Validation of HPV Knowledge Tool and Assessment of HPV Knowledge and Awareness among Students and Staff at IBB University, Niger State, Nigeria: Implications for Health Education and Prevention

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Article

Validation of HPV Knowledge Tool and Assessment of HPV Knowledge and Awareness Among Students and Staff at IBB University, Niger State, Nigeria: Implications for Health Education and Prevention

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Abstract: In Nigeria, Cervical cancer (CC) and lack of Human Papillomavirus (HPV) awareness poses significant HPV infection risk among women. This study was conducted at Ibrahim Badamasi Babangida (IBB) University in Nigeria; focused on assessing HPV awareness and knowledge, particularly concerning its association with CC and oral contraceptive (OC) pills among students and staff. We adapted and validated a 20-item HPV knowledge scale and explored factors influencing knowledge, vaccination rates, awareness, and the impact of ethnicity on HPV knowledge. Also, due to the non-normality of the knowledge score, non-parametric tests were done. Data were summarized using median and interquartile range (IQR), while categorical data were presented in frequency and percentage distribution. We established the reliability of the 20-item knowledge scale with a strong Cronbach's alpha coefficient of 0.913, indicating internal consistency. However, it revealed a concerning lack of awareness and knowledge about HPV, only 34.8% of participants were aware of HPV infection, and only 25.0% knew about HPV vaccine. Additionally, ethnicity was identified as a significant factor affecting HPV knowledge. Considering these findings, this study emphasizes the need for targeted interventions to enhance HPV awareness and knowledge, particularly among specific ethnic groups. Despite the development and validation of a reliable knowledge scale, the study underscores the importance of educational initiatives to address this knowledge gap, ultimately reducing the risk of HPV infection and CC in Nigeria.

Keywords: cervical cancer; HPV knowledge; Awareness of HPV infection; Awareness of HPV vaccine; Scale validation; quantile regression

1. Introduction

Cervical cancer (CC) poses a substantial worldwide public health challenge, especially in low- and middle-income nations, where it continues to be a primary contributor to women's health issues in terms of non-communicable disease (NCD) associated morbidity and mortality [1]. According to World Health Organization (WHO), CC ranks as the fourth most prevalent cancer among women on a global scale. It is estimated to result in approximately 570,000 new cases and 311,000 mortality each year, making up a significant 85% of the total burden of CC-related deaths worldwide [2]. Some epidemiological studies indicates that although awareness regarding HPV, a risk factor for CC, has grown over time, there remains a deficiency in comprehension among specific individuals [3]. Limited knowledge of HPV and CC has been associated with reduced participation in preventive measures like HPV vaccination and CC screening. Moreover, a lack of awareness can lead individuals to overlook seeking medical attention for symptoms related to HPV or CC. As a result, it is imperative

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to implement interventions such as community-based campaigns, outreach programs, and the provision of precise information by healthcare providers. These efforts play a pivotal role in advancing prevention, early detection, and treatment of CC by enhancing education and raising awareness about HPV and CC [2]. HPV genotypes 16 and 18 are acknowledged as high-risk variants responsible for approximately 70% of CC cases [3]. These genotypes lead to the deregulation of the expression of HPV oncoproteins E6 and E7. This, in turn, causes the abnormal growth of cervical cells and the formation of cancerous tumors [4]. Nonetheless, previous studies have shown that not all women infected with HPV 16 and 18 will develop CC. Other risk factors, such as smoking, multiple sexual partners, high parity, use of oral contraceptive (OC) pills, a compromised immune system, and a history of sexually transmitted infections (STI), can elevate the chances of developing CC [5], [6], [7]. Regular screening with either a Pap smear or an HPV test is recommended to identify abnormal cervical cells at an early stage. Additionally, vaccines that provide protection against HPV 16 and 18 are accessible for both men and women, serving as preventive measures to hinder the transmission of these high-risk genotypes [8]. Furthermore, it has been established that cigarette smoking represents a significant risk factor for both HPV infection and CC. This association is likely attributed to the negative impact of smoking on the immune system and genetic changes in cervical cells. Studies have revealed that women who smoke are more vulnerable to HPV infection and face an elevated risk of developing CC, with particularly higher risks observed among heavy and long-term smokers [6], [9], [10], [11]. As a result, interventions aimed at promoting smoking cessation can play a crucial role in lowering the risk of HPV infection and CC among women. Additionally, it is well-established that having multiple sexual partners is a significant risk factor for both HPV infection and CC, as it heightens the chances of contracting the virus. Research findings indicate that women who report having had multiple sexual partners over their lifetime have a substantially higher risk of developing CC compared to those with fewer partners [12]. Hence, advocating for safe sexual practices, which includes limiting the number of sexual partners, becomes essential in mitigating the risk of HPV infection and CC [13].

In Nigeria, CC ranks as the second most prevalent cancer among women, with approximately 14,943 new cases and 10,403 deaths reported annually [14]. HPV infection, which is transmitted through sexual contact, is a widely recognized risk factor for the development of CC. Specific high-risk HPV types are responsible for approximately 99% of all CC cases [15], [16]. Niger State, situated in northern Nigeria, bears a substantial burden of cervical cancer, with limited availability of preventive and early detection services [17]. Research has also shown that the utilization of Pap smear tests is not prevalent among women in Nigeria [18], [19]. Therefore, IBB University – a notable institution in the state, serves as a significant environment to investigate the awareness and knowledge of HPV and CC among university students and staff. Young adults, including those in university, constitute a vital demographic for implementing intervention strategies focused on preventing CC through HPV vaccination and enhancing awareness about CC and its associated risk factors. Assessing the awareness of infection and vaccines, as well as the knowledge of HPV, among university students and staff is of utmost importance for the development of effective educational programs and interventions. These initiatives aim to enhance awareness, knowledge, and preventive behaviors within this specific population.

