



DSPACE

<https://dspace.org/>

Correlates of Adherence to Oral and Vaginal Preexposure Prophylaxis PrEP Among Adolescent Girls and Young Women AGYW Participating in the MTN034REACH Trial

K Ngure; E Browne; Krishnaveni Reddy; B Friedland; Thesla Palanee-Philips ...

SPRINGER/PLENUM PUBLISHERS

<https://hdl.handle.net/10539/42684>

WOS



Correlates of Adherence to Oral and Vaginal Pre-exposure Prophylaxis (PrEP) Among Adolescent Girls and Young Women (AGYW) Participating in the MTN-034/REACH Trial

Kenneth Ngunjiri^{1,2} · Erica N. Browne³ · Krishnaveni Reddy⁴ · Barbara A. Friedland⁵ · Ariane van der Straten^{6,7} · Thesla Palanee-Phillips⁴ · Rita Nakalega⁸ · Brenda Gati⁸ · Hadijah N. Kalule⁸ · Bekezela Siziba⁹ · Lydia Soto-Torres¹⁰ · Gonasagrie Nair¹¹ · Morgan Garcia¹² · Connie Celum^{2,13,14} · Sarah T. Roberts³

Accepted: 15 May 2024 / Published online: 9 June 2024

© The Author(s), under exclusive licence to Springer Science+Business Media, LLC, part of Springer Nature 2024

Abstract

We evaluated correlates of adherence to PrEP, including daily oral tenofovir disoproxil fumarate in combination emtricitabine (oral FTC/TDF) and the monthly dapivirine ring (ring) among adolescent girls and young women (AGYW) in the MTN-034/REACH study. We enrolled 247 AGYW aged 16–21 years in South Africa, Uganda and Zimbabwe (ClinicalTrials.gov: NCT03074786). Participants were randomized to the order of oral FTC/TDF or ring use for 6 months each in a crossover period, followed by a 6-month choice period. We assessed potential adherence correlates—individual, interpersonal, community, study, and product-related factors—quarterly via self-report. We measured biomarkers of adherence monthly; high adherence was defined as > 4 mg dapivirine released from returned rings or intracellular tenofovir diphosphate levels ≥ 700 fmol/punch from dried blood spots (DBS). We tested associations between correlates and objective measures of high adherence using generalized estimating equations. High adherence to oral FTC/TDF was significantly associated with having an older primary partner ($p=0.04$), not having exchanged sex in the past 3 months ($p=0.02$), and rating oral FTC/TDF as highly acceptable ($p=0.003$). High ring adherence was significantly associated with unstable housing ($p=0.01$), disclosing ring use to a male family member ($p=0.01$), and noting a social benefit from study participation ($p=0.03$). All associations were moderate, corresponding to about 6%–10% difference in the proportion with high adherence. In our multinational study, correlates of adherence among African AGYW differed for oral FTC/TDF and the ring, highlighting the benefit of offering multiple PrEP options.

Keywords Adherence · Heterosexual women · Pre-exposure prophylaxis (PrEP) · Africa

✉ Kenneth Ngunjiri
kngure@jkuat.ac.ke; kngure@uw.edu

¹ School of Public Health, Jomo Kenyatta University of Agriculture and Technology, Box 19704-00202, Nairobi, Kenya

² Department of Global Health, University of Washington, Seattle, USA

³ Women's Global Health Imperative (WGHI), RTI International, Berkeley, CA, USA

⁴ Wits RHI, Faculty of Health Sciences, University of the Witwatersrand, Johannesburg, South Africa

⁵ Center for Biomedical Research, Population Council, New York, NY, USA

⁶ Department of Medicine, Center for AIDS Prevention Studies, University of California, San Francisco, USA

⁷ ASTRA Consulting, Kensington, CA, USA

⁸ Makerere University – Johns Hopkins University Research Collaboration, Kampala, Uganda

⁹ University of Zimbabwe Clinical Trials Research Centre, Harare, Zimbabwe

¹⁰ National Institute of Allergy and Infectious Diseases, National Institutes of Health, Rockville, MD, USA

¹¹ University of Cape Town, Cape Town, South Africa

¹² FHI 360, Durham, NC, USA

¹³ Department of Medicine, University of Washington, Seattle, WA, USA

¹⁴ Department of Epidemiology, University of Washington, Seattle, WA, USA

Introduction

Women accounted for 63% of all new HIV infections in sub-Saharan Africa in 2021, with adolescent girls and young women (AGYW) aged 15–24 being twice as likely to be living with HIV compared to their male counterparts [1]. Several biological and social factors, including physical susceptibility, intimate partner violence and challenges in negotiating safer sex put AGYW at increased risk of HIV acquisition [2, 3]. Methods that are female-initiated have the potential to address some of these challenges.

