

Knowledge of HPV and HPV vaccine among senior secondary school students in Nigeria: Implications on cancer prevention strategies, the CHANCE Study

Omotayo F. Fagbule^{1,2}, Kehinde K. Kanmodi^{1,2}, Emmanuel O. Aliemeke¹, Kayode E. Ogunniyi¹, Mike Ogbeyide^{1,2}, Samuel O. Victor¹, Taiwo O. Isola¹, Habeeb O. Adewuyi¹, Semeeh A. Omoleke³, Precious A. Kanmodi^{1,2}

AFFILIATION

1 Cephas Health Research Initiative Inc, Ibadan, Nigeria
2 Mental and Oral Health Development Organization, Birnin Kebbi, Nigeria
3 World Health Organization, Kebbi State Field Office, Birnin Kebbi, Nigeria

CORRESPONDENCE TO

Kehinde K. Kanmodi. Cephas Health Research Initiative Inc, Ibadan, Nigeria. E-mail: kanmodikehinde@yahoo.com

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ABSTRACT

INTRODUCTION Human papillomavirus (HPV) is one of the major causes of head and neck cancer (HNC). The incidence rate of newly diagnosed HPV-induced HNC cancer is on the rise, year-by-year; this is a problem of public health concern. This study aims to determine the prevalence and predictors of knowledge of senior secondary (high) school students in Nigeria on HPV and HPV vaccines.

METHODS This study was a cross-sectional survey of 2530 high school students from six states in Nigeria using a self-administered structured questionnaire. Data collected were analyzed using the SPSS version 25 software.

RESULTS The mean (\pm SD) age of the respondents was 16.4 (\pm 2.0) years, 56.0% were male and 34.9% were from the Yoruba ethnic group. Only 23.0% and 18.3% of the respondents were aware of HPV and HPV vaccine, respectively. The majority (78.2%) of those who were

aware of HPV had below-average knowledge score about HPV. Those respondents: in the highest class in high school (AOR=1.36; CI=1.00–1.84; $p=0.048$); attending girls-only schools (AOR=2.86; CI: 1.93–4.24; $p<0.001$); and schooling in Bauchi state (AOR=2.56; CI: 1.47–4.51; $p=0.001$) were most likely to be aware of HPV compared to those in the other categories. However, those: attending girls-only (AOR=2.80; CI: 1.84–4.27; $p<0.001$); schooling in Bauchi state (AOR=2.87; CI: 1.55–5.33; $p=0.001$); and belonging to the Hausa tribe (AOR=2.41; CI: 1.51–3.85; $p<0.001$) were most likely to be aware to HPV vaccine than those in other categories.

CONCLUSIONS The level of knowledge of HPV and HPV vaccine among high school students in Nigeria is very poor. There is a need for health education programs on HPV and HPV vaccines in Nigerian secondary schools.

INTRODUCTION

Human papillomavirus (HPV) is a double-stranded DNA virus, which belongs to the family of *Papillomaviridae*^{1,2}. There are over 100 types of HPV and they include HPV types 6, 11, 16, 18, 31, 33, 35, 39, and others^{3,4}. However, about 30 HPV types are known to cause HPV-induced anogenital and oral infections⁵. These infectious HPVs are further categorized as 'low risk' and 'high risk' HPVs based on the clinical manifestations associated with the lesions they cause⁵. The low risk HPVs are responsible for causing benign epithelial hyperplasias (i.e. warts) while the high

risk HPVs are responsible for causing malignant lesions (i.e. cancers)^{5,6-9}.

The high risk HPVs are also called oncogenic HPVs. Oncogenic HPVs (such as HPV 16 and 18) are responsible for almost 100%, 90%, 70%, 50%, 40%, and 13–72% of cervical, anal, vaginal, penile, vulvar, and oropharyngeal cancers, respectively^{6-9,10-12}. Every year, about 0.51 million women are newly diagnosed with invasive cervical cancer while 0.288 million women die as a result of the disease. Furthermore, approximately 80% of newly reported cervical cancer cases are from the developing world¹³. Similarly, about 30000 new

cases of oropharyngeal cancers are reported yearly¹⁴.

