Cervical Cancer Screening in Nigeria: A Social Media Survey of Women's Awareness, Beliefs, and Screening Uptake

The PENKUP Collaboration

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ABSTRACT

Background: Cervical cancer (CC) remains a leading cause of preventable mortality among women in Nigeria and other low- and middle-income countries (LMICs), mainly due to inadequate screening uptake despite increasing public health campaigns. This study assessed awareness, attitudes, and screening behaviours related to cervical cancer among women residing in Nigeria.

Methods: This was a cross-sectional online survey conducted using a structured, self-administered questionnaire that was distributed via social media platforms. A total of 718 valid responses from women aged 18 years and above were analysed. Descriptive statistics were used to summarise the sociodemographic variables, awareness levels, and screening behaviours of the respondents. The associations between cervical cancer screening uptake and relevant variables were tested using Pearson's chi-square.

Results: Most respondents (92.9%) were aware of CC screening, yet only 29.9% had ever undergone a Pap smear or Human Papillomavirus (HPV) test. Only 32.2% had acted on that knowledge among those who were aware. Furthermore, 44.9% indicated they knew when screening should be done, but only 57.1% correctly identified the recommended three-year interval. Screening uptake was significantly associated with awareness ($p = 1.27 \times 10^{-6}$), marital status ($p = 0.00072$), age group ($p = 2.09 \times 10^{-9}$), and HPV vaccination status ($p = 0.00020$). The most frequently cited barriers to screening were cost (43.3%), limited access to screening centres (27.3%), and lack of awareness (23.6%). While 96.7% agreed that early detection improves survival, the media were widely acknowledged as an influential source of health information.

Conclusion: High awareness and education levels among Nigerian women did not translate into adequate CC screening uptake. Addressing systemic barriers such as cost, misinformation, and limited-service access is essential. Targeted interventions that combine accurate health education, subsidised screening, and culturally

sensitive outreach, particularly for younger, unmarried, and unvaccinated women, are crucial to improving uptake and reducing the cervical cancer burden in Nigerian women.

1. INTRODUCTION

Cervical cancer remains a significant public health threat, especially in Nigeria and other low- and middle-income countries (LMICs), where over 85% of cervical cancer deaths occur due to limited access to screening, vaccination, and treatment services (Lawson et al., 2023). In Nigeria, the disease is the second most common cancer among women, with over 12,000 new cases and nearly 10,000 deaths recorded annually (Nguyen et al., 2020; Uchendu et al., 2021). The persistent infection with high-risk human papillomavirus (HPV), especially types 16 and 18, is the primary etiological factor, and the infection is most common among sexually active women of reproductive age (Iluno et al., 2024). Despite being preventable, cervical cancer continues to impose a heavy burden: the National Task Force on Cervical Cancer Elimination (2025) estimates that approximately 60 million Nigerian women are currently at risk. However, screening and vaccination remain low, primarily due to inadequate awareness, cultural barriers, fear, and financial constraints (Ike et al., 2025). The World Health Organisation (WHO) recommends a minimum screening coverage of 70% to reduce disease incidence. Nigeria continues to fall short, hindered by fragmented healthcare services and poor health-seeking behaviours (Mafiana et al., 2022; Lawson et al., 2023; Ike et al., 2025).

Most CC cases are caused by human papillomavirus (HPV), a common and often asymptomatic sexually transmitted infection. In Africa, the cervical cancer burden is compounded by limited preventive services, human resource shortages, inadequate access to treatment, and low awareness among both the population and health providers (Lott et al., 2020). Women in LMICs disproportionately bear the burden of cervical cancer due to persistent challenges in implementing preventive health strategies. Organised screening programmes in high-income countries have reduced mortality by over 50%, demonstrating the life-saving potential of early detection (Lawson et al., 2023). In contrast, only 15–20% of eligible women in Nigeria report having ever been screened, despite the availability of HPV vaccines and Pap smear services (Ike et al., 2025; Iluno et al., 2024). Even among highly educated women, perceived barriers such as discomfort, fear, and the absence of female health providers negatively affect screening uptake (Iluno et al., 2024).