Multinational clinical trials and implementation studies have demonstrated that daily oral tenofovir disoproxil fumarate in combination emtricitabine (FTC/TDF) and the monthly dapivirine vaginal ring (ring) are safe and efficacious HIV prevention strategies for women [4–11]. However, these biomedical prevention products require consistent and correct use to be effective. In a systematic review, HIV acquisition risk was reduced by 70% in trials and demonstration products with high oral FTC/TDF adherence, but there was no risk reduction in trials with low adherence [12]. Adherence and persistence with oral FTC/TDF has been low among AGYW in multiple studies and demonstration projects across sub-Saharan Africa [5, 13–17], and most adherence support measures evaluated to date have not had a significant impact on adherence [13, 18]. Similarly, the ring reduced HIV risk by ~30% in two phase III trials, with open-label extensions suggesting efficacy of 50% [8, 11, 19, 20], and subgroup analyses indicating efficacy of 75% in those with high adherence [21]. However, in subgroup analysis women aged < 21 years had significantly lower adherence, and there was no HIV risk reduction observed in this younger age group in ASPIRE [19].

In recent studies among African AGYW, correlates of oral FTC/TDF adherence have included factors at the individual level (e.g. age, education, depression, perception of HIV risk, duration of use), interpersonal level (e.g. number of sex partners, knowledge of partner HIV status, relationship power, intimate partner violence (IPV), disclosure to partners or family members), community level (e.g. oral FTC/TDF use stigma), and structural level (e.g. travel time/distance to the clinic), though results have often been inconsistent across studies [22–25]. Among women ages 18–45 in the ASPIRE efficacy trial of the ring, correlates of adherence to the ring included age, duration of ring use, calendar time, condom use, disclosure of study participation to primary partner, worries about the ring, frequency of menstrual bleeding, having a new vs. ongoing partnership, vaginal washing, and use of long-acting contraceptive methods [26]. However, to our knowledge no published studies have reported on

correlates of adherence to the ring among younger women, or compared them directly to correlates of adherence to oral FTC/TDF.

The MTN 034/REACH study recently reported high adherence for both oral FTC/TDF and the ring among AGYW aged 16–21 years [27]. This analysis sought to identify and compare correlates of objectively measured adherence to the two products. Understanding whether correlates of adherence to these two products are the same or different could inform demand generation and adherence support efforts, providing useful insights to implementation of these two biomedical products for African AGYW.

Methods

Study Design and Participants

Reversing the Epidemic in Africa with Choices in HIV Prevention (MTN-034/REACH) was a Phase IIa open-label randomized crossover trial with young women ages 16–21 enrolled at four sites in Johannesburg and Cape Town, South Africa; Kampala, Uganda; and Harare, Zimbabwe between February 2019 and September 2021 (ClinicalTrials.gov: NCT03074786) [28]. Participants were randomized (1:1) to one of two sequences: use of a vaginal ring containing 25 mg of dapivirine (ring) inserted monthly for six months followed by six months of 200 mg FTC/300 mg TDF oral tablets taken daily (oral FTC/TDF), or vice versa. After completing the one-year randomized crossover sequence (crossover period), participants were able to choose either or neither of the two products to use in the final six months of the trial (choice period). At any time during the choice period participants could elect to stop or switch products.

Measures

Adherence

Adherence was assessed monthly throughout the study by objective drug level evaluation. Oral FTC/TDF adherence was measured using intracellular concentrations of tenofovir diphosphate (TFV-DP) in dried blood spots (DBS) TFV-DP in red blood cells provides a cumulative measure of dosing and average adherence to oral FTC/TDF in the prior four to six weeks [29]. TFV-DP levels were analyzed by a liquid chromatography-tandem mass spectrometry assay at the University of Cape Town, South Africa, with levels ≥ 700 fmol/punch (consistent with at least 4 doses per week) considered “high adherence” for oral FTC/TDF. Assessment of ring adherence in the past month was based on residual dapivirine drug levels in returned rings, determined by acetone extraction and high-pressure liquid chromatography

(Farmovs, South Africa). The dapivirine release rate was calculated by subtracting the amount of residual dapivirine in returned rings from the amount of dapivirine in control rings from the same lot, divided by the length of time during which the participant had the ring. A release rate > 4.0 mg/month (consistent with 28 continuous days of use) was considered “high adherence” for the ring [8].