There are various routes of transmission of HPV. The virus can be transmitted through sexual contact (e.g. anal sex, penetrative vaginal sex, and oral sex), skin-to-skin contact, and through child delivery (from mother to child)¹⁵⁻¹⁹.

The lifetime risk of HPV infection is as high as 80%²⁰. Fortunately, HPV infection is a vaccine-preventable disease³. As a way of reducing the heavy burden of HPV-associated diseases among their populace, countries like Australia, USA, Norway, Austria, and Germany had included HPV vaccination programs into their routine immunization programs, years back²¹. Through massive vaccination campaigns against HPV, many people in these countries have been protected against HPV-associated diseases²¹. Unfortunately, in Nigeria, HPV vaccination is yet to be introduced into its national routine immunization programs despite the very high prevalence rate of HPV-associated diseases among its populace^{22,23}.

Generally, young people are known to be a highly vulnerable population group when it comes to the risk of contracting HPV infections²⁴⁻²⁶. This assertion was made based on the rising rate of risky sexual behaviors (such as unprotected oral, vaginal and anal sexual intercourse) among the population group, coupled with the lack of a history of vaccination against HPV infection among them^{22,23,26}.

In Nigeria, only very few and limited studies have assessed the knowledge of in-school young persons on HPV and HPV vaccines. Therefore, it will be of huge public health benefit if the prevalence and predictors of knowledge of young people in Nigeria on HPV and HPV vaccine are known, as such information will go a long way in helping the Nigerian government and other relevant stakeholders on how to develop, promote, and implement public health policies/programs that will mitigate the community spread of the virus among them and also encourage their uptake of HPV vaccine.

This study was conducted with the aim of determining the prevalence and predictors of knowledge of senior secondary (high) school students (a population group that is predominantly made up of adolescents) in Nigeria on HPV and HPV vaccine. Conducting this kind of study amongst this population group is of high relevance because: 1) roughly 1 in 10 adolescents in Nigeria are sexually active²⁷⁻³²; 2) the knowledge of HPV and HPV vaccine among Nigerian adolescents reflects their collective level of preparedness towards the prevention of HPV transmission; and 3) the outcomes of this study will help to inform all relevant stakeholders in the Nigerian public health sector on how to effectively formulate, promote, and implement school health education policies/programs targeted at mitigating the spread of HPV infection among adolescents in Nigeria.

METHODS

Study design

This study was a descriptive cross-sectional population-based study that was conducted in order to assess the level of knowledge of senior secondary school students in Nigeria

on HPV and HPV vaccine. Also, this study forms part of the multi-year 'Campaign for Head And Neck Cancer Education (CHANCE)' Program conducted under the aegis of the Cephas Health Research Initiative Inc, Nigeria³³⁻⁴².

Five geopolitical zones (south-west, south-south, north-east, north-west, and north-central), out of 6 geopolitical zones in Nigeria were randomly selected for the study. One state was randomly selected per zone, with the exception of the south-west zone where two states were selected. Using convenient sampling technique, a minimum of two schools were selected per state for the study. However, simple random sampling technique was used in the selection of the study participants. For a student to be considered eligible to participate in this study, he/she must belong to any of the senior classes (Senior Secondary Classes, SS1, SS2 and SS3) in a secondary school situated within Nigeria; and he/she must also be willing to participate.

Study instrument

The instrument used for the data collection was a self-administered structured questionnaire that was developed through literature search⁴³⁻⁴⁹ and through a thorough review and editing process by a certified health education specialist (CHES). The questionnaire was anonymous and obtained information about sociodemographic characteristics (sex, age, tribe, religion, class, school etc.), knowledge of HPV, and knowledge of HPV vaccines from the participants.

Measures

Awareness of HPV and HPV vaccine

These were assessed using the questions: 'Have you ever heard of the Human Papillomavirus (HPV)?' and 'Have you ever heard of HPV vaccine?', respectively. The response options were 'Yes', 'No', or 'I don't know'. Those that responded in the affirmative were considered as being aware of HPV and HPV vaccine, respectively.