Despite the critical role that knowledge plays in preventing CC, there is a shortage of research on the awareness and understanding of HPV among university students in Niger State, Nigeria. Furthermore, there is a lack of validated tools for assessing HPV knowledge among students in this context. Consequently, this study sought to adapt and validate an instrument for measuring HPV knowledge specifically for this setting. It also aimed to examine the pattern of HPV knowledge and the factors associated with it among students and staff at IBB University. Additionally, this study explored the rate of HPV vaccination and assessed awareness levels regarding HPV infection and the HPV vaccine. The insights gained from this research have the potential to influence future interventions and policies focused on enhancing HPV knowledge. By doing so, we can advance prevention and control strategies, ultimately reducing the burden of CC among universities in Niger State, Nigeria, and similar populations. In the paucity of publications on knowledge about HPV

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infection among students at IBB University in Niger State, Nigeria, there is a potential risk of HPV transmission within this population.

Due to the limited availability of publications concerning knowledge about HPV infection among students at IBB University in Niger State, Nigeria, there exists a potential risk of HPV transmission within this specific population [17]. The lack of knowledge among male students regarding their HPV status contributes to the vulnerability of females who may contract HPV and potentially develop CC in the future. The primary objective of this study is to adapt and validate a tool for measuring HPV knowledge. Additionally, it aims to identify the factors associated with HPV knowledge and assess awareness levels regarding HPV infection and the vaccine among students, academic, and non-academic staff at IBB University in Niger State. This research employs the quantile regression model for analysis. The outcomes of this study can be invaluable for the Niger State Ministry of Health in enhancing HPV awareness within the academic setting. Moreover, these findings can benefit healthcare sectors, private organizations, and individuals seeking guidance on safe sexual practices and increasing their knowledge of HPV-related matters.

2. Materials and Methods

2.1. Study Design and Setting

This study was conducted as an online cross-sectional survey involving students, non-academic staff, and academic staff members of Ibrahim Badamasi Babangida University in Lapai, Niger State, Nigeria. To prioritize the privacy of the participants, it was important to note that Nigerian citizens have the right to protect their data, and this right was safeguarded by the Nigerian constitution. As a result, during the process of data collection, the Nigerian Data Protection Regulation (NDPR) was implemented and adhered to [20].

2.1.1. Sample size

The estimates of the sample size are based on Z = 1.96, d = 5%, and non-response rate = 10%. The sample size determination formula for a cross-sectional study was used in this study. Thus;

$$N = \frac{(Z(\alpha)^2 * pq)}{e^2} \quad (1)$$

Where;

n = minimum sample size.

z = standard normal deviation of 95% confidence interval (CI) level; corresponds to a value of 1.96.

p = Record of HPV infection from similar studies in northern, Nigeria was (0.125) [18].

e = level of precision of 0.04.

q = 1 - p; 1 - 0.10 = 0.90.

n = 277 (approximately).

na (after adjusting for a 10% non-response rate) = 304 (approximately).

A total of 304 participants who completed the online surveys and met the selection criteria for this study based on the previous studies we have conducted [1] and were enrolled for this study.

2.1.2. Sampling Method

To address the pressing need for a validated scale to assess knowledge about HPV infection among both university students and staff at IBB University in Lapai, Niger State, Nigeria, we conducted this study within the university community. IBB University is situated in the North-Central region of Nigeria and has an approximate population of 7,000 students, 820 non-academic staff, and 310 academic staff. For the purpose of data collection, we employed an online tool known as the Human Papillomavirus and Cervical Cancer Risk Assessment (HCRA) Tool. This tool was developed using a Google survey form. The survey, designed within the Google survey form, is a modified version of our existing survey (the Human Papillomavirus Assessment Tool – HAT [1]) that

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was initially developed at the outset of this research in 2019. The adapted survey incorporates validated questions capable of gauging knowledge about HPV and CC. It also educates participants about HPV and CC after they submit their responses. Additionally, a feature was enabled to prevent multiple responses from participants and to ensure that responses were collected specifically from Nigerians.

2.2. Instrument

Data collection instruments used for this study consisted of the demographic survey and other forms to measure Knowledge and awareness of HPV. The following forms were adapted and validated to measure the knowledge and awareness of HPV: HPV Infection Awareness Questions [21], HPV Infection Knowledge Questions (Scale) [21], [22], HPV Vaccine Knowledge Questions (Scale) [21], [23] and Cervical Cancer Awareness on OC Pills [24], [25], [26]. The data instrument was adapted and validated for use in the study settings. The questions contained in the instrument are contained in Appendix A.

2.3. Data Analysis

2.3.1. Reliability and Normality

Ensuring a high level of reliability in our survey was essential to guarantee the accuracy and validity of our study findings. This reliability instills confidence in our ability to analyze participants' responses and evaluate their knowledge about HPV. We assessed the survey's reliability and coherence by examining its strong internal consistency, indicated by a value of 0.9 or higher (i.e., ≥0.9). This, in turn, strengthens the content validity of our survey. To score the knowledge scale consisting of 20 items, we employed a specific method: for positively phrased questions, we assigned a "1" to responses indicating "strongly agree" (considered correct), while all other responses were given a "0" (considered incorrect). Conversely, for negatively phrased questions, we reversed this coding process. We then summed up all the scores for each participant, resulting in a range of scores from 0 to 20, with higher scores indicating a better understanding of the subject matter. Furthermore, we assessed the normality of the knowledge scores using the Shapiro-Wilk Test for Normality.