Potential Correlates

Data on sociodemographic characteristics (e.g., age, education, income, food security, parity, and housing stability [“have a regular place where [they] stay and store [their] things”]) and HIV risk perception were collected via surveys administered by trained study staff at the study screening visit. Updates to these measures and additional measures of participant characteristics across levels of the socioecological framework were collected through audio computer-assisted self-interviews (ACASI) at baseline and quarterly throughout the study. These included measures of mental well-being and psychological development, sexual behavior, relationship characteristics, peer social support, community engagement, product use disclosure and support or opposition, product-related stigma, product acceptability, and experiences of social harms and benefits during the

study. Community engagement was defined by any participation in clubs, sports teams, or other social group activities outside of home or school. The following validated scales were used: (1) the 10-item Center for Epidemiological Studies—Depression scale (CES-D-10) [30], (2) the Alcohol Use Disorders Identification Test (AUDIT-C) [31], (3) an abbreviated version Brief Self-Control Scale (BSCS) [19] and (4) the peer subscale of the Multidimensional Scale of Perceived Social Support (MSPSS) [32–35]. The interpretation of these scores in our study is reported elsewhere [36]. Data on factors unrelated to the study or products were generally collected at the start and end of each product period (i.e., months 0, 6, 12, 18) while data related to specific dimensions of product acceptability (e.g. ease of use, product characteristics) were collected in the middle of the study period only (months 3, 9, 15), and certain variables hypothesized to be most strongly related to product use were collected at all time points (e.g. sexual behavior, partnership status, disclosure, overall acceptability) (Table 1).

Statistical Analysis

In total, there were 3980 adherence observations collected from all enrolled participants ($n = 247$). At times participants were given two rings at a visit (when it was anticipated they

Table 1 Data collection schedule

	Screening	Enrollment	Months 3, 9, 15 (middle of each study period)	Months 6, 12 (in between study periods)	Month 18 (study exit)
Individual					
Demographics	X				
Risk perception	X		X		X
Brief self-control scale (BSCS)		X		X	
Sexual behavior		X	X	X	X
Alcohol use (AUDIT-C)		X		X	
Depression (CESD-10)		X		X	
Housing and Food Security		X		X	
Schooling and income	X			X	
Interpersonal					
Peer Social Support Scale (MSPSS)		X		X	
Partnership characteristics		X	X	X	X
Partner & non-partner violence		X		X	X
Product Use Disclosure		X	X	X	X
Community					
Community engagement		X			
Stigma & Product Awareness			X		
Study design & Product-related					
Overall acceptability		X	X	X	X
Experience of social harms or benefits			X	X	X
Crossover vs. choice period		X	X	X	X

could not return for a new ring within the 30 days or during COVID-19 clinic closure). Observations from visits where multiple rings were returned were excluded from the analysis, given the uncertainty of which ring was used for how many days and hence uncertainty in a calculated dapivirine release rate. This analysis included 3816 observations (96%) from 247 participants.

Descriptive statistics were calculated for all measures of potential adherence correlates. We used generalized estimating equations (GEE) to estimate the proportion of the sample with high adherence over time and to test the association between each correlate and high adherence. Poisson models were estimated with a log link function, unstructured working correlation structure, and robust standard errors. The model to estimate the proportion with high adherence included an interaction term between product and month of product use. Models to assess correlates of adherence each included an interaction term between the correlate measure and product, as well as an interaction term between product and study period (crossover versus choice), to estimate the effect of the correlate on adherence to each product separately while accounting for time and study design effects specifically product sequence phase. Correlate values were carried forward from each measurement point until the next measurement was taken. The only exception was for the overall acceptability measure, which was collected after use, and was therefore carried back to prior visits where no measure was available. Models also controlled randomization arm and site. Associations are presented as risk ratios (RRs) with corresponding 95% confidence intervals (CIs). All analyses were performed using Stata 16.1.

Ethics Statement

The study was approved by site Institutional Review Boards/Ethics Committees (IRBs/ECs) prior to implementation. Written informed consent was obtained from adult participants, and from minors who were legally able to consent as per local regulations. Written informed assent and parental/guardian consent was obtained from all other minors and their respective parents/guardians. Minors who turned 18 during the study subsequently signed the adult informed consent form.

Results

Of the 247 AGYW enrolled, 207 (84%) had adherence data from at least 10 of 12 monthly visits during the crossover periods, and 194 participants (79%) had at least five of six adherence measure during the choice period; Table 2 describes the participants at enrollment. The average age was 18 years (standard deviation 1.4), most (86%) had

completed secondary education and 37% were currently in school. Nearly all had a primary partner (89%), and about a third had had more than one sex partner in the past 3 months (36%). Characteristics of the sample were generally consistent during the study (Supplemental Table 1). All participants were assumed to be assigned female at birth though we did not ask their gender identity [37].