Knowledge of HPV and HPV vaccine

Nineteen questions were used to assess knowledge of HPV among those participants who identified themselves to be aware of HPV, while five questions were used to assess the knowledge of HPV vaccine among those participants who identified themselves to be aware of HPV vaccine. The response options to virtually all these questions were 'Yes', 'No', or 'I don't know'. Every correct response was given a score of '1' and other responses were given a score of '0'. The total knowledge score on HPV and HPV vaccine was calculated for each participant, with the highest achievable score being '19' and '5' for HPV and HPV vaccine, respectively.

Data collection and entry

Between November 2016 and January 2018, a total of 3000 students who fulfilled the study's eligibility criteria were approached for the study. They were informed about the purpose of the study. They were also informed that

their participation is strictly voluntary and completely confidential. Only those students (2754) that agreed to participate and who also gave written informed consent were recruited and issued a self-administered questionnaire to fill in. A total of 2701 students returned their questionnaires to the investigators, giving a response rate of 98.1%. During the data cleaning process, 171 questionnaires were excluded from the study because a significant proportion of their content was inappropriately/not filled in. Finally, only 2530 filled questionnaires were considered for data analysis.

This study was conducted under strict compliance with the 1964 Helsinki Declaration on health research involving human subjects. Ethical clearance to conduct this study was obtained from the University of Ibadan, University College Hospital Institutional Review Board, Ibadan, Nigeria. Approval was also obtained from the participating schools. All participants were informed about the purpose of the study; they were also informed that their participation was completely voluntary and strictly confidential. Informed consent was obtained from the participants (i.e. SS1 to SS3 students), class teachers, and parents. All participation was voluntary. No participant was harmed as a result of the study.

Data analysis

Only the data obtained from the appropriately filled in questionnaires were analyzed using SPSS version 25 software. Frequency distribution of all variables was determined. The frequency distributions of all variables were obtained and the mean scores (and standard deviations) of the respondents' age, knowledge of HPV, and HPV vaccine, were determined. Pearson's chi-squared test was used to compare the sociodemographic characteristics of those respondents who were aware of HPV and HPV vaccine with their responses to the questions/statements assessing their knowledge on HPV and HPV vaccine, respectively. Also, those respondents who had average and/or above average scores on HPV and HPV vaccine were determined, classified and compared with the independent variables (sociodemographics) using Pearson's chi-squared test. Multivariable logistic regression modeling was also done to determine the factors predicting the respondents' knowledge of HPV and HPV vaccine. A $p < 0.05$ was used to determine the level of statistical significance in the comparisons.

RESULTS

Sociodemographic data

This study was conducted across six states, spreading across five geopolitical zones in Nigeria. One-fifth (20.9%) of the 2530 respondents were from Benue state (in the north-central zone of Nigeria). Their mean age (\pm SD) was 16.4 (\pm 2.0) years, 56.0% were male, 34.9% belonged to the Yoruba tribe, 60.8% were Christians, 51.7% had monogamous family background, 73.5% were attending public schools, 78.1% were attending day-schools, and 31.3% were in SS1 (Table 1).

Table 1. Sociodemographic characteristics of respondents (N=2530)

Variables	Frequency/ value	Percentage (%)
State		
Osun	464	18.3
Oyo	370	14.6
Bauchi	357	14.1
Sokoto	424	16.8
Edo	385	15.2
Benue	530	20.9
School type		
Public	1860	73.5
Private	670	26.5
Mode of studentship		
Boarding	554	21.9
Day	1976	78.1
Class		
SS3	817	32.3
SS2	831	32.8
SS1	791	31.3
No response	91	3.6
Age (years)		
Youth (\geq 20)	138	5.5
Late adolescence (15–19)	1999	79.0
Early adolescence (10–14)	372	14.7
No response	21	0.8
Mean age (\pm SD)	16.4 (\pm 2.0)	
Gender		
Male	1418	56.0
Female	1088	43.0
No response	24	1.0
Religion		
Christianity	1537	60.8
Islam	959	37.9
Traditional/pagan/other	20	0.8
No response	14	0.6
Family background		
Polygamous/other	743	29.4
Single parent	326	12.9
Monogamous	1307	51.7
No response	154	6.1
Tribe		
Yoruba	884	34.9
Hausa	599	23.7
Igbo	250	9.9
Other	797	31.5
School composition		
Mixed	1749	69.1
Boys only	551	21.8
Girls only	230	9.1

SD: standard deviation.

Prevalence of awareness and knowledge of HPV and HPV vaccine

Only 23.0% and 18.3% of the respondents were aware of HPV and HPV vaccines, respectively (Supplementary file,

Table 2. Sociodemographic factors associated with awareness of HPV and HPV vaccine, among those respondents that were aware of each one

Variable	HPV		HPV vaccine	
	Yes* (%)	p#	Yes* (%)	p#
Age (years)		0.001		0.016
Early adolescence (10–14)	64 (17.2)		51 (13.7)	
Late adolescence (14–19)	467 (23.4)		372 (18.6)	
Youth (≥20)	44 (31.9)		33 (23.9)	
State		<0.001		<0.001
Osun	93 (20.0)		66 (14.2)	
Oyo	83 (22.4)		60 (16.2)	
Bauchi	140 (39.2)		119 (33.3)	
Sokoto	77 (18.2)		83 (19.6)	
Edo	71 (18.4)		50 (13.0)	
Makurdi	119 (22.5)		84 (15.8)	
Religion		0.001		<0.001
Christianity	315 (20.5)		225 (14.6)	
Islam	254 (26.5)		224 (23.4)	
Tribe		0.007		<0.001
Yoruba	209 (23.6)		144 (16.3)	
Hausa	164 (27.4)		170 (28.4)	
Igbo	53 (21.2)		38 (15.2)	
Others	157 (19.7)		110 (13.8)	
Type of school		<0.001		<0.001
Public	379 (20.4)		300 (16.1)	
Private	204 (30.4)		162 (24.2)	
School composition		<0.001		<0.001
Mixed	381 (21.8)		290 (16.6)	
Boys only	119 (21.6)		110 (20.0)	
Girls only	83 (36.1)		62 (27.0)	
Class		<0.001		<0.001
SS1	140 (17.7)		116 (14.7)	
SS2	219 (26.4)		179 (21.5)	
SS3	195 (23.9)		146 (17.9)	

HPV: human papillomavirus. *All percentages were calculated based on the total number of eligible respondents per category (i.e. total responses per category/total number of eligible respondents). #Only the data on sociodemographic variables that yielded statistically significant comparisons with HPV awareness, and HPV vaccine awareness, are presented.

Tables S1 and S2). Among those that were aware of HPV (n=583), the sources of their information were: TV/radio/magazines (28.5%); internet (17.5%); health-workers (11.3%); friends (18.5%); and parents (10.6%) (Table S1). The majority (78.2%) of those who were aware of HPV had below-average knowledge score in their assessment on HPV (Table S1).

As for those who were aware of HPV vaccine (n=462), the sources of their information were: the internet (22.5%); school (18.4%); TV/radios (16.7%); health-workers (14.3%); posters in pharmacies (14.3%); student health centers (8.7%); information leaflets (6.1%); and other (4.3%). Their mean (±SD) knowledge score regarding their knowledge assessment on HPV vaccine was 1.0 (±1.2). The majority (74.0%) had below average knowledge about the HPV vaccine (Table S2).

Factors associated with awareness of HPV and HPV vaccine

Table 2 shows that a higher proportion of those respondents who were: aged ≥20 years (31.9%), from the Hausa tribe (27.4%); and attending private secondary schools (30.4%) were aware of HPV compared to: the adolescent respondents; those who were non-Hausas; and those attending public secondary schools, respectively (p<0.05).

Factors associated with knowledge of HPV and HPV vaccine

Table 3 shows that the respondents’ state of residence, tribe, and gender were significantly associated with their knowledge of HPV and HPV vaccine. In addition, the family background, religion, and school composition of the respondents were significantly associated with their knowledge of HPV vaccine.

Table 3. Sociodemographic factors associated with the knowledge of HPV and HPV vaccine, among those respondents that were aware of each one

Variable	Average and above average score on HPV* (%)	p#	Above average score on HPV vaccine* (%)	p#
State		0.002		<0.001
Osun	30 (32.3)		13 (19.7)	
Oyo	28 (33.7)		12 (20.0)	
Bauchi	26 (18.6)		43 (36.1)	
Sokoto	12 (15.6)		32 (38.6)	
Edo	12 (16.9)		10 (20.0)	
Makurdi	19 (16.0)		10 (11.9)	

Continued

Table 3. Continued

Variable	Average and above average score on HPV* (%)	p#	Above average score on HPV vaccine* (%)	p#
Tribe		0.020		0.008
Yoruba	60 (28.7)		36 (25)	
Hausa	32 (19.5)		58 (34.1)	
Igbo	10 (18.9)		8 (21.1)	
Others	25 (15.9)		18 (16.4)	
Gender		0.025		<0.001
Male	83 (25.3)		89 (34.2)	
Female	43 (17.5)		29 (14.9)	
Religion		0.589		0.001
Christianity	66 (21.0)		43 (19.1)	
Islam	58 (22.8)		73 (32.6)	
School composition		0.277		0.005
Girls only	17 (20.5)		6 (9.7)	
Boys only	20 (16.8)		35 (31.8)	
Mixed	90 (23.6)		79 (27.2)	

HPV: human papillomavirus. *All percentages were calculated based on the total number of eligible respondents per category (i.e. total responses per category/total number of eligible respondents). #Only the data on sociodemographic variables that yielded statistically significant comparisons with HPV knowledge and/or HPV vaccine knowledge, are presented.

Factors predicting awareness and knowledge of HPV

We found that class, school composition, age, state (location of school), and tribe, were factors that predicted the likelihood of HPV awareness among our respondents (Table 4). For example, those respondents that were attending girls-only (OR=2.86; 95% CI: 1.93–4.24) had the highest odds when compared with those attending other school types. Similarly, those in SS3 (OR=1.36; 95% CI: 1.00–1.84) had the highest odds when compared with those in other classes, while those schooling in Bauchi state (OR=2.56; 95% CI: 1.47–4.51) had the highest odds when compared with those schooling in other states.

However, only gender and state were the factors that predicted a deeper understanding (knowledge) of HPV among our respondents (Table 5). Pertinently, the males were found to have higher odds (OR=1.76; 95% CI: 1.14–2.71) than females on the likelihood of having an average or above average knowledge score on HPV, while those schooling in Oyo state (OR=2.78; 95% CI: 1.05–7.34) had the highest odds of having an average or above average knowledge score on HPV when compared with those schooling in the other surveyed states.

Factors predicting awareness and knowledge of HPV vaccine

We found that class, school composition, age, state (location of school), and tribe were factors that predicted the likelihood of the respondents’ awareness on HPV vaccine (Table 4). For instance, those respondents that were attending a girls-only school (OR=2.80; 95% CI: 1.84–4.27) had the highest odds of being aware of the vaccine

Table 4. Predictors of respondents’ awareness of HPV and HPV vaccine

Variable	Aware of HPV		Aware of HPV vaccine	
	OR	95% CI	OR	95% CI
Class				
SS3	1.36	1.00–1.84	1.208	0.88–1.66
SS2	1.28	0.98–1.72	1.308	0.96–1.78
SS1 (Ref.)	1		1	
School composition				
Girls only	2.86	1.93–4.24	2.80	1.84–4.27
Boys only	1.66	1.17–2.37	2.01	1.38–2.92
Mixed (Ref.)	1		1	
Age (years)				
Early adolescence (10–14)	0.65	0.37–1.14	0.77	0.42–1.40
Late adolescence (15–19)	0.63	0.40–0.98	0.71	0.44–1.14
Youth (≥20) (Ref.)	1		1	
State				
Osun	0.68	0.41–1.11	0.95	0.55–1.63

Continued

Table 4. Continued

Variable	Aware of HPV		Aware of HPV vaccine	
	OR	95% CI	OR	95% CI
Oyo	0.85	0.50–1.43	1.28	0.72–2.28
Bauchi	2.58	1.47–4.51	2.87	1.55–5.33
Sokoto	0.55	0.32–0.93	0.62	0.35–1.10
Edo	0.71	0.47–1.08	0.73	0.46–1.16
Benue (Ref.)	1		1	
Tribe				
Yoruba	1.44	0.96–2.16	1.15	0.73–1.81
Hausa	1.34	0.87–2.07	2.41	1.51–3.85
Igbo	1.10	0.74–1.62	1.07	0.70–1.65
Other (Ref.)	1		1	

OR: odds ratio. CI: confidence interval. HPV: human papillomavirus.

Table 5. Predictors of having an average and above knowledge of HPV among respondents

Variable	Average and above knowledge	
	OR	95% CI
Gender		
Male	1.76	1.14–2.71
Female (Ref.)	1	
State		
Osun	2.71	1.02–7.24
Oyo	2.78	1.05–7.34
Bauchi	0.81	0.34–1.94
Sokoto	0.51	0.17–1.51
Edo	1.00	0.45–2.25
Benue (Ref.)	1	

OR: odds ratio. CI: confidence interval.

when compared with those from other school types, while schooling in Bauchi state (OR=2.87; 95% CI: 1.55–5.33) had the highest odds of respondents’ awareness on HPV vaccine when compared with those schooling in other states.

However, only family background, gender and state were the factors that predicted a deeper understanding (knowledge) of HPV vaccine among our respondents (Table 6). Furthermore, our findings showed that the males had higher odds (OR=2.89; 95% CI: 1.53–5.45) than females when it comes to having above average knowledge score on HPV vaccine knowledge assessment. Also, those respondents who were schooling in Sokoto state (OR=4.64; 95% CI: 1.32–16.28) or coming from a polygamous family (OR=1.83; 95% CI: 1.08–3.10) had higher odds than those in their counterpart groups (Table 6).

Table 6. Predictors of having an above average knowledge of HPV vaccine among respondents

Variable	Above average knowledge	
	OR	95% CI
Family background		
Polygamous/Other	1.83	1.08–3.10
Single parent	1.19	0.57–2.46
Monogamous (Ref.)	1	
Gender (without transgender)		
Male	2.89	1.53–5.45
Female (Ref.)	1	
State		
Osun	0.92	0.24–3.60
Oyo	0.89	0.21–3.75
Bauchi	3.26	0.99–10.74
Sokoto	4.64	1.32–16.28
Edo	2.43	0.79–7.44
Benue (Ref.)	1	

OR: odds ratio. CI: confidence interval.

DISCUSSION

This study surveyed 2530 secondary school students in Nigeria on their awareness and understanding of HPV and HPV vaccine and the findings are quite noteworthy.

Looking at the sociodemographic characteristics of the respondents, we observed that the study sample was very representative and diversified. The gender distribution of the surveyed respondents was fairly even. Also, all the three major Nigerian tribes (Yoruba, Hausa, and Igbo) were well represented in the study. However, the distribution of the

respondents based on their religious faiths was skewed; only a very negligible number of our respondents who were practicing traditional religions participated in the study; this skewedness is expected because traditional religion is practiced only by a minority of Nigeria's population⁵⁰. Also, all forms of schools (such as boys-only, girls-only, mixed schools, private schools, public schools etc.) were included in the survey.

A large majority of the respondents were unaware of HPV and HPV vaccine. This finding is consistent with other published studies exploring awareness of HPV and HPV vaccine among Nigerian adolescents and young adults⁵¹⁻⁵³. Furthermore, the generally low awareness rate of HPV and HPV vaccine in Nigeria is similar to that in high-income countries and other middle-income countries; this shows that low awareness rate on HPV and HPV vaccine among young persons is a global phenomenon, and not just limited to Nigeria⁵⁴⁻⁵⁷.

This study also shows that media and internet were the most commonly utilized sources of information on HPV and HPV vaccines among the respondents. This finding supports another study that reported that media and internet are top sources of information on HPV and HPV vaccine among high school students⁵⁸. Also, the above confirm that media and internet are very powerful tools that can be judiciously used for disseminating information among Nigerian secondary school students, especially on issues pertaining to health. However, there are some other sources of information on HPV and HPV vaccine that were also utilized by the surveyed respondents. These sources include friends, parents, and health workers. However, this finding strengthens some Nigerian studies that reported that friends, health workers and parents can be a source of information on HPV and HPV vaccine^{41,59-62}.

It is also noteworthy that many of those respondents who claimed awareness of HPV and HPV vaccines actually lacked adequate knowledge of HPV and HPV vaccines. This may suggest that their sources of information on HPV and HPV vaccine were probably inadequate or misleading; however, this suggestion is supported by previous studies, which reported that the quality of some health-related information shared among people, especially via the internet and social media, is unreliable⁶³. This implies that all health-related information obtained from the internet and social media must first be scrutinized with extreme caution before its acceptance.

Also in this study, we observed that those respondents that belonged to a single sex (boys-only or girls-only) school, SS3 class, and a school located in Bauchi state, were more likely to be aware of HPV and HPV vaccine than their counterpart groups. These observations are very interesting, although not too surprising because: 1) most school-based health education programs in Nigeria are on reproductive health and commonly conducted at single-sex schools⁶⁰; this may be a strong reason why students from single sex

schools are more likely to be aware about HPV and HPV vaccines than those in mixed-sex schools; 2) The SS3 class is the highest level in the Nigerian senior secondary schools, nationwide; hence they are expected to be more knowledgeable than those in the junior classes due to their higher level of maturity and exposure to more information than the junior classes. However, based on the existing data and our knowledge of Bauchi state, we find it very difficult to explain how schooling in the state increases a student's likelihood of awareness about HPV and HPV vaccine. Hence, this calls for future studies that will deeply explore this particular knowledge gap.

Interestingly, some factors were found to reduce the likelihood of the respondents' awareness or understanding about HPV and HPV vaccine. Such factors include schooling in Sokoto state and having a polygamous family background. The reasons why those respondents in these categories had the likelihood of lacking knowledge or awareness about HPV and HPV vaccine cannot be ascertained based on the findings of the present study; hence, it will be worthwhile to conduct a study that will explore these area in the future.

However, it can be inferred from this study that many young in-school Nigerians are at high risk of developing HPV-associated diseases including HPV-induced cancers; this inference was made based on the observed low level of awareness of HPV and HPV vaccine among them. Unfortunately, among the infectious disease types ever known to man, HPV-induced cancers are among the notorious types^{13,14}. Importantly, adequate knowledge about a disease goes a long way in the prevention of such disease⁶⁰; if the youth in Nigeria are not made knowledgeable about HPV and preventive measures (such as HPV vaccination and the practice of safe sexual intercourse), then they stand a high risk of contracting HPV infections in the future.

Strengths and limitations

This study has limitations. This study adopted the use of convenience sampling technique (a non-probability sampling technique) in the selection of the schools that participated in the study; this gave all the schools in the participating states an unequal chance of participating in the study. Also, not all the states in Nigeria were included in the study due to limited financial and human resources.

Notwithstanding the limitations, this study is believed to be the largest survey assessing the knowledge of HPV and HPV vaccines among senior secondary school students in Nigeria. Furthermore, this study was conducted at a period when the Nigerian government is yet to introduce HPV vaccination into the national immunization programs in Nigeria^{22,23}. Hence, the findings obtained in this study will provide additional relevant information to the government and all other relevant stakeholders towards the formulation and implementation of HPV sensitization and immunization policies and programs in Nigeria.

Recommendations

Based on our findings and our discussion so far, we make the following recommendations. First, a nationally representative study that will determine the prevalence of risks of contracting HPV infection (such as unprotected sexual intercourse, sexual violence etc.) among in-school youth in Nigeria needs to be conducted. Second, a nationwide school-based campaign/sensitization on HPV prevention (with focus on HPV-induced cancers) among young people in Nigeria needs to be conducted. Third, the Federal Government of Nigeria needs to quickly introduce HPV vaccine into the routine immunization program of Nigeria to curb the spread of HPV infection in Nigeria.

CONCLUSIONS

This study suggests that most of the senior secondary school students in Nigeria lacked adequate knowledge of HPV and HPV vaccines. Pertinently, their lack of knowledge of HPV and HPV vaccine places them at very high risk of contracting HPV infections.

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CONFLICTS OF INTEREST

The authors have completed and submitted the ICMJE Form for Disclosure of Potential Conflicts of Interest and none was reported.

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Study conceptualization: KKK, OFF; protocol design: KKK, OFF; data collection: all authors except SAO and PAK; data analysis: OFF, KKK; manuscript drafting: KKK, OFF; review of drafts: all authors; final draft review: all authors. Note: KKK and OFF contributed equally to the study.

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