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Knowledge and Uptake of Human Papillomavirus Vaccination Among Female Students of Government Secondary Schools in Enugu Metropolis, Nigeria

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Abstract: **Background: Background:** Human papillomavirus (HPV) infection is the leading cause of cervical cancer, one of the most common cancers affecting women worldwide. Although safe and effective HPV vaccines are available, vaccine uptake remains low in many low- and middle-income countries, including Nigeria. Poor awareness and inadequate knowledge of HPV and its vaccine contribute significantly to low vaccination coverage among adolescents, who constitute the primary target population for HPV vaccination. **Objective:** To assess the knowledge and uptake of Human Papillomavirus (HPV) vaccination among female students of government secondary schools in Enugu Metropolis, Enugu State, Nigeria. **Methods:** A descriptive cross-sectional study was conducted among 204 female students aged 9–14 years selected from government secondary schools in Enugu Metropolis using a multistage sampling technique. Data were collected using a pretested structured self-administered questionnaire. Information on socio-demographic characteristics, knowledge of HPV vaccination, vaccine uptake, and factors associated with uptake was obtained. Data were analyzed using IBM Statistical Product and Service Solutions (SPSS) version 27. Descriptive statistics were presented as frequencies, percentages, means, and standard deviations, while Chi-square tests were used to determine factors associated with HPV vaccine uptake. Statistical significance was set at $p < 0.05$. **Results:** The mean age of the respondents was 12.72 ± 1.06 years. Most participants were Igbo (97.5%), Christians (96.6%), and enrolled in Junior Secondary School 2 (51.5%). Although 36.3% had heard of HPV, only 25.5% had heard of HPV vaccination. Overall, good knowledge of HPV vaccination was observed in only 25.0% of respondents, while 52.9% demonstrated poor knowledge. Forty-four (21.6%) respondents reported having received the HPV vaccine, whereas 78.4% had not been vaccinated. The commonest reason for non-vaccination was lack of awareness (61.9%). HPV vaccine uptake was significantly associated with age ($p = 0.011$), class level ($p < 0.001$), father's occupation ($p = 0.038$), mother's occupation ($p < 0.001$), father's education ($p = 0.001$), mother's education ($p = 0.049$), living arrangement ($p < 0.001$), and knowledge level ($p < 0.001$). **Conclusion:** Knowledge and uptake of HPV vaccination among female students of government secondary schools in Enugu Metropolis remain suboptimal despite the availability of effective vaccines. Poor awareness remains the major barrier to vaccination. Strengthening school-based health education, improving parental awareness, and expanding access to adolescent HPV vaccination services are essential for increasing vaccine uptake and reducing the future burden of cervical cancer.

Keywords: Obesity; Metabolic syndrome; Insulin resistance; Weight management; GLP-1 receptor agonists; Bariatric surgery.

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INTRODUCTION

Human papillomavirus (HPV) is one of the most common sexually transmitted viral infections worldwide and is the primary cause of cervical cancer, a disease that remains a major public health challenge, particularly in low- and middle-income countries [1–4]. More than 200 HPV genotypes have been identified, of which at least 14 are classified as high-risk oncogenic types. HPV types 16 and 18 alone account for approximately 70% of cervical cancer cases globally [1]. Persistent infection with these high-risk HPV types is responsible for virtually all cases of cervical cancer and contributes substantially to the global burden of anogenital and oropharyngeal cancers [2,3].

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Globally, cervical cancer remains one of the leading causes of cancer-related morbidity and mortality among women. In 2022, an estimated 600,000 new cases and approximately 340,000 deaths were reported worldwide, with over 90% of these deaths occurring in low- and middle-income countries, particularly in sub-Saharan Africa [1,5]. Nigeria bears one of the highest burdens of cervical cancer in Africa, recording approximately 12,000 new cases and nearly 8,000 deaths annually [5]. These figures underscore the urgent need for effective preventive strategies, particularly among adolescent girls before the onset of sexual activity.

The introduction of prophylactic HPV vaccines represents one of the most significant advances in cervical cancer prevention. Currently available vaccines provide effective protection against the high-risk HPV types responsible for the majority of cervical cancer cases and have demonstrated excellent safety and effectiveness in reducing HPV infection and precancerous cervical lesions [6,7]. The World Health Organization (WHO) recommends routine HPV vaccination for girls aged 9–14 years, preferably before sexual debut, as the primary strategy for preventing cervical cancer [8]. Depending on age and immune status, vaccination is administered as either a two-dose or three-dose schedule [8].