Recent studies confirm that high awareness and knowledge do not automatically lead to increased CC screening in Nigeria (Ike et al., 2025; Muhammad et al., 2024; Iluno et al., 2024; Ogundipe et al., 2023). Awareness levels among women attending academic institutions, antenatal, and postnatal clinics are moderate to high, yet screening rates remain low (Ike et al., 2025; Ogundipe et al., 2023). For example, more than 63% of antenatal patients had never undergone screening despite 59.8% being aware of it (Ike et al., 2025). Socio-cultural dynamics such as spousal consent, stigma, and misconceptions, such as associations between cervical cancer and promiscuity or divine punishment, further deter screening (Nguyen et al., 2020). The Health Belief Model (HBM) has been applied to explain this awareness–uptake gap. Iluno et al. (2024) found that perceptions of severity, susceptibility, and cues to action, such as recommendations from female physicians, play a major role in shaping screening behaviour.

According to the World Health Organisation, CC can be eliminated within a generation through a comprehensive strategy that includes screening and treating precancerous lesions in asymptomatic women, particularly those aged

30-49 years. Recommended screening methods include HPV testing, Pap smear, and visual inspection with acetic acid, all aimed at preventing the progression to invasive cancer (Mafiana et al., 2022). This study, therefore, aims to assess the knowledge, attitudes, and practices related to cervical cancer screening among women of reproductive age in Nigeria, to inform culturally relevant, evidence-based interventions to improve uptake and reduce preventable mortality.

2. METHODOLOGY

2.1   Ethical Consideration

All measures were carried out following the ethical considerations of the Covenant Health Research Ethics Committee (CHREC), Covenant University, P.M.B. 1023, Ota, Ogun State, Nigeria (approval number: IORG0010037), as well as the ethical standards of the 1964 Declaration of Helsinki. All participants provided informed consent before data collection and following the explanation of research objectives.

2.2   Questionnaire and Data Collection

The study was conducted among women residing in Nigeria to assess their awareness, attitudes, and screening behaviours related to cervical cancer. A descriptive cross-sectional survey design was employed to capture self-reported knowledge and preventive health practices at a single time. Data were collected using a structured, self-administered questionnaire designed in Google Forms. The questionnaire was adapted from validated tools used in previous CC research and modified for cultural and contextual relevance. It consisted of seven sections covering: (1) socio-demographic characteristics, (2) awareness of cervical cancer and screening methods, (3) attitudes toward screening, (4) exposure to cervical cancer education, (5) screening history, (6) symptoms and medical history, and (7) risk and preventive practices.

Data collection was conducted over six weeks using purposive sampling. The online questionnaire link was disseminated via social media platforms, including WhatsApp, Facebook, and email networks, targeting Nigerian women aged 18 years and above. Participation was voluntary, and informed consent was obtained electronically before completing the questionnaire. The Google Form was configured to allow only one submission per email address to prevent duplicate responses. No personally identifiable information was collected, and respondents were assured of the confidentiality of their responses. A total of 720 responses were received. Following initial screening for completeness, 2 responses were excluded due to incomplete missing values, resulting in 718 valid responses in the final analysis.

2.3   Data Management and Analysis

After data collection, responses were downloaded in Microsoft Excel format, cleaned, and validated for completeness and consistency. The data were subsequently imported into R (version 4.4.0) for statistical analysis. Descriptive statistics, including frequencies and percentages, were used to summarise the characteristics of the study population and key variables such as awareness levels, screening uptake, and exposure to health education. Inferential statistics were conducted using Pearson's Chi-square tests to assess associations between cervical cancer screening uptake and awareness, marital status, age group, and vaccination. A significance level of $p < 0.05$ was considered statistically significant for all analyses.

3. RESULTS

3.1   Sociodemographic Profile of Respondents

The study captured the demographic characteristics of 718 Nigerian women aged 18 and above. The majority (33.4%) were within the 24-36 age range, predominantly single (53.6%), and had attained tertiary-level education (95.7%). The respondents' high education level and digital access reflect the study's online distribution strategy.

