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Parental Knowledge, Attitudes, and Determinants of HPV Vaccine Uptake Among Eligible Children in Kogi State, North Central Nigeria: A Cross-Sectional Mixed-Methods Study

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Abstract

Background

Cervical cancer remains a leading cause of cancer-related mortality among women in Nigeria, despite being largely preventable through Human Papillomavirus (HPV) vaccination. Following Nigeria's integration of HPV vaccine into the national immunization schedule in 2023, uptake remains suboptimal, particularly in North Central Nigeria. This study assessed parental knowledge, attitudes, and determinants influencing HPV vaccine uptake among parents of eligible girls in Kogi State.

Methods

A cross-sectional study was conducted among 336 parents/guardians of girls aged 9–14 years across three Local Government Areas in Kogi State. Multi-stage cluster sampling was employed. Data were collected using validated semi-structured questionnaires assessing sociodemographic characteristics, HPV and vaccine knowledge, attitudes, perceptions, and vaccine uptake. Knowledge scores were categorized using Bloom's cut-off criteria (Bloom, 1956). Logistic regression analysis identified determinants of vaccine uptake, adjusting for potential confounders. Statistical significance was set at $p < 0.05$.

Results

Participants' mean age was 41.2 ± 8.4 years; 70.2% were female, 64.3% Christian, and 62.2% had tertiary education. Overall, HPV-related knowledge was low: only 58.9% had heard of HPV, 52.1% knew what it is, and 31.0% understood transmission routes. Using Bloom's criteria, 66% demonstrated low knowledge, 12% moderate, and 22% high. Vaccine awareness was limited (49.4%), with only 38.1% knowing its purpose and 11.6% aware of dosing requirements. Attitudes toward vaccination were moderately positive (78.3%), with 79.1% believing the vaccine is safe and 74.4% willing to vaccinate their children. However, actual uptake was only 18.2% (n = 61). Major barriers included lack of awareness (42.0%) and fear of side effects (21.4%). In multivariable analysis, higher parental knowledge was associated with lower vaccine uptake (aOR = 0.244, 95% CI: 0.164–0.364, $p < 0.001$). Higher education level was the only sociodemographic factor significantly associated with increased uptake (aOR = 0.543, 95% CI: 0.332–0.888, $p = 0.015$). Socioeconomic status and religious beliefs were not significant predictors.

Conclusion

Despite high willingness, HPV vaccine uptake among eligible girls in Kogi State remains critically low due to poor parental knowledge and significant information gaps. The inverse relationship between knowledge and uptake suggests exposure to misinformation among knowledge-seeking parents.

Targeted, evidence-based health education delivered through trusted healthcare workers, school-based programs, and community engagement is urgently needed to improve vaccine coverage and advance cervical cancer prevention efforts in North Central Nigeria.

INTRODUCTION

Cervical cancer is the fourth most common cancer among women globally, with over 600,000 new cases and 340,000 deaths reported annually, of which more than 85% occur in low- and middle-income countries (LMICs) (World Health Organization [WHO], 2020). Persistent infection with high-risk Human Papillomavirus (HPV) types, particularly types 16 and 18, accounts for approximately 70% of all cervical cancer cases worldwide (Bruni et al., 2023). In sub-Saharan Africa, cervical cancer remains a leading cause of cancer-related morbidity and mortality among women of reproductive age, largely due to limited access to screening and preventive services (Sung et al., 2021).

Nigeria bears a disproportionate burden of cervical cancer, with an estimated 12,000 new cases and 8,000 deaths occurring annually (Federal Ministry of Health [FMOH] Nigeria, 2018). The national HIV prevalence among women aged 15–49 years is 1.4%, but regional disparities persist, with the South-South geopolitical zone reporting the highest prevalence at 3.1% (National Agency for the Control of AIDS [NACA], 2024). Kogi State, located in the North Central region, reports an HIV prevalence of 1.9%, above the national average, underscoring the urgent need for effective cervical cancer prevention strategies in this region (NACA, 2024).

The advent of prophylactic HPV vaccines represents a critical breakthrough in cervical cancer prevention. The WHO recommends HPV vaccination for girls aged 9–14 years, ideally before sexual debut, as part of a comprehensive strategy to eliminate cervical cancer as a public health problem (WHO, 2020). The vaccine is highly efficacious, preventing over 90% of HPV infections caused by targeted high-risk types when administered according to schedule (Drolet et al., 2019). Recognising this potential, Nigeria launched its National Cancer Control Plan and integrated HPV vaccination into the routine immunization schedule in 2023, with the ambitious goal of achieving 90% vaccine coverage among eligible girls by 2030 in alignment with WHO's global elimination strategy (FMOH Nigeria, 2022).

Despite this policy progress and demonstrated vaccine efficacy, HPV vaccine uptake in Nigeria remains alarmingly low. National surveys indicate coverage rates below 20% in most states, with significant regional variation (Odetola & Ekpo, 2019; Okunade et al., 2021). Studies from southern Nigeria report uptake ranging from 18.5% in Benin City to 31% in Lagos State (Elebiyo et al., 2023; Urang, 2023), while North-Eastern states such as Taraba achieved coverage as high as 98% through intensive school-based campaigns (Adamu et al., 2025). However, the North Central region, which includes Kogi State, remains critically under-researched, with limited data on vaccine uptake, parental knowledge, or implementation barriers.