Despite the proven effectiveness of HPV vaccines, vaccine uptake remains low in many developing countries. Limited awareness, inadequate knowledge, financial constraints, poor access to vaccination services, and insufficient public health education continue to impede vaccine acceptance [9,10]. In many African countries, including Nigeria, HPV vaccination coverage remains considerably below the levels required to achieve the WHO global strategy for cervical cancer elimination [1].

Knowledge of HPV infection and its vaccine play a fundamental role in vaccine acceptance and uptake. Adolescents who understand the relationship between HPV infection and cervical cancer are more likely to accept vaccination and recommend it to others [11]. Likewise, parental knowledge and educational status strongly influence adolescents' vaccination decisions because parents remain the principal decision-makers regarding childhood immunization [12]. Several studies have demonstrated that higher parental education and increased awareness significantly improve HPV vaccine acceptance and uptake [10–13].

In Nigeria, awareness and knowledge of HPV vaccination among adolescents remain inadequate. Previous studies conducted among secondary school students have consistently reported poor knowledge of HPV infection and low awareness of the HPV vaccine [14–17]. Before the introduction of the national HPV vaccination programme, reported vaccine uptake among Nigerian adolescents ranged from less than 1% to about 5%, largely because of poor awareness, limited accessibility, and the high cost of vaccination [14–16]. Although Nigeria introduced routine HPV vaccination into the national immunization programme in October 2023, evidence regarding knowledge and vaccine uptake among adolescent girls following the rollout remains limited.

Several socio-demographic factors have been reported to influence HPV vaccine uptake. Age, educational level, parental occupation, parental educational attainment, and family support have all been shown to affect vaccination behaviour among adolescents [10,12,18]. School-based vaccination programmes, parental recommendations, and healthcare provider counselling have also been associated with improved vaccine uptake in many countries [19,20]. Conversely, inadequate access to vaccination services and poor health education continue to limit vaccine coverage in many resource-limited settings.

Female students attending government secondary schools constitute one of the priority populations for HPV vaccination because most fall within the WHO-recommended vaccination age of 9–14 years. Assessing their level of knowledge and vaccine uptake provides important evidence for evaluating existing vaccination programmes and identifying opportunities to strengthen adolescent immunization services. Such information is essential for planning effective school-based health education programmes and improving HPV vaccination coverage.

Despite increasing national efforts to promote HPV vaccination, there is limited information regarding the knowledge of HPV vaccination and vaccine uptake among female students attending government secondary schools in Enugu Metropolis. Most previous studies conducted within Enugu State focused on vaccine awareness or acceptability among teachers or students in selected schools and did not comprehensively evaluate both knowledge and vaccine uptake among female adolescents in government secondary schools [13,17]. Generating such evidence is important for guiding policy decisions, strengthening school health programmes, and improving cervical cancer prevention strategies.

This study therefore aimed to assess the knowledge and uptake of Human Papillomavirus vaccination among female students of government secondary schools in Enugu Metropolis, Enugu State, Nigeria.

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Objective of the Study

To assess the knowledge and uptake of Human Papillomavirus (HPV) vaccination among female students of government secondary schools in Enugu Metropolis, Enugu State, Nigeria.

METHODOLOGY

STUDY AREA

The study was conducted in Enugu Metropolis, which comprises Enugu North, Enugu East, and Enugu South Local Government Areas of Enugu State, South-East Nigeria. Enugu State lies between latitudes 6°27′N and 7°28′N and longitudes 7°30′E and 8°19′E. It is bounded by Benue and Kogi States to the north, Ebonyi State to the east, Abia State to the south, and Anambra State to the west. The state has a predominantly Igbo population and is recognized for its urban commercial activities, educational institutions, and healthcare services.

The educational system in Enugu State comprises both public and private secondary schools under the supervision of the Post Primary Schools Management Board (PPSMB). According to PPSMB records, there were approximately 293 government-owned secondary schools in Enugu State as of 2024. Government secondary schools in Enugu Metropolis provide an appropriate setting for assessing HPV vaccine knowledge and uptake among adolescent girls because they enroll students within the World Health Organization (WHO)-recommended age group for HPV vaccination.

STUDY DESIGN

This study employed a descriptive cross-sectional design to assess the knowledge and uptake of Human Papillomavirus (HPV) vaccination among female students attending government secondary schools in Enugu Metropolis.

STUDY POPULATION

The study population comprised female students aged 9–14 years attending Junior Secondary School (JSS) classes 1 and 2 in selected government secondary schools within Enugu Metropolis.

INCLUSION CRITERIA

The study included:
Female students aged 9–14 years.
Female students who were present in school during data collection.
Female students who consented to participate in the study.

EXCLUSION CRITERIA

The following students were excluded:
Female students who were seriously ill during data collection.
Female students who declined participation.