Table 1: Respondents' Demographic Data

Variable	Frequency (N) N= 718	Percentage (%)
Age Group		
18–23	39	5.43
24–30	240	33.43
31–36	212	29.53
37–41	103	14.35
42 and above	124	17.27
Marital Status		
Single	385	53.62
Married	282	39.28
Separated	28	3.90
Divorce	12	1.67
Widowed	11	1.53
Religion		
Christian	641	89.28
Islam	60	8.36
Other	17	2.37
Educational Status		
Primary	N/A	N/A
Secondary	19	2.65
Tertiary	687	95.68
None	12	1.67
Country of Origin		
Nigeria	706	98.33
Other	12	1.67

Data are represented in percentages; N/A = Not applicable.

3.2   Awareness of Cervical Cancer and Screening Methods

Most respondents had a high general awareness of CC screening (92.9%), but their specific knowledge about screening methods and correct screening intervals was limited. Less than half (44.85%) of 718 knew when screening should be done, and among them, only 57.14% (187) correctly identified the recommended three-year interval. Out of 718 respondents, 51.11% have received awareness on CC prevention, and the majority were in the hospital (37.6%) and (37.68%) media (social media, television, radio).

Table 2: Awareness of Cervical Cancer Screening

Variable	Frequency (N)	Percentage (%)
Have you heard about cervical cancer screening (N=718)		
Yes	667	92.90
No	51	7.10
Do you know the method of cervical cancer screening (e.g., Pap smear, HPV test)? (N=718)		
Yes	549	76.46
No	169	23.54
Do you consider the following as means of screening for cervical cancer? (N=718)		
HPV Test	110	15.32
Pap Smear	341	47.49
Pap Smear, HPV Test	267	37.19
Do you know when to perform cervical cancer screening? (N=718)		
Yes	322	44.85
No	396	55.15
If yes, how often should it be done? (N= 322)		
Every 3 years	184	57.14
Every year	90	27.95
I don't know	27	8.39
Every 5 years	21	6.52
Have you ever received health education on cervical cancer prevention? (N=718)		

Yes	367	51.11
No	351	48.89
If yes, where did you receive it? (N= 359)		
Church	26	7.24
Hospital	135	37.6
Media (Social Media, TV, Radio)	136	37.68
Mosque	1	0.28
Other	61	16.97

Data are represented in percentages.

3.3 Attitudes and Perceptions Toward Cervical Cancer Screening

Most respondents, 96.65% acknowledged the importance of early detection and regular Pap smears. However, notable stigma and community-level avoidance were still reported. Health personnel (82.46%) and media (98.74%) were viewed as influential sources for promoting CC screening practices.

Table 3 (A -B): Respondents' Attitude Towards Cervical Cancer and Enlightenment on Cervical Cancer Screening

A) Attitude Towards Cervical Cancer	Strongly Agree	Agree	Neutral	Strongly Disagree	Disagree
Women in my community avoid cervical cancer screening at health facilities.	78 (10.86)	150 (20.89)	328 (45.68)	33 (4.60)	129 (17.97)
There are few trained personnel conducting cervical cancer screening, making it discouraging.	133 (18.95)	250 (34.82)	206 (28.69)	20 (2.79)	109 (15.18)
Early detection of cervical cancer increases the chances of survival.	505 (70.33)	189 (26.32)	14 (1.95)	4 (0.56)	6 (0.84)
Every sexually active woman should go for a Pap smear at least once every three years.	417 (58.16)	241 (33.61)	48 (6.69)	2 (0.28)	9 (1.26)
B) Enlightenment on Cervical Cancer Screening					
I have listened to health talks on cervical cancer through electronic media.	161 (22.42)	334 (46.52)	104 (14.48)	13 (1.81)	106 (14.76)

My health facility provides health education on cervical cancer screening.	75 (10.45)	186 (25.91)	255 (35.52)	38 (5.29)	164 (22.84)
Health personnel are responsible for informing people about cervical cancer screening.	255 (35.52)	337 (46.94)	88 (12.26)	3 (0.42)	35 (4.87)
Do you agree that the media plays a vital role in educating people on cervical cancer screening?	465 (64.76)	244 (33.98)	N/A	3 (0.42)	6 (0.84)

Data are represented in percentages; N/A = Not applicable.

3.4   Screening History and Barriers to Uptake

Only 29.94% (215) of participants had undergone a Pap smear or HPV test, and barriers like cost (43.28%), limited access (27.26%), and lack of awareness (23.57%) were common among the unscreened. Furthermore, 67.13% (482) of all women reported being asymptomatic, underscoring the challenge of asymptomatic conditions reducing proactive screening uptake.

