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HPV vaccine hesitancy among parents and caregivers of adolescents in Northern Nigeria

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ABSTRACT

Background: The recent introduction of the HPV vaccine into Nigeria's routine immunization schedule has brought parental vaccine hesitancy to the forefront. This cross-sectional study, conducted in Kano State, a region with historically low immunization rates, is crucial in assessing the level of parental hesitancy and uncovering its determinants, potentially informing future public health policies.

Methods: The participants were a representative sample of parents or caregivers of children aged 9–14 years (n = 1071) in Kano State and were selected via a multi-stage sampling method. We administered structured questionnaires anchored in the Socio-ecological Model and the Precaution Adoption Process Model. We utilized validated measures to assess intent to vaccinate against HPV and potential key indicators of intent to vaccinate adolescent boys and girls. Multivariate logistic regression analysis was performed to determine predictors of parental HPV vaccine hesitancy.

Result: If the HPV vaccine were free or subsidized, about one-third [32.7 %] of parents would choose not to vaccinate their children against the virus. Only 4.2 % had ever heard of HPV, and a mere 5.1 % had heard of the cervical cancer vaccine or HPV vaccine. Compared to those who were aware of the virus, those who had never heard of HPV had higher adjusted odds of vaccine hesitancy [OR: 2.86, 95 %CI: 1.28–6.40]. Some of the top reasons for parental hesitancy were their concerns about the safety of the vaccine and the lack of doctors' recommendations.

Conclusion: The study revealed that parental hesitancy is a significant barrier to HPV uptake in Kano State. There is an urgent need for a multi-faceted HPV knowledge enhancement approach focusing on elevating parental awareness about the HPV vaccine and, particularly, its relationship to cervical cancer prevention.

1. Background

Human papillomavirus [HPV] is a group of viruses that are very prevalent and cause several health problems in both males and females, including genital warts and cervical cancer [1]. HPV is responsible for about 90 % of cervical or anal cancer cases, 60 % of penile cancer cases, and about 70 % of oropharyngeal cancer cases worldwide [2,3]. The World Health Organization [WHO] estimated that there were 604,000 new cases of cervical cancer and 342,0002 deaths in the year 2020, making cervical cancer the fourth most fatal cancer in women [3,4]. Sub-Saharan Africa has the highest global prevalence of cervical cancer at 28 % [5]. Similarly, the sub-Saharan African region bears a disproportionate burden of cervical cancer, accounting for approximately 75,000 new cases and 50,000 deaths annually [5]. Overcoming the obstacles to controlling HPV infection and HPV-related cancers is crucial, given the immense burden of the disease.

In Nigeria, cervical cancer is the second most common cancer among women; there are about 12,000 new diagnoses and approximately 8000 deaths annually [6]. A nationwide study across the six geo-political regions of Nigeria revealed a 34.4 % prevalence of HPV infection [7]. A

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recent study in a large urban area in South-West Nigeria reported a prevalence of 18.6 % among women of all ages [1]; another study in North-central Nigeria reported a prevalence of 13.2 % among young girls aged 9–20 years [8]. Risk factors for HPV infection in Nigeria include early sexual debut, having multiple sexual partners, unprotected intercourse, and a weakened immune system [1,9,10]. Further, socio-economic variables, such as poverty and limited access to healthcare, influence delays in the diagnosis and treatment of HPV-related illnesses [11]. Additionally, cultural attitudes and beliefs influence screening, immunization programs, and other HPV preventative measures [11].

HPV vaccination is a highly effective preventative strategy to lower the prevalence of illnesses linked to HPV, including cancers [12]. However, due to a variety of reasons, including vaccine availability, cost, accessibility, and parental and caregiver reluctance, vaccination coverage varies both internationally and within sub-Saharan Africa [7]. In 2020, the WHO introduced the 90–70-90 strategy for eliminating HPV-related cervical cancer, consisting of targets to: 1) fully vaccinate 90 % of girls with HPV vaccine by age 15 years; 2)screen 70 % of women with a high-performance test by age 35 years and again by 45 years; and 3) provide appropriate treatment to 90 % of women with identified cervical precancerous lesions or invasive cervical cancer [13]. Vaccination not only offers individual protection but also contributes to the development of herd immunity, which reduces the spread of the virus in the community [14].

