

Prevalence and Associated Risk Factors of Cervical Human Papillomavirus (HPV) Infection among Women in Northcentral Nigeria: A cross-sectional study

Zakka AW¹, ²[ID](#), Ayolabi CI¹[ID](#), Olusola BA³[ID](#), Egwuatu TO¹[ID](#)

¹Department of Microbiology, University of Lagos, Lagos State, Nigeria

²Department of Microbiology, Kaduna State University, Kaduna, Kaduna State, Nigeria

³Department of Virology, College of Medicine, University of Ibadan, Ibadan, Oyo State, Nigeria

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Abstract

Objective: This study aimed to determine the prevalence of cervical HPV infections and its associated socio-demographic risk factors among women attending selected hospitals in some parts of Northcentral Nigeria.

Methods: A cross-sectional study was conducted among 250 women attending the cervical screening units of three tertiary health facilities. The screening for some participants was based on referral following a risk assessment by healthcare staff. Information about the socio-demographic/risk factors was obtained through structured questionnaires, while HPV DNA was detected from the cervical swab samples collected using Nested PCR. Socio-economic characteristics and factors were analyzed using frequency and percentages while categorical variables were analyzed using chi-square. $P < 0.05$ was statistically significant.

Results: The prevalence of HPV infection in this study was 35.6%. Women who participated were between the ages of 20 and 70. The results obtained showed a high prevalence of HPV among women within the age range of 30 – 39 years (17.6%). Demographic data and risk factors such as age range 30 – 39 years ($p=0.001$; $r=0.56$), coital age of 15 - 19 years ($p=0.004$; $r= 0.62$), use of contraceptives ($p=0.002$; $r=0.54$), history of STI ($p=0.035$; $r= 0.47$), age at first pregnancy ($p= 0.002$; $r= 0.53$), pre-menopausal age ($p=0.019$, $r= 0.51$) and multiparity ($p=0.033$; $r=0.49$) were found to have a significant association with HPV infection.

Conclusion: The HPV prevalence observed shows increased virus transmission in Northcentral Nigeria. Hence, a need to employ early diagnoses, treatment, and vaccination to avert an upsurge in cervical cancer cases in Northcentral Nigeria.

Keywords: Human papillomavirus; prevalence; risk factors; type-specific primers; Northcentral Nigeria

Plain English Summary

Worldwide, Sub-Saharan Africa has the highest prevalence of Human Papillomavirus (HPV) infection with Nigeria having the highest prevalence in Sub-Saharan Africa. It is a leading cause of cancer deaths in Nigerian women. Infection of HPV leads to the development of cervical cancer, particularly the high-risk types. There is a need to combat cervical cancer through HPV testing using molecular methods such as the polymerase chain reaction (PCR) (using type-specific primers) that permit exact typing of the HPV infections and are sensitive to detecting high-risk HPV genotypes including multiple infections rather than the conventional cytology. This method of HPV detection is lacking in this part of the world thus contributing to the unknown circulation of several high-risk HPV types in Nigeria. Hence, this study aims to determine the prevalence of cervical HPV infections using type-specific primers and its associated risk factors among women in Northcentral Nigeria. The prevalence of HPV infection was

Correspondence:

Zakka, Abigail W

Department of Microbiology,

University of Lagos,

Lagos State, Nigeria

+2348036345386, diyva.abigail@yahoo.com

found to be high while multiparity, the use of contraceptives, history of women with sexually transmitted infections (STI), pre-menopausal age, age at coitarche and age at first pregnancy were the risk factors associated with the infection. This high prevalence points to increased transmission of HPV infection amongst sexually active women in Northcentral Nigeria. There is a need to fight cervical cancer through HPV testing using methods that allow particular typing of the HPV infections and are sensitive to detecting high-risk HPV genotypes as an alternative to cytology in addition to the introduction of multivalent HPV vaccines.