Table 4: Respondents' Screening History of Cervical Cancer

A) Screening History	Frequency	Percentage (%)
Have you ever undergone a Pap smear or HPV test?		
Yes	215	29.94
No	503	70.06
If yes, what was the result of your last screening? (N= 215)		
Abnormal but no cancer detected	9	4.19
I don't remember/I don't know	14	6.51
Normal	189	87.91
Precancerous cells detected	3	1.4
If no, what is your reason?		
Cost	235	43.28
Lack of Access to Healthcare	148	27.26
Lack of Awareness	128	23.57
Fear (Results/Procedure)	65	11.97
Perceived Not Necessary	30	5.52
Other	64	11.79

Have you experienced any of the following symptoms? (N=718)

Unusual vaginal bleeding	41	5.71
Pelvic pain or discomfort	152	21.17
Pain during intercourse	99	13.79
Unusual vaginal discharge	74	10.31
None of the above	482	67.13

How long have you been experiencing these symptoms? (N=718)

1-6 months	59	8.22
I don't have symptoms	499	69.5
Less than 1 month	71	9.89
More than six months	89	12.4

Data are represented in percentages.

3.5 Risk Factors, Preventive Behaviours, and Vaccination Coverage

In Table 5, the reported prevalence of HPV diagnosis and HPV vaccination was low (2.09% and 11.84%, respectively), while smoking and long-term hormonal contraceptive use were also rare. Notably, a high proportion of respondents (6.55%) were unaware of their vaccination status, highlighting a gap in preventive healthcare literacy.

Table 5: Risk Factors and Prevention of Cervical Cancer

Risk Factors	Frequency (N) (N=718)	Percentage (%)
Have you ever been diagnosed with Human Papillomavirus (HPV)?		
Yes	15	2.09
No	660	91.92
I don't know	43	5.99
Have you received the HPV vaccine?		
Yes	85	11.84
No	586	81.62
I don't know	47	6.55
Do you have a family history of cervical cancer?		

Yes	17	2.37
No	643	89.55
I don't know	58	8.08
Do you smoke or have you ever smoked?		
Yes	44	6.13
No	674	93.87
Have you ever used hormonal contraceptives for more than 5 years?		
Yes	11	1.53
No	640	89.14
I don't know	11	1.53

Data are represented in percentages.

3.6 Comparative Analysis of Cervical Cancer Screening Uptake by Cervical Cancer Screening, Marital Status, Age Group and Vaccination.

3.6.1 Association Between Awareness and Screening Uptake

Based on Pearson's chi-square test, the statistical analysis showed a significant association (p-value = 1.27×10^6) between CC awareness and CC screening uptake among women. All screened respondents were aware of cervical cancer screening, affirming the significant role of awareness in promoting CC screening uptake. However, awareness alone was insufficient, as many informed individuals remained unscreened.

Table 6. Association Between Awareness of Cervical Cancer Screening and Screening Uptake Among Respondents (N = 718)

Awareness of Cervical Cancer Screening	Screened (N)	Not Screened (N)	Screening Rate (%)	p-value
Yes	215	452	32.20%	1.27×10^{-6}
No	N/A	51	N/A	

* Pearson's chi-square test for awareness vs screening uptake: with a significant p = 1.27×10^6.

3.6.2 Association Between Marital Status and Screening Uptake

The CC screening uptake was higher among married (36.9%) and previously married women (37.3%) compared to singles (23.9%). Based on Pearson's chi-square test, the statistical analysis showed a significant association (p-

value = 0.00072) between marital status and CC screening uptake. This suggests that marital status may influence health-seeking behaviours, possibly due to increased engagement with reproductive health services.

Table 7. Association Between Marital Status and Cervical Cancer Screening Uptake (N = 718)

Marital Status	Screened (N)	Not Screened (N)	Screening Rate (%)	p-value
Single	92	293	23.90%	
Married	104	178	36.90%	0.00072
Separated/Divorced/Widowed	19	32	37.30%	

* Pearson's chi-square test for marital status vs screening uptake with a significant p = 0.00072.