Parental knowledge and attitudes are recognised as pivotal determinants of childhood vaccination decisions, particularly for adolescent health interventions where parents serve as primary decision-

makers (Perlman et al., 2014; Forster et al., 2010). The Health Belief Model (HBM) and Theory of Planned Behaviour (TPB) provide theoretical frameworks for understanding these dynamics, positing that health behaviours are shaped by perceived susceptibility and severity of disease, perceived benefits and barriers to preventive action, subjective norms, and behavioural control (Rosenstock, 1974; Ajzen, 1991). In the Nigerian context, additional factors, including cultural beliefs, religious influences, trust in government health programs, exposure to misinformation, and healthcare accessibility, further complicate vaccination decision-making (Umeh et al., 2019; Umeh & Maduka, 2020).

Existing studies from Nigeria have identified significant knowledge gaps, misconceptions, and hesitancy regarding HPV vaccination. For instance, studies in Anambra State found that only 35.5% of mothers had heard of the HPV vaccine, and detailed knowledge of its purpose and schedule was limited (Umeh et al., 2017). In Lagos, although 68.6% of parents expressed willingness to vaccinate their daughters, actual uptake remained low due to barriers including cost, accessibility, and misinformation (Akinleye et al., 2020). Fear of side effects, concerns about promoting early sexual activity, and lack of healthcare provider recommendations have been documented as common barriers across multiple Nigerian states (Ohaeri et al., 2020; Ogunbanjo et al., 2020).

No published studies have comprehensively assessed parental knowledge, attitudes, and determinants of HPV vaccine uptake specifically in Kogi State or the broader North Central region. This geographic knowledge gap is significant given the region's unique socio-cultural composition, including ethnic diversity (Igala, Ebira, Yoruba subgroups), religious plurality (Christianity and Islam), variable health infrastructure, and substantial urban-rural disparities (National Population Commission [NPC] Nigeria, 2006). Understanding region-specific barriers and facilitators is essential for designing culturally appropriate, evidence-based interventions to improve vaccine coverage.

This study aimed to assess the level of parental knowledge about HPV infection and vaccination, evaluate parental attitudes and perceptions toward HPV vaccination, determine actual vaccine uptake among eligible children, and identify sociodemographic, knowledge-based, and attitudinal determinants influencing vaccine uptake among parents of girls aged 9–14 years in Kogi State, North Central Nigeria. The findings will provide critical baseline data to inform targeted public health interventions, policy adjustments, and community engagement strategies necessary to achieve Nigeria's cervical cancer elimination goals.

METHODS

Study Design and Setting

This cross-sectional study was conducted in Kogi State, located in the North Central geopolitical zone of Nigeria. Kogi State was created on August 27, 1991, and comprises 21 Local Government Areas (LGAs) with an estimated population of 5.2 million as of 2022 (National Bureau of Statistics [NBS], 2022). The state is strategically positioned as the confluence state where the Niger and Benue Rivers meet at

Lokoja, the capital city. The population is ethnically diverse, predominantly comprising Igala, Ebira, and Okun (Yoruba subgroup) ethnic groups, with religious affiliations split between Christianity (approximately 65%) and Islam (approximately 35%) (Kogi State Government, 2021).

Kogi State's healthcare system consists of a mix of public and private facilities, with primary healthcare centers (PHCs) forming the backbone of rural health services. The state operates a mature Laboratory Information Management System (LIMS) with integration into the national health information architecture, although healthcare access and quality vary substantially between urban centers and rural communities (Kogi State Ministry of Health, 2020). The state's HIV prevalence of 1.9% and documented cervical cancer burden underscore the public health significance of HPV vaccination in this region (NACA, 2024).

Data were collected from three purposively selected LGAs representing both urban and rural contexts: Lokoja (urban), Igalamela (rural), and Ibaji (rural). This stratification ensured representation of diverse socioeconomic conditions, cultural practices, and healthcare access patterns characteristic of Kogi State.

Study Population and Eligibility Criteria

The study population comprised parents and primary caregivers of girls aged 9–14 years residing in the selected LGAs. This age range aligns with WHO recommendations for HPV vaccination as the primary target group (WHO, 2020).

Inclusion criteria were: (i) parent or legal guardian of at least one girl aged 9–14 years, (ii) resident in one of the selected LGAs for at least six months, and (iii) provision of informed consent to participate.

Exclusion criteria included: (i) parents or guardians with no female children within the eligible age range, and (ii) refusal to provide informed consent.

Sample Size Determination

Sample size was calculated using Cochran's formula for cross-sectional studies with populations greater than 10,000 (Cochran, 1977):

$n = Z^2 \times p \times q / d^2$

Where: Z = 1.96 (standard normal deviate for 95% confidence level); p = 0.31 (prevalence of HPV vaccine uptake from a previous Nigerian study) (Urang, 2023); q = 1 − p = 0.69; d = 0.05 (margin of error).

This yielded: $n = (1.96)^2 \times (0.31 \times 0.69) / (0.05)^2 = 328.7 \approx 329$. Adjusting for a 10% non-response rate: $n = 329 \times 1.10 = 361.9 \approx 360$. A total of 360 participants were targeted, with 120 per LGA. Ultimately, 336

questionnaires were completed and analysed, representing a 93.3% response rate.

Sampling Technique

A multi-stage cluster sampling approach was employed to ensure representation across urban and rural populations.

Stage 1

Stratification of Kogi State's 21 LGAs into urban and rural categories based on classification by the Kogi State Ministry of Health and National Population Commission (NPC Nigeria, 2006). One urban LGA (Lokoja) and two rural LGAs (Igalamela and Ibaji) were randomly selected using a random number generator.

Stage 2

Within each selected LGA, two wards were randomly selected from the list of all wards using simple random sampling.

Stage 3

From each selected ward, two communities were randomly selected, yielding a total of 12 communities across the three LGAs.

Stage 4

Within each community, a comprehensive household list was compiled. Using systematic random sampling with a sampling interval of k = 2, 50 households per community were selected. From each household, one eligible respondent (parent/guardian of a girl aged 9–14 years) was recruited. This process ensured equal representation across communities while maintaining randomisation.

Data Collection Instruments

Data were collected using a validated semi-structured questionnaire developed based on existing HPV vaccine knowledge, attitude, and practice (KAP) instruments from prior Nigerian studies (Umeh et al., 2017; Akinleye et al., 2020; Odetola, 2015) and adapted to the local Kogi State context.

Data Collection Procedure

Data collection was conducted over three months. A team of 12 trained research assistants, proficient in local languages (Igala, Ebira, Yoruba) and English, administered the questionnaires. A comprehensive two-day training workshop was conducted covering study objectives, ethical principles, informed consent procedures, questionnaire administration, and data quality assurance.

Face-to-face interviews were conducted in participants' homes or convenient community locations. Each interview lasted approximately 25–30 minutes. For participants with limited literacy, research assistants read questions aloud and recorded responses verbatim. All questionnaires were reviewed daily for completeness and consistency by the research team.

Data Management and Analysis

Data were entered into Microsoft Excel, cleaned, and exported to IBM SPSS Statistics version 26.0 for analysis. Data quality checks included range verification, consistency checks, and identification of outliers. Missing data were minimal (< 3%) and managed using pairwise deletion for specific analyses.

Ethical Considerations

Ethical approval

was obtained from the Kogi State Ministry of Health Research Ethics Committee (Approval Number: MOH/PRS/465/V.1/130) before data collection. All participants provided written informed consent after receiving detailed information about the study's purpose, procedures, risks, benefits, confidentiality measures, and right to withdraw at any time without penalty. Consent forms were available in English and translated into local languages. For participants with limited literacy, consent was obtained through thumbprint signature in the presence of a literate witness.

Data confidentiality was maintained by using unique identification codes rather than participant names. All completed questionnaires were stored in locked cabinets accessible only to the research team. Electronic data were password-protected and stored on encrypted devices. No personal identifiers were included in data analysis or reporting.

RESULTS

Sociodemographic Characteristics of Participants

A total of 336 parents/guardians participated in the study. The mean age was 41.2 ± 8.4 years, ranging from 20 to over 50 years. The largest age group was 30–39 years (40.8%), followed by 40–49 years (42.0%). Most respondents were female (70.2%), married (82.1%), and Christian (64.3%). Islam was practised by 33.6% of participants. Ethnically, Igala was the predominant group (61.6%), followed by Yoruba (21.1%) and Ebira (6.5%).

Educational attainment was relatively high, with 62.2% having completed tertiary education, 25.6% secondary education, 7.7% primary education, and only 3.9% reporting no formal education. Monthly household income varied: 39.6% earned ₦50,000–₦100,000, 31.0% earned more than ₦100,000, and 22.6% earned less than ₦50,000. Most participants (69.3%) had 1–2 daughters in the eligible age range (9–14 years), with 27.4% having 3–4 daughters.

Among the 336 participants, only 61 (18.2%) reported that at least one of their daughters aged 9–14 years had received the HPV vaccine, representing the actual vaccine uptake rate in the study population. Detailed sociodemographic characteristics are presented in Table 1.

Table 1
Sociodemographic Characteristics of Participants (N = 336)

Variable	All Participants n (%)	Vaccinated Children n (%)
Age (years)	Mean: 41.2 ± 8.4	Mean: 41.6 ± 8.3
20–29	10 (3.0)	1 (1.6)
30–39	137 (40.8)	24 (39.3)
40–49	141 (42.0)	27 (44.3)
≥50	48 (14.3)	9 (14.8)
Sex		
Male	100 (29.8)	17 (27.9)
Female	236 (70.2)	44 (72.1)
Marital Status		
Single	26 (7.7)	1 (1.6)
Married	276 (82.1)	55 (90.2)
Divorced	26 (7.7)	2 (3.3)
Widowed	8 (2.4)	3 (4.9)
Religion		
Christianity	216 (64.3)	41 (67.2)
Islam	113 (33.6)	19 (31.1)
Traditional	5 (1.5)	1 (1.6)
Others	2 (0.6)	0 (0.0)
Ethnic Group		
Igala	207 (61.6)	37 (60.7)
Yoruba	71 (21.1)	15 (24.6)
Ebira	22 (6.5)	4 (6.6)
Others	36 (10.7)	5 (8.2)
Education Level		
No formal education	13 (3.9)	0 (0.0)
Primary	26 (7.7)	4 (6.6)
Secondary	86 (25.6)	9 (14.8)

Variable	All Participants n (%)	Vaccinated Children n (%)
Tertiary	209 (62.2)	47 (77.0)
Don't want to say	2 (0.6)	1 (1.6)
Monthly Income (₦)		
<50,000	76 (22.6)	13 (21.3)
50,000–100,000	133 (39.6)	23 (37.7)
>100,000	104 (31.0)	24 (39.3)
Don't want to say	23 (6.8)	1 (1.6)
Female Children Aged 9–14 years		
None	7 (2.1)	0 (0.0)
1–2	233 (69.3)	46 (75.4)
3–4	92 (27.4)	14 (23.0)
>4	4 (1.2)	1 (1.6)

Parental Knowledge of HPV and HPV Vaccine

Knowledge of HPV and the HPV vaccine was generally low. While 58.9% of respondents had heard of HPV, only 52.1% could accurately describe what HPV is, and just 31.0% knew how it is transmitted. Knowledge of HPV's link to cervical cancer was particularly poor, with 57.4% expressing uncertainty and only 25.9% correctly identifying the association.

Awareness of the HPV vaccine was limited: 49.4% had heard of the vaccine, 38.1% knew its purpose (cervical cancer prevention), 29.8% knew the recommended vaccination age (9–14 years), and only 11.6% were aware of the required dosage schedule. More than half (55.1%) were uncertain whether the HPV vaccine is available in Nigeria, despite the national rollout in 2023 (FMOH Nigeria, 2022).

The composite knowledge score ranged from 0 to 9, with a mean of 3.29 ± 3.11 and median of 2 (IQR: 1–4), confirming generally low knowledge levels. Internal consistency of the 9-item knowledge scale was acceptable (Cronbach's α = 0.70) (Tavakol & Dennick, 2011). Using Bloom's cut-off criteria (Bloom, 1956), knowledge levels were categorised as follows: 66% of participants demonstrated low knowledge (score 0–4), 12% moderate knowledge (score 5–6), and 22% high knowledge (score 7–9). Knowledge items and their distribution are presented in Table 2.

Table 2
Parental Knowledge of HPV and HPV Vaccine (N = 336)

Knowledge variables	Yes n (%)	No n (%)	Not Sure n (%)
Ever heard of HPV	198 (58.9)	138 (41.1)	—
Know what HPV is	175 (52.1)	125 (37.2)	36 (10.7)
Know how HPV is transmitted	104 (31.0)	153 (45.5)	79 (23.5)
HPV can lead to cancer	87 (25.9)	56 (16.7)	193 (57.4)
Heard of HPV vaccine	166 (49.4)	167 (49.7)	3 (0.9)
Know the use of HPV vaccine	128 (38.1)	171 (50.9)	37 (11.0)
Know recommended vaccination age	100 (29.8)	180 (53.6)	56 (16.7)
Know dosage of vaccine required	39 (11.6)	215 (64.0)	82 (24.4)
Is HPV vaccine available in Nigeria	109 (32.4)	42 (12.5)	185 (55.1)

Composite Knowledge Score: Mean = 3.29 ± 3.11; Median = 2 (IQR: 1–4); Range: 0–9. Internal Consistency: Cronbach's α = 0.70.

Parental Attitudes and Perceptions Toward HPV Vaccination

Attitudes toward HPV vaccination were moderately positive. Most respondents agreed or strongly agreed that the HPV vaccine is safe for children (79.1%) and indicated they would allow their child to be vaccinated (74.4%). A strong 86.0% reported that a recommendation from a healthcare professional would influence their vaccination decision, highlighting the critical role of trusted health workers.

Perceptions revealed mixed views. While 80.6% expressed concern about possible side effects of the vaccine, only 28.3% believed the vaccine promotes early sexual activity a common myth in many settings. Over 80% felt there is insufficient information about the HPV vaccine, reflecting significant information gaps. Religious beliefs influenced decision-making for 26.5% of respondents, and 27.4% acknowledged cultural or religious objections within their communities, though these proportions were relatively modest.

The composite attitude/perception score ranged from 0–100, with a mean of 2.92 ± 0.51. However, internal consistency of the attitude scale was poor (Cronbach's α = 0.44) (Tavakol & Dennick, 2011), suggesting items may not form a tightly cohesive construct. Using Bloom's criteria (Bloom, 1956), 78.3% of participants demonstrated moderate attitudes, 5.4% positive attitudes, and 16.4% negative attitudes. Full attitude and perception distributions are presented in Table 3.

Table 3
Parental Attitudes and Perceptions Toward HPV Vaccination (N = 336)

Item	Strongly Disagree n (%)	Disagree n (%)	Agree n (%)	Strongly Agree n (%)
ATTITUDES				
HPV vaccine is safe for children	16 (4.8)	54 (16.1)	241 (71.7)	25 (7.4)
I would allow my child to be vaccinated	20 (6.0)	66 (19.6)	208 (61.9)	42 (12.5)
Health professional recommendation influences decision	14 (4.2)	33 (9.8)	191 (56.8)	98 (29.2)
PERCEPTIONS				
I am concerned about side effects	17 (5.1)	48 (14.3)	203 (60.4)	68 (20.2)
HPV vaccine promotes early sexual activity	24 (7.1)	217 (64.6)	87 (25.9)	8 (2.4)
There is not enough information about the vaccine	16 (4.8)	41 (12.2)	200 (59.5)	79 (23.5)
My religious beliefs affect my decision	43 (12.8)	204 (60.7)	68 (20.2)	21 (6.3)
There are cultural/religious objections in my community	59 (17.6)	185 (55.1)	85 (25.3)	7 (2.1)

Composite Attitude Score: Mean = 2.92 ± 0.51. Internal Consistency: Cronbach's α = 0.44.

HPV Vaccine Uptake and Barriers

Overall, HPV vaccine uptake was low: only 18.2% (n = 61) of parents reported that at least one daughter aged 9–14 years had received the vaccine. Among those vaccinated, the majority received the vaccine at public hospitals (69.5%), followed by school-based programs (15.3%) and private hospitals (11.9%). The mean number of vaccinated children per household was 1.52 ± 0.57, indicating most parents vaccinated only one eligible daughter.

Among the 275 parents who had not vaccinated any eligible daughter, the most cited barriers were lack of awareness (42.0%), fear of side effects (21.4%), vaccine unavailability (9.8%), and lack of interest (8.3%). Despite low actual uptake, willingness to vaccinate was remarkably high: 88.7% of all respondents stated they would vaccinate their child if the vaccine were provided free of charge, revealing a substantial intention-behaviour gap.

Health workers emerged as the primary information source (39.5%), though 35.6% of respondents had never heard of the HPV vaccine before this study. Overwhelmingly, 98.8% of participants agreed that more awareness programs are needed in their community. Full uptake and barrier data are presented in Table 4.

Table 4
HPV Vaccine Uptake, Barriers, and Information Sources

Variable	n (%)
Child aged 9–14 years received HPV vaccine	
Yes	61 (18.2)
No	275 (81.8)
Where did vaccinated children receive vaccine (n = 59)	
Public hospital	41 (69.5)
Private hospital	7 (11.9)
School-based program	9 (15.3)
Others	2 (3.4)
Reasons for not vaccinating child (n = 276)	
Lack of awareness	116 (42.0)
Fear of side effects	59 (21.4)
Vaccine not available	27 (9.8)
Not interested	23 (8.3)
Distance to facility	11 (4.0)
Cost	8 (2.9)
Cultural/religious reasons	7 (2.5)
Others	25 (9.1)
Would vaccinate if vaccine was free (n = 336)	
Yes	298 (88.7)
No	38 (11.3)
Where did you hear about HPV vaccine (n = 334)	
Health worker	132 (39.5)
Never heard of it	119 (35.6)
Television/radio	28 (8.4)
Internet/social media	18 (5.4)
Community sensitization	14 (4.2)
School program	13 (3.9)

Variable	n (%)
Child aged 9–14 years received HPV vaccine	
Friends/family	10 (3.0)
More awareness programs needed in community (n = 336)	
Yes	332 (98.8)
No	4 (1.2)

Relationship Between Knowledge and Vaccine Uptake

Contrary to conventional expectations, an independent samples t-test revealed that parents who had not vaccinated their daughters had significantly higher knowledge scores (M = 11.16, SD = 3.50) compared to those who had vaccinated (M = 8.70, SD = 2.71), t(109.40) = 6.044, p < 0.001. The mean difference of 2.46 was substantial, with a large effect size (Cohen's d = 0.73). This inverse relationship persisted after adjusting for potential confounders in multivariable logistic regression. Full t-test results are presented in Table 5.

Table 5
Independent Samples t-Test Comparing Knowledge Scores by Vaccine Uptake Status

Group	n	Mean Knowledge Score	SD	t (df)	p-value	Mean Difference (95% CI)
Vaccinated	61	8.70	2.71	6.044 (109.4)	< 0.001	2.46 (3.26 to 1.65)
Not vaccinated	275	11.16	3.50			

Levene's Test for Equality of Variances: F = 15.701, p < 0.001 (equal variances not assumed). Effect Size: Cohen's d = 0.73 (large).

Determinants of HPV Vaccine Uptake: Multivariable Analysis

Binary logistic regression analysis was conducted to identify independent predictors of HPV vaccine uptake. After adjusting for sex, ethnicity, education level, monthly income, marital status, and religion, two variables emerged as significant (Table 6).

Knowledge score remained a highly significant predictor, but in an inverse direction (β = 1.410, p < 0.001; aOR = 0.244, 95% CI: 0.164–0.364). For each one-unit increase in knowledge score, the odds of vaccine uptake decreased by approximately 76%. This paradoxical finding suggests that higher knowledge was associated with a reduced likelihood of vaccinating an eligible child.

Education level was the only sociodemographic factor significantly associated with uptake (β = 0.610, p = 0.015; aOR = 0.543, 95% CI: 0.332–0.888). Higher education was associated with increased odds of vaccination, indicating that educated parents were more likely to vaccinate despite knowledge-related complexities. Sex, ethnicity, monthly income, marital status, and religion were not significant independent predictors of vaccine uptake in the final model.

Table 6
Binary Logistic Regression Predicting HPV Vaccine Uptake from Knowledge Score and Sociodemographic Covariates (N = 336)

Variable	β	SE	Wald	p-value	aOR	95% CI
Constant	3.337	1.539	4.699	0.030	28.128	—
Knowledge score	1.410	0.203	48.150	< 0.001	0.244	0.164–0.364
Education level	0.610	0.251	5.930	0.015	0.543	0.332–0.888
Sex	0.205	0.350	0.342	0.559	1.227	0.618–2.439
Ethnicity	0.272	0.180	2.272	0.132	1.312	0.922–1.868
Monthly income	0.369	0.214	2.984	0.084	1.447	0.951–2.199
Marital status	0.138	0.352	0.154	0.695	1.148	0.576–2.288
Religion	0.185	0.347	0.285	0.593	0.831	0.421–1.640

Model Statistics: χ^2=62.45, df = 7, p < 0.001; Nagelkerke R^2=0.25; Classification accuracy = 82.7%.

Attitudes, Perceptions, and Vaccine Uptake

An independent samples t-test comparing attitude scores between parents who vaccinated versus those who did not show a modest difference. Parents who vaccinated had slightly higher mean attitude scores (M = 21.98, SD = 2.76) compared to non-vaccinators (M = 21.12, SD = 2.48), t(334) = 2.412, p = 0.016, with a small-to-moderate effect size (Cohen's d = 0.34) (Table 7). However, when attitude score was entered into a multivariable logistic regression model adjusting for sociodemographic covariates, it was not a significant independent predictor of uptake (β = 0.432, p = 0.197; aOR = 0.649, 95% CI: 0.337–1.251) (Table 8). This indicates that while attitudes were slightly more positive among vaccinators, this association did not hold after controlling for other factors, particularly education.

Table 7
Independent Samples t-Test Comparing Attitude Scores by Vaccine Uptake Status

Group	n	Mean Attitude Score	SD	t (df)	p-value	Mean Difference (95% CI)
Vaccinated	61	21.98	2.76	2.412 (334)	0.016	0.86 (0.16–1.57)
Not Vaccinated	275	21.12	2.48			

Effect Size: Cohen's d = 0.34 (small-to-moderate).

Table 8
Logistic Regression Predicting HPV Vaccine Uptake from Attitude/Perception Score (Adjusted Model) (N = 336)

Variable	β	SE(β)	Wald	p-value	aOR	95% CI
Constant	4.485	1.579	8.072	0.004	88.680	—
Attitude/Perception score	0.432	0.334	1.666	0.197	0.649	0.337–1.251
Sex	0.128	0.310	0.171	0.679	1.137	0.619–2.087
Ethnicity	0.019	0.149	0.017	0.896	1.020	0.761–1.366
Education level	0.610	0.251	5.930	0.015	0.543	0.332–0.888
Monthly income	0.099	0.176	0.318	0.573	1.104	0.782–1.558
Marital status	0.193	0.301	0.409	0.523	0.825	0.457–1.489
Religion	0.015	0.310	0.003	0.960	0.985	0.537–1.807

Socioeconomic Status, Religion, and Vaccine Uptake

Principal Component Analysis was used to derive a composite SES index from education, occupation, and household income (Table 9). The Kaiser-Meyer-Olkin measure was 0.52 (acceptable), and Bartlett's test was significant (χ^2=50.92, $p < 0.001$), confirming suitability for factor extraction. One component with an eigenvalue > 1 was retained, accounting for 47.1% of variance. Education showed the strongest loading (0.808), followed by occupation (0.592) and income (0.641).

In multivariable logistic regression, neither the SES composite index nor religious affiliation was a significant predictor of HPV vaccine uptake after adjusting for age and sex (Table 10). The overall model was not statistically significant (χ^2=2.19, $p = 0.90$) and explained only approximately 1% of the variance in vaccine uptake, highlighting the limited explanatory power of these structural variables.

Table 9
Principal Component Analysis of Socioeconomic Status Indicators (N = 336)

SES Indicator	Component Loading	Communality
Level of education	0.808	0.653
Occupation	0.592	0.351
Household income	0.641	0.410

Kaiser-Meyer-Olkin (KMO) Measure: 0.52. Bartlett's Test of Sphericity: $\chi^2=50.92$, $p < 0.001$. Eigenvalue: 1.414 (Component 1); Variance Explained: 47.1%.

Table 10
Logistic Regression Analysis of SES, Religion, and HPV Vaccine Uptake (N = 336)

Predictor Variable	aOR	95% CI	p-value
SES composite index (continuous)	0.86	0.59–1.26	0.43
Religion — Islam vs Christianity	1.06	0.12–9.55	0.956
Religion — Other vs Christianity	1.20	0.14–10.59	0.867
Religious belief affects decision (Agree vs Disagree)	1.23	0.66–2.27	0.514
Age (continuous)	1.06	0.72–1.56	0.762
Sex (Female vs Male)	0.81	0.44–1.50	0.504

Model Statistics: $\chi^2=2.19$, $df = 6$, $p = 0.90$; Nagelkerke $R^2=0.01$.

DISCUSSION

This study provides the first comprehensive assessment of parental knowledge, attitudes, and determinants of HPV vaccine uptake among parents of eligible girls in Kogi State, North Central Nigeria. The findings reveal critically low vaccine uptake (18.2%), poor HPV-related knowledge, moderate positive attitudes, and a paradoxical inverse relationship between knowledge and vaccination behaviour. These results have important implications for cervical cancer prevention efforts in Nigeria and underscore the complexity of vaccine acceptance dynamics in culturally diverse, resource-limited settings.

Low HPV Vaccine Uptake Despite High Willingness

The observed uptake of 18.2% is alarmingly low and falls far short of the 90% coverage target set by WHO and Nigeria's National Cancer Control Plan (WHO, 2020; FMOH Nigeria, 2022). This finding is consistent with recent reports from other Nigerian regions. A study among female undergraduates in North-Central Nigeria reported only 15% uptake with 7.6% completing the full series (Olubodun et al.,

2023), while studies in Benin City (South-South) and Lagos (Southwest) reported uptake of 18.5% and 31%, respectively (Elebiyo et al., 2023; Urang, 2023). However, our findings contrast sharply with the 98% uptake achieved in Taraba State (North-East) through intensive, government-supported school-based vaccination campaigns (Adamu et al., 2025), demonstrating that high coverage is achievable when programmatic barriers are systematically addressed.

The stark gap between high willingness (88.7% willing if the vaccine is free) and low actual uptake (18.2%) reveals significant implementation failures. This intention-behaviour gap is not unique to HPV vaccination; similar patterns have been documented for other childhood immunisations in Nigeria (Adedire et al., 2016; Ophori et al., 2014). The disconnect suggests that parental receptivity exists but is undermined by structural barriers, including inadequate awareness, poor vaccine accessibility, inconsistent supply, and weak health system delivery mechanisms.

Knowledge Gaps

Parental knowledge of HPV and its vaccine was generally poor, with two-thirds of participants demonstrating low knowledge according to Bloom's criteria (Bloom, 1956). While 58.9% had heard of HPV, fewer understood its transmission (31.0%), its link to cervical cancer (25.9%), or the purpose and schedule of the vaccine (38.1% and 11.6%, respectively). These findings align closely with studies from other Nigerian states. In Anambra State (Southeast), only 35.5% of mothers had heard of the HPV vaccine (Umeh et al., 2017); in Lagos, 36.3% had adequate knowledge (Okunowo et al., 2018); and in Jos (North-Central), only 1.6% were aware of HPV (Anyaka et al., 2024). The consistency of these findings across diverse Nigerian contexts underscores a national-level health literacy deficit regarding HPV and cervical cancer prevention.

The knowledge gap is particularly concerning given Nigeria's recent national HPV vaccine rollout in 2023 (FMOH Nigeria, 2022). More than half of respondents (55.1%) were uncertain whether the vaccine is available in Nigeria, indicating that public awareness campaigns have not effectively reached target populations in Kogi State. Comparison with sub-Saharan African contexts reveals similar patterns. In Ethiopia, parental HPV knowledge was low despite vaccine availability (Assefa et al., 2021). In Kenya, only 15% correctly identified HPV as a sexually transmitted infection (Rosser et al., 2020), and in Uganda, fewer than one-third understood the HPV-cervical cancer link (Mwaka et al., 2016). These findings highlight a continent-wide challenge: the disconnect between vaccine availability and public health literacy necessary for informed uptake.

Attitudes: Fragile Positivity

Attitudes toward HPV vaccination were moderately positive, with 79.1% agreeing that the vaccine is safe and 74.4% willing to vaccinate their children. However, internal consistency of the attitude scale was poor ($\alpha = 0.44$) (Tavakol & Dennick, 2011), suggesting parental views are fragmented rather than rooted in coherent belief systems. Moreover, attitudes did not independently predict vaccine uptake in

multivariable analysis, indicating that favourable attitudes alone are insufficient to drive behaviour change without supporting knowledge, trust, and access.

The finding that 86.0% would be influenced by healthcare provider recommendations underscores the pivotal role of trusted health workers. This aligns with evidence from across Nigeria showing that provider endorsement is a primary motivator for vaccine acceptance (Akinleye et al., 2020; Ogunbanjo et al., 2020; Ezeanochie & Ofohan, 2019). However, only 39.5% of participants received HPV information from health workers, revealing a missed opportunity. Concerns about vaccine side effects (80.6%) and insufficient information (83.0%) were widespread, echoing findings from Lagos, where safety concerns were major barriers (Akinleye et al., 2020). Interestingly, only 28.3% believed the vaccine promotes sexual activity, lower than proportions reported in some settings (Newman et al., 2018), suggesting this myth may be less entrenched in Kogi State. Religious and cultural objections were noted by approximately one-quarter of respondents, modest compared to northern states where religious resistance has historically impeded vaccination programs (Abdullahi et al., 2020; Babalola & Lawan, 2009).

The Knowledge-Behaviour Paradox

Perhaps the most striking and counterintuitive finding was the inverse relationship between parental knowledge and vaccine uptake: parents with higher knowledge scores were significantly less likely to have vaccinated their daughters (aOR = 0.244, $p < 0.001$). This contradicts conventional health behaviour models, including the Health Belief Model and Theory of Planned Behaviour, which posit that increased knowledge drives preventive behaviours (Rosenstock, 1974; Ajzen, 1991).

This paradox has been observed, though less dramatically, in other Nigerian studies. Ezeanochie and Ofohan (2019) noted that educated mothers in Benin City sometimes declined HPV vaccination after encountering conflicting information online. Okunowo et al. (2018) found that parents in Lagos who actively sought vaccine information were more likely to encounter unverified claims linking the vaccine to infertility or long-term health risks. Similarly, studies in Abuja and Port Harcourt documented that misinformation and poor communication drove vaccine hesitancy despite knowledge gains (Onyema et al., 2020; Wokocha & Worlu, 2021).

Several mechanisms may explain this inverse association. First, 'knowledge' in this context may not equate to accurate knowledge: parents with higher scores may have been more exposed to both correct information and misinformation, with the latter disproportionately influencing behaviour.

Nigeria's digital landscape is characterised by the rapid spread of health-related rumours via WhatsApp groups, social media, and informal networks (Larson et al., 2015; Ezeah et al., 2021). Second, the inverse relationship may reflect distrust in government-led health programs, with studies from Kaduna and Kano documenting vaccine hesitancy rooted in historical mistrust of government intentions (Yusuf et al., 2021; Ibrahim et al., 2021). Third, knowledge-seeking behaviour may correlate with health literacy and critical thinking, enabling parents to identify inconsistencies or uncertainties in health messaging.

These findings underscore a critical lesson: improving knowledge quantity is insufficient; improving knowledge quality is paramount. Public health interventions must prioritise countering misinformation, strengthening trust in health systems, and delivering consistent, evidence-based messages through credible channels.

Education as a Protective Factor

Higher parental education level was the only sociodemographic factor independently associated with increased vaccine uptake (aOR = 0.543, p = 0.015). This finding is consistent with Nigerian and global literature linking education to health-seeking behaviours (Okunowo et al., 2018). Educated parents likely possess greater health literacy, better access to credible information, and a stronger capacity to navigate health systems. This finding has important equity implications: if education drives uptake, populations with lower education levels, often overlapping with rural residence, poverty, and limited health access, will be systematically disadvantaged. Interestingly, income and religion were not significant predictors, contrary to some studies linking higher income or Christian affiliation with vaccine acceptance (Talabi et al., 2023; Fagbule et al., 2020). The lack of income effect may reflect Nigeria's provision of free HPV vaccination in public facilities, reducing financial barriers.

Barriers to Uptake

Lack of awareness (42.0%) and fear of side effects (21.4%) were the predominant barriers, followed by vaccine unavailability (9.8%) and lack of interest (8.3%). These findings mirror studies from across Nigeria. In Ogun State, lack of awareness and cost were primary barriers (Olubodun et al., 2024); in Kano, fear of safety and absence of provider recommendations predominated (Olawepo et al., 2024). Vaccine unavailability (9.8%) is particularly concerning given the national rollout, possibly reflecting inconsistent supply chains or inadequate communication about vaccine access points. The low proportion citing cost (2.9%) and religious/cultural reasons (2.5%) as barriers is encouraging, suggesting these are not insurmountable obstacles in Kogi State.

Study Limitations

Several limitations warrant acknowledgment. First, the cross-sectional design precludes causal inference; associations observed do not establish causality. Second, vaccine uptake was based on parental self-report rather than verification through vaccination records, potentially introducing recall bias. Third, the study was conducted in Kogi State only; findings may not generalize to other Nigerian regions with different socio-cultural or health system contexts. Fourth, selection bias may exist as the sample was drawn from accessible households; hard-to-reach populations may have been underrepresented.

CONCLUSION

HPV vaccine uptake among girls aged 9–14 years in Kogi State, North Central Nigeria, remains critically low at 18.2%, far below the 90% target necessary for cervical cancer elimination (WHO, 2020). This low

coverage persists despite high parental willingness to vaccinate (88.7%), revealing profound implementation failures rooted in poor awareness, misinformation, and systemic barriers. Parental knowledge of HPV and its vaccine is alarmingly deficient, with two-thirds demonstrating low knowledge (Bloom, 1956). The paradoxical inverse relationship between knowledge and uptake underscores the pernicious role of misinformation and highlights that increasing knowledge quantity without improving quality and trust may be counterproductive.

Attitudes toward vaccination are moderately positive but fragile, lacking coherence and failing to independently predict behaviour. Education emerges as the only protective sociodemographic factor, raising equity concerns for less-educated populations. Health workers are recognised as trusted information sources but are underutilised, representing a missed opportunity.

Achieving Nigeria's cervical cancer elimination goals will require multi-faceted, sustained interventions: evidence-based health education delivered through trusted channels; school-based vaccination programs with robust community sensitisation; proactive healthcare provider engagement; aggressive counter-misinformation campaigns; targeted outreach to low-education populations; and strengthened vaccine supply chains (FMOH Nigeria, 2022). Without urgent, coordinated action, the substantial burden of preventable cervical cancer mortality in Nigeria will persist, undermining progress toward health equity and the Sustainable Development Goals.

Declarations

Ethics Approval and Consent to Participate:

Ethical approval was obtained from the Kogi State Ministry of Health Research Ethics Committee (Approval Number: MOH/PRS/465/V.1/130). All participants provided written informed consent before participation.

Consent for Publication:

Not applicable (no person's data are presented).

Competing Interests:

The authors declare no competing interests.

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Authors' Contributions

Daniel Oseji conceived the idea, designed the questionnaire, and conducted data collection; Moses Luke performed statistical analysis and drafted the manuscript; Olumide Adeyeye provided supervisory oversight and critically reviewed the manuscript; Nneka Oseji conducted a grammatical review and corrections. All authors read and approved the final manuscript.

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Availability of Data and Materials:

The datasets generated and analysed during this study are available from the corresponding author upon reasonable request and with appropriate ethical approval.

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