2.3.2. Descriptive statistics and test of association

We utilized descriptive statistics, including measures such as frequency and percentage distribution, as well as summary statistics like the median and interquartile range (chosen due to the non-normal distribution of the data). These statistical methods were employed to provide a comprehensive overview of the patients' characteristics and their level of knowledge regarding HPV. To investigate factors that have independent associations with HPV knowledge, we employed appropriate statistical tests, specifically the Mann-Whitney test and Kruskal-Walli's test as warranted. We considered variables to be statistically significant when the P-value was less than 0.05, indicating a meaningful relationship between the variables and HPV knowledge.

2.3.3. Quantile Analysis

In our quantile analysis, we specifically concentrated on the 0.75 quantile of the knowledge distribution, which corresponds to the upper quartile or the 75th percentile. For various characteristics, we calculated coefficients along with their corresponding confidence intervals. Our findings revealed that although there were certain connections between demographic characteristics and knowledge levels, not all of these effects reached statistical significance at the 0.75 quantile. Factors such as sex, education level, and ethnicity displayed varying degrees of association with knowledge levels but did not consistently achieve statistical significance. It's important to note that all data analyses were carried out using Stata MP 16 [27].

2.3.3.1. Model Expression

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The model expression implemented for statistical analysis is the logistic regression model [28], [29].

$$Y_i = \beta_0^q + X_1\beta_1^q + X_2\beta_2^q + X_3\beta_3^q + \varepsilon_i^q \quad (2)$$

Where;

Y_i is the probability of HPV knowledge up to ith participant.

q represents the specific quantile associated with the equation, in this model (0.75).

X_1 denotes sex, X_2 represents education, and X_3 represents ethnic group.

β_0 is the model intercept while β_1, β_2, and β_3 denotes the coefficients for sex, education, and ethnic group.

ε_1 (error term) is the variance between the true value and the observed outcome (response value of students, academic, and non-academic staff) within the entire population.

3. Results

3.1. Reliability and Normality Test

To validate data, we have collected for this study, we conducted a reliability test on the survey utilized in this study to gauge participants' knowledge of HPV as shown in Table 1.0 below. This test utilized Cronbach's alpha coefficient, a widely recognized measure of internal consistency [30]. The robust Cronbach's alpha coefficient of 0.913 signals that the survey utilized in this study exhibits strong internal consistency. This implies that the 20 items contained in the survey are highly interconnected and collectively serve as a dependable measure of participants' knowledge regarding HPV. The elevated level of internal consistency indicates that these items consistently gauge the same underlying aspect of HPV knowledge. Cronbach's alpha value exceeding 0.9 is notably high, affirming that the survey items serve as reliable indicators of participants' knowledge. This underscores the survey's effectiveness in capturing the intended information and underscores its capacity to provide robust results for the analysis of participants' comprehension of HPV-related concepts. Furthermore, the results presented in Table 1.1 confirm that the knowledge score did not follow a normal distribution, as indicated by the p-value, $p<0.05$.

Table 1.0. Reliability Statistics.

Statistics	Value
Cronbach's Alpha	0.913
Cronbach's Alpha Based on Standardized Items	0.913
Number of items	20

Table 1.1. Shapiro-Wilk Test for Normality.

Variable	N	Z	P>z
Age	304	7.22	0.000

3.2. Demographic Characteristics of Participants

The survey encompassed a diverse group of 304 participants, each with their own unique demographic characteristics as represented in Table 1.2 below. The median age of the participants was 28, with an interquartile range (IQR) spanning from 24 – 35 years. The gender distribution among participants was 44.4% females and 55.6% males. Regarding education, the majority (76.0%) held a bachelor's degree, while 18.1% had pursued post-tertiary education, and 5.9% had completed high school. In terms of employment, 35.2% were employed, 29.3% were self-employed, and 35.5% were

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unemployed. Marital status varied among participants, with 58.2% identifying as single and 37.2% as married, while smaller percentages represented other marital categories. Ethnically, the participants encompassed a diverse range, including 17.4% Hausa, 9.2% Igbo, and 21.7% Yoruba, as well as individuals from other ethnic backgrounds. Concerning sexual practices, approximately two-thirds (66.1%) of the participants reported having ever engaged in sexual intercourse. Among this group, 51.3% practiced protected sex, 91.8% exclusively engaged in vaginal intercourse, and 8.2% practiced a combination of anal, oral, and vaginal sex.

Table 1.2. Demographic characteristics of the study's participants.

Characteristics	***n* (%)**	***Median* (25–75 *p*)**
Total	304 (100)	
Variables		
Age		28 (24–35)
Sex		
Female	135 (44.4)	
Male	169 (55.6)	
Highest level of Educational		
High School/Secondary Education	18 (5.9)	
Tertiary Education (Bachelor's degree)	231 (76.0)	
Post Tertiary (Master's degree/Doctorate)	55 (18.1)	
Employment Status		
Employed	107 (35.2)	
Self-Employed	89 (29.3)	
Unemployed	108 (35.5)	
Marital Status		
Divorced	1 (0.3)	
Living with Partner	7 (2.3)	
Married	113 (37.2)	
Separated	2 (0.7)	
Single	177 (58.2)	
Widowed	4 (1.3)	
Ethnicity		

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Hausa	53 (17.4)
Igbo	28 (9.2)
Yoruba	66 (21.7)
Other	157 (51.6)
Ever had sexual intercourse	
Yes	195 (66.1)
No	109 (35.9)
Protected Sex	
Yes	100 (51.3)
No	95 (48.7)
Kind of sex mostly engaged in	
Anal, Oral, and Vaginal Sex	16 (8.2)
Vaginal sex only	179 (91.8)

3.3. Awareness of HPV Infection and Vaccine

Table 2.0 below presents data on participants' knowledge of HPV infection and vaccine.