3.6.3 Age Distribution and Screening Uptake

Figure 1 shows the relationship between age groups and CC screening uptake. Screening rates increased significantly across age groups (p-value = 2.09×10^{-9}). While only 14.6% of women aged 24–30 had undergone screening, the rate rose to 50.8% among those aged 42 and above. This trend highlights the influence of age on perceived susceptibility and engagement with preventive healthcare. Younger women may underestimate their risk, despite WHO recommendations to initiate screening by age 25.
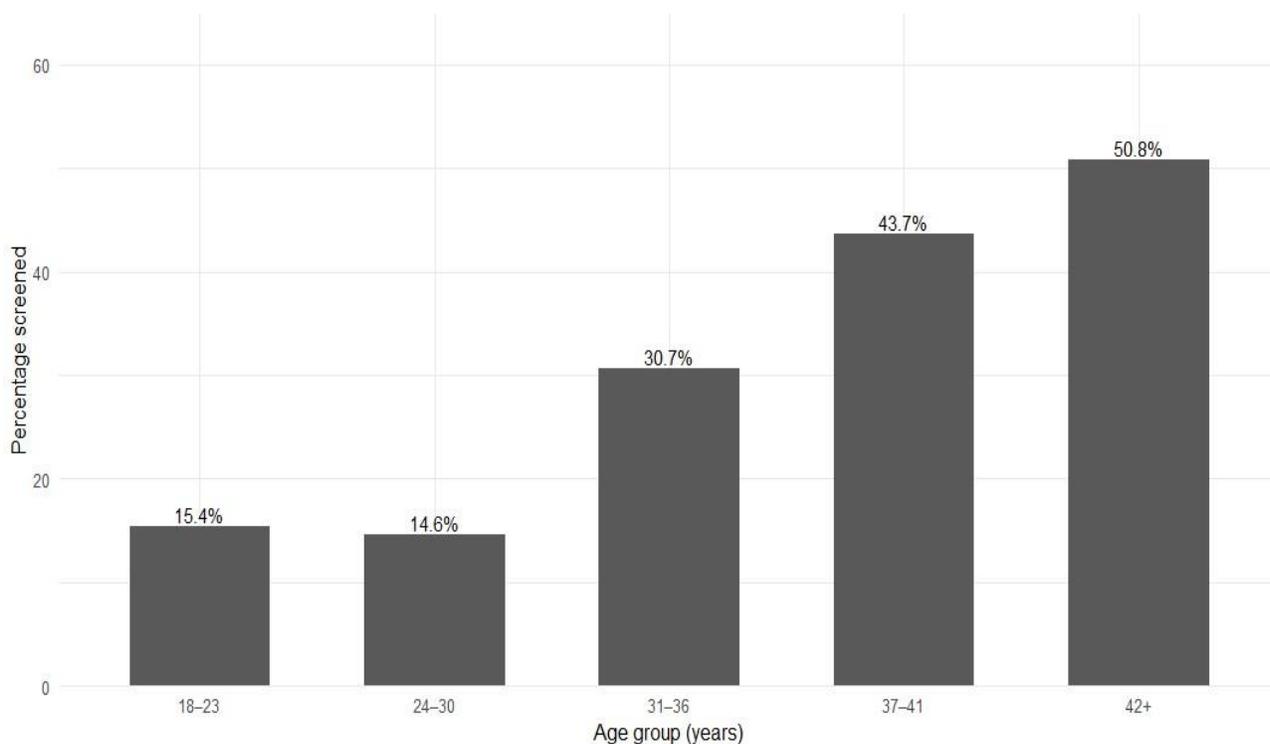
Figure 1: Bar chart showing cervical-cancer screening uptake by age group (N = 718). The difference across groups was statistically significant (p = 2.09×10^{-9}).

3.6.4 HPV Vaccination and Its Association with Cervical Cancer Screening Uptake

Among the 85 women who reported receiving the HPV vaccine, nearly half (49.4%) had undergone screening, compared to 29.5% of those who were not vaccinated. None of the respondents who were unsure of their vaccination status had been screened. This statistically significant association (p-value = 0.00020) suggests that engagement with one preventive service (vaccination) may increase the likelihood of participating in another (screening), highlighting the importance of integrated preventive health messaging.