SAMPLE SIZE DETERMINATION

The minimum sample size was determined using Cochran's formula for descriptive studies:

$$\mathbf{N = Z^2P(1 - P) / d^2}$$

Where:
N = Minimum sample size
Z = Standard normal deviate at 95% confidence level (1.96)
P = Prevalence of knowledge of HPV vaccination (13.86%) obtained from a previous study conducted among secondary school students in Enugu State.
d = Margin of error (0.05)

The calculated minimum sample size was 183 participants. After adding a 10% allowance for non-response, the minimum sample size became 202 participants. A total of 204 female students were eventually recruited and participated in the study.

SAMPLING TECHNIQUE

A multistage sampling technique was employed.

Stage One

Government secondary schools in Enugu North, Enugu East, and Enugu South Local Government Areas were listed. One government secondary school was selected from each Local Government Area using simple random sampling by balloting.

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The selected schools were:
Queen's Secondary School, Enugu (Enugu North)
Trans-Ekulu Girls' Secondary School (Enugu East)
Girls' High School, Uwani (Enugu South)

Stage Two
Proportionate allocation was used to determine the number of participants selected from each school according to student population. Students were stratified by class (JSS1 and JSS2), after which proportionate allocation was again applied to each class. Systematic random sampling was subsequently used to select eligible participants from each class register until the required sample size was achieved.

STUDY INSTRUMENT
Data were collected using a pretested structured self-administered questionnaire developed following extensive literature review and expert review.
The questionnaire consisted of three sections:
Section A: Socio-demographic characteristics.
Section B: Knowledge of Human Papillomavirus and HPV vaccination.
Section C: Uptake of Human Papillomavirus vaccination.

DATA COLLECTION METHOD
Data were collected over a four-week period.
Permission to conduct the study was obtained from the relevant school authorities, including the school principals, vice principals (academics), guidance and counselling units, and class teachers. The objectives of the study were explained to all eligible participants before questionnaire administration.

Questionnaires were administered during break periods under the supervision of the researchers. The research team received prior training from the project supervisor to ensure uniformity in questionnaire administration and data collection.
Junior Secondary School Three (JSS3) students were excluded because they had proceeded on the Junior WAEC examination break before commencement of data collection.

PRETEST OF STUDY INSTRUMENT
The questionnaire was pretested among approximately 20 female students attending a government secondary school that was not selected for the main study.
The pretest assessed:
clarity of questions,
appropriateness of wording,
logical sequence,
ease of administration,
time required for completion.
Feedback obtained during the pretest was used to revise and improve the questionnaire before commencement of the main study.

DATA MANAGEMENT
Completed questionnaires were checked daily for completeness and consistency before data entry.
Data were coded and entered into IBM Statistical Product and Service Solutions (SPSS) version 27. Data cleaning was performed to identify incomplete responses and inconsistencies before statistical analysis.

MEASUREMENT OF VARIABLES
A. Socio-demographic Characteristics
The socio-demographic characteristics included:
age,
ethnicity,
religion,
class level,
father's occupation,
mother's occupation,
father's educational level,
mother's educational level,
living arrangement.

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These variables were summarized using frequencies, percentages, means, and standard deviations.
B. Knowledge of Human Papillomavirus Vaccination
Knowledge was assessed using seven structured questions covering:
awareness of HPV,
awareness of HPV vaccination,
HPV transmission,
HPV-related diseases,
recommended age for vaccination,
benefits of HPV vaccination.
Each correct response scored **1**, while incorrect or "I don't know" responses scored **0**.
The maximum obtainable score was **7**.
Knowledge was categorized as:
Poor knowledge: 0–2
Fair knowledge: 3–4
Good knowledge: 5–7
C. Uptake of Human Papillomavirus Vaccination
HPV vaccine uptake was assessed using questions on:
receipt of HPV vaccination,
number of doses received,
place of vaccination,
reasons for non-vaccination,
willingness to recommend HPV vaccination to others.
Results were summarized using frequencies and percentages.

STATISTICAL ANALYSIS

Data analysis was performed using IBM Statistical Product and Service Solutions (SPSS) version 27.
Descriptive statistics were used to summarize socio-demographic characteristics, knowledge of HPV vaccination, and HPV vaccine uptake.
Categorical variables were presented as frequencies and percentages, while continuous variables were summarized using means and standard deviations.
Bivariate analysis using the Chi-square test was conducted to determine factors associated with HPV vaccine uptake.
A p-value less than **0.05** was considered statistically significant.

ETHICAL CONSIDERATION

Ethical approval was obtained from the Health Research Ethics Committee of Enugu State University Teaching Hospital (ESUTH), Parklane, Enugu State.

Permission was also obtained from the relevant educational authorities and participating schools before commencement of the study.

Participation was voluntary, and informed verbal consent was obtained from all participants before questionnaire administration.

Confidentiality and anonymity were maintained throughout the study by ensuring that no personal identifiers were recorded on the questionnaires.

LIMITATION

The study was limited to female students attending selected government secondary schools within Enugu Metropolis; therefore, the findings may not be generalizable to adolescents attending private schools or residing outside the study area. Additionally, information obtained was based on self-report and may have been affected by recall bias.

RESULTS

A total of **204 female students** from selected government secondary schools in Enugu Metropolis participated in this study, giving a **response rate of 100%**. The findings are presented according to the study objectives, beginning with the socio-demographic characteristics of the respondents, followed by their knowledge and uptake of Human Papillomavirus (HPV) vaccination and factors associated with vaccine uptake.

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Table 1. Socio-demographic Characteristics of Female Secondary School Students in Enugu Metropolis, Enugu State, Nigeria (N = 204)

Variable	Frequency (n)	Percentage (%)
Age (years)		
10	5	2.5
11	18	8.8
12	62	30.4
13	67	32.8
14	48	23.5
15	4	2.0
Mean age (SD)	**12.72 ± 1.06 years**	
Ethnicity		
Igbo	199	97.5
Yoruba	1	0.5
Urhobo	2	1.0
Ibibio	2	1.0
Present Class		
JSS1	99	48.5
JSS2	105	51.5
Religion		
Christianity	197	96.6
Islam	4	2.0
Traditional religion	3	1.5
Father's Occupation		
Unemployed	2	1.0
Farmer	24	11.8
Businessman	143	70.1
Civil servant	35	17.2
Mother's Occupation		
Unemployed	12	5.9
Farmer	21	10.3
Businesswoman	129	63.2
Civil servant	42	20.6
Father's Education		
None	15	7.4
Primary	13	6.4
Secondary	55	27.0
Tertiary	121	59.3
Mother's Education		
None	12	5.9
Primary	23	11.3
Secondary	59	28.9
Tertiary	110	53.9
Living Arrangement		
Parents	134	65.7
Guardians	46	22.5
Family members	24	11.8

Table 1 shows that the respondents had a mean age of 12.72 ± 1.06 years**,** with most being 13 years old (32.8%)**,** followed by 12 years (30.4%) and 14 years (23.5%)**.** The majority were Igbo (97.5%)**,** Christians (96.6%)**,** and were enrolled in Junior Secondary School Two (51.5%)**.** Most fathers (70.1%) and mothers (63.2%) were engaged in business. More than half of both fathers (59.3%) and mothers (53.9%) had attained tertiary education. Approximately two-thirds (65.7%) of the respondents lived with their parents.

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Table 2. Knowledge of Human Papillomavirus Vaccination Among Female Secondary School Students in Enugu Metropolis, Enugu State, Nigeria (N = 204)

Variable	Frequency (n)	Percentage (%)
Ever heard of HPV		
Yes	74	36.3
No	130	63.7
Ever heard of HPV vaccination		
Yes	52	25.5
No	152	74.5
Source of Information (n = 80)		
School	29	36.3
Church	20	25.0
Hospital	16	20.0
Television	6	7.5
Social media	5	6.2
Parents/Relatives	4	5.0
Radio	0	0.0
Newspaper	0	0.0
HPV is		
A virus that can cause cancer	94	46.1
A type of cancer	15	7.3
A bacterial infection	10	4.9
I don't know	85	41.7
HPV is spread through		
Sexual contact	78	38.2
Touching	4	2.0
Food	0	0.0
I don't know	122	59.8
Recommended age for HPV vaccination		
9–14 years	78	38.2
After 18 years	28	13.7
Before school age	2	1.0
I don't know	96	47.1
HPV vaccine prevents		
Cervical cancer	80	39.2
HIV	15	7.4
Malaria	0	0.0
I don't know	109	53.4
Overall Knowledge		
Good	51	25.0
Fair	45	22.1
Poor	108	52.9

Table 2 demonstrates that only 36.3% of respondents had heard of HPV, while 25.5% had heard of HPV vaccination. Among those who had received information, the commonest source was school (36.3%), followed by church (25.0%) and hospital (20.0%). Less than half (46.1%) correctly identified HPV as a virus capable of causing cancer, while 41.7% did not know what HPV is. Only 38.2% correctly identified sexual contact as the principal mode of transmission, and an equal proportion correctly recognized that girls aged 9–14 years should receive the HPV vaccine. Furthermore, 39.2% correctly identified cervical cancer prevention as the major benefit of HPV vaccination. Overall, 52.9% of respondents demonstrated poor knowledge, 22.1% had fair knowledge, and only 25.0% had good knowledge of HPV vaccination.

Table 3. Uptake of Human Papillomavirus Vaccination Among Female Secondary School Students in Enugu Metropolis, Enugu State, Nigeria (N = 204)

Variable	Frequency (n)	Percentage (%)
Received HPV vaccine		
Yes	44	21.6
No	160	78.4
Number of doses received*		

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One dose	25	29.1
Two doses	12	14.0
Three doses	6	7.0
Not sure	43	50.0
Reasons for non-vaccination†		
Had not heard about the vaccine	122	61.9
Parents did not allow	9	4.7
Vaccine not available in school	7	3.5
Afraid of vaccination	11	5.6
Church discourages vaccination	14	7.1
Did not know where to obtain the vaccine	13	6.6
Did not believe the vaccine works	14	7.1
Did not have time	7	3.5
Place of vaccination		
School	16	7.8
Health centre	9	4.4
Campaign/Outreach	17	8.3
None	7	3.4
Not sure	155	76.0
Would recommend HPV vaccine to others		
Yes	127	62.3
No	77	37.7

*Among respondents who reported receiving the vaccine.
†Multiple responses were allowed.

Table 3 shows that 44 (21.6%) respondents reported having received the HPV vaccine, whereas 160 (78.4%) had not been vaccinated. Among vaccinated respondents, 29.1% reported receiving one dose, 14.0% had received two doses, 7.0% had completed three doses, while 50.0% were unsure of the number of doses they had received. The commonest reason for non-vaccination was lack of awareness of the vaccine (61.9%), followed by disbelief in vaccine effectiveness (7.1%), church discouragement (7.1%), and lack of knowledge regarding where the vaccine could be obtained (6.6%). With respect to the place of vaccination, 8.3% received the vaccine during campaigns or outreach programmes, 7.8% at school, and 4.4% at health centres, while 76.0% were unsure of the place of vaccination. Overall, 62.3% of respondents indicated that they would recommend HPV vaccination to others.

Table 4. Factors Associated with Human Papillomavirus Vaccine Uptake Among Female Secondary School Students in Enugu Metropolis, Enugu State, Nigeria

Variable	Vaccinated n (%)	Not Vaccinated n (%)	χ^2	p-value
Age (years)			**14.824**	**0.011***
10	0 (0.0)	5 (100.0)		
11	0 (0.0)	18 (100.0)		
12	12 (19.4)	50 (80.6)		
13	14 (20.9)	53 (79.1)		
14	18 (37.5)	30 (62.5)		
15	0 (0.0)	4 (100.0)		
Ethnicity			**1.129**	**0.569**
Igbo	44 (22.1)	155 (77.9)		
Yoruba	0 (0.0)	1 (100.0)		
Urhobo	0 (0.0)	2 (100.0)		
Ibibio	0 (0.0)	2 (100.0)		
Present Class			**31.023**	**<0.001***
JSS1	5 (5.1)	94 (94.9)		
JSS2	39 (37.1)	66 (62.9)		
Religion			**0.861**	**0.650**
Christianity	43 (21.8)	154 (78.2)		

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Islam	1 (25.0)	3 (75.0)		
Traditional religion	0 (0.0)	3 (100.0)		
Father's Occupation			**8.437**	**0.038***
Unemployed	0 (0.0)	2 (100.0)		
Farmer	10 (41.7)	14 (58.3)		
Businessman	30 (21.0)	113 (79.0)		
Civil servant	4 (11.4)	31 (88.6)		
Mother's Occupation			**18.244**	**<0.001***
Unemployed	0 (0.0)	12 (100.0)		
Farmer	4 (19.0)	17 (81.0)		
Businesswoman	39 (30.2)	90 (69.8)		
Civil servant	1 (2.4)	41 (97.6)		
Father's Education			**16.048**	**0.001***
None	0 (0.0)	15 (100.0)		
Primary	0 (0.0)	13 (100.0)		
Secondary	7 (12.7)	48 (87.3)		
Tertiary	37 (30.6)	84 (69.4)		
Mother's Education			**7.876**	**0.049***
None	0 (0.0)	12 (100.0)		
Primary	3 (13.0)	20 (87.0)		
Secondary	10 (16.9)	49 (83.1)		
Tertiary	31 (28.2)	79 (71.8)		
Living Arrangement			**16.540**	**<0.001***
Parents	40 (29.9)	94 (70.1)		
Guardians	4 (8.7)	42 (91.3)		
Family members	0 (0.0)	24 (100.0)		
Knowledge Level			**28.323**	**<0.001***
Good	17 (33.3)	34 (66.7)		
Fair	19 (42.2)	26 (57.8)		
Poor	8 (7.4)	100 (92.6)		

*Statistically significant at **p < 0.05**.

Table 4 presents the factors associated with HPV vaccine uptake among the respondents. Age was significantly associated with vaccine uptake ($\chi^2 = 14.824$, $p = 0.011$), with the highest uptake observed among 14-year-old students (37.5%). Class level also showed a significant association, as students in JSS2 (37.1%) had substantially higher vaccination rates than those in JSS1 (5.1%) ($\chi^2 = 31.023$, $p < 0.001$).

Parental socio-economic characteristics significantly influenced vaccine uptake. Father's occupation ($p = 0.038$), mother's occupation ($p < 0.001$), father's educational level ($p = 0.001$), and mother's educational level ($p = 0.049$) were all significantly associated with vaccination status. Respondents whose parents had tertiary education demonstrated higher vaccination rates than those whose parents had no formal education.

Living arrangement was also significantly associated with HPV vaccine uptake ($\chi^2 = 16.540$, $p < 0.001$). Students living with their parents had higher vaccination rates (29.9%) than those living with guardians (8.7%) or other family members (0.0%).

Knowledge of HPV vaccination was strongly associated with vaccine uptake ($\chi^2 = 28.323$, $p < 0.001$). Respondents with good or fair knowledge were considerably more likely to have received the HPV vaccine than those with poor

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knowledge. In contrast, ethnicity (p = 0.569) and religion (p = 0.650) were not significantly associated with HPV vaccine uptake.

DISCUSSION

This study assessed the knowledge and uptake of Human Papillomavirus (HPV) vaccination among female students attending government secondary schools in Enugu Metropolis, Nigeria. The findings demonstrate that despite relatively favourable socio-demographic characteristics, knowledge of HPV vaccination remains inadequate, and vaccine uptake is still low among adolescent girls.

A total of 204 female students participated in this study, with a mean age of 12.72 ± 1.06 years. Most respondents were 13 years old (32.8%), which falls within the World Health Organization (WHO)-recommended age group (9–14 years) for routine HPV vaccination [1]. This finding differs slightly from the study conducted in Nnewi, Nigeria, where the mean age was 15.0 ± 1.9 years, with the majority of respondents aged 15–18 years [2]. The difference is expected because the present study deliberately included only girls aged 9–14 years, who constitute the primary target population for HPV vaccination. Similarly, studies conducted in Ethiopia and Malaysia also reported that most participants were within the recommended adolescent age group for HPV vaccination [3,4].

Almost all respondents (97.5%) belonged to the Igbo ethnic group, reflecting the predominantly Igbo population of Enugu State. Similar findings have been reported in previous studies conducted in Enugu and Nnewi, where over 95% of respondents were also Igbo [2,5]. In contrast, studies conducted in Ethiopia and Malaysia reported more ethnically diverse study populations because of the multicultural composition of those countries [3,4].

More than half of the respondents (51.5%) were enrolled in Junior Secondary School Two (JSS2), while the remainder were in JSS1. Junior Secondary School Three students were excluded because they had commenced the Junior WAEC examination before data collection. This differs from the earlier Enugu study by Israel *et al*., which included students from all junior secondary classes [5].

Most respondents were Christians (96.6%), which is consistent with the religious composition of southeastern Nigeria and similar studies conducted within Enugu State [2,5]. Comparable findings have also been reported in Nnewi, whereas studies from Ethiopia and Malaysia reported more diverse religious distributions [3,4].

Most fathers (70.1%) and mothers (63.2%) were engaged in business, reflecting the commercial nature of Enugu metropolis. Similar occupational patterns have been reported in studies conducted in Nnewi and Lagos, where trading constituted the predominant parental occupation [2,6]. Conversely, studies from Ethiopia and Uganda reported farming as the major parental occupation because of their predominantly agrarian settings [3,7].

More than half of both fathers (59.3%) and mothers (53.9%) had tertiary education. This proportion is considerably higher than reports from Benin City and Port Harcourt, where secondary education constituted the highest educational attainment among parents [8,9]. The relatively high educational attainment observed in this study may positively influence parents' understanding of preventive healthcare and willingness to support childhood vaccination.

Approximately two-thirds (65.7%) of respondents lived with their parents. Similar findings have been reported in previous Nigerian studies [2,5]. Living with parents is particularly important because parental involvement and consent remain major determinants of adolescent vaccination decisions [7].

Knowledge of HPV Vaccination

Knowledge of HPV vaccination among respondents was generally poor. Although 36.3% had heard of HPV infection, only 25.5% had heard of HPV vaccination. Overall, only 25.0% demonstrated good knowledge, while 52.9% had poor knowledge.

These findings indicate that awareness of HPV vaccination among adolescent girls in Enugu remains inadequate despite the introduction of routine HPV vaccination into Nigeria's national immunization programme. Poor knowledge remains one of the greatest barriers to achieving optimal vaccine coverage among adolescents.

The findings are, however, better than those reported by Israel *et al*. in Enugu, where 97.8% of respondents had no knowledge of HPV vaccination [5]. The relatively improved awareness observed in the present study may reflect increased public sensitization following the introduction of free HPV vaccination by the Federal Government of Nigeria in October 2023.

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Similarly, Duru *et al*. reported that approximately 65% of secondary school students in Nnewi had never heard of HPV infection or HPV vaccination before the national vaccine rollout [2]. This closely resembles the present findings, where 63.7% of respondents had never heard of HPV infection and 74.5% had never heard of HPV vaccination. The similarity probably reflects comparable educational and healthcare environments within southeastern Nigeria.

Studies conducted outside Nigeria have reported substantially better levels of knowledge. In Jimma, Ethiopia, over half (52.7%) of female secondary school students demonstrated good knowledge of HPV vaccination [10]. Likewise, Malaysian researchers reported that approximately half of their respondents had good knowledge regarding HPV vaccination [4]. These higher knowledge levels may be attributed to stronger school-based health education programmes, greater public awareness campaigns, and more established national HPV vaccination programmes.

In the present study, schools constituted the principal source of HPV information (36.3%), followed by churches (25.0%) and hospitals (20.0%). This finding highlights the important role educational institutions can play in improving adolescent awareness of HPV infection and vaccination. Strengthening school health education programmes therefore represents an important strategy for improving HPV vaccine awareness among adolescents.

Knowledge of specific aspects of HPV infection also remained limited. Fewer than half of respondents correctly identified HPV as a virus capable of causing cancer (46.1%), while only 38.2% correctly recognized sexual contact as the major route of transmission. Similarly, only 38.2% knew the recommended age for HPV vaccination, and only 39.2% correctly identified cervical cancer prevention as the principal benefit of HPV vaccination.

These findings suggest that awareness alone does not necessarily translate into adequate understanding of HPV infection or the benefits of vaccination. Comprehensive school-based health education programmes that provide accurate information on HPV transmission, vaccination schedules, and cervical cancer prevention are therefore needed to improve adolescents' knowledge and ultimately increase vaccine acceptance.

Uptake of Human Papillomavirus Vaccination

This study found that only 21.6% of respondents had received the HPV vaccine, indicating a relatively low level of vaccine uptake despite the availability of effective vaccines for the prevention of cervical cancer. Although this finding is higher than those reported in earlier Nigerian studies conducted before the introduction of routine HPV vaccination, it remains below the level required to achieve optimal population protection.

The uptake observed in this study is considerably higher than that reported by Israel *et al*. in Enugu, where less than 5% of respondents had received the HPV vaccine before its inclusion in the national immunization programme [5]. Likewise, Duru *et al*. in Nnewi reported extremely low vaccine uptake among adolescent girls, largely because of poor awareness, limited vaccine availability, and high vaccination costs [2]. The relatively higher uptake observed in the present study may reflect the positive impact of the Federal Government of Nigeria's introduction of free HPV vaccination into the National Programme on Immunization in 2023.

Nevertheless, the vaccination coverage observed in this study remains substantially lower than reports from countries with long-established school-based vaccination programmes. Studies conducted in Australia, the United Kingdom, and Rwanda have consistently reported HPV vaccine coverage exceeding 70%, largely because vaccination is routinely delivered through organized school health programmes supported by sustained public awareness campaigns [11–13]. These findings demonstrate the effectiveness of integrating HPV vaccination into school health services and ensuring consistent community engagement.

Among respondents who had not received the vaccine, the most frequently reported reason was lack of awareness (61.9%), followed by disbelief in vaccine effectiveness, religious discouragement, fear of vaccination, and uncertainty regarding where the vaccine could be obtained. Similar barriers have been documented in studies conducted across Nigeria, Ethiopia, Uganda, and Ghana, where inadequate knowledge, parental concerns, misinformation, and poor access to vaccination services were identified as major obstacles to HPV vaccine uptake [3,7,10,14].

Interestingly, despite the relatively low vaccination rate, nearly two-thirds (62.3%) of respondents indicated that they would recommend HPV vaccination to others. This suggests that many adolescents have a generally positive perception of vaccination once informed about its benefits, highlighting the potential impact of targeted health education and community sensitization programmes.

Factors Associated with HPV Vaccine Uptake

Several socio-demographic factors were significantly associated with HPV vaccine uptake in this study.

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Age demonstrated a statistically significant association with vaccination status, with older adolescents showing higher uptake than younger respondents. This finding is consistent with studies conducted in Ethiopia and Uganda, where increasing age was associated with improved awareness and greater opportunity to receive HPV vaccination [3,7]. Older students are more likely to have been exposed to health education programmes and school-based awareness campaigns, thereby increasing vaccine acceptance.

Class level was also significantly associated with vaccine uptake. Students in JSS2 were substantially more likely to have received the vaccine than those in JSS1. Similar findings have been reported in previous Nigerian studies, suggesting that students in higher classes generally possess better health knowledge and are more likely to participate in school health activities [2,5].

Parental educational attainment significantly influenced vaccine uptake. Respondents whose fathers and mothers had tertiary education were more likely to be vaccinated than those whose parents had lower educational levels. This finding agrees with studies conducted in Nigeria, Kenya, and Malaysia, where higher parental education was consistently associated with improved knowledge of HPV infection, increased confidence in vaccine safety, and greater willingness to vaccinate their children [4,15,16]. Educated parents are generally more receptive to evidence-based health information and preventive healthcare interventions.

Similarly, parental occupation showed significant associations with vaccine uptake. Adolescents whose parents were engaged in business or formal employment were more likely to have received the vaccine than those whose parents were unemployed or engaged in lower-income occupations. Comparable findings have been reported in studies from Ghana and Ethiopia, where household socioeconomic status influenced access to vaccination services and healthcare information [10,14].

Living arrangement also demonstrated a significant relationship with vaccine uptake. Students living with their parents had significantly higher vaccination rates than those living with guardians or other relatives. This finding underscores the important role of parental supervision and decision-making in adolescent immunization. Parents are generally responsible for providing consent, seeking healthcare services, and ensuring completion of vaccination schedules.

One of the strongest predictors of vaccine uptake in this study was knowledge of HPV vaccination. Respondents with good or fair knowledge were significantly more likely to have received the HPV vaccine than those with poor knowledge. This finding is consistent with reports from numerous studies conducted in Nigeria, Ethiopia, Kenya, Malaysia, and Uganda, all of which identified knowledge as one of the most important determinants of HPV vaccine acceptance and uptake [2–4,7,10]. Adequate knowledge increases confidence in vaccine safety and effectiveness while reducing the influence of myths and misconceptions surrounding vaccination.

In contrast, ethnicity and religion were not significantly associated with HPV vaccine uptake in this study. Similar observations have been reported in several Nigerian studies, suggesting that educational and socioeconomic factors may play a greater role than ethnic or religious background in determining vaccination behaviour [5,8].

OVERALL DISCUSSION

Overall, this study demonstrates that knowledge of HPV vaccination among female secondary school students in Enugu Metropolis remains inadequate, with only one-quarter of respondents demonstrating good knowledge. Although HPV vaccine uptake has improved compared with earlier Nigerian studies conducted before nationwide vaccine introduction, vaccination coverage remains suboptimal. Lack of awareness remains the principal barrier to vaccine uptake, while parental education, parental occupation, age, class level, living arrangement, and knowledge significantly influence vaccination status. These findings emphasize the need for strengthened school-based health education, increased community awareness, parental engagement, and wider access to HPV vaccination services to improve vaccine coverage among eligible adolescent girls.

CONCLUSION

Knowledge of Human Papillomavirus vaccination among female secondary school students in Enugu Metropolis was generally poor, and HPV vaccine uptake remained low despite the introduction of routine vaccination into Nigeria's national immunization programme. Lack of awareness was identified as the major barrier to vaccination. Vaccine uptake was significantly associated with age, class level, parental occupation, parental educational status, living arrangement, and knowledge of HPV vaccination. Improving awareness through school-based health education, parental involvement, and community sensitization programmes may substantially increase HPV vaccine acceptance and uptake among adolescent girls.

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RECOMMENDATIONS

Based on the findings of this study, the following recommendations are made:

School-based health education programmes should be strengthened to improve knowledge of HPV infection, cervical cancer, and HPV vaccination among adolescent girls.

Government and public health agencies should intensify awareness campaigns through schools, healthcare facilities, religious institutions, and mass media to improve public understanding of HPV vaccination.

Parents and guardians should be actively engaged through community education programmes to enhance acceptance of HPV vaccination and encourage timely vaccination of eligible adolescents.

School-based HPV vaccination programmes should be expanded to improve accessibility and increase vaccination coverage among adolescent girls.

Healthcare providers should continue educating adolescents and parents regarding the safety, effectiveness, and benefits of HPV vaccination during routine healthcare visits.

Further multicentre studies involving both public and private secondary schools should be conducted to provide broader evidence for policy development and national HPV vaccination strategies.

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