Among the total respondents, 98 individuals (34.8%) stated that they were aware of HPV infection, while 206 participants (67.8%) mentioned that they had no knowledge of HPV infection. In terms of the sources of information about HPV infection, the most mentioned source was hospitals, where participants received information from doctors, nurses, or healthcare providers. This source was relied upon by 48 individuals (15.8%). Public health materials such as brochures, pamphlets, flyers, or posters were cited by 41 participants (13.5%) as their source of information. Additionally, 43 respondents (14.1%) mentioned that they had conducted online research about HPV on the internet, while 35 individuals (11.5%) reported obtaining information from social media platforms like Facebook or Twitter. Family members, friends, or peers were identified as a source of information by 24 participants (7.9%), and a smaller number mentioned traditional media like TV, radio, newspapers, or magazines (9 individuals, 3.0%). The table also explores participants' awareness of the HPV vaccine, with 76 individuals (25.0%) indicating that they had heard of the HPV vaccine, while 228 participants (75.0%) reported no awareness of the vaccine. Regarding sources of information about the HPV vaccine, hospitals were mentioned by 32 individuals (10.6%) as the primary source, where they received information from doctors, nurses, or other healthcare providers. Public health materials, such as brochures, pamphlets, flyers, or posters, were cited by 35 participants (11.6%). Additionally, 19 respondents (6.3%) reported conducting their own online research to gather information about the vaccine. Social media platforms like Facebook, Instagram, or Twitter were mentioned by 21 individuals (6.9%) as a source of vaccine information. Family members, friends, or peers were identified as a source by 22 participants (7.3%), while a small number mentioned

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traditional media (TV, radio, newspapers, or magazines) with only 6 individuals (2.0%). Lastly, participants were asked whether they had received the HPV vaccine. Out of the total respondents, 10 individuals (3.3%) reported that they had taken the vaccine, while 294 participants (96.7%) indicated that they had not received the vaccine.

Table 2.0. Awareness of HPV Infection and Vaccine.

Variable	Yes n (%)	No n(%)
Awareness of HPV infection		
Heard about HPV Infection?	98 (34.8)	206 (67.8)
Sources of information (multiple options)		
Hospitals through doctors or nurses, or healthcare providers	48 (15.8)	256 (84.2)
Public health brochures, pamphlets, flyers or posters	41 (13.5)	263 (86.5)
Self-search on the internet	43 (14.1)	261 (85.9)
Social media through Facebook or Twitter e.t.c	35 (11.5)	269 (88.5)
Family member(s) or friend(s) or peer(s)	24 (7.9)	280 (92.1)
Tv or radio, newspapers or magazine	9 (3.0)	295 (97.0)
HPV Vaccine Information		
Heard of HPV Vaccine?	76 (25.0)	228 (75.0)
Sources of information (multiple options)		
Hospital through Doctors or nurses, or other health care provider(s)	32 (10.6)	272 (89.4)
Public health brochures, pamphlets, flyers, posters, etc	35 (11.6)	269 (88.5)
Self-search on the internet	19 (6.3)	285 (93.7)
Social media through Facebook or Instagram or Twitter, etc	21 (6.9)	283 (93.1)
Family member(s) or Friend(s) or peer or colleague	22 (7.3)	281 (92.7)

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TV or radio, Newspapers or magazines	6 (2.0)	298 (98.0)
Have you taken the Vaccine	10 (3.3)	294 (96.7)

3.4. Distribution of Participants' Responses to HPV infection knowledge questions

Table 3.0 below outlines the responses from participants regarding their level of agreement or disagreement with various statements related to HPV infection knowledge. The majority of participants (54.2%) expressed strong agreement that HPV is a virus, not a bacteria, while 30.0% simply agreed with this statement. A small proportion (8.3%) strongly disagreed with this notion.

Table 3.0. Distribution of Participants' Responses to HPV infection knowledge questions.

Knowledge Statements	Strongly Agree		Agree		Neutral		Disagree		Strongly Disagree	
	n	%	*n*	%	*n*	%	*n*	%	*n*	%
HPV was a virus, not a bacteria	65	54.2	36	30.0	6	5.0	3	2.5	10	8.3
Women cannot contract HPV infection	1	0.8	5	4.2	2	1.7	33	27.5	79	65.8
Men cannot contract HPV infection	3	2.5	9	7.5	10	8.3	37	30.8	61	50.8
In most cases, HPV infection may not cause any symptoms	19	15.8	35	29.2	31	25.8	22	18.3	13	10.8
HPV 16 and 18 Genotypes are High-risk HPV Genotypes	21	17.5	25	20.8	65	54.2	4	3.3	5	4.2
HPV 6, 11, 42 and 61 Genotypes are High-risk HPV Genotypes	11	9.2	22	18.3	77	64.2	9	7.5	1	0.8
Having sex at an early age increases the risk of getting HPV infection	36	30.0	43	35.8	21	17.5	17	14.2	3	2.5
HPV infection usually doesn't need any treatment to clear before it goes	8	6.7	14	11.7	19	15.8	36	30.0	43	35.8
HPV can be contracted through sexual intercourse	53	44.2	51	42.5	6	5.0	1	0.8	9	7.5
HPV-related genital warts are cancerous	17	14.2	45	37.5	34	28.3	14	11.7	10	8.3
There are several types of HPV Genotypes (e.g. 6, 11, 16, 18, 70, 72)	28	23.3	32	26.7	54	45.0	5	4.2	1	0.8
HPV 16 and 18 infections can lead to cervical cancer if untreated for a long time.	27	27.6	44	44.9	23	23.5	2	2.0	2	2.0
HPV infection can be contracted from an infected person through genital skin.	30	25.0	49	40.8	22	18.3	12	10.0	7	5.8