Table 8. Association Between Cervical Cancer Screening Uptake and Vaccination (N = 718)

HPV Vaccination Status	Screened (N)	Not Screened (N)	Screening Rate (%)	p-value
Vaccinated (Yes)	42	43	49.40%	
Not Vaccinated (No)	173	413	29.50%	0.00020
Don't Know	N/A	47	N/A	

* Pearson's chi-square test for Vaccinated vs Not Vaccinated only: with a significant p = 0.00020. The "Don't know" group was excluded from the test.

4. DISCUSSION

This study assessed cervical cancer screening behaviour among women in Nigeria, focusing on awareness, sociodemographic factors, and behavioural influences that shape uptake. Despite most participants having tertiary education (95.68%) and high awareness of cervical cancer screening (667 of 718, 92.9%), only 215 women (29.94%) reported having undergone a Pap smear or HPV test. This is higher than prior studies in Nigeria that reported uptake between 4% and 15%; however, it remains well below global recommendations and illustrates a critical, persistent gap between awareness and preventive health action (Idowu et al., 2016; Abugu & Nwagu, 2021). The CC awareness did not equate to accurate knowledge. From the 44.85% of respondents who claimed to know when screening should be done, only 57.14% correctly identified the WHO-recommended three-year interval (WHO, 2021). Similar discrepancies between awareness and accurate knowledge have been documented in Nigeria CC studies, underscoring a significant knowledge gap between general awareness and accurate, actionable health information (Idowu et al., 2016; Maitanmi et al., 2023). This persistent gap highlights the need for more in-depth intervention to promote awareness, understanding, and motivation towards timely screening behaviour.

Barriers to screening were strongly evident among those who had never been screened. Among unscreened participants, common reasons included cost (43.28%), limited access to screening centres (27.26%), and lack of awareness (23.57%). These systemic constraints highlight the limitations of awareness-raising campaigns when unaccompanied by accessible, affordable screening services (Farajimakin, 2024). Furthermore, 67.13% of all respondents reported no symptoms, which may explain some of the low uptake, as many individuals may not seek care until symptomatic. This behaviour highlights the misperception that cervical cancer screening is only necessary when symptoms are present, rather than as a routine preventive measure. Attitudes towards screening were largely positive. Most participants, 96.65% agreed that early detection increases survival, reflecting a generally favourable outlook toward preventive health. However, 45.68% were neutral or agreed with the statement that "women avoid screening," suggesting that fear, stigma, or social discomfort may still discourage participation. The media (social media such as Facebook, X, YouTube, television, and radio) emerged as a powerful channel of influence, with 64.76% of respondents strongly agreeing that the media plays a vital role in promoting CC awareness. This finding is consistent with evidence from other sub-Saharan African countries, where media-driven health campaigns have successfully increased CC knowledge and screening uptake (Bawuah et al., 2025). This presents opportunities for public health authorities to intensify media-based outreach campaigns, particularly in formats accessible to younger and rural women.

Significant associations were found between key variables and screening uptake. Awareness had a strong and statistically significant ($p = 1.27 \times 10^{-6}$) relationship with uptake: all 215 women who had undergone screening had heard about CC screening, whereas none of the 51 women who were unaware had been screened. Some studies have reported this finding (Okunowo et al., 2018; Okunade et al., 2022; Ogundipe et al., 2023). Nevertheless, among those who were aware (667 women), only 215 (32.2%) had acted on that awareness. This suggests that, while necessary, awareness is insufficient to drive CC screening uptake without addressing other enablers like access, affordability, and social support. Marital status also showed a significant association with screening uptake. Screening was reported by 104 of 282 married women (36.9%) and 19 of 51 previously married women (37.3%), compared to only 92 of 385 single women (23.9%) ($p = 0.00072$). This disparity may be attributed to increased healthcare engagement during pregnancy or the informational and emotional support often received from partners. Other studies involving Nigerians confirm that spousal awareness and encouragement are crucial in motivating women to complete CC screening (Adegboyega et al., 2019; Okedo-Alex et al., 2020). Similar patterns have been observed in low-resource settings, including Bolivia, Peru, Kenya, South Africa, and Mexico (Isabirye, 2022). Conversely, single women may perceive lower risk or experience more difficulty accessing services independently.