Figure 1 depicts the estimated probability of high adherence over time for each of the two products during each period. Overall, there was no statistically significant difference in the probability of high adherence by product ($p=0.18$). On average, the probability of high monthly adherence was 0.60 for the ring and 0.57 for oral FTC/TDF during the crossover periods, $p=0.30$. The probability of high monthly adherence dropped for both products during the choice period; the average probability of high adherence was 0.54 for those who chose the ring (RR 0.90, 95% CI 0.82, 0.99; $p=0.03$) and 0.46 for those who chose oral FTC/TDF (RR 0.82, 95% CI 0.70, 0.95; $p<0.01$).

Different factors were associated with high adherence for each product (Table 3). For oral FTC/TDF the probability of high adherence during the month was associated with having an older primary partner (RR 1.18, 95% CI 1.01, 1.37; $p=0.04$) and inversely associated with having exchanged goods or money for sex in the past 6 months (RR 0.87, 95% CI: 0.77, 0.98; $p=0.02$). Those who rated oral TDF/FTC as highly acceptable were more likely to have high adherence (RR 1.21, 95% CI 1.08, 1.35; $p=0.003$). There were non statistically significant trends between those who perceived stigma in the community about using oral FTC/TDF (RR 0.88, 95% CI: 0.76, 1.00; $p=0.07$) and those who had any engagement in the community (RR 0.87, 95% CI: 0.74, 1.02; $p=0.09$) and high monthly adherence.

In contrast, participants were more likely to have high monthly adherence with the dapivirine ring if they were unstably housed; RR 1.17; 95% CI: 1.04, 1.31; $p=0.008$), had disclosed ring use to a male family member (RR 1.11, 95% CI: 1.03, 1.24; $p=0.01$), and had noted a social benefit from participating in the study (RR 1.19, 95% CI 1.01, 1.39; $p=0.03$). Risk ratios correspond to differences in high adherence of about 6–10%.

In a subgroup analysis among younger participants (aged 16–17), different measures were found to be associated with oral FTC/TDF adherence (Table 4). Younger participants who had been with their partner for less than 6 months (RR 1.45, 95% CI: 1.05, 2.00; $p=0.03$), who were living with their partner (RR 1.29, 95% CI: 1.07, 1.56; $p=0.01$), or who were unstably housed (RR 1.36, 95% CI 1.10, 1.68; $p<0.01$) were more likely to have high adherence using oral FTC/TDF, and these associations were significantly different than those for ring adherence (p -values ≤ 0.01). In addition, those who were worried about HIV were somewhat more likely to have high adherence with oral FTC/TDF (RR 1.25,

Table 2 Description of participants at enrollment in MTN-034/REACH Crossover Study