Progress has been achieved in reducing the burden of HPV infections and associated cancers in countries where the HPV vaccine is readily available and accessible, and people can access screening and treatments [3]. However, global HPV vaccination rates are below the WHO recommendation of 90 % [13], especially in sub-Saharan Africa, where the vaccine has been introduced in only a few countries [14]. One of the leading causes of low vaccination uptake is vaccine hesitancy [15] due to concerns about vaccine safety and effectiveness and misconceptions about its use in prepubescent children. In sub-Saharan Africa, cultural preconceptions, religious views, and limited health system capacities are additional immunization barriers [16,17].

The HPV vaccine was introduced into Nigeria's routine immunization schedule for prepubescent girls aged 9–14 years, using a phased approach, starting in October 2023 [6,18]. Vaccine hesitancy in Nigeria has been a significant challenge to the successful introduction and effectiveness of vaccination programs, including polio, measles, meningitis, yellow fever, and now HPV vaccines [19,20]. Common reasons cited by parents and caregivers for vaccine hesitancy in Nigeria include lack of awareness and information about the benefits and safety of vaccines, fear of adverse effects of vaccines, mistrust of government and the health system, religious and cultural objections to vaccines or their ingredients, rumors, myths and misinformation about the vaccine, and preference for alternative or traditional remedies [19,21]. Additionally, key lessons identified from HPV pilots in sub-Saharan Africa, including Nigeria, highlight the need for community engagement, involvement of key decision-makers, contextualized health education, and media advocacy as ways to address vaccine hesitancy and strong political will to ensure the successful introduction and effectiveness of HPV vaccination efforts [22,23].

It is pertinent to identify high-risk groups and ameliorate factors that, if addressed, can increase parental vaccine confidence and willingness to accept the HPV vaccination for adolescent girls and boys in Kano State. Therefore, this study aimed to examine the factors associated with parental hesitancy toward the HPV vaccine in Kano, a region in Nigeria with one of the lowest immunization acceptance rates in the country. The findings can contribute to filling knowledge gaps in HPV vaccine introduction and promotion in Nigeria. Our results can also help vaccination program managers identify important levers for increasing community education and advocacy, raising awareness about HPV and the HPV vaccine, reducing vaccine hesitancy, and increasing vaccine uptake in Northern Nigeria.

2. Methods

This cross-sectional study was conducted in Kano State, Northern Nigeria, in December 2022. Surveys were administered to the parents or caregivers of children aged 9–14 years ($n = 1071$). The participants were selected via a multi-stage sampling method. For decades, this sampling strategy has been utilized in national surveys conducted in Nigeria, including the Multiple Indicator Cluster Survey (MICS) and the Demographic and Health Survey (DHS) [24,25]. For population enumeration purposes, the State has been divided into several clusters (Enumeration Areas) based on the last census conducted in 2006 by the National Population Commission. The list and maps of the State's Enumeration Areas (EAs) were obtained from the National Population Commission. Since a higher proportion of the population in Kano resides in rural areas [about 55 %] [25], a proportionate number of clusters were randomly selected to represent the population distribution. One hundred clusters were selected in urban and rural areas in a ratio of 4.5:5.5. The research team went around the area with a community guide to locate the boundaries of the selected EAs. The households in the EAs were listed to update the map the National Population Commission provided. The sampling interval was then calculated. In each cluster, we chose 13 occupied households based on systematic sampling, with the first interviewed household selected using simple random sampling. The calculated sampling interval was used to determine the remaining households. This approach, as utilized by previous surveys, produced population-representative households. [25].