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Some HPV genotype infections can cause genital warts.	31	25.8	57	47.5	25	20.8	5	4.2	2	1.7
HPV infection can cause HIV/AIDS infections	11	9.2	19	15.8	33	27.5	30	25.0	27	22.5
Having multiple sexual partners increases the risk of contracting HPV infection.	44	44.9	41	41.8	5	5.1	3	3.1	5	5.1
HPV infection can be cured with Antibiotics.	7	5.83	34	28.33	40	33.33	15	12.50	3	2.50
The use of condoms reduces the risk of HPV infection.	42	35.00	54	45.00	15	12.50	6	5.00	3	2.50
A person could be HPV infected for several years and not know it.	29	24.17	69	57.50	11	9.17	8	6.67	3	2.50
Most sexually active people will get HPV infection at some point in their lifetime.	17	14.17	31	25.83	38	31.67	25	20.83	9	7.50

Misconceptions emerged regarding HPV infection and gender. Only 0.8% of participants strongly believed that women cannot contract HPV, whereas 65.8% strongly disagreed. Similarly, 2.5% strongly agreed that men cannot contract HPV, while 50.8% strongly disagreed. About 15.8% of participants strongly agreed that HPV infection may not exhibit symptoms in most cases, while 10.8% strongly disagreed, indicating a lack of consensus among respondents. Participants' understanding of high-risk HPV genotypes varied. For example, 17.5% strongly agreed that HPV 16 and 18 genotypes are high-risk, while 4.2% strongly disagreed. In contrast, 9.2% strongly agreed that HPV 6, 11, 42, and 61 genotypes are high-risk, whereas 64.2% strongly disagreed. Misconceptions were also observed regarding the consequences and transmission of HPV infection. For instance, 44.2% of participants strongly believed that HPV can be contracted through sexual intercourse, while 7.5% strongly disagreed. Regarding the misconception that HPV-related genital warts are cancerous, 37.5% expressed strong agreement, while 8.3% strongly disagreed. The table further illustrates varying degrees of agreement with preventive measures. For example, 35.0% of participants strongly agreed that using condoms reduces the risk of HPV infection, while 2.5% strongly disagreed.

3.5. Scored 20-Item Knowledge scale about HPV infection.

Table 4.0 below provides an overview of the participants' knowledge regarding HPV infection. In summary, the median knowledge score was 0, with an interquartile range spanning from 0 to 5. Out of all the respondents, 36 individuals (11.8%) correctly identified HPV as a virus, while 268 participants (88.2%) had this knowledge statement incorrect. Approximately 79 (26.0%) participants correctly recognized that women could contract HPV, whereas 225 individuals (74.0%) believed otherwise. Similarly, 61 respondents (20.1%) acknowledged that men can contract HPV, while 243 participants (79.9%) held the incorrect belief. Only 19 participants (6.3%) correctly acknowledged that HPV infection may not cause symptoms in most cases, while the majority, 285 respondents (93.7%), believed that symptoms are always present. The understanding of high-risk HPV genotypes revealed that 21 participants (6.9%) correctly identified HPV 16 and 18 as high-risk, while 283 individuals (93.1%) had this knowledge statement wrong. Similarly, only 11 participants (3.6%) correctly recognized that HPV genotypes 6, 11, 42, and 61 are not high-risk, while 293 respondents (96.4%) held the incorrect belief.

Table 4.0. Scored 20-Item Knowledge Scale about HPV infection.

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Knowledge Statement	Correct		Wrong	
	N	*%*	*N*	*%*
HPV was a virus, not a bacterium.	36	11.8	268	88.2
Women cannot contract HPV infection.	79	26.0	225	74.0
Men cannot contract HPV infection.	61	20.1	243	79.9
In most cases, HPV infection may not cause any symptoms.	19	6.3	285	93.7
HPV 16 and 18 Genotypes are High-risk HPV Genotypes.	21	6.9	283	93.1
HPV 6, 11, 42 and 61 Genotypes are High-risk HPV Genotypes.	11	3.6	293	96.4
Having sex at an early age increases the risk of getting HPV infection.	36	11.8	268	88.2
HPV infection usually doesn't need any treatment to clear before it goes.	8	2.6	296	97.4
HPV can be contracted through sexual intercourse.	53	17.4	251	82.6
HPV-related genital warts are cancerous.	10	3.3	294	96.7
There are several types of HPV Genotypes (e.g. 6, 11, 16, 18, 70, 72).	28	9.2	276	90.8
HPV 16 and 18 infections can lead to cervical cancer if untreated for a long time.	27	8.9	277	91.1
HPV infection can be contracted from an infected person through genital skin.	30	9.9	274	90.1
Some HPV genotype infections can cause genital warts.	31	10.2	273	89.8
HPV infection can cause HIV/AIDS infections.	27	8.9	277	91.1
Having multiple sexual partners increases the risk of contracting HPV infection.	44	14.5	260	85.5
HPV infection can be cured with Antibiotics.	24	7.9	280	92.1
The use of condoms reduces the risk of HPV infection.	42	13.8	262	86.2
A person could be HPV infected for several years and not know it.	29	9.5	275	90.5
Most sexually active people will get HPV infection at some point in their lifetime.	17	5.6	287	94.4