Background

Human Papilloma Virus (HPV) is an icosahedral, non-envelope, double-stranded DNA virus measuring about 8 kilobases in length and 55 nanometers in diameter belonging to the Papillomaviridae family and is capable of infecting humans (1). HPV like other papillomaviruses creates productive infections at the stratified epithelium of the skin or mucous membrane which leads to the progression of cancer (1). Approximately 40 HPV species have been known to be connected with the genital mucosal, which are characterized according to their carcinogenic potential and are mostly spread through sexual intercourse and not easily noticed at the initial point of infection (2). Globally, cervical cancer is the second most common cancer in women and is the main reason for cancer-related deaths among women (3, 4). Nearly 500,000 incidences are identified yearly with roughly 85% of deaths occurring in developing countries of the world (5). Globally, the incidence and mortality rate of cervical cancer is 14, 550 and 9, 659 per 100, 000 respectively (6). Cervical cancer is the most common cancer next to breast cancer in Nigeria (7) and a significant cause of cancer-related deaths in Nigerian women with over 9000 deaths documented every year (8). High-risk HPV types e.g., HPV-16, and -18 are the strains involved in the onset of cancers (9).

The prevalence of HPV in different regions of the world varies. An estimated HPV prevalence of 11.7% was reported globally. Latin America and the Caribbean have a prevalence of 16.1%, the second-highest prevalence for women next to Sub-Saharan Africa (24%) (10) which is among the highest in the world and a pooled prevalence of 32.0% in Nigeria (11). Nigeria has the highest HPV prevalence in Sub-Saharan Africa (12). The Republic of Congo has a reported prevalence of 23.5%, Burkina Faso has 25.4%, Benin Republic has 33.2% Rwanda has 34%, respectively (13, 14, 15, 16).

Diverse prevalence has also been reported by studies across some states in Nigeria which include studies in Kano State (17), Nasarawa (18), Osun (3), Lagos (19), Adamawa (20), Rivers (21) and Abuja (22) (76.0%, 32.0%, 21.6%, 19.6%, 18.6%, 10.0%, and 37.0%, respectively). Reported prevalence in North Central Nigeria includes 57.5% in Benue State

(23), 4.3% in Niger State (24), 3.1% in Kogi State (25) and 13.2% in Plateau State (26). The methods used to detect HPV in most studies contributed to the differences in prevalence observed. Signal amplification methods (hybridization techniques in the liquid phase) and target amplification methods (the techniques of gene amplification or PCR) are the two main types of HPV detection methods (27). Many clinical and epidemiological studies make wide use of PCR for HPV typing because of its high sensitivity for detecting HPV DNA. The use of more than one primer set has been shown to offer better results and sensitivity for detecting multiple HPV infections. PCR-based HPV detection methods have been used for detailed clinical, epidemiological, and natural history studies to elucidate the importance of the different HPV genotypes. There is a need to combat cervical cancer through HPV testing using methods (such as the nested PCR with type-specific primers) that permit exact typing of the HPV infections and are sensitive to detecting high-risk HPV genotypes including multiple infections rather than the conventional cytology. This method of HPV detection is lacking in this part of the world (28) thus contributing to the unknown circulation of several high-risk HPV types and hence the discrepancy in the HPV prevalence in Nigeria.

The moderately high prevalence of cervical cancer in Nigeria can be reduced through screening with new methods such as the use of type-specific primers and the suggestion of new algorithms for diagnostic and therapeutic decisions (29). Some risk factors associated with HPV infection are level of education, age at sexual debut, parity, number of lifetime sexual partners, age at first pregnancy, and history of other malignancies (30). Worldwide, Early onset of sexual activity (≤ 15 age), multiparity and sexual promiscuity have been recognized as some of the significant risk factors for HPV infection (7). In Africa, several studies have reported that earlier sexual debut is a risk factor for HPV infection, although the reason for this relationship is still unclear (31). In Nigeria, Risk factors such as level of education, age at sexual debut, parity, number of lifetime sexual partners, age at first pregnancy and history of other malignancies were found to have a statistically significant association with HPV infection (19).