The study's inclusion criteria were 1) parents or caregivers of an adolescent girl or boy aged 9–14 and 2) residency in the study population for at least six months. We excluded parents of adolescent girls who were too ill to participate or unable to provide consent. All eligible parents were listed in each household, and one parent was selected randomly using balloting. All selected parents consented to participate, and the response rate was 100 %. This rate is similar to the response rates of 99 % in commonly conducted national surveys in Nigeria [24,25]. Very few participants asked to reschedule their interview for a later time, but they were all successfully interviewed. The study population is an understudied one, and community members are very willing to participate in observational studies. The parents of the eligible adolescents received information about the study, and verbal consent was obtained from all participants.

The participants were approached through traditional and community leaders, who are the community gatekeepers. The community leaders assigned community guides, often their children, to accompany data collectors to selected households. The data collectors were all college graduates who had at least two previous successful community data collection experiences on health-related issues in the state. Face-to-face interviews were conducted using computer-assisted personal interviewing (CAPI). The survey questions were structured and guided by the Socio-ecological Model (SEM) and the Precaution Adoption Process Model (PAPM) [26,27]. The SEM conceptual framework encompasses various levels of influence on health behavior. These levels or circles of influence overlap, meaning one stage is nested within or affects the next level. According to this model, indices of public policy (Level 5), community (Level 4), organizational (Level 3), interpersonal/family influence (Level 2), and individual health or health behaviors (Level 1) will impact parents' intent to vaccinate their adolescents. The PAPM is a categorical stage theory that aims to identify *all* the stages involved when people commence health-protective behaviors. It consists of six distinct stages of health decision-making: 1) unaware of the health behavior]; 2) unengaged in the decision; 3) undecided; 4) decided not to act; 5) decided to act (intending); and 6) acting (vaccinated). We utilized validated measures to assess intent to vaccinate, HPV vaccine uptake, and potential key indicators of intent to vaccinate adolescent boys and girls, such as parental HPV health literacy, attitudes, beliefs, and socio-odemographic characteristics [24,28,29]. The questionnaire was compiled in English and translated into Hausa, the commonly spoken

language in the region.

3. Sample size estimation

Based on sample size computation, 1009 participants were required to estimate the proportion of the primary outcome, namely, "parental HPV vaccine hesitancy" for their adolescent youngsters. The sample size calculation was based on the following assumptions: 1) an estimated population of adolescents aged 10–14 years in Kano of 1,597,858 [30]; 2) a proportion of parents of adolescents who intend to uptake HPV vaccine for their adolescents of 30 % [estimated from preliminary data of unpublished dissertation]; 3) confidence limits of 4 % and 4) Design effect for cluster surveys-DEFF] of 2 [25]. We slightly oversampled our population by 5 % to account for missing data, but this was not an issue in our study.

4. Study location and population

Kano State, the most populous state in Nigeria, is located in the North-Western part of the country [30]. The Hausa and Fulani tribes comprise most of the State's population, and the Hausa language is predominantly spoken. It is a Muslim-majority state with a high prevalence of early marriage and polygamy [30]. Almost a third (30.8 %) of girls under 15 years old are married or in a union in Kano, and nearly half of the women (48.2 %) are in a polygamous marriage [30]. Kano State has a low overall literacy rate, with less than half (47.9 %) of its population being able to read and write. Additionally, there is a significant gender disparity, with the male literacy rate (60.5 %) being considerably higher than the female literacy rate (35.6 %). Literacy rates vary significantly between urban and rural areas and across socioeconomic groups [31].

The state is known as a center for commerce with diverse economic and agricultural activities. Health services are provided via three tiers of government, namely, primary health care by the State primary health care development agency, secondary health care by the State Government, and tertiary care by the Federal Government. There is a very high concentration of health infrastructure, services, and personnel in the Kano metropolis compared to the rest of the state, which is predominantly rural [31]. In rural communities, health services are mainly available at the primary healthcare level, and residents have limited access due to distance and lack of healthcare providers [31]. It is one of the five Northern states with a history of polio vaccination boycotts in 2003 due to fears that the vaccine was unsafe [24]. Kano has one of Nigeria's lowest childhood immunization rates [24].

