gather many caregivers in public schools at once, unlike the high-income group who had easy access to technology and were easily reachable. In addition, those who did not accept the vaccination were less inclined to consent to participation. To make up for this, we made repeated visits to the schools to get a good number of participants. The fact that our study took place during the COVID-19 pandemic—with an observed high level of vaccine hesitancy globally<sup>46–48</sup>—may also have impacted the responses of some of our participants in both directions. We attempted to minimise this limitation by probing for COVID-19-induced hesitancy as differentiated from real hesitancy in our FGDs. In the same vein, our study may have been limited by the fact that it is school based. Girls who took their vaccination outside the school programme were excluded, hence we could not capture the views of their caregivers. Though participants from different parts of Nigeria were enrolled in our study, only a few people from the northern part of the country participated. Because the north has a significant population of rural dwellers, our study may have limited generalisability to this group of people, and we advise future studies to look specifically at a section of this population who have been offered the HPV vaccine. Our study did not also report on the effect of religion on HPV vaccination uptake,<sup>49</sup> though we found it in our discussions. We chose not to explore it due to its sensitive nature in a country like Nigeria, where the north is predominantly Muslim and the south is predominantly Christian.

Some of the strengths of our study are that, unlike previous studies that enrolled the general population, it enrolled people who have been offered the HPV vaccination. In addition, the quantitative part (case-control) of our study is analytical, which can help establish a true relationship between the exposure and the outcome variable (uptake of HPV vaccine). Furthermore, both quantitative and qualitative parts of our study included participants from different groups (including low income, high income, up-takers and non-up-takers), thus increasing the possibility of holistic findings.

Lastly, the mixed-methods design used for our study helped us understand how different factors affected uptake, with each study helping explain or elaborate on the other.

## CONCLUSION

In conclusion, our study is the first we are aware of, which studied a subpopulation that was offered HPV vaccines in Nigeria. We studied the four different categories of possible outcomes of such an offer, such as rejecting or

accepting the vaccination when asked to pay or rejecting or accepting the vaccination when offered free. We believe our study can make contributions to the effective roll-out of a sustainable HPV vaccination programme. Policy-makers can use some of our findings to put in place measures that would reduce barriers and possibly reduce the cost of roll-out.

The convergent mixed-methods and the analytical study revealed that cost, high awareness, convenience and easy accessibility can influence the uptake of vaccination. School-based vaccination delivery programmes significantly eased some of the key barriers associated with vaccination. Governments committed to fulfilling their citizens' right to health by making the HPV vaccine widely available should prioritise awareness prior roll-out. School-based programmes that offer HPV vaccinations free of charge or through a subsidised, need-based copayment system, stand to overcome many structural barriers to HPV vaccination.

**Acknowledgements** The authors wish to acknowledge the roles of participant parents and caregivers, Rotary Club District 9110 Nigeria, Prettyhealth Care, Nigeria, school administrators and other participating stakeholders in completing this study.

**Contributors** OT contributed to curriculum development, coordinated field activities, drafted the manuscript, performed the statistical analysis, interpreted the analysis, and is the author acting as guarantor, HG contributed to drafting the qualitative sections of the manuscript, contributed to preparing the manuscript for submission and consulted on qualitative study curriculum development. MCSF contributed to drafting the quantitative sections of the manuscript, contributed to preparing the manuscript for submission and consulted on quantitative study curriculum development. RA consulted on curriculum development and fieldwork. TR supervised curriculum development, consulted on drafting of the manuscript, supervised field activities, data analysis and interpretation. All authors have read and approved the final manuscript.

**Funding** The authors have not declared a specific grant for this research from any funding agency in the public, commercial or not-for-profit sectors.

**Competing interests** None declared.

**Patient and public involvement** Patients and/or the public were not involved in the design, or conduct, or reporting, or dissemination plans of this research.

**Patient consent for publication** Not applicable.

**Ethics approval** This study involves human participants and was approved by Health Research Ethics Committees at the LASUTH, Lagos, Nigeria (#LREC/06/10/1648), and the Institutional Review Board of Harvard University, USA (#IRB21-0163). Participants gave informed consent to participate in the study before taking part.

**Provenance and peer review** Not commissioned; externally peer reviewed.

**Data availability statement** All data relevant to the study are included in the article or uploaded as online supplemental information.

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