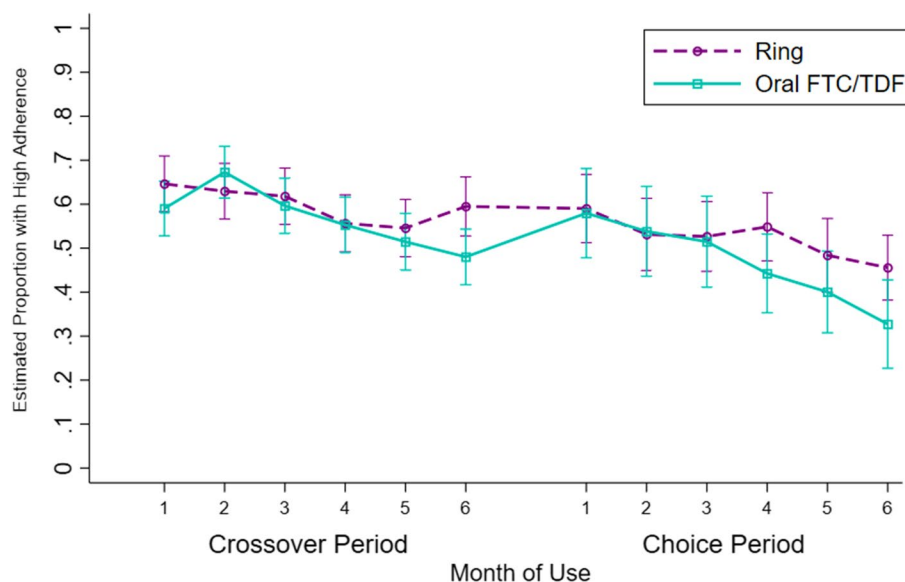
	N (%)
Total	247 (100)
Age < 18 years	85 (34)
Secondary education completed	212 (86)
Currently in school	92 (37)
Lives with parent(s)	156 (63)
Earns own income	53 (22)
Food insecure	62 (25)
Unstably housed	45 (18)
Self-control scale score— <i>mean, median (range)</i>	26, 27 (13–35)
Parous at enrollment	99 (40)
Hazardous drinking (AUDIT-C)	97 (39)
Depression indicated (CESD-10)	91 (37)
Risk perception, somewhat/very worried about HIV	100 (41)
<i>Sexual behavior</i>	
Sexually active in past 3 months	203 (83)
Condom use at last sex	112 (55)
Vaginal sex at least weekly in past 3 months	107 (43)
More than 1 sex partner in past 3 months	90 (36)
Transactional sex in past 6 months	66 (27)
<i>Interpersonal</i>	
Peer social support scale score— <i>mean, median (range)</i>	14, 15 (4–20)
Has a primary partner	219 (89)
Primary partner > 4 years older	106 (43)
Newer partnership (< 6 months)	58 (24)
Primary partner has/may have other partners ^a	167 (68)
Primary partner provides financial support	136 (55)
Lives with partner	22 (10)
Any physical partner violence past 6 months	36 (15)
Any verbal partner violence past 6 months	75 (30)
Any sexual partner violence past 6 months	27 (11)
Any non-partner sexual violence past 6 months	17 (7)
<i>Community</i>	
Any community engagement ^b	131 (53)
<i>Study design & product-related</i>	
<i>Arm</i>	
A: Ring → oral FTC/TDF	124 (50)
B: oral FTC/TDF → Ring	123 (50)
<i>Location</i>	
Cape Town, South Africa	60 (24)
Johannesburg, South Africa	67 (27)
Kampala, Uganda	60 (24)
Harare, Zimbabwe	60 (24)

^aIncludes don't know if partner has other partners^bparticipation in clubs, sports teams, or other social group activities outside of home/school

95% CI 0.98, 1.58; $p=0.07$) and less likely with the ring (RR 0.84, 95% CI 0.63, 1.13; $p=0.25$; p -value for interaction = 0.02). Although not statistically significant, younger women who disclosed oral FTC/TDF use to their partner were more likely to have high adherence (RR 1.31, 95%

CI 1.00, 1.41; $p=0.05$), and those with higher peer social support scores (RR 0.66, 95% CI 0.39, 1.11; $p=0.12$) and higher self-control scores (RR 0.52, 95% CI: 0.26, 1.05; $p=0.07$) were less likely to have high adherence using oral FTC/TDF. Only disclosure to a male family member was

Fig. 1 The estimated proportion of participants with high adherence per month, by product and study period



significantly associated with high ring adherence among younger participants (RR 1.34, 95% CI 1.16, 1.55; $p < 0.01$).

Discussion

In a crossover study where participants used oral FTC/TDF and the ring for six months each before choosing a product to use for another six months, roughly half of participants were able to use the products consistently in any given month. Different factors were associated with adherence for each product, suggesting that offering a range of options may help AGYW to choose the product that best suits their circumstances. However, there were no strong associations between characteristics or experiences of AGYW and high monthly adherence; all effect sizes were modest. Notably, for both products, the proportion with high adherence decreased modestly in the choice period, but still remained higher than previous studies of AGYW in sub-Saharan Africa [13–17]. Therefore, adherence may remain a challenge regardless of the product chosen or the fact that participants were able to try products before making a choice.

Among participants in this study, there were inconsistent associations between oral FTC/TDF adherence and factors associated with higher risk of HIV acquisition. Epidemiological studies have demonstrated that age-disparate relationships increase the risk of HIV acquisition especially for AGYW [38, 39], and we found that having an older primary partner was associated with high adherence to oral FTC/TDF. However, participants who had exchanged sex in the past 6 months were less likely to have high oral FTC/TDF adherence, and there was no association between having more than one sex partner and high oral FTC/TDF adherence. Further, none of these factors were associated with

ring adherence. The robust adherence support program may have helped participants recognize HIV risk within their primary or only partnerships in addition to risk from additional partners [22]. However, women who exchange sex often face stressful life circumstances such as poverty, discrimination, and sexual violence, all of which may impede oral FTC/TDF use [40, 41] despite recognition of its protective benefits.