Hence, this study aims to determine the prevalence of cervical HPV infections using type-specific primers and its associated risk factors among women in Northcentral Nigeria.

Methods

The Study Area

The hospitals (Jos University Teaching Hospital, Plateau State, Federal Medical Centre Keffi, Nasarawa State and National Hospital Abuja) are tertiary health institutions owned by the Federal government and they offer speciality care for cervical cancer screening such as Papanicolaou (Pap) tests and colposcopy. The hospitals serve as referral centres for other neighbouring hospitals owned by the government or private sectors. Abuja is the Federal Capital of Nigeria and it is located in the central part of the country between latitude 9.072264 and longitude 7.491302 with GPS coordinates of 9° 4' 20.1504" N and 7° 29' 28.6872". The National Hospital Abuja (NHA) is to serve as an apex Referral Hospital of Medical Care in the West African sub-region for the specialized care of patients; curative and promotive health, research and the implementation of a holistic medical education programme for sustainable national and regional development. It has an estimated patient attendance of three per week.

Federal Medical Centre (FMC) Keffi is located in Keffi which is approximately 68km from Abuja, the Federal Capital Territory and 128km from Lafia, the capital of Nasarawa state. It is located between latitude 8.85 °N of the equator and longitude 7.87 °E and situated at an altitude of 850m above sea level. The hospital also serves as an apex Referral Hospital of Medical Care in Nigeria. It has an estimated patient attendance of two per week.

Jos University Teaching Hospital (JUTH) is located in the central part of Jos. Jos is the capital of Plateau State. Plateau State lies between latitude 7 and 11 North and longitude 70 and 250. The capital city of Jos is a pear-shaped upland which stretches for approximately 140 km from North to South and 80km from East to West, covering an area of about 8,600 km². This region has a height of 1200m above the sea. It is one of the teaching hospitals situated in the North-Central zone of Nigeria. It serves as a referral Centre for Plateau State and neighbouring states such as Bauchi, Benue, Kogi, Nasarawa, Adamawa, Taraba and part of Kaduna. It has an estimated patient attendance of 6 per week.

Study Design

The study is a hospital-based cross-sectional study.

Sample Size Determination

The sample size for this study was determined by using a statistical formula (32) at a 95% confidence level and a reported 18.6% prevalence of human papillomavirus infection among women in the South-western part of Nigeria (7).

$$N = \frac{Z^2pq}{d^2}$$

Where,

N = Sample Size,

Z = Standard normal distribution at 95% confidence interval = 1.96,

P= Prevalence rate of Human papillomavirus infection from previous studies = 18.6% (7).

q= 1-p,

d= Allowable error (0.05)

Thus,

$$N = \frac{(1.96)^2 \times 0.186 \times (1-0.186)}{(0.05)^2}$$

$$= \frac{3.84 \times 0.186 \times 0.814}{0.0025}$$

$$= 0.581/0.0025$$

$$= 232.5$$

$$10\% \text{ non-response} = 255.7 \approx 256$$

Study Population

A total of 259 participants were recruited into the study out of which only nine participants did not give their written informed consent. Using the multistage sampling technique, a total of 250 consenting women between ages 20 and 70 years with or without cytological anomalies were registered in the study during their routine Pap smear (cervical cancer screening) at the cervical screening units of the hospitals between December 2020 and November 2021. Pregnant women, women who have undergone a hysterectomy, women with existing cervical cancer findings or any woman who did not consent were excluded from the study.

Data Collection

Interviewer-administered questionnaires were used to collect data on the socio-demographic/risk factors of the participants and were kept confidential. Research assistants were employed in each of the study sites to help in data collection.

Sampling Techniques

- i. Using a simple random method, 3 states from the North Central were selected
- ii. Another simple random method to pick a hospital per state
- iii. All the patients who visited the selected hospitals between December 2020 to November 2021 were selected.