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The impact of sexual behavior on HPV infection was assessed. Regarding the early age of sexual initiation, 36 individuals (11.8%) recognized the increased risk, while 268 participants (88.2%) believed otherwise. Additionally, 44 respondents (14.5%) correctly identified that having multiple sexual partners increases the risk, while 260 individuals (85.5%) held the incorrect belief. Misconceptions were observed regarding the transmission and consequences of HPV infection. For instance, 53 participants (17.4%) correctly acknowledged that HPV can be contracted through sexual intercourse, while 251 individuals (82.6%) held the incorrect belief. Similarly, 10 respondents (3.3%) correctly recognized that HPV-related genital warts are not cancerous, whereas 294 participants (96.7%) had this knowledge statement wrong. The participants' understanding of HPV infection, including its persistence, treatment, and association with other conditions, varied. For instance, 8 individuals (2.6%) correctly recognized that HPV infection usually doesn't require treatment to clear, while 296 participants (97.4%) held the misconception. Moreover, 27 respondents (8.9%) correctly identified that HPV infection can lead to cervical cancer if left untreated, while 277 individuals (91.1%) had this knowledge statement incorrect. Similarly, 27 participants (8.9%) correctly recognized that HPV infection does not cause HIV/AIDS, whereas 277 respondents (91.1%) held the incorrect belief. The table also assessed participants' knowledge of preventive measures. Among the respondents, 42 individuals (13.8%) correctly identified that the use of condoms reduces the risk of HPV infection, while 262 participants (86.2%) believed otherwise.

3.6. Participants' knowledge scores stratified by participants' characteristics.

Table 5.0 above provides an overview of the median knowledge scores and their interquartile range, categorized by participants' profiles. The overall median score was 0, with an interquartile range spanning from 0 to 5. When stratified by sex, a statistically significant difference in knowledge scores was observed between males and females (p-value = 0.000). Females had a median knowledge score of 0, with scores ranging from 0 to 6, while males had a median knowledge score of 0, with scores ranging from 0 to 4. These results suggest a slight discrepancy in knowledge levels between males and females. Significant disparities in knowledge scores were also found based on the participants' highest level of education (p-value = 0.000). Participants with a high school or secondary education had a median knowledge score of 2.5, with scores ranging from 0 to 6. In contrast, those with tertiary education (bachelor's degree) had a median knowledge score of 5, with scores ranging from 0 to 7. Participants with post-tertiary education (master's degree/Doctorate) had a median knowledge score of 0, with scores ranging from 0 to 4. These findings indicate that education level was associated with variations in knowledge levels, with higher education generally linked to greater knowledge. Ethnicity also showed significant differences in knowledge scores (p-value = 0.001). Participants of Hausa ethnicity had a median knowledge score of 0, with scores ranging from 0 to 2. In contrast, participants of Igbo ethnicity had a median knowledge score of 5, with scores ranging from 0 to 8. Participants of Yoruba ethnicity and other ethnicities had median knowledge scores of 0, with scores ranging from 0 to 5, and 0 to 4, respectively. These results highlight the influence of ethnicity on knowledge levels and reveal variations among different ethnic groups.

Table 5.0. Participants' knowledge scores stratified by their characteristics.

Characteristics	**Knowledge Score** *Median (25–75 p)*	*p-Value*
Sex		
Female	0 (0–6)	0.000
Male	0 (0–4)	
Highest level of Educational		
High School/Secondary Education	2.5 (0-6)	0.000

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Tertiary Education (bachelor's degree)	5 (0-7)	
Post Tertiary (master's degree/Doctorate)	0 (0-4)	
Employment Status		
Employed	0 (0-6)	0.401
Self-Employed	0 (0-5)	
Unemployed	0 (0-5)	
Ever had sexual intercourse		
Yes	0 (0-6)	0.073
No	0 (0-3)	
Protected Sex		
Yes	0 (0-6)	0.461
No	0 (0-6)	
Ethnicity		
Hausa	0 (0-2)	0.001
Igbo	5 (0-8)	
Yoruba	0 (0-5)	
Other	0 (0-4)	

3.7. Multivariate analysis for predicting knowledge score.

Table 6.0 below presents the results of the analysis focusing on the 0.75 quantiles. This quantile represents the upper quartile or the 75th percentile of the distribution. The coefficients, along with their corresponding 95% confidence intervals (CI) and p-values, are reported for different characteristics. Regarding sex, the coefficient for males was -2.5, indicating a negative association with the outcome variable. However, the 95% confidence interval (-5.34, 0.34) includes zero, suggesting that the effect was not statistically significant in the quantile model Q0.75 (p=0.084). Looking at education, individuals with post-tertiary education have a coefficient of 2.5, indicating a positive association. However, the 95% confidence interval (-0.95, 5.95) includes zero, suggesting that the effect was not statistically significant Q0.75 (p=0.154) in the quantile model. Similarly, for individuals with tertiary education, the coefficient was -0.5, suggesting a negative association, but the effect was not statistically significant as indicated by the confidence interval (-4.81, 3.81) and Q0.75 (p = 0.820). Analyzing the ethnic groups, individuals from the Igbo ethnic group show a coefficient of 4, indicating a positive association. The 95% confidence interval (0.20, 7.80) does not include zero, indicating a statistically significant effect Q0.75 (p=0.039). On the other hand, the coefficients for the Yoruba ethnic group 0.5 and other ethnic groups 2.0 suggest positive associations in the quantile model, but their 95% confidence intervals include zero, suggesting no statistically significant effects Q0.75 (p=0.745) and Q0.75 (p=0.232) respectively.

Table 6.0. Multivariate analysis for predicting knowledge score.

Characteristics	Coefficient	95% C.I. Lower Limit	95% C.I. Upper Limit	*p*-Value
Sex				
Male	-2.5	-5.34	0.34	*0.084*
Education				
Post Tertiary	2.5	-0.95	5.95	*0.154*
Tertiary Education	-0.5	-4.81	3.81	*0.82*

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Ethnic				
Igbo	4.0	0.20	7.80	*0.039*
Yoruba	0.5	-2.53	3.53	*0.745*
Other	2.0	-1.29	5.29	*0.232*

4. Discussion

The study had the primary objective of evaluating the knowledge levels of a cohort of 304 participants regarding HPV infection. The survey encompassed a wide range of participants, characterized by diverse demographic backgrounds, thus facilitating a thorough and comprehensive analysis of the study's findings. These results served to illuminate the participants' comprehension of various aspects related to HPV, including its classification as a virus, its modes of transmission, the manifestation of symptoms, identification of high-risk genotypes, recognition of potential consequences, understanding of available treatments, and awareness of preventive measures.

4.1. Normality and Reliability

The reliability of data is a crucial aspect of any research study, as it ensures that the measurements used are consistent and dependable. In the context of this study, a reliability test was conducted to assess the survey's internal consistency, specifically evaluating participants' knowledge about HPV. Cronbach's alpha coefficient, a widely utilized measure of internal consistency to validate the usefulness of the instrument items was employed for this purpose [31]. The obtained Cronbach's alpha coefficient of 0.913 indicates that the survey used in this study exhibits excellent internal consistency. The high value of Cronbach's alpha suggests that the items included in the survey are strongly correlated and collectively form a reliable measure of participants' knowledge about HPV. In other words, the survey items consistently measure the same underlying construct of HPV knowledge. A Cronbach's alpha value above 0.9 is considered exceptionally strong [30], indicating that the survey used in this study is highly reliable in assessing participants' knowledge levels. This high level of internal consistency enhances the confidence in the survey's ability to capture accurate and consistent information regarding participants' understanding of HPV-related concepts. The Shapiro-Wilk analysis was conducted to assess the normality of the Age variable, which was a key component of the study. The aim was to understand the distribution of ages among the participants and determine whether it followed a normal distribution. The Shapiro-Wilk test is commonly used to evaluate the normality assumption of a dataset [23]. In this analysis, the test statistic (W) was calculated to be 7.22, and the corresponding p-value was determined to be 0.000, indicating a significant departure from normality [31].

Given that the Age variable did not follow a normal distribution, it became necessary to consider alternative measures to describe the central tendency of the data. The median, as a robust statistic, was found to be appropriate in this scenario. Unlike the mean, which is sensitive to extreme values and the shape of the distribution [32], the median provides a more resistant measure of central tendency that is less affected by outliers or non-normality. By using the median, we were able to summarize the distribution of ages in a way that was not influenced by the non-normality observed in the data [32]. The median age was calculated to be 28, with a concentration between 24 and 35. This information accurately represents the middle value of the age distribution and provides insight into the central tendency of the dataset, regardless of its departure from normality.

4.2. Demographic Characteristics

The demographic characteristics of the participants revealed interesting insights. Most participants were between the ages of 24 and 35, reflecting a relatively young population. Gender distribution was almost equal, with slightly more males than females. The educational background of the participants showed a higher proportion with a bachelor's degree, followed by post-tertiary qualifications and high school completion. Employment status varied, with a significant portion

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being unemployed or self-employed. Marital status also exhibited variation, with a higher percentage of participants being single. Ethnicity demonstrated a diverse composition, with a significant percentage categorized as "Other" and notable representations from Hausa, Igbo, and Yoruba ethnic groups. In terms of sexual practices, the majority practiced protected vaginal sex, while a smaller percentage engaged in anal, oral, and vaginal sex.

4.3. Awareness of HPV Infection and Vaccine

The majority of the respondents (67.8%) reported not having heard about HPV infection. In 2021, a similar proportion was reported in a previous study conducted by a researcher in the city of Kosovo, where they also found that the majority of the participant (66.4%) also have not heard about HPV infection [33]. Another study which was also carried out in 2021 reported a low percentage of prior knowledge of HPV infection and vaccine [34], this indicates a significant gap in awareness about HPV infection . Sources of information for HPV infection such as hospitals through doctors, nurses, or healthcare providers were the most (15.8%) mentioned source of information for HPV awareness. Public health brochures, pamphlets, flyers, or posters (13.5%), self-search on the internet (14.1%), and social media platforms like Facebook or Twitter (11.5%) were also cited as sources. Family members, friends, or peers (8.3%) and traditional media channels such as TV, radio, newspapers, or magazines (2.9%) were mentioned to a lesser extent, the most common source of information reported among the participant was also in line with one of the three most reliable sources of HPV infection reported among youths in 2022, in the study they found that the three most reported sources for learning and staying informed on HPV infection and vaccine were school health programmes, healthcare providers, and participants' social networks [35].

In terms of HPV vaccine awareness, only 25.4% of participants reported they are aware of its existence. Hospitals through doctors, nurses, or other healthcare providers were the most mentioned source of information (10.9%). Public health brochures, pamphlets, flyers, or posters (12.1%), self-search on the internet (6.4%), social media platforms (7.0%), family members, friends, or peers (7.9%), and traditional media channels (3.0%) were also identified as sources of vaccine information. Some researchers also reported a similar percentage of HPV vaccine awareness in their study, where they reported that the majority of the study participant (≥ 70.1%) does not have any prior knowledge concerning the HPV vaccine [33], [35]. In 2023, a systematic review and meta-analysis conducted in Ethiopia also found that a low percentage of study participants took the vaccine, although they reported a percentage that was higher than what was found in this study, nevertheless, it was still below half of the participants, and this might have been as a result of more sensitization on HPV vaccine in this area [36]. These findings highlight the need for improved education and awareness campaigns to bridge the gaps in knowledge about HPV infection and the HPV vaccine. Healthcare professionals play a crucial role in disseminating accurate information and addressing individual concerns, as evident from the reliance on hospitals and healthcare providers as primary sources of information. Public health initiatives should also leverage other sources such as public health materials, online resources, social media platforms, interpersonal networks, and traditional media outlets to reach a broader audience and ensure accurate information reaches the public.

To increase awareness and knowledge about HPV infection, efforts should focus on providing reliable information through various channels, addressing misconceptions, and promoting preventive measures. Similarly, for the HPV vaccine, enhanced efforts are needed to educate the public about its benefits and importance. Collaboration between healthcare providers, public health campaigns, and educational institutions is vital to disseminate accurate information, debunk myths, and address concerns surrounding the vaccine.

4.4. Knowledge of HPV Infection

The knowledge scores of the participants regarding HPV infection were assessed through a series of knowledge statements (20 items). The findings indicated a relatively low level of accurate knowledge among the participants. Only a small percentage correctly identified HPV as a virus, while the majority held this knowledge statement incorrectly. Misconceptions were observed

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regarding the ability of both women and men to contract HPV, with a significant percentage believing that women cannot contract the virus. Participants also displayed a lack of awareness regarding symptom manifestation, as the majority believed that symptoms are always present in HPV infection. Furthermore, there were misunderstandings regarding high-risk HPV genotypes, transmission, consequences, treatment, and the association of HPV with other conditions. This poor knowledge of HPV was also consistent with the study conducted in Lagos, Nigeria – in 2010, it was discovered that a high percentage of their study subjects also had poor knowledge of HPV and cervical cancer [37]. Correspondingly, the result in this this study is in line with a study that was conducted in Turkey, and they found that the knowledge level of HPV of their study participant was also low [38]. These findings emphasize the need for targeted education and awareness campaigns to improve knowledge and dispel misconceptions related to HPV infection.

4.5. Factors Associated with HPV Knowledge

The analysis of knowledge scores stratified by demographic characteristics provided valuable insights into the factors influencing knowledge levels. Sex was found to have a significant association with knowledge scores, with females exhibiting slightly higher median knowledge scores compared to males, which was also the same case in the study carried out in previous studies [38]; thus, they found the average knowledge score of females to be much higher than that of the male. This suggests that females may have a better understanding of HPV infection compared to males, highlighting the importance of gender-specific educational interventions.

Education level also demonstrated a significant association with knowledge scores, with participants holding a higher degree of education showing higher median knowledge scores, this was expected as those that are more educated are expected to be well-informed in matters concerning health due to their exposure to information. According to a study conducted in China by Junyong and others, a significant association have been discovered between levels of education and the knowledge of HPV in their study. This finding suggests that higher education contributes to a better understanding of HPV infection, underscoring the need for targeted educational initiatives at different educational levels [39]. Ethnicity was another significant factor influencing knowledge levels, with participants from the Igbo ethnic group demonstrating the highest median knowledge scores. The knowledge and attitude of people have also been found to be associated with ethnicity by various studies in the past. Furthermore, other epidemiological studies found ethnicity to be significantly associated with the knowledge of HPV [40], this was also consistent with the findings in the USA in 2009 where they found that people of different race have a significantly different level of knowledge regarding the HPV [41]. These variations among different ethnic groups highlight the importance of culturally sensitive educational programs to address specific knowledge gaps and misconceptions prevalent within each ethnic group.

5. Conclusion

In this study, we successfully adapted and validated a 20-item knowledge scale, demonstrating its consistency and reliability. However, the findings indicated a low level of awareness and knowledge about HPV among the participants. Furthermore, ethnicity was found to be significantly associated with knowledge of HPV. These results highlight the need for targeted interventions to improve awareness and knowledge about HPV, particularly among specific ethnic groups.

6. Recommendations

This finding suggests the implementation of targeted educational interventions to improve knowledge about HPV infection and the vaccine. In achieving this collaboration between healthcare providers, public health campaigns, and educational institutions will be instrumental in driving the efforts towards the improvement of awareness and knowledge about HPV in this context. Similarly, because this study identified ethnicity as an associated factor of HPV infection, we suggest culturally sensitive programs to address specific knowledge gaps within different ethnic groups. Overall,

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conducting regular monitoring and evaluation to assess the impact of interventions and refine future initiatives may help in addressing the knowledge gap and promote preventive measures, and reduce the burden of cervical cancer in this study population.

7. Limitations

While this study yielded significant findings, it is important to acknowledge its limitations. These limitations include the relatively small sample size and the focus on a specific state in Nigeria, which may restrict the generalizability of the results. Additionally, relying on self-reported data may introduce biases and the study did not delve into the underlying reasons for the observed lack of knowledge or awareness. Despite these limitations, the findings still hold value and contribute to our understanding of the topic.

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Institutional Review Board Statement: The ethical approval for this study was obtained from the Niger State Ministry of Health Ethical Review Committee (NSMOH ERC) (protocol number: ERC PIN/2022/08/17 and approval number: ERC PAN/2022/08/17) in Minna, Niger state, Nigeria. Participants provided consent by clicking the "accept to participate" button after reading the informed consent on the first page of the online survey. In order to assure the privacy and confidentiality of the participants, all participants voluntarily participated in this study and no identifying information was captured. Since data was collected online, the study has no/minimal risk to the health of the participants, their environment, and their relatives.

Informed Consent Statement: Informed consent was obtained from all subjects involved in the study.

Data Availability Statement: The HPV and CC data collected during this project and processed for this research publication as part of this study were submitted to from the Niger State Ministry of Health Ethical Review Committee (NSMOH ERC) and are available upon request.

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Conflicts of Interest: The authors declare no conflict of interest.

Appendix A

This section (see attached document) contains the survey questions included in the Human papillomavirus (HPV) and Cervical Cancer (CC) Risk Assessment (HCRA) Tool used for data collection and awareness creation of this research.

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