PrEP-related stigma has been a key barrier to optimal PrEP adherence for AGYW in SSA, where several studies have reported that participants who anticipated/experienced stigma were reluctant to disclose oral FTC/TDF use and reported adherence challenges [25, 42, 43]. Similarly in the REACH study, those who perceived stigma in the community about using oral FTC/TDF were less likely to have high monthly adherence. Though this finding was not statistically significant, it still points to the need to deliver oral FTC/TDF in AGYW friendly spaces. In addition, we have previously reported that very few participants disclosed ring use to male family members [44] (other than male partners), both because they found it unnecessary and because they feared stigmatizing reactions. Yet in the current analysis, those who had disclosed ring use to male family members were more likely to adhere. Those who chose to disclose may have anticipated less stigma, which may in turn have facilitated ring use.

Participants rating oral FTC/TDF as highly acceptable was a strong correlate of high adherence. This further points to the need to consider AGYW preferences and choices when providing HIV prevention services. A recent study among women aged 18–24 years who had been on oral FTC/TDF for two years demonstrated that only a third of women would prefer oral FTC/TDF if other methods of HIV prevention such as injectables, rings or implants were available [45]. This supports the need for

Table 3 Correlates of high adherence, for oral FTC/TDF and the Dapivirine vaginal ring (N = 247; obs = 3816)

Measures	Oral FTC/TDF			Dapivirine ring			
	RR ^a	95% CI	p-value	RR ^a	95% CI	p-value	p-value interaction
<i>Individual</i>							
Age < 18 years	0.93	(0.79, 1.10)	0.38	0.99	(0.86, 1.14)	0.93	0.48
Secondary education completed	1.10	(0.82, 1.50)	0.52	0.91	(0.73, 1.14)	0.40	0.14
In school	1.14	(1.00, 1.30)	0.05	1.06	(0.93, 1.20)	0.37	0.38
Earns own income	1.11	(0.98, 1.26)	0.10	1.02	(0.90, 1.15)	0.80	0.28
Lives with parent(s)	1.02	(0.90, 1.16)	0.78	0.94	(0.84, 1.06)	0.31	0.36
Food insecure	0.96	(0.85, 1.10)	0.57	1.01	(0.91, 1.13)	0.85	0.56
Unstably housed	0.96	(0.81, 1.13)	0.61	1.17	(1.04, 1.31)	0.01	0.06*
Self-control scale score (range 13–35)	0.79	(0.50, 1.25)	0.31	0.99	(0.98, 1.00)	0.42	0.42
Parous at enrollment	0.96	(0.80, 1.15)	0.65	1.06	(0.91, 1.24)	0.43	0.29
Hazardous drinking (AUDIT-C)	1.00	(0.88, 1.13)	0.99	1.00	(0.88, 1.13)	0.96	0.96
Depression indicated (CESD-10)	0.96	(0.85, 1.08)	0.46	1.06	(0.97, 1.17)	0.21	0.14
Risk perception—worried about HIV	1.08	(0.91, 1.28)	0.36	0.97	(0.84, 1.12)	0.64	0.24
<i>Sexual behavior</i>							
Vaginal sex at least weekly in past 3 months	1.04	(0.95, 1.14)	0.39	0.96	(0.87, 1.04)	0.32	0.16
More than 1 sex partner in past 3 months	0.95	(0.85, 1.06)	0.37	1.01	(0.92, 1.10)	0.81	0.36
Condom use at last sex	0.98	(0.88, 1.09)	0.73	0.95	(0.86, 1.05)	0.31	0.66
Exchanged sex in past 6 months	0.87	(0.77, 0.98)	0.02	1.10	(0.98, 1.23)	0.12	0.01*
<i>Interpersonal</i>							
Peer social support scale score (range 4–20)	0.95	(0.73, 1.23)	0.70	1.00	(0.99, 1.02)	0.70	0.97
Has a primary partner	1.06	(0.94, 1.21)	0.35	0.95	(0.84, 1.08)	0.45	0.21
Primary partner > 4 years older	1.18	(1.01, 1.37)	0.04	0.99	(0.87, 1.13)	0.87	0.07*
Newer partnership (< 6 months)	1.03	(0.91, 1.18)	0.63	1.03	(0.90, 1.17)	0.69	0.96
Primary partner has/may have other Partners ^b	0.99	(0.88, 1.10)	0.80	0.97	(0.86, 1.10)	0.68	0.90
Primary partner provides financial Support	1.04	(0.89, 1.22)	0.62	1.01	(0.89, 1.15)	0.85	0.76
Lives with partner	0.91	(0.75, 1.10)	0.32	1.09	(0.93, 1.28)	0.30	0.15
Any physical partner violence past 6 mos	0.96	(0.85, 1.08)	0.48	1.10	(0.98, 1.22)	0.09	0.09*
Any verbal partner violence past 6 mos	1.00	(0.89, 1.12)	0.94	1.02	(0.90, 1.15)	0.81	0.81
Any sexual partner violence past 6 mos	0.93	(0.78, 1.11)	0.45	0.93	(0.79, 1.11)	0.43	0.99
Any non-partner sexual violence past 6 mos	0.86	(0.69, 1.08)	0.21	0.91	(0.76, 1.10)	0.34	0.72
Disclosure of product use, to							
Primary partner	1.02	(0.89, 1.17)	0.78	0.96	(0.83, 1.11)	0.57	0.14
Female family member	1.10	(0.89, 1.35)	0.37	0.92	(0.81, 1.05)	0.22	0.14
Male family member	1.08	(0.96, 1.22)	0.21	1.11	(1.01, 1.22)	0.03	0.73
Friends	0.94	(0.83, 1.07)	0.34	1.02	(0.91, 1.15)	0.72	0.34
<i>Community</i>							
Community engagement, at all vs never	0.87	(0.74, 1.02)	0.09	0.94	(0.82, 1.07)	0.33	0.42
Believe community not aware of product	1.11	(0.91, 1.35)	0.29	1.07	(0.92, 1.24)	0.39	0.77
Perceive stigma in community about product	0.88	(0.76, 1.00)	0.07	1.00	(0.89, 1.12)	0.99	0.16
<i>Study design & product related</i>							
Rated product highly acceptable	1.21	(1.08, 1.35)	< 0.01	1.01	(0.91, 1.12)	0.89	0.02*
Experienced social harm	0.93	(0.65, 1.33)	0.70	0.87	(0.58, 1.30)	0.49	0.79
Experienced social benefit	1.11	(0.93, 1.33)	0.25	1.19	(1.01, 1.39)	0.03	0.51
Crossover period (vs choice period)	1.23	(1.06, 1.42)	0.01	1.11	(1.01, 1.22)	0.03	0.26