Sample Collection/Analysis

A speculum was inserted into the vagina to expose the cervix and a cervical brush was used to collect the samples of exfoliated cervical cells from the cervix of the participants. The cytobrush, containing the exfoliated cells was placed into a labelled screw-capped vial containing 10ml liquid-based cytological processing/ preservative reagent and was transported to the laboratory on ice packs. It was vortexed for 60 sec after which the cervical cell suspension was transferred into cryovials and stored at -80°C until analyzed.

A commercially available DNA extraction kit (JENA Bioscience, Jena, Germany) was used to extract the genomic DNA from each sample according to the manufacturer's instructions. The consensus region of HPV DNA was amplified by nested PCR using primers targeting the E6 and E7 gene region [one forward primer (GP-E6-3F) and two reverse primers (GP-E7-5B and GP-E7-6B)] as described in a study conducted by (33) for the nested amplification. The amplified DNA products were visualized on 2% agarose gel containing ethidium bromide in 0.5x Tris-borate buffer (pH 8.0) and visualized using a blue light transilluminator (Clever Scientific, UK). The size of the PCR products

that were generated with GP-E6/E7 consensus primers was 630bp while the length of the products amplified with type-specific primer pairs ranged from 151bp to 457bp.

Statistical Analysis

Descriptive and inferential statistical analysis of the data was done using Statistical Package for the Social Sciences version 21 (SPSS Inc., Illinois, USA). Chi-square was used to measure the association between the variables while logistic regression was performed to ascertain the degree of relatedness of the variables. The analyzed data were presented in figures and tables using frequencies and simple percentages $P < 0.05$ was statistically significant.

Results

Table 1 shows the frequency distribution of the socio-demographic characteristics of the participants. In total, 250 cervical swab samples were collected. The age range of the participants was between 20 and 70 years with a mean age range of 44.5 ± 11.9 years. Most of the participants, 80 (32.0%) were within the age group 40 - 49 years, were married (60.4%), had attained a tertiary education level (51.6%) and were housewives (50.4%) (Table 1).

Table 1: Frequency Distribution of the Socio-demographic Characteristics of the Participants

Variables	Frequency	Percentage
Age (Years)		
< 20	0	0
20 – 29	34	13.6
30 – 39	66	26.4
40 – 49	80	32
50 – 59	38	15.2
60 – 69	30	12
≥ 70	2	0.8
Marital Status		
Single	20	8
Married	151	60.4
Divorced	35	14
Widowed	44	17.6
Education Status		
Primary	40	16
Secondary	66	26.4
Tertiary	129	51.6
None	15	6
Employment Status		
House Wife	126	50.4
Unskilled	56	22.4
Skilled/Professional	61	24.4
Others	7	2.8
Total	250	100

Table 2 shows the frequency distribution of the risk-factor characteristics of the participants. Most of the participants, 175 (70.0%) had a parity of 3 and above, 83 (33.2%) made use of

IUCD as a contraceptive, 136 (54.4%) had their first coitarche between ages 15 and 19 years while 96 (38.4%) had their first pregnancy at age 20 - 24 years (Table 2).

Table 2: Frequency Distribution of the Risk Factor Characteristics of the Participants

Variables	Frequency	Percentage
Parity		
0	37	14.8
1 - 2,	38	15.2
≥ 3	175	70
Life Time Sexual Partners		
0	0	0
1	77	30.8
2 - 3,	97	38.8
≥ 3	76	30.4
Spouse With Multiple Sexual Partners		
Yes	159	63.6
No	71	28.4
N/A (Singles)	20	8
Use of Contraceptive		
Hormonal drugs	40	16
Condom	41	16.4
IUCD	83	33.2
None	86	34.4
Cigarette Intake		
Yes	3	1.2
No	247	98.8
Alcohol Intake		
Yes	0	18
No	205	82
History of Sexually Transmitted Infections		
HIV	56	22.4
Hepatitis	26	10.4
Others	2	0.8
None	166	66.4
Menopause		
Yes	42	16.8
No	208	83.2
Age At First Coitarche		
< 10	0	0
10 -14,	7	2.8
15 -19	136	54.4
≥ 20	107	42.8
Age At Menarche		
< 10	3	1.2
10 - 14,	156	62.4
> 14	91	36.4
Age At First Pregnancy		
< 20	25	10
20 – 24	96	38.4
≥ 25	92	36.8
N/A	37	14.8
Family History of Cervical Cancer		
Yes	10	4
No	240	96
Total	250	100

Key: N/A (Not applicable) means never been pregnant

Table 3 shows the prevalence of HPV infection in this study. Out of the 250 cervical swab samples analyzed, 89 samples were positive for

HPV DNA giving an overall prevalence of 35.6% (Table 3).

Table 3: Prevalence of HPV infection

Variables	No	Percentage
HPV DNA Positive	89	35.6
HPV DNA Negative	161	64.4
Total	250	

Table 4 shows the prevalence of HPV Infection by the socio-demographic/ risk factors of the participants. The prevalence of HPV infection by age showed that the age group 30 - 39 years had the highest prevalence (17.6%) with a significant statistical relationship and a moderately high correlation ($p=0.001$; $r= 0.56$). Other significant risk factors identified in this study are multiparity (≥ 3 births) ($p=0.033$; $r=$

0.49), the use of contraceptives ($p=0.002$; $r= 0.54$), history of women with STI ($p=0.035$; $r= 0.47$), pre-menopausal age ($p=0.019$; $r= 0.51$), age at coitarche ($p=0.004$; $r= 0.62$) and age at first pregnancy ($p=0.002$; $r= 0.53$). The prevalence of HPV infection by the socio-demographic/risk factors of the participants is shown in Table 4.

Table 4: Prevalence of HPV Infection by Socio-demographic/ Risk Factors of the Participants

Variables	No. Examined	No. Positive	Prevalence (%)	P	R
Age (Year)					
< 20	0	0	0		
20 – 29	34	23	9.2		
30 – 39	66	44	17.6		
40 – 49	80	15	6	0.001	0.56
50 – 59	38	5	2		
60 – 69	30	2	0.8		
≥ 70	2	0	0		
Marital Status					
Single	20	10	4		
Married	151	50	20	0.182	0.07
Divorced	35	19	7.6		
Widowed	44	10	4		
Educational Status					
Primary	40	20	8		
Secondary	66	19	7.6	0.242	0.32
Tertiary	129	41	16.4		
None	15	9	3.6		
Employment Status					
Housewife	126	43	17.2		
Unskilled	56	23	9.2	0.904	0.17
Skilled/Professional	61	20	8		
Others	7	3	1.2		
Parity					
0	37	4	1.6		
1 - 2,	38	13	5.2	0.033	0.49
≥ 3	175	72	28.8		
Lifetime sexual partner					
0	0	0	0		
1	77	19	7.6	0.258	0.31
2 - 3,	97	35	14		
≥ 3	76	35	14		
Spouse with multiple sexual partners					
Yes	159	60	24		
No	71	19	7.6	0.341	0.26
N/A (Singles)	20	10	4		
Use of contraceptive					
Hormonal drugs	40	28	11.2		
Condom	41	20	8	0.002	0.54
IUCD	83	24	9.6		
None	86	17	6.8		
Cigarette Intake					
Yes	3	2	0.8	0.482	0.23
No	247	87	34.8		
Alcohol Intake					
Yes	45	16	6.4	0.996	0.25
No	205	73	29.2		
History of Sexually Transmitted infection					
HIV	56	34	13.6		
Hepatitis	26	7	2.8	0.035	0.47
Others	2	1	0.4		
None	166	47	18.8		
Menopause					

Yes	42	6	2.4	0.019	0.51
No	208	83	33.2		
Age at First Coitarche					
< 10	0	0	0		
10 -14,	7	3	1.2		
15 -19	136	67	26.8	0.004	0.62
≥ 20	107	19	7.6		
Age at Menarche					
< 9	3	1	0.4		
10 - 14,	156	62	24.8	0.467	0.25
> 15	91	26	10.4		
Age at First Pregnancy					
< 20	25	13	5.2		
20 – 24	96	51	20.4		
≥ 25	92	20	8	0.002	0.53
N/A	37	5	2		
Family History of Cervical Cancer					
Yes	10	6	2.4	0.295	0.23
No	240	83	33.2		
Total	250	89			

Key: N/A (Not applicable) means never been pregnant

Discussion

This study reported an HPV prevalence of 35.6% which is high compared to the estimated global HPV prevalence of 11.7%, a prevalence of 24.0% in Sub-Saharan Africa (10) and a pooled prevalence of 32.0% in Nigeria (11). This high prevalence agrees with the finding of a study (12) that reported that Nigeria has the highest HPV prevalence in Sub-Saharan Africa. This high rate shows an incessant transmission of the infection and hence the importance of implementation of measures for the control of the spread of the virus and its resultant consequences in Nigeria. The 35.6% prevalence obtained in this study is also one of the highest reported from North Central Nigeria. It is comparable with the result of the study conducted in Abuja Nigeria which reported a 37.0% prevalence (22). Lower prevalence is also reported in other parts of the country which includes; 21.6% in Ile-Ife (3), 19.6% in Lagos (19), 18.6% in Ibadan (7), 18.6% in Yola (20), and 10.0% in Port Harcourt (21). However, some Nigerian studies (34) in Lagos, (35) in Kaduna and (36) reported 81.82%, 42.7%, and 41.5% prevalence respectively which is higher than the prevalence reported in this study. The disparity in the reported HPV prevalence rates may be explained by several factors such as exposure to different risk factors like early marriage, early pregnancy, high parity, etc. Various socio-cultural and geographical differences such as polygamy which is a common practice in Africa could also be attributed to the difference in prevalence. The sensitivity of the assay used in isolating HPV could also be a possible reason for the disparity as some studies make use of HPV antigen ELISA kit while others make use of PCR.

A peak of HPV positivity was shown in the age pattern of women within the age range of 30 - 39 years (17.6%). Likewise, a study reported a high HPV infection rate among women within the age range of 35 - 44 years (3). Since it is presumed that cervical cancer is more common in women older than 35 years, this suggests that HPV infection arises at a younger age and then slowly perseveres over some time (37). The high-risk group for cervical cancer is middle-aged women who remain persistent carriers of HPV infection (37). There was a statistically significant difference and a moderately high correlation between HPV infection and the different age ranges ($p = 0.001$; $r = 0.56$)

In this study, HPV infection and parity were significantly associated though the correlation is weak which is in support of the previous findings of study (3) which observed that women with 3 or more births had about two times higher risk of human papillomavirus infection. Similarly, studies conducted by (21) also reported that about 83.7% of women with high-risk HPV are women with high parity (having three or more pregnancies). In addition, studies conducted by (38) also postulated that women who have had more children had a two-fold danger of HPV infection. This suggests that the danger of being infected with the virus as per the number of times a woman has given birth doubles owing to the incidence of a cervical disturbance at the time of delivery. Several reasons such as hormonal changes in pregnancy which result in reduced immunity and the exposure of the ectocervix during recurrent childbirth leading to the easy attachment of the human papillomavirus are some of the reasons that have been put forward to explain the preponderance of positivity among women with more than 3 childbirths (21). In addition, damage

to the cervical epithelium during childbirth and easy accessibility of the virus to be incorporated into the cellular matrix of the cervix is another possible reason (21). However, the findings of studies (7) and (39) found no association between HPV infection and parity.

HPV infection was also found to be significantly related to age at coitarche with a strong correlation. It was higher among the participants who had their first sexual intercourse (coitarche) between the ages of 15 and 19 years (26.8%) compared to those who had their first sexual intercourse after the age of 20 years (7.6%). This could be the reason that earlier intercourse exposes young adults to other risky sexual behaviours such as greater numbers of lifetime sexual partners and coexisting partnerships. In addition, some studies reported that early age at first sexual intercourse (coitarche) may be considered an indicator of early age at first exposure to HPV and other STIs (40, 41). Similarly, among the participants, a significant association between HPV infection and a history of STI was shown while the correlation is weak. Although a majority of the participants (18.8%) did not have STI, however, the rate of HPV infection was higher among those with HIV (13.6%) than any other type of STI. This could be credited to the fact that HIV is known to weaken the immune system of an individual hence, the proliferation of persistent HPV infection.

It has been established in our study that the use of contraceptives was a significant risk factor for HPV infection with a moderately high correlation as HPV prevalence was higher in subjects who use contraceptives than those who did not use any contraceptive. Although those who use hormonal drugs had the highest prevalence 11.2% compared to those who use intrauterine devices like IUCD (9.6%) and condoms (8.0%). This result is comparable to the findings of a study carried out by (42) which also recorded a significant association between HPV infection and the use of birth control. Some studies conducted in Lagos and Brazil also reported the use of oral contraceptive pills (12, 43) while (7) reported condoms as a significant risk factor for HPV infection.

The relationship between HPV infection and age at first pregnancy is significant in this study with a moderately high correlation. The highest prevalence was found among participants whose first pregnancy was between ages 20 and 24 years (20.4%). The reports of study (44) from a survey conducted in eight developing countries established that both age at first coitarche and age at first pregnancy are risk factors for cervical cancer which are caused by persistent HPV infection regardless of other

known risk factors for cervical cancer. There is a possible added increase in risk when the early event of first sexual intercourse is shortly followed by pregnancy.

Pre-menopausal age is also a significant risk factor associated with HPV infection in this study although the correlation is weak. Contrary to this, a study reported that women are at increased risk of low squamous cell epithelial lesions (LSIL) and high squamous cell epithelial lesions (HSIL) if they have an HPV infection or are in menopause (45). The study explained that menopause may be related to the collective effect of the perseverance or the reactivation of HPV infection with weakness of the local immune response at menopause.

Conclusion

In conclusion, this study reports a high prevalence of HPV infection (35.6%) pointing to increased transmission of HPV infection amongst sexually active women in Northcentral Nigeria. Some risk factors such as early coitarche, use of contraceptives, presence of STI, early pregnancy, pre-menopausal age, and high parity were identified in this study. There is a need to combat cervical cancer through HPV testing using methods that are sensitive to detecting high-risk types rather than conventional cytology for the early detection of cervical cancer in addition to the introduction of multivalent HPV vaccines which will be more effective for infection control in Nigeria.

List of Abbreviations

DNA:	Deoxyribonucleic acid
FMC:	Federal Medical Centre
HPV:	Human Papillomavirus
HSIL:	High-grade squamous cells intraepithelial lesions
IUCD:	Intra-uterine contraceptive device
JUTH:	Jos University Teaching Hospital
LSIL:	Low-grade squamous cells intraepithelial lesions
NHA:	National Hospital Abuja
PCR:	Polymerase chain reaction
SPSS:	Statistical package for social sciences

Ethics approval and consent to participate

Written informed consent was obtained from the study group before the participants were enrolled. Ethical approval was obtained from the human research and ethics committee of the health institutions used for this study (JUTH/DCS/ADM/127/XXVIII/1343), (FMC/KF/HREC/244/18) and (NHA/ADMIN/236/V.VII). In addition, the ethical principles of the Declaration of Helsinki were observed during the study.

Consent for publication

Not applicable in this section.

Availability of data and materials

All data generated or analyzed in this study are included in this published article.

Competing interests

The authors declare that they have no competing interests" in this section.

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Authors' contributions

AWZ designed the research plan, was involved in the collection of the cervical swab, administered the structured questionnaires to the participating population and was principal in the write-up of the manuscript. CIA was involved in the statistical analysis of the research, participated in designing the methods used and also participated in the preparation of the manuscripts. BAO also participated in designing the methods used. TOE was involved in the design of the research plan and worked on the references. All authors gave their approval for the submission of the article.

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