Screening uptake also increased with age. The women aged 42 and above, 63 of 124 (50.8%) had been screened, compared to only 35 of 240 (14.6%) among those aged 24–30, as shown in Figure 1. The trend was statistically significant ($p = 2.09 \times 10^{-9}$), suggesting a likely increase in perceived risk and healthcare engagement as women age. The WHO recommends screening starting from age 25 (WHO, 2021); these findings signal a missed opportunity to reach younger women earlier. Tailored messages and peer-based interventions targeting this group may help address this gap.

The HPV vaccination status was significantly associated ($p = 0.00020$) with CC screening uptake. Among women who reported being vaccinated, nearly half (49.4%; 42 of 85) had undergone screening, compared to 29.5% (173 of 586) of unvaccinated women. None of the 47 women unsure of their vaccination status reported being screened. This clustering of positive health behaviours suggests that women who engage in one form of preventive care are

more likely to engage in others. Conversely, being unaware of vaccination status may reflect a lack of exposure to health systems or gaps in health education (Ogundipe et al., 2023). Integrating HPV vaccination campaigns with screening education may be a high-yield strategy to improve both outcomes.

The findings of our study thus suggest that improving cervical cancer screening rates in Nigeria will require more than raising awareness alone. Though knowledge is foundational, it must be accompanied by policies that reduce economic barriers, improve service delivery, and address psychosocial deterrents like stigma and cultural discomfort. Special attention must be given to subgroups with particularly low uptake, such as younger, single, and unvaccinated women, and health messaging must shift toward highlighting screening as a routine, necessary, and empowering act of self-care.

Limitations of the Study

One key limitation of this study is purposive sampling via social media platforms, which inherently favours the inclusion of educated women, internet-literate, and active on digital platforms. As a result, the sample may not fully represent women from lower socioeconomic backgrounds, those with limited digital access, or rural populations. This selection bias likely contributed to the high proportion of tertiary-educated respondents (95.68%) and may have influenced the awareness and attitudes reported. Therefore, generalising these findings to the broader Nigerian female population or other LMIC should be cautiously approached.

Recommendations

Multifaceted interventions are needed to close this gap. To improve reach, these should include subsidised or free screening services, mobile clinics, and self-sampling options. Screening programs should also be integrated with maternal health visits, youth outreach, and HPV vaccination campaigns to encourage comprehensive preventive care. Media campaigns and peer-led education can help normalise screening and overcome stigma, especially among younger and unmarried women. Culturally sensitive messaging, delivered through trusted platforms like religious centres or community health workers, may enhance effectiveness. Hence, the national cervical cancer control strategies must prioritise both awareness and access, ensuring that every woman, regardless of age, marital status, or economic condition, is empowered and equipped to engage in life-saving preventive care.

Conclusion

High levels of awareness and education among Nigerian women did not translate into adequate cervical cancer screening uptake. Misconceptions regarding screening intervals and barriers such as limited access, financial constraints, and cultural beliefs continue to impede participation. In this study, only 29.94% of respondents reported ever being screened, and among those who believed they knew when screening should occur, just 57.14% correctly identified the recommended three-year interval. Despite awareness being significantly associated with screening uptake, only one-third of those informed had acted, pointing to persistent structural and behavioural challenges that must be addressed.

Author Contributions

All authors contributed meaningfully to the development of this study and the preparation of the manuscript. The study was conceptualised and designed by J.A.C., C.C., I.O and C.C.E. Data collection, cleaning, management and analysis were carried out collaboratively, with each author reviewing analytical decisions to ensure accuracy and

consistency. J.A.C., C.C.E., O.O.O. and K.O.O. led the drafting of the manuscript, including the introduction, methods, results and discussion. Co-authors contributed to the interpretation of findings, provided critical revisions and strengthened the clarity and coherence of the final text. All authors reviewed the full manuscript, approved the final version and agreed to be accountable for the integrity of the work.

Informed Consent Statement

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

Data Availability Statement

The data supporting this study's findings are available on request from the corresponding authors [J.A.C./C.C.E./K.O.O.].

Conflicts of Interest

The authors declare no conflicts of interest.

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