*Interaction p-value < 0.10 are indicates in bold

^aAll models controlled for randomization arm and study site and included an interaction term between product and study period^bResponse of yes or don't know compared to no

Table 4 Correlates of adherence for AGYW ages 16–17 years (N = 85; observations = 1249)

Measures	Oral FTC/TDF			Dapivirine ring			
	RR ^a	95% CI	p-value	RR ^a	95% CI	p-value	p-value inter-action
<i>Individual</i>							
Secondary education completed	0.95	(0.72, 1.25)	0.72	0.92	(0.68, 1.23)	0.56	0.79
Currently in school	1.03	(0.79, 1.34)	0.81	1.05	(0.83, 1.33)	0.70	0.93
Earns own income	1.18	(0.93, 1.50)	0.16	1.25	(0.92, 1.70)	0.15	0.76
Lives with parent(s)	0.92	(0.74, 1.15)	0.48	0.92	(0.71, 1.18)	0.50	0.97
Food insecure	1.07	(0.85, 1.34)	0.55	0.83	(0.66, 1.04)	0.10	0.11
Unstably housed	1.36	(1.10, 1.68)	< 0.01	0.99	(0.83, 1.19)	0.95	< 0.01*
Self-control scale score (range 13–35)	0.52	(0.26, 1.05)	0.07	0.98	(0.96, 1.00)	0.05	0.12
Parous at enrollment	0.86	(0.61, 1.22)	0.40	1.00	(0.71, 1.43)	0.97	0.41
Hazardous drinking (AUDIT-C)	0.86	(0.68, 1.08)	0.20	0.98	(0.79, 1.21)	0.84	0.43
Depression indicated (CESD-10)	0.85	(0.67, 1.08)	0.18	1.07	(0.87, 1.31)	0.54	0.08
Risk perception—worried about HIV	1.25	(0.98, 1.58)	0.07	0.84	(0.63, 1.13)	0.25	0.02*
<i>Sexual behavior</i>							
Vaginal sex at least weekly in past 3 months	0.91	(0.66, 1.23)	0.54	0.97	(0.76, 1.23)	0.79	0.70
More than 1 sex partner in past 3 months	0.97	(0.66, 1.43)	0.88	1.11	(0.86, 1.42)	0.26	0.50
Condom use at last sex	0.92	(0.71, 1.19)	0.54	0.86	(0.67, 1.11)	0.24	0.68
Exchanged sex in past 6 months	0.83	(0.66, 1.05)	0.12	1.02	(0.83, 1.26)	0.77	0.22
<i>Interpersonal</i>							
Peer social support scale score (range 4–20)	0.66	(0.39, 1.11)	0.12	0.99	(0.97, 1.02)	0.63	0.19
Has a primary partner	0.99	(0.79, 1.23)	0.90	1.04	(0.79, 1.37)	0.78	0.74
Primary partner > 4 years older	1.06	(0.82, 1.38)	0.64	0.92	(0.70, 1.20)	0.54	0.35
Newer partnership (< 6 months)	1.45	(1.05, 2.00)	0.03	0.87	(0.71, 1.07)	0.19	0.01*
Primary partner has/may have other Partners ^b	1.05	(0.81, 1.37)	0.71	1.08	(0.90, 1.29)	0.41	0.89
Primary partner provides financial support	1.16	(0.76, 1.77)	0.49	1.01	(0.83, 1.24)	0.88	0.57
Lives with partner	1.29	(1.07, 1.56)	0.01	0.86	(0.64, 1.16)	0.32	0.01*
Any physical partner violence past 6 mos	0.87	(0.70, 1.09)	0.23	0.96	(0.77, 1.21)	0.75	0.55
Any verbal partner violence past 6 mos	0.91	(0.72, 1.14)	0.39	0.89	(0.71, 1.12)	0.33	0.93
Any sexual partner violence past 6 mos	0.95	(0.70, 1.29)	0.75	0.84	(0.60, 1.17)	0.58	0.59
Any non-partner sexual violence past 6 mos	0.95	(0.71, 1.28)	0.73	0.79	(0.57, 1.10)	0.16	0.42
Disclosure of product use, to							
Primary partner	1.31	(1.00, 1.71)	0.05	1.13	(0.89, 1.43)	0.33	0.62
Female family member	1.32	(0.95, 1.82)	0.10	1.15	(0.94, 1.41)	0.17	0.44
Male family member	1.13	(0.92, 1.38)	0.24	1.34	(1.16, 1.55)	< 0.01	0.12
Friends	0.96	(0.76, 1.21)	0.71	1.02	(0.83, 1.25)	0.85	0.68
<i>Community</i>							
Community engagement, at all vs never	1.00	(0.79, 1.27)	0.98	1.07	(0.83, 1.37)	0.60	0.68
Believe community not aware of product	1.17	(0.90, 1.53)	0.23	1.14	(0.90, 1.44)	0.29	0.83
Perceive stigma in community about product	0.91	(0.72, 1.16)	0.45	0.95	(0.75, 1.20)	0.68	0.80
<i>Study design & product related</i>							
Rated product highly acceptable	1.11	(0.94, 1.32)	0.22	1.12	(0.93, 1.35)	0.23	0.96
Experienced social harm	0.75	(0.49, 1.16)	0.20	0.79	(0.42, 1.46)	0.45	0.93
Experienced social benefit	1.13	(0.85, 1.51)	0.39	0.94	(0.69, 1.26)	0.67	0.25
Crossover period (vs choice period)	1.37	(1.01, 1.88)	0.05	1.14	(0.93, 1.40)	0.22	0.40

*Interaction p-value < 0.10 are indicated in bold

^aAll GEE models controlled for randomization arm and study site and included an interaction term between product and study period^bResponse of yes or don't know compared to no

providing multiple options of HIV prevention to cater for individual preferences that could translate to higher uptake and adherence.

Longer acting products that have recently been approved or are in development that could be inserted or given in the clinic such as the ring, long-acting cabotegravir (CAB-LA) and semi-annual lenacapivir could appeal to populations of AGYW who have product storage concerns, which may explain why unstable housing was a significant predictor of ring adherence in our study. For women who do not have a safe space or access to running water, etc. may be less likely to take it out during the month for lack of a way to store or clean it [46]. However, other structural factors such as distance to the clinic have been reported to influence oral FTC/TDF adherence and may be more important for products that are not stored at home [47]. A differentiated model of oral FTC/TDF delivery that provides products closer to where AGYW live and work such as through retail pharmacies could overcome this barrier [48].

In sub-Saharan Africa studies have shown partners have a strong influence on adult women's oral FTC/TDF and ring adherence [49, 50], and in a recent South African study among AYGW, disclosure to parents was strongly associated with oral FTC/TDF adherence [51]. Surprisingly, these findings were not replicated in our study. However, in sub-group analysis we found that younger participants (aged 16–17) who disclosed oral FTC/TDF use to their male partner or female family members were marginally more likely to have high oral FTC/TDF adherence. The adherence support provided through the study may have helped participants use both products without disclosure and have provided an alternative source of social support. Disclosure to partners and parents could lead to negative consequences such as violence and discrimination, and therefore AGYW should be counