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# The impact of an educational intervention on undergraduate students' knowledge, acceptability, and willingness to pay for dapivirine vaginal ring in Nigeria's first indigenous university: a single-arm, non-randomized study

**Abdulmuminu Isah[1] · Gabriel Ezenri[1] · Ogechi Obi[1] · Nnamdi A. Okibe[1] · Hadiza Usman Ma'aji[2] · Ezinwanne J. Ugochukwu[1] · Cynthia C. Eze[1] · Chisom M. Amoke[1] · Augustus Ezeodimegwu[1] · Charles C. Idabor[1] · Mustapha Muhammed Abubakar[3] · Francis Iloabuchi[1] · Ikenna John Ugwu[1] · Chukwuebuka M. Asogwa[1] · Chinwe V. Ukwe[1] · Blessing Onyinye Ukoha-kalu[4]**

Received: 27 July 2024 / Accepted: 16 January 2025
Published online: 23 January 2025


## Abstract

**Background** This study aimed to assess the impact of an educational intervention on knowledge, acceptability, and willingness to pay (WTP) for dapivirine vaginal ring (DPV-VR) by undergraduate female students at the University of Nigeria (UNN).

**Methods** A cross-sectional design was adopted to obtain responses from the respondents using a validated 23-item questionnaire. A sample size of 1500 was estimated from five systematically sampled faculties. Their acceptability was accessed before and after educating them on the dapivirine vaginal ring (DPV-VR). WTP was determined in Naira (N490/$1) using contingent valuation. Descriptive statistics were used to summarize the findings, with inter-faculty comparison done with the Chi-squared test.

**Results** 1017 students responded to the questionnaire. The modal age was 18–24 years (754 [74.1%]), and most of them (886 [87.1%]) were unmarried. More than half of the respondents had tested for HIV (531 [52.2%])), with 3 (1.5%), 3 (1.7%), 2 (0.6%), 2 (1.8%) and 1 (0.5%) student from Arts, Biological Sciences, Pharmaceutical Sciences, Social Sciences, and Veterinary Medicine, respectively, having positive results. Only 304 (29.9%) of the students had prior knowledge of DPV-VR. There was about a two-fold increase in the acceptability of the dapivirine vaginal ring (DPV-VR) (294 to 596) after the intervention ($p \leq 0.001$). Most of the students (466 [45.8%]) indicated that they would be willing to pay < N410.00 for a single dapivirine vaginal ring (DPV-VR).

**Conclusions** Many of the female students at UNN were willing to use the dapivirine vaginal ring (DPV-VR); even more after they were informed of its importance. Most of the students were willing to pay less than one dollar out-of-pocket for the ring.

**Keywords** Dapavirine vaginal ring · Pre-exposure prophylaxis · Female students · HIV · Educational intervention · Awareness · Willingness to pay

✉ Blessing Onyinye Ukoha-kalu, blessing.ukoha-kalu@nottingham.ac.uk | [1]Department of Clinical Pharmacy and Pharmacy Management, University of Nigeria, Nsukka 410001, Enugu State, Nigeria. [2]Department of Clinical Pharmacy and Pharmacy Practice, Ahmadu Bello University, Zaria, Kaduna State, Nigeria. [3]Directorate of Therapeutic Services, Medical Services Branch, Nigerian Air Force, Abuja, Nigeria. [4]School of Medicine, University of Nottingham, Nottingham, England, UK.

## 1 Introduction

There remains a significant global public health concern about Human Immunodeficiency Virus (HIV), despite recent advances in HIV science. It was first identified in the 1980s and has since become a pandemic, affecting an estimated 38 million people (about twice the population of New York) worldwide as of 2019 [1]. The sub-Saharan African region accounted for two-thirds of new HIV infections in 2018, with young women and adolescent girls being at particularly elevated risk [2]. With an incidence rate close to 1.4% in the adult population, Nigeria ranks among the top ten countries with the world's largest HIV burden. There is a higher prevalence in urban areas and among certain populations such as men who have sex with men, sex workers, and injecting drug users (IDUs) [3, 4].

Certain social and cultural factors like gender violence, unequal power dynamics in sexual relationships, and limited access to HIV prevention information and services place women and girls at a greater risk of HIV infection. A study of HIV prevalence among female sex workers in Nigeria found that 60% were HIV positive [5]. As such, the development and implementation of effective HIV prevention strategies for women are crucial to reducing the burden of HIV in sub-Saharan Africa and achieving global HIV/AIDS targets such as the 95:95:95. One potential HIV prevention method for women is the dapivirine vaginal ring (DPV-VR), which is a slow-release formulation of the antiretroviral drug dapivirine that is inserted into the vagina to provide sustained levels of the drug over one month [6, 7].

The DPV-VR, developed specifically for women, can be used in conjunction with other HIV prevention methods, including condoms. Clinical trials have demonstrated the effectiveness of the DPV-VR in reducing the risk of HIV infection in women. According to 2016 studies, dapivirine ring reduced the risk of HIV infection by 27% [6] and 30% [7] in women who use it consistently. Women in Malawi, South Africa, Uganda, and Zimbabwe have perceived the ring to be effective and well-tolerated [8].

Despite the established effectiveness of the DPV-VR, the awareness, availability, and utilization of the ring in many developing countries are still low. The use of the ring may be influenced by awareness and willingness to pay for the ring among potential users. Many at-risk individuals do not use pre-exposure prophylaxis (PrEP) due to a lack of knowledge of it [9]. Other factors such as perceived effectiveness, convenience, and stigma influence young women's willingness to pay for antiretroviral drugs, HIV self-test kits, and other preventive tools [10]. Several studies have been done on HIV prevention and pre-exposure prophylaxis. However, studies focusing on the use of dapivirine vaginal rings for the prevention of HIV are scarce. Price is often a determinant of the desire of clients to request a service, especially in low- and middle-income countries like Nigeria where the utilization of out-of-pocket payment compared to insurance as the predominant model has limited access to healthcare [11].

Therefore, the present study aimed to investigate the impact of an educational intervention on knowledge, acceptability, and willingness to pay (WTP) for dapivirine rings among students at the University of Nigeria.

## 2 Methods

### 2.1 Study design and setting

A single-arm pre-post educational interventional study was conducted among female students at the University of Nigeria, Nsukka in June 2022. This study used a single-arm non-randomised study design because its objective was to compare participants' awareness and willingness to pay for the Dapivirine Vaginal Ring (DPV-VR) before and after the educational intervention. Since the focus of the study was on assessing the impact of the intervention within the same group of participants, there was no need for a control group. The University of Nigeria, Nsukka (UNN) is Nigeria's first indigenous federal public university (post-independence in 1960), with its main campus located in Nsukka, a semi-urban town in Enugu State, Nigeria. The university offers a wide range of undergraduate and postgraduate programs in the arts, sciences, social sciences, education, law, engineering, and medicine. UNN is known for its strong emphasis on research and has several research centers and institutes dedicated to various fields of study. Its students come from different states of the country and beyond. The University comprises students of various economic statuses ranging from low-income to high-income economic status. It also comprises students with diverse religious backgrounds with Christianity being the most popular.

### 2.2 Study population

The study population included all female undergraduate students at the Nsukka Campus of the University of Nigeria. The selection of the female gender was, obviously, purposively to use the population that would be required to use the DPV-VR.

### 2.3 Sampling technique

A systematic sampling technique was used to randomly select the faculties whose students would be recruited for the study. The University of Nigeria, Nsukka has ten faculties, each representing a diverse cross-section of academic disciplines. Using systematic sampling, faculties were listed in alphabetical order and the study researchers selected every other faculty, starting with the first. This method ensured a representative and balanced sample that reflected the diversity of the student body. The choice of 1,500 students was carefully considered, based on statistical power calculations, to achieve a sample size that would give room to capture meaningful insights while maintaining feasibility and precision.

### 2.4 Study instrument

A 23-item self-administered questionnaire was developed and validated for the study. The 23-item questionnaire underwent validation to ensure its reliability and accuracy. Content validity was established with input from experts in HIV research at the University of Nigeria, who reviewed the relevance and clarity of the items. Face validity was tested with 10 students who provided feedback on the questionnaire's clarity and flow, leading to minor revisions. For reliability, Cronbach's alpha was calculated and the score was greater than 0.7, indicating good internal consistency. These steps ensured that the questionnaire was both valid and reliable for measuring the intended constructs in this study. The questionnaire consisted of three sections (A–C) and included closed-ended and open-ended questions. Section A (6 items) included socio-demographic parameters such as age, level of study, and marital status. Section B (5 items) inquired about the participants' HIV status and sexual behavior. Section C (12 items) consisted of questions that assessed the students' awareness of DPV-VR, willingness to pay for the ring, how much they were willing to pay, and reasons for unwillingness to pay as appropriate.

The educational intervention was a professionally designed visual poster specifically created to provide essential information on the dapivirine vaginal ring (DPV-VR) following baseline data collection. The content covered five main areas: the image and physical description of the ring, its composition, the mechanism of action, the method and frequency of use, and possible adverse effects. To ensure the information was accurate, relevant, and effectively communicated, the poster content was developed in consultation with experts in HIV research and management at the University of Nigeria. These experts reviewed the scientific accuracy, language clarity, and visual appeal of the poster to maximize engagement and understanding among students. Furthermore, the tool underwent validation to ensure it met educational standards and was aligned with the needs of the target audience, making it both informative and accessible.

### 2.5 Data collection procedure

The questionnaire was converted into a Google Form and the link was sent to the selected students' WhatsApp contacts, after obtaining consent from the respective class representatives to be added to the various class to aid the identification of genuine members of each class. For each person, the baseline data was first documented, and, on confirmation that the response had been submitted, the educational intervention was done. Also, on confirmation that the educational material had been accessed and studied, the post-intervention questionnaire was sent. For each stage of the study, reminder messages were sent to the participants, as necessary. The interval between each stage of the study was one week to measure immediate changes in participants' knowledge and attitudes right after the educational intervention. This short timeframe helped us assess the direct impact of the intervention before other factors might influence their responses over time. The setting of the Google account was also programmed to ensure that non-eligible persons did not have access to the links, just as multiple responses from a single user was also barred. Persons who did not submit the baseline responses were not allowed to go any further in the study. The study process took two months to complete.

### 2.6 Data management and analysis

At the end of the data collection period, the submission of responses was deactivated on the Google Form. Thereafter, the responses were downloaded in Microsoft Excel (2019) format and thoroughly checked for errors. The cleaned data was then imported into Statistical Product and Services Solution (V.27) for analysis. To summarize the study's findings, descriptive analyses such as frequency and percentage were used to describe the study's independent and dependent variables. A chi-squared test was used in the comparison of the respondents' levels of acceptability of the DPV-VR before and after the educational intervention. Binary logistic regression was employed in the determination of the respondents' sociodemographic characteristics that were predictors of their post-intervention acceptability and willingness to pay for the DPV-VR, with both dichotomized into 'yes' and 'others (no and not sure).' WTP amount was obtained in Naira (N490/$1 at the time of the study, 2022) using contingent valuation. The study used the N490/$1 exchange rate because it reflected the average rate at the time of the study in 2022, ensuring that participants' responses on willingness to pay (WTP) would be meaningful in terms of local currency. In addition, contingent valuation was used because it is especially useful for estimating what people might be willing to pay for health products that are not widely available yet, like the Dapivirine Vaginal Ring (DPV-VR). By using this approach, this study was able to create a scenario where participants could realistically consider and respond to the value, they would place on the DPV-VR, thereby making it easy to get a true sense of potential demand and affordability for this new health intervention. The level of significance was set at $P < 0.05$.

## 3 Results

A total of 1017 students (67.8% response rate) participated in the study: 196 (19.3%), 173 (17%), 342 (33.6%), 113 (11.1%), and 193 (19%) students from the faculties of Arts, Biological Sciences, Pharmaceutical Sciences, Social Sciences and Veterinary Medicine, respectively. The level of study, marital status, and age distribution varied among the students in the five faculties ($P < 0.001$). Most of the participants (754[74.1%]) were between the ages of 18 to 24 years, single, (886[87.1%]), and had SSCE as the highest education qualification, (751[73.8%]). The details about the socio-demographic characteristics of the respondents are shown in Table 1.

Among the 1017 participants, 531 (52.2%) students knew their HIV status at the time of the study: 98 (50.0%), 103 (59.5%), 170 (49.7%), 69 (61.1%), 91 (47.2%) students from Arts, Biological Sciences, Pharmaceutical Sciences, Social Sciences, and Veterinary Medicine, respectively. Out of the students who conducted the HIV test, only 11 (1.1) students were HIV-positive while 129 (12.7%) could not remember the results. Other details about the HIV serostatus of the respondents and their partners are presented in Table 2.

Overall, only 304 (29.9%) out of 1017 students had heard about the DPV-VR. Yet only 12 (1.2%) respondents correctly indicated that DPV-VR is used by females ($p < 0.001$). However, 486 (47.8) rightly stated that a single DPV-VR is to be used for one month. There was a significant relationship between the students' faculties of study and their knowledge about DPV-VR before the intervention. Table 3 provides further information about the respondent's knowledge of DPV-VR before the intervention.

294 students were willing to use the DPV-VR without proper prior knowledge of its function. The number increased to 596 after the educational intervention about DPV-VR ($p < 0.001$). The proportion of the students who were 'not sure' of their choices in the use of DPV-VR reduced from 517 to 255 after the intervention ($p < 0.001$). On the willingness to pay for DPV-VR (out-of-pocket) if it is not provided free of charge, 572 students expressed a positive willingness to pay for it, but when given different possible willingness-to-pay ranges, 466 respondents chose below N410. Of the possible reasons for not willing to pay for DPV-VR, '*It should be provided by the government at no cost*' was the major reason, given by 381 (53.7%) respondents. See Tables 4, 5, and 6 for details about the effect of the educational intervention on the students' acceptability of DPV-VR.

Only the students' level of study in the Pharmacy school was a predictor of their acceptability of DPV-VR after the educational intervention. Being in the fifth or second year of study was associated with 2.999 or 3.050 odds of accepting DPV-VR compared to being in the first year ($p = 0.044$ and $p = 0.046$), respectively. For the willingness to pay for DPV-VR, the only predictor among the respondents' sociodemographic characteristics was marital status, such that being married had a 14.1% higher chance compared to being single (Tables 7 and 8).

**Table 1** Sociodemographic characteristics of the respondents

| Characteristics | | Faculty | | | | | Total | P-Value |
|---|---|---|---|---|---|---|---|---|
| | | Arts | Bio Sci | n (%) Pharm. Sci | Social Sci | Vet. Med | | |
| Age (years) | < 18 | 21 (10.7) | 2 (1.2) | 5 (1.5) | 3 (2.7) | 16 (8.3) | 47 (4.6) | < 0.001 |
| | 18–24 | 134 (68.4) | 141 (81.5) | 261 (76.3) | 79 (69.9) | 139 (72.0) | 754 (74.1) | |
| | 25–29 | 36 (18.4) | 28 (16.2) | 71 (20.8) | 26 (23.0) | 33 (17.1) | 194 (19.1) | |
| | 30 and above | 5 (2.6) | 2 (1.2) | 5 (1.5) | 5 (4.4) | 5 (2.6) | 22 (2.2) | |
| Total | | 196 (100.0) | 173 (100.0) | 342 (100.0) | 113 (100.0) | 193 (100.0) | 1017 (100) | |
| Level | 100 | 31 (15.8) | 3 (1.7) | 21 (6.1) | 8 (7.1) | 27 (14.0) | 90 (8.8) | < 0.001 |
| | 200 | 65 (33.2) | 24 (13.9) | 40 (11.7) | 18 (15.9) | 74 (38.3) | 221 (21.7) | |
| | 300 | 47 (24.0) | 41 (23.7) | 61 (17.8) | 41 (36.3) | 43 (22.3) | 233 (22.9) | |
| | 400 | 53 (27.0) | 105 (60.7) | 129 (37.7) | 46 (40.7) | 36 (18.7) | 369 (36.3) | |
| | 500 | 0 (0.0) | 0 (0.0) | 91 (26.6) | 0 (0.0) | 13 (6.7) | 104 (10.2) | |
| Total | | 196 (100.0) | 173 (100.0) | 342 (100.0) | 113 (100.0) | 193 (100.0) | 1017 (100) | |
| Entry mode | UTME | 177 (90.3) | 154 (89.0) | 280 (81.9) | 96 (85.0) | 154 (79.8) | 861 (84.7) | 0.012 |
| | DE/transfer | 19 (9.7) | 19 (11.0) | 62 (18.1) | 17 (15.0) | 39 (20.2) | 156 (15.3) | |
| Total | | 196 (100.0) | 173 (100.0) | 342 (100.0) | 113 (100.0) | 193 (100.0) | 1017 (100) | |
| Highest qualification | SSCE | 136 (69.4) | 125 (72.3) | 283 (82.7) | 67 (59.3) | 140 (72.5) | 751 (73.8) | < 0.001 |
| | B.Sc | 38 (19.4) | 40 (23.1) | 45 (13.2) | 34 (30.1) | 22 (11.4) | 179 (17.6) | |
| | NCE/ND | 22 (11.2) | 8 (4.6) | 14 (4.1) | 12 (10.6) | 31 (16.1) | 87 (8.6) | |
| Total | | 196 (100.0) | 173 (100.0) | 342 (100.0) | 113 (100.0) | 193 (100.0) | 1017 (100) | |
| Marital status | Single | 151 (77.0) | 153 (88.4) | 318 (93.0) | 104 (92.0) | 160 (82.9) | 886 (87.1) | < 0.001 |
| | Engaged | 28 (14.3) | 17 (9.8) | 9 (2.6) | 4 (3.5) | 14 (7.3) | 72 (7.1) | |
| | Married | 13 (6.6) | 3 (1.7) | 15 (4.4) | 5 (4.4) | 15 (7.8) | 51 (5.0) | |
| | Divorced | 4 (2.0) | 0 (0.0) | 0 (0.0) | 0 (0.0) | 4 (2.1) | 8 (0.8) | |
| Total | | 196 (100.0) | 173 (100.0) | 342 (100.0) | 113 (100.0) | 193 (100.0) | 1017 (100) | |

## 4 Discussion

This study examined the effect of an educational intervention on the levels of awareness and willingness to pay for dapivirine vaginal rings among female undergraduate students at the University of Nigeria. Most of the respondents were between 18 to 24 years and only a few were above 30 years of age. This was expected as the official University age in Nigeria begins at 16 years, with many students spending between four to six years in the University. Although over half of the respondents reported testing for HIV within the last four weeks before the study, only a small proportion reported HIV-positive results. Many students would prefer to conceal their status, and this may limit their chances of accessing the appropriate care.

### 4.1 Key findings

Before the educational intervention, most respondents had poor awareness of the DPV-VR. Many of the students had not heard about it, and did not know the gender that it is supposed to use, the duration of its use, as well as the time to onset of action. The faculties or areas of study played a key role in the participants' awareness of the dapivirine ring. More students in the pharmaceutical sciences exhibited significantly more awareness than students of other faculties. This could be because the pharmacy curriculum consists of topics relating to the prevention and management of HIV at various levels of their study, and their students might have received lectures on the topic before participating in the study.

A considerable proportion of the respondents were not sure, initially, if they would accept the DPV-VR. However, after the intervention, well over half of them were willing to accept to use the vaginal ring if they were provided

**Table 2** HIV serostatus of respondents and their partners

| | | Faculty | | | | | Total | P-Value |
|---|---|---|---|---|---|---|---|---|
| | | Arts | Bio. Sci | n (%) Pharm. Sci | Social Sci | Vet. Med | | |
| Have you ever been tested for HIV? | Yes | 98 (50.0) | 103 (59.5) | 170 (49.7) | 69 (61.1) | 91 (47.2) | 531 (52.2) | 0.033 |
| | No | 98 (50.0) | 70 (40.5) | 172 (50.3) | 44 (38.9) | 102 (52.8) | 486 (47.8) | |
| Total | | 196 (100.0) | 173 (100.0) | 342 (100.0) | 113 (100.0) | 193 (100.0) | 1017 (100.0) | |
| If yes, what is your current HIV status? | Positive | 3 (1.5) | 3 (1.7) | 2 (0.6) | 2 (1.8) | 1 (0.5) | 11 (1.1) | 0.198 |
| | Negative | 165 (84.2) | 152 (87.9) | 303 (88.9) | 99 (87.6) | 157 (81.3) | 876 (86.2) | |
| | Cannot remember | 28 (14.3) | 18 (10.4) | 36 (10.6) | 12 (10.6) | 35 (18.1) | 129 (12.7) | |
| Total | | 196 (100.0) | 173 (100.0) | 341 (100.0) | 113 (100.0) | 193 (100.0) | 1016 (100.0) | |
| Has any of your sex partners ever tested positive for HIV in the past four weeks? | Yes | 15 (7.7) | 18 (10.4) | 19 (5.6) | 11 (9.7) | 8 (4.1) | 71 (7.0) | 0.015 |
| | No | 101 (51.5) | 100 (57.8) | 208 (60.8) | 72 (63.7) | 102 (52.8) | 583 (57.3) | |
| | Do not know | 80 (40.8) | 55 (31.8) | 115 (33.6) | 30 (26.5) | 83 (43.0) | 363 (35.7) | |
| Total | | 196 (100.0) | 173 (100.0) | 342 (100.0) | 113 (100.0) | 193 (100.0) | 1017 (100.0) | |
| Has your male partner used condom during vaginal sex in the past 4 weeks? | Yes | 47 (24.0) | 46 (26.6) | 75 (21.9) | 41 (36.3) | 41 (21.2) | 250 (24.6) | 0.007 |
| | No | 52 (26.5) | 45 (26.0) | 62 (18.1) | 24 (21.2) | 44 (22.8) | 227 (22.3) | |
| | Do not have a partner | 97 (49.5) | 82 (47.4) | 205 (59.9) | 48 (42.5) | 108 (56.0) | 540 (53.1) | |
| Total | | 196 (100.0) | 173 (100.0) | 342 (100.0) | 113 (100.0) | 193 (100.0) | 1017 (100.0) | |
| Have you ever been involved with anal sex in the past 1 year? | Yes | 29 (14.8) | 9 (5.2) | 17 (5.0) | 10 (8.8) | 20 (10.4) | 85 (8.4) | < 0.001 |
| | No | 125 (63.8) | 159 (91.9) | 315 (92.1) | 98 (86.7) | 121 (62.7) | 818 (80.4) | |
| | Cannot remember | 42 (21.4) | 5 (2.9) | 10 (2.9) | 5 (4.4) | 52 (26.9) | 114 (11.2) | |
| Total | | 196 (100.0) | 173 (100.0) | 342 (100.0) | 113 (100.0) | 193 (100.0) | 1017 (100.0) | |

**Table 3** Respondents' knowledge on dapivirine vaginal ring

| | | Faculty | | | | | Total | P-value |
|---|---|---|---|---|---|---|---|---|
| | | Arts | Biological sciences | Pharmaceutical sciences | Social sciences | Veterinary medicine | | |
| Have you ever heard of dapivirine vaginal ring? | Yes | 30 (15.3) | 55 (31.8) | 160 (46.8) | 29 (25.7) | 30 (15.5) | 304 (29.9) | < 0.001 |
| | No | 137 (69.9) | 114 (65.9) | 173 (50.6) | 81 (71.7) | 123 (63.7) | 628 (61.8) | |
| | Cannot remember | 29 (14.8) | 4 (2.3) | 9 (2.6) | 3 (2.7) | 40 (20.7) | 85 (8.4) | |
| Total | | 196 (100.0) | 173 (100.0) | 342 (100.0) | 113 (100.0) | 193 (100.0) | 1017 (100.0) | |
| Who uses dapivirine vaginal ring? | Male | 6 (3.1) | 1 (0.6) | 0 (0.0) | 2 (1.8) | 3 (1.6) | 12 (1.2) | < 0.001 |
| | Female | 94 (48.0) | 104 (60.1) | 263 (76.9) | 59 (52.2) | 42 (21.8) | 562 (55.3) | |
| | Do not know | 16 (8.2) | 1 (0.6) | 2 (0.6) | 3 (2.7) | 14 (7.3) | 36 (3.5) | |
| | Both | 80 (40.8) | 67 (38.7) | 77 (22.5) | 49 (43.4) | 134 (69.4) | 407 (40.0) | |
| Total | | 196 (100.0) | 173 (100.0) | 342 (100.0) | 113 (100.0) | 193 (100.0) | 1017 (100.0) | |
| How many hours does it take for a dapivirine vaginal ring to become effective? | < 24 h | 27 (13.8) | 22 (12.7) | 47 (13.7) | 7 (6.2) | 21 (10.9) | 124 (12.2) | < 0.001 |
| | ≥ 24 h | 44 (22.4) | 28 (16.2) | 124 (36.3) | 20 (17.7) | 25 (13.0) | 241 (23.7) | |
| | Do not know | 125 (63.8) | 123 (71.1) | 171 (50.0) | 86 (76.1) | 147 (76.2) | 652 (64.1) | |
| Total | | 196 (100.0) | 173 (100.0) | 342 (100.0) | 113 (100.0) | 193 (100.0) | 1017 (100.0) | |
| How long is a single dapivirine ring used? | One vaginal sex act | 81 (41.3) | 59 (34.1) | 81 (23.7) | 37 (32.7) | 57 (29.5) | 315 (31.0) | < 0.001 |
| | One month | 65 (33.2) | 85 (49.1) | 220 (64.3) | 45 (39.8) | 71 (36.8) | 486 (47.8) | |
| | Six months | 21 (10.7) | 15 (8.7) | 19 (5.6) | 11 (9.7) | 23 (11.9) | 89 (8.8) | |
| | One year | 13 (6.6) | 8 (4.6) | 9 (2.6) | 4 (3.5) | 16 (8.3) | 50 (4.9) | |
| | Lifetime | 16 (8.2) | 6 (3.5) | 13 (3.8) | 16 (14.2) | 26 (13.5) | 77 (7.6) | |
| Total | | 196 (100.0) | 173 (100.0) | 342 (100.0) | 113 (100.0) | 193 (100.0) | 1017 (100.0) | |

**Table 4** Respondent's acceptance of dapivirine vaginal ring before the intervention

| | | Faculty | | | | | Total | P-value |
|---|---|---|---|---|---|---|---|---|
| | | Arts | Bio. Sci | Pharm. Sci | Social Sci | Vet. Med | | |
| Would you accept to use dapivirine vaginal ring? | Yes | 54 (18.4) | 43 (14.6) | 115 (39.1) | 30 (10.2) | 52 (17.7) | 294 (100.0) | 0.019 |
| | No | 57 (27.7) | 35 (17.0) | 60 (29.1) | 20 (9.7) | 34 (16.5) | 206 (100.0) | |
| Total | | 196 (19.3) | 173 (17.0) | 342 (33.6) | 113 (11.1) | 193 (19.0) | 1017 (100.0) | |
| If Yes, Why? | Not sure | 85 (16.4) | 95 (18.4) | 167 (32.3) | 63 (12.2) | 107 (20.7) | 517 (100.0) | < 0.001 |
| | It can prevent other STDs | 58 (27.8) | 27 (12.9) | 39 (18.7) | 20 (9.6) | 65 (31.1) | 209 (100.0) | |
| | It would prevent pregnancy | 24 (22.9) | 10 (9.5) | 18 (17.1) | 4 (3.8) | 49 (46.7) | 105 (100.0) | |
| Total | | 150 (21.0) | 101 (14.1) | 225 (31.5) | 70 (9.8) | 168 (23.5) | 714 (100.0) | |
| If No, why? | It may make me uncomfortable | 32 (18.8) | 31 (18.2) | 45 (26.5) | 19 (11.2) | 43 (25.3) | 170 (100.0) | < 0.001 |
| | It may make my partner uncomfortable | 47 (38.2) | 9 (7.3) | 21 (17.1) | 11 (8.9) | 35 (28.5) | 123 (100.0) | |
| | It may have side effects | 74 (16.9) | 73 (16.7) | 144 (33.0) | 52 (11.9) | 94 (21.5) | 437 (100.0) | |
| Total | | 153 (21.0) | 113 (15.5) | 210 (28.8) | 82 (11.2) | 172 (23.6) | 730 (100.0) | |

**Table 5** Respondent's acceptance and willingness to pay for dapivirine vaginal ring after the intervention

| | | Faculty | | | | | Total | P-value |
|---|---|---|---|---|---|---|---|---|
| | | Arts | Bio. Sci | Pharm. Sci | Social Sci | Vet. Med | | |
| Now that you know about Dapivirine vaginal ring, will you accept to use it? | Yes | 95 (15.9) | 97 (16.3) | 193 (32.4) | 63 (10.6) | 148 (24.8) | 596 (100.0) | < 0.001 |
| | No | 56 (33.7) | 28 (16.9) | 56 (33.7) | 13 (7.8) | 13 (7.8) | 166 (100.0) | |
| | Not Sure | 45 (17.6) | 48 (18.8) | 93 (36.5) | 37 (14.5) | 32 (12.5) | 255 (100.0) | |
| Total | | 196 (19.3) | 173 (17.0) | 342 (33.6) | 113 (11.1) | 193 (19.0) | 1017 (100.0) | |
| Will you be willing to pay to be provided with the vaginal ring by a clinician? | Yes | 83 (14.5) | 115 (20.1) | 232 (40.6) | 71 (12.4) | 71 (12.4) | 572 (100.0) | < 0.001 |
| | No | 113 (25.4) | 58 (13.0) | 110 (24.7) | 42 (9.4) | 122 (27.4) | 445 (100.0) | |
| Total | | 196 (19.3) | 173 (17.0) | 342 (33.6) | 113 (11.1) | 193 (19.0) | 1017 (100.0) | |
| If given the below price ranges, how much are you willing to pay to be provided dapivirine vaginal rings per year? | < N410 | 78 (16.7) | 83 (17.8) | 151 (32.4) | 55 (11.8) | 99 (21.2) | 466 (100.0) | < 0.001 |
| | N410–N8,200 | 20 (22.0) | 11 (12.1) | 39 (42.9) | 1213.2) | 9 (9.9) | 91 (100.0) | |
| | N8,700–N16,500 | 1 (4.0) | 4 (16.0) | 15 (60.0) | 2 (8.0) | 3 (12.0) | 25 (100.0) | |
| | N16,800–N24,700 | 7 (41.2) | 2 (11.8) | 4 (23.5) | 1 (5.9) | 3 (17.6) | 17 (100.0) | |
| | N25,100–N32,900 | 3 (42.9) | 1 (14.3) | 3 (42.9) | 0 (0.0) | 0 (0.0) | 7 (100.0) | |
| | N33,300–41,100 | 0 (0.0) | 2 (28.6) | 4 (57.1) | 0 (0.0) | 1 (14.3) | 7 (100.0) | |
| | > N41,100 | 42 (20.1) | 40 (19.1) | 80 (38.3) | 27 (12.9) | 20 (9.6) | 209 (100.0) | |
| Why may you not willing to pay for it? | It may not be effective | 46 (28.6) | 28 (26.4) | 36 (17.7) | 12 (17.9) | 31 (18.0) | 153 (21.6) | 0.071 |
| | It may be expensive | 36 (22.4) | 29 (27.4) | 56 (27.6) | 19 (28.4) | 35 (20.3) | 175 (24.7) | |
| | It should be provided by the government at no cost | 79 (49.1) | 49 (46.2) | 111 (54.7) | 36 (53.7) | 106 (61.6) | 381 (53.7) | |
| Total | | 161 (100.0) | 106 (100.0) | 203 (100.0) | 67 (100.0) | 172 (100.0) | 709 (100.0) | |

**Table 6** Comparison of the respondents' levels of acceptability of dapavirine vaginal ring before and after the intervention

| | | Post-intervention acceptability | | | | | | Total | | *P*-value |
|---|---|---|---|---|---|---|---|---|---|---|
| | | Yes | | No | | Not sure | | | | |
| | | n | % | n | % | n | % | n | % | |
| Pre-intervention acceptability | Yes | 258 | 43.3 | 15 | 9.0 | 21 | 8.2 | 294 | 28.9 | ≤ 0.001 |
| | No | 62 | 10.4 | 91 | 54.8 | 53 | 20.8 | 206 | 20.3 | |
| | Not sure | 276 | 46.3 | 60 | 36.1 | 181 | 71.0 | 517 | 50.8 | |
| Total | | 596 | 100.0 | 166 | 100.0 | 255 | 100.0 | 1017 | 100.0 | |

**Table 7** Respondents' Sociodemographic Characteristics of their Acceptability of the Dapavirine Vaginal Ring after Educational Intervention

| | | B | S.E | Wald | df | Sig | Exp (B) | 95% C.I.for EXP (B) | |
|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | | Lower | Upper |
| Age (years) | < 18 (Ref.) | | | 0.179 | 3 | 0.981 | | | |
| | 18–24 | − 0.377 | 0.906 | 0.173 | 1 | 0.677 | 0.686 | 0.116 | 4.053 |
| | 25–29 | − 0.347 | 0.952 | 0.133 | 1 | 0.716 | 0.707 | 0.109 | 4.568 |
| | 30 and above | 21.012 | 1E4 | 0.000 | 1 | 0.999 | 1E9 | 0.000 | |
| Level of study | 100 (Ref.) | | | 8.027 | 5 | 0.155 | | | |
| | 200 | 1.115 | 0.559 | 3.987 | 1 | 0.046 | 3.050 | 1.021 | 9.114 |
| | 300 | 0.473 | 0.535 | 0.783 | 1 | 0.376 | 1.605 | 0.562 | 4.583 |
| | 400 | 0.819 | 0.523 | 2.451 | 1 | 0.117 | 2.268 | 0.814 | 6.324 |
| | 500 | 1.098 | 0.546 | 4.044 | 1 | 0.044 | 2.999 | 1.028 | 8.750 |
| | 600 | 1.285 | 1.002 | 1.646 | 1 | 0.200 | 3.616 | 0.507 | 25.771 |
| Highest qualification | | − 0.418 | 0.294 | 2.022 | 1 | 0.155 | 0.659 | 0.370 | 1.171 |
| Marital status | Single (Ref.) | | | 1.090 | 2 | 0.580 | | | |
| | Engaged | 0.107 | 0.618 | 0.030 | 1 | 0.862 | 1.113 | 0.332 | 3.739 |
| | Married | − 0.810 | 0.790 | 1.049 | 1 | 0.306 | 0.445 | 0.095 | 2.095 |
| | Constant | − 0.075 | 0.981 | 0.006 | 1 | 0.939 | 0.928 | | |

**Table 8** Respondents' sociodemographic characteristics of their willingness to pay for dapavirine vaginal ring

| | | B | S.E | Wald | df | Sig | Exp (B) | 95% C.I.for EXP (B) | |
|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | | Lower | Upper |
| Age (years) | < 18 (Ref.) | | | 0.708 | 3 | 0.871 | | | |
| | 18–24 | 0.060 | 0.891 | 0.005 | 1 | 0.946 | 1.062 | 0.185 | 6.095 |
| | 25–29 | − 0.220 | 0.941 | 0.055 | 1 | 0.815 | 0.802 | 0.127 | 5.075 |
| | 30 and above | 21.653 | 1E4 | 0.000 | 1 | 0.999 | 2E9 | 0.000 | |
| Level of study | 100 (Ref.) | | | 6.488 | 5 | 0.262 | | | |
| | 200 | − 0.213 | 0.597 | 0.128 | 1 | 0.721 | 0.808 | 0.251 | 2.604 |
| | 300 | − 0.498 | 0.575 | 0.751 | 1 | 0.386 | 0.607 | 0.197 | 1.875 |
| | 400 | − 0.320 | 0.564 | 0.323 | 1 | 0.570 | 0.726 | 0.240 | 2.193 |
| | 500 | 0.368 | 0.601 | 0.376 | 1 | 0.540 | 1.445 | 0.445 | 4.690 |
| | 600 | − 0.230 | 1.020 | 0.051 | 1 | 0.822 | 0.794 | 0.108 | 5.867 |
| Highest qualification | | 0.047 | 0.313 | 0.023 | 1 | 0.880 | 1.049 | 0.568 | 1.937 |
| Marital status | Single (Ref.) | | | 5.187 | 2 | 0.075 | | | |
| | Engaged | 0.252 | 0.643 | 0.154 | 1 | 0.695 | 1.287 | 0.365 | 4.537 |
| | Married | − 1.958 | 0.876 | 4.997 | 1 | 0.025 | 0.141 | 0.025 | 0.786 |
| | Constant | 0.896 | 0.991 | 0.817 | 1 | 0.366 | 2.450 | | |

with it. The majority of those who would not accept it reported the fear of potential side effects as their main reason. These concerns vary among the students in different faculties. Furthermore, most of the respondents were willing to pay for the DPV-VR if provided by a clinician, with close to half of them willing to pay a token for it. The willingness to pay differed across the faculties as more students from the Arts and Veterinary Medicine were unwilling to pay. More than half of the respondents stated that they are unwilling to pay for DPV-VR because the government should ordinarily provide it at no cost.

### 4.2 Comparison with previous studies

Pre-exposure prophylaxis is effective in preventing HIV in individuals at elevated risk of HIV infection, including female sex workers. The use of a dapivirine ring, along with safe sex practices during vaginal intercourse, provides protection against HIV infection in women. Studies have reported varied awareness and knowledge of pre-exposure prophylaxis across different populations. In a study by Griffin et al., over 80% of men who have sex with men in the southeastern United States have good awareness of PrEP, but only 9.2% had used it [12]. Predictors of PrEP awareness include education, HIV status, recent HIV testing, and lack of provider awareness about sexual minorities [12]. Similar findings were also reported in China where men who have sex with men showed good awareness of PrEP but a low rate of use [13]. According to Ogunbajo and colleagues, about half of gay and bisexual men in Nigeria had no prior knowledge of PrEP but the majority were willing to use it after being informed about it [14]. Similar findings were reported about female sex workers in Nigeria who were found to have a poor level of awareness but a high willingness to use pre-exposure methods. A study conducted in Miami among women of reproductive age found that out of 63% of women who knew about PrEP, only 5% were using it. The study established that women had poor awareness of PrEP and women with income below poverty level, more male sexual partners, and lifetime HIV testing were more likely to be aware of PrEP [15]. Furthermore, Nigerian university students have been shown to have poor levels of awareness of PrEP [16]. Women and female students in developing countries would benefit from educational interventions utilizing informational sessions or workshops led by healthcare providers and other trained professionals to increase awareness and knowledge of DPV-VR and other PrEP options. Also, targeted marketing and advertising campaigns could be implemented to reach a wider audience and increase awareness of the product among female undergraduate students in Nigeria.

There is a paucity of studies that specifically focus on the knowledge and awareness of DPV-VR as an effective PrEP measure. A large proportion of the respondents in the current study were willing to accept the dapivirine ring. This corroborates with previous findings from clinical trials where 97% of the participants were willing to use the DPV-VR [17]. Participants of the MTN-020/ASPIRE phase III trial, involving women from Malawi, South Africa, Uganda, and Zimbabwe, exhibited overall high acceptability of the vaginal ring, which varied across countries [18]. Although dapivirine ring has a good safety and acceptability profile, women have perceived concerns about the ring's interference with sex, menstruation, or other problematic changes that may arise [18]. A systematic review of the acceptability of the vaginal ring in low- and middle-income countries showed overall high acceptability and up to 100% continuation rate, with infrequent adverse effects and major concerns about the ring getting lost in the body [19]. The respondents of the present study who were unwilling to accept the vaginal ring were mostly concerned about the potential side effects. According to the qualitative part of the ASPIRE trial, initial fears of potential side effects of the ring reduced with the ring's uptake and use, as the women that participated in the trial began to like it and developed ownership of it over time [20].

It is also noted that most respondents in the present study were willing to pay for the DPV-VR and prepared to pay less than one dollar for it. These findings are like a Kenyan study presented at the INTEREST 2022 conference in Kampala. The researchers reported that out of 83% of women who were willing to pay for a dapivirine ring, about 50% agreed to pay 100 shillings, which is less than one dollar [21]. The current price for the dapivirine ring is $6–$8 per ring or $72–$96 per year. Model studies suggest that the implementation of DPV-VR is a cost-effective measure for HIV prevention even in female sex workers and other high-risk groups [22, 23]. However, the willingness to pay could challenge its uptake and utilization, particularly in low- and middle-income countries where most healthcare expenditures are paid out-of-pocket. Although HIV medications, including oral PrEP, are provided at no cost to the clients at most HIV treatment centers in Nigeria.

As much as this study introduces significant insight into the acceptability of DPV-VR in Nigeria, the use of a single university in Nigeria may limit the generalization of its findings to all female undergraduate students in Nigeria. Another limitation is the short interval between the pre-and post-intervention surveys. The study's results may have been different if a longer interval between the two survey periods had been used. However, it is worth noting that there is no consensus on the best duration to use in studies like this to minimize recall bias. A longer interval between the pre- and

post-intervention surveys may increase the risk of recall bias, as participants may have a challenging time accurately recalling their experiences or behaviors after a longer period. On the other hand, a shorter interval may increase the risk of contamination, which is when the intervention being studied affects the results of the post-intervention survey. Nonetheless, the study, being the first study to assess the acceptability and willingness to pay for the dapivirine vaginal ring among female university students, has set the tone for further research on HIV prevention strategies in women.

## 5 Conclusion

This study establishes that an educational intervention plays an invaluable role in improving the level of knowledge and acceptability of dapavirine vaginal rings by female undergraduate students as an HIV pre-exposure prophylaxis strategy. The intervention also positively increased the students' willingness to pay for the ring. These findings suggest that providing information about the ring can significantly increase the level of awareness, uptake, and willingness to pay for the ring among young women of reproductive age.

**Acknowledgements** The authors appreciate the students who participated in the study despite their tight academic schedules and the University of Nottingham for their support.

**Author contributions** AI, GE, and BOU-K conceptualized the design of the study. NAO and CCE participated in data collection, while AI, GE, CVU, and BOU-K conducted the data analysis and interpretation. OO, HUM, and BOU-K drafted the initial and final versions of the manuscript, all the authors approved the manuscript for submission.

**Funding** This study was supported by the University of Nottingham.

**Data availability** The data related to this study are available with the corresponding author and could be shared upon a reasonable request.

### Declarations

**Ethics approval and consent to participate** Ethical approval to conduct this study was obtained for this study from the Health Research Ethics Committee of the Faculty of Pharmaceutical Sciences, University of Nigeria (Reference Number: FPSRE/UNN/22/0007). No identifier data was collected from the respondents and all information obtained was treated with the utmost confidentiality. Informed consent was obtained from all the respondents after explaining the purpose of the study to them. They were also duly informed that they could withdraw from the study at any point.

**Consent for publication** Not applicable.

**Competing interests** The authors declare no competing interests.



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