5. Measures and variables

The outcome variable was parental HPV vaccine hesitancy, defined as the refusal to uptake the HPV vaccine for their children even if the vaccine was offered free or at a subsidized cost (Yes or No). This variable was assessed using a validated question from the National Health Interview Survey (NHIS), 2010 [32]; If you could get the HPV vaccine free or at a much lower cost, would you get it? We chose this question to assess vaccine hesitancy because of its simplicity and relevance to the situation of the HPV vaccine in Nigeria at the time of the study. The vaccine was only available at a fee, which was not affordable to the average Nigerian. The main exposure variable, parental awareness of HPV, was assessed with the question, 'Have you ever heard of HPV? HPV stands for Human Papillomavirus. It is not HIV, HSV, or herpes' (Yes or No). This question has been asked in US national surveys, including NHIS and the Health Information National Trends Survey (HINT) [33]. We also adopted a question from NHIS to examine parents' reasons for not wanting to get the HPV vaccine for their adolescents: what is the main reason you would not want to get the vaccine? (Does not need the vaccine, not sexually active, too expensive, too old for the vaccine, the doctor didn't recommend it, worried about the safety of the vaccine, don't know where to get the vaccine, my spouse/family member is against it, don't know enough about the vaccine, already have HPV). The study instrument is available as supplementary material.

The study covariates included parents' and children's sociodemographic characteristics, which were measured using validated questions from the Nigerian Demographic Health Survey (NDHS) (26). The NDHS is a national sample survey that provides up-to-date information on demographic and health indicators and has been administered in all Nigerian states since 1990 (26). The parents' sociodemographic characteristics include age in years, educational status (none, primary, secondary, or higher), area of residence (rural/urban); ethnicity (Fulani, Hausa, Igbo, Yoruba, others); religion (Islam, Christianity, other), marital status (currently married/in a union or never/formerly married); and parity (number of male and female children). Adolescents' sociodemographic factors included age in years, gender (male, female), and educational level.

6. Data analysis

The data were checked for errors and consistencies and cleaned. Categorical variables were described using numbers and percentages, and continuous variables were summarized using means and standard deviation. The prevalence of the outcome (parental HPV vaccine hesitancy) and the main predictor (awareness of HPV vaccine) were estimated. The reasons for parental HPV vaccine hesitancy were summarized using percentages. The chi-square ($\chi 2$) test was used to compare crude frequencies and percentages of the predictors (including covariates) with respect to the outcome. Independent sample *t*-test was used to assess the differences in the mean of the continuous predictors by HPV vaccine hesitant status.

The main exposure variable, parental awareness of HPV, and the following sociodemographic variables were chosen as independent variables to evaluate associations with the outcome of interest: 1) parents' sociodemographic characteristics (age in years, educational status, area of residence, ethnicity, religion, marital status, and parity (number of male and female children). and 2) adolescents' sociodemographic factors (age in years and gender). These variables have been defined under the measures and variables subsection above. Odds ratio (with 95 % confidence intervals) of the association between each of the potential predictors and parental uptake intention was estimated using simple logistic regression models. Collinearity between the predictors was examined. Multivariate logistic regression analysis was conducted by simultaneously including the outcome variable, main predictor and all the statistically significant covariates in the simple logistic models. The total number of children was excluded from the adjusted model because of the high collinearity between this variable and the total number of male children (spearman's correlation coefficient: 0.76). All statistical analyses were performed in SPSS 28. All tests were 2-sided with *p*-values less than 0.05 considered statistically significant.

7. Results

The participants' mean (SD) age was 42.0 (11.0) years. Table 1 shows the socio-demographic and health-related characteristics of the study population. Most participants were mothers (61.8 %), married (92.0 %), Muslims (97.9 %), resided in a rural area (57.8 %), had non-formal education (45.6 %) and were of Hausa ethnicity (83.2 %). Only 4.2 % had ever heard of HPV, and 5.1 % had heard of the cervical cancer vaccine or HPV vaccine. Very few participants (2.2 %) reported that either they or their partner had ever been screened for cervical cancer. Most participants support the vaccine for adolescent boys (83.1 %) and girls (84.1 %). However, approximately one-third (32.7 %) would not vaccinate their children against HPV, even if the vaccine was free or subsidized. Some of the reasons for their hesitancy included the following in descending order: worried about the safety of the vaccine (24.3 %), not knowing enough about the vaccine (23.2 %), doctors not

Table 1
Sociodemographic characteristics of the study participants, HPV Vaccine Uptake Study Kano, 2022 [$n = 1071$].

Characteristics	n [%]
Respondent's age in years, Median [1QR]	40.0 [15.0]
Total number of children, Median [IQR]	6.0 [4.1]
Respondent	
Mother	662 [61.8]
Father	336 [31.4]
Caregiver	73 [6.8]
Gender	
Female	716 [66.9]
Male	355 [33.1]
Highest Educational Level	
Non-formal	488 [45.5]
None	19 [1.8]
Primary	183 [17.1]
Secondary	257 [24.0]
Tertiary	124 [11.6]
Religion	
Christianity	17 [1.6]
Islam	1048 [97.8]
Missing	6 [0.6]
Ethnic Group	
Fulani	154 [14.4]
Hausa	891 [83.2]
Other	26 [2.4]
Marital Status	
Divorced/Widowed	74 [6.9]
Married	985 [92.0]
Single	10 [0.9]
Missing	2 [0.2]
Place of Residence	
Rural	614 [57.3]
Urban	452 [42.2]
Missing	5 [5.5]
Child's Gender	
Female	563 [52.6]
Male	507 [47.3]
Missing	1 [0.1]
Child's Highest Educational Level	
Non-formal	87 [8.1]
None	2 [0.2]
Primary 1–6	656 [61.3]
JSS 1–3	280 [26.2]
SSS 1–3	45 [4.2]

Note: N = number, % = percentage; IQR = Interquartile Range.

Table 2
Factors Associated with HPV Vaccine Hesitancy in Kano State.

Characteristics	Unadjusted OR [95 % CI]	Adjusted OR [95 % CI]
Respondent's age in years, Median [1QR]	1.01 [0.99–1.02]	–
Total number of children	**1.04 [1.01–1.07]**	–
Total number of male children	**1.06 [1.02–1.12]**	1.03 [0.98–1.09]
Total number of female children	1.02 [0.97–1.08]	–
Ever Heard of HPV		
No	1.00	1.00
Yes	**2.60 [1.21–5.61]**	**2.86 [1.28–6.40]**
Respondent		
Mother	1.00	1.00
Father	**1.50 [1.14–1.97]**	**1.69 [1.24–2.32]**
Caregiver	0.81 [0.47–1.40]	0.84 [0.48–1.48]
Gender		
Female	1.00	–
Male	**1.40 [1.07–1.82]**	
Highest Educational Level		
Non-formal/ None	1.00	
Primary	0.94 [0.66–1.36]	0.86 [0.59–1.25]
Secondary	1.08 [0.79–1.49]	0.92 [0.64–1.32]
Tertiary	**0.60 [0.38–0.94]**	**0.60 [0.38–0.94]**
Religion		
Christianity	1.00	–
Islam	1.18 [0.41–3.37]	
Ethnic Group		
Hausa	1.00	
Fulani	**1.83 [1.29–2.59]**	**1.95 [1.35–2.82]**
Other	0.70 [0.28–1.78]	0.92 [0.34–2.40]
Marital Status		
Divorced/Widowed/ Single	1.00	–
Married	1.01 [0.63–1.62]	
Place of Residence		
Rural	1.00	1.00
Urban	**1.37 [1.06–1.77]**	**2.10 [1.54–2.87]**
Child's Gender		
Female	1.00	–
Male	0.87 [0.67–1.12]	
Child's Highest Educational Level		
Non-formal/None	1.00	1.00
Primary 1–6	**0.49 [0.31–0.77]**	**0.51 [0.32–0.82]**
JSS 1–3	**0.49 [0.30–0.80]**	**0.46 [0.27–0.78]**
SSS 1–3	0.48 [0.23–1.03]	0.52 [0.23–1.16]

Note: Respondents' age in years, religion, marital status, total number of female children, and child's gender were not significant in the crude models and were excluded from the adjusted models. The total number of children was excluded from the adjusted model because of collinearity with total number of male children.

recommending it (20.3 %), the child does not need it (20.3 %), child is not sexually active (18.6 %), child is too young (16.5 %), my spouse/family member is against it (10.9 %), and my religion is against it (6.7 %).

Participants who were HPV vaccine hesitant for their child were more likely to be of Fulani ethnicity, males/fathers, and resided in an urban area (p-values- <0.05). The average number of children or male children of parents/caregivers who were vaccine-hesitant was significantly higher than for those who intended to accept the vaccine (p-values- <0.05). In Table 2, we present the results of the multivariate logistic regression analyses of the association between HPV awareness and parental HPV uptake intention for their children. Compared to those who were aware of the virus, those who had never heard of HPV had almost three times higher odds of vaccine hesitancy (OR: 2.86, 95 % CI: 1.28–6.40). Fathers, in comparison to mothers, had 69 % higher odds of vaccine hesitancy (OR: 1.69, 95 % CI: 1.24–2.32). Fulanis had approximately twice the odds of vaccine hesitancy (OR: 1.95, 95 % CI: 1.35–2.89) as the Hausas. Urban residents also had higher odds of vaccine hesitancy than their counterparts in rural areas (OR: 2.10, 95 % CI: 1.54–2.87). Other significant predictors of vaccine hesitancy in this study were respondents' educational level and the highest level of education attained by the respondent's child, about whom we asked vaccination questions. Parents or caregivers with tertiary-level education had 40 % lower odds of vaccine hesitancy compared to those with non-formal or no education (OR: 0.60, 95 % CI: 0.38–0.94). Overall, parents or caregivers with children who had any formal education had about 50 % lower odds of vaccine hesitancy compared to their counterparts whose children had only non-formal or no education.

8. Discussion

In this study, we found a substantial level of HPV vaccine hesitancy among parents of adolescents in Kano State, Nigeria. If the HPV vaccine were free or subsidized, about one-third [32.7 %] of parents would choose not to vaccinate their children against the virus. This implies that the level of parental willingness to vaccinate [the antonym of hesitancy] in the area was 67.3 %. This level of parental acceptability was greater than the baseline average value of 47.7 % reported recently from the same state [34] but appears low compared to most reports from Nigeria, which found parental willingness to vaccinate their children against HPV to be greater [35–37] than 70 % [range: 72 % to 96.8 %]. However, a study conducted in Lagos, Nigeria [38] reported a similar level of parental willingness to vaccinate [65.8 %] as in our study. The parental willingness to vaccinate in our study was also lower than those reported in other parts of Africa [39]. In a meta-analysis on parental acceptability

to vaccinate their children, the authors found a high level of acceptance [>70 %] in all the countries analyzed, with parental willingness as an outcome. The African countries included in the meta-analysis were drawn from Western Nigeria, Ghana, Mali, Central Cameroon, Eastern Uganda, Kenya, Tanzania, Zambia, and Southern [Botswana, Zimbabwe, South Africa] African sub-regions [39]. Conclusively, the overwhelming majority of studies performed in Nigeria and other African countries reported higher parental willingness to vaccinate than the level we found in Kano. The lower level of parental willingness to accept the HPV vaccine in Kano might be related to the history of polio vaccination boycotts in 2003 due to fears that the vaccine was unsafe [24]. Lack of trust in vaccines still remains, and Kano has one of Nigeria's lowest childhood immunization rates [24]. The significant level of parental HPV vaccine hesitancy in this study highlights an important challenge to the effectiveness of the recently introduced HPV vaccination program in Kano State. Our finding has far-reaching consequences for the HPV vaccination campaigns and overall efforts to control cervical cancer in Kano, where a successful HPV vaccination program rests on its acceptability by parents of eligible children.

The top four reasons (prevalence of at least 20 %) why the parents in our study would not accept HPV vaccination for their adolescents were: (a) their concerns about the safety of the vaccine; (b) lack of knowledge about the vaccine; (c) lack of doctors' recommendations, and (d) their belief that their child did not need the vaccine. Parental negative feelings and beliefs about HPV vaccine safety could be an important barrier to intention on HPV uptake, which may be adopted by the adolescents themselves due to generally regarding their parents as role models [40], thereby anchoring HPV vaccine hesitancy in their children. Unfounded parental worries about vaccine safety were also reported from other parts of Nigeria [35] and the rest of the world [41], rendering it an important variable to consider in articulating strategies for augmenting HPV vaccine acceptance. One such strategy involves an investment of great effort using a socio-ecologic model to promote and enhance parents' positive perceptions about the HPV vaccine framed on robust community engagement approaches, taking into consideration the cultural sensitivities in those settings.

Both lack of knowledge about the vaccine and parental belief that their child did not need the vaccine are latent variables that indicate poor general knowledge about HPV infection and its direct linkage to cervical cancer causation. Among parents in our study, we found that only 4.2 % had ever heard of HPV, and a mere 5.1 % had heard of the HPV vaccine. In the adjusted analysis to remove the potential effects of confounders, we still detected a significant association between awareness of HPV and vaccine hesitancy. Parents who were unaware of HPV had approximately three times higher adjusted odds of being vaccine-hesitant than those who were aware of the virus. In a most recent meta-analysis of studies conducted specifically in Ethiopia, the authors reported that parents who had good knowledge about the HPV vaccine were around three times as likely to be willing to vaccinate their daughters as compared to parents who had poor knowledge about it [42]. That level of association between parental HPV vaccine literacy and HPV vaccination acceptance was exactly the same as that reported in our study. Our findings on poor HPV vaccine knowledge as being an important driver of vaccine hesitancy/absence of willingness to vaccinate children against HPV were also in agreement with reports from other parts of Nigeria [43–45]. The implication of these findings is that enhanced HPV vaccine literacy serves as a signaling pathway that inhibits HPV vaccine hesitancy, leading to lower vaccination resistance and improved willingness to vaccinate, resulting in a rise in HPV uptake. Such a hypothesis is supported by a recent study in the Kano metropolis, which demonstrated that a one-time-only HPV vaccine knowledge improvement intervention increased HPV vaccine acceptability by a staggering 83.0 % (from a baseline of 49.8 % to 91.2 %) [35]. This evidence supports a multi-faceted HPV knowledge enhancement approach, focusing on elevating the level of parental awareness about the HPV vaccine and, particularly, its relationship to cervical cancer prevention.

The fourth topmost reason for parental hesitancy in our study was the lack of doctors' recommendations. This highlights the strategic role of healthcare providers as important and credible sources of information for parents and adolescents in the decision-making process regarding the acceptance and uptake of preventive healthcare services, such as the HPV vaccine. Parents tend to regard their health providers as the most frequent and trusted source of information about vaccines [46], and research has shown that parents will be more willing to allow their adolescents to receive HPV vaccines if recommended by their health providers [47]. This credibility stems from repeated parent healthcare-provider interactions and understanding between the two that developed over time. Therefore, health facilities and health professionals should put in place an effective mechanism that encourages the recommendation of the HPV vaccine to parents during consultations and visits, as our findings suggest a lack of recommendation by healthcare providers to be one of the top four reasons for parental HPV vaccine hesitancy. Specific and culturally sensitive training modules should be periodically used to train healthcare professionals as part of continuous medical and health education, which will provide them with accurate knowledge, information, as well as skills to mitigate parental concerns about vaccine safety and effectiveness, dispel negative myths and conspiracy theories, as well as induce parental and adolescent motivation toward HPV vaccine uptake.

An interesting finding in the study was that fathers were more likely to express vaccine hesitancy than mothers. To our knowledge, specific literature on fathers' role in HPV vaccination in Kano State is scarce. The single identified study at the location found that males had a 60 % reduced likelihood (aOR = 0.4, 95 % CI (0.13–0.94)) of willingness to accept the vaccine ($p = 0.038$) [34]. However, an aggregated study of men across the six geopolitical zones in Nigeria on their willingness to support HPV vaccination and cervical cancer screening in Nigeria shows that the majority (>80 %) of them believed HPV vaccine and cervical screenings are important. Additionally, a good number (>58 %) would encourage and pay for their family members to receive HPV vaccine and cervical screening [48]. The higher vaccine hesitancy among fathers in our study could be due to factors unrelated to gender, such as differences in health literacy. Women, who are often caregivers of the elderly and children, have more contact with healthcare workers and facilities and, hence, more access to health education. This gender difference in vaccine acceptance is an important finding that can inform targeted interventions, especially in this environment where men often make the final decision on vaccination. This study points to the importance of male-targeted health education that would emphasize the effects of HPV-associated cancers on both males and females, families, and communities.

Our study also found that Fulani ethnicity was associated with higher adjusted odds of vaccine hesitancy. This is consistent with a similar study in the same environment in which ethnicity was found to affect willingness to accept the HPV vaccine ($p = 0.016$] [48]. While earlier studies did portray Fulanis, in their mobile and migrant status, as favorably disposed to vaccination if delivered in the context of "One-Health" that addresses animal and human health, this study only had a representation of settled and/or urbanized Fulanis, who were no longer rearing animals [49].

Collectively, these findings suggest that vaccine hesitancy is influenced by socio-demographic, cultural, and environmental factors in Kano State. Tailoring interventions to address the unique compositions and concerns of these communities is essential for improving vaccine uptake, as what works in one region or community may not be effective in another due to cultural and/or social differences. Therefore, vaccination program managers should consider these nuances when designing and implementing interventions. This study contributes to the field by shedding light on the specific factors that can potentially generate HPV vaccine hesitancy in Kano State, Nigeria. It emphasizes the need for targeted interventions that address cultural, gender, and

knowledge-related barriers to vaccination. Strategies should involve community engagement, education, and awareness campaigns to dispel myths and misconceptions surrounding the vaccine.

Like any study, this research has limitations. Face-to-face interviews were conducted, and this could result in parents overreporting their willingness to accept the vaccine, i.e., social desirability bias. We could not select participants at random, but the multistage sampling technique used was effective in selecting a representative sample. Our urban vs. rural participants (42.2 % vs. 57.3 %) in this study closely mimicked the distribution in Kano State [25]. Consequently, our findings can be generalized to the entire state. We investigated the intention to vaccinate at a period when the vaccine was not widely and freely available in Kano. There is a known gap between the intention and actual uptake of many health services when they eventually become available [50]. Future research in this area should employ longitudinal designs to track changes in vaccine hesitancy over time, especially in the mix of freely available vaccines under the National Routine Immunization program and health promotion interventions based on the findings of this and other studies. Additionally, interventions aimed at increasing vaccine acceptance should be deployed and rigorously evaluated to determine their effectiveness in improving HPV vaccination rates in Kano State and similar settings.

9. Conclusion

This study underscores the importance of addressing HPV vaccine hesitancy in Kano State, Nigeria. By understanding the factors influencing parental vaccination decisions, tailored interventions need to be developed to increase vaccine confidence and acceptance, ultimately contributing to the reduction of HPV-related diseases in the State.

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CRediT authorship contribution statement

Korede K. Yusuf: Writing – review & editing, Writing – original draft, Project administration, Methodology, Funding acquisition, Formal analysis, Conceptualization. **Comfort Z. Olorunsaiye:** Writing – review & editing, Writing – original draft, Funding acquisition, Conceptualization. **Muktar A. Gadanya:** Writing – review & editing, Writing – original draft, Project administration, Methodology, Funding acquisition, Conceptualization. **Samira Ouedraogo:** Writing – review & editing, Writing – original draft. **Aisha A. Abdullahi:** Writing – review & editing, Writing – original draft. **Hamisu M. Salihu:** Writing – review & editing, Writing – original draft, Supervision.

Declaration of competing interest

The authors declare the following financial interests/personal relationships which may be considered as potential competing interests: Korede Yusuf reports financial support was provided by Merck Sharp & Dohme LLC. If there are other authors, they declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

Data availability

Data will be made available on request.

Appendix A. Supplementary data

Supplementary data to this article can be found online at https://doi.org/10.1016/j.jvacx.2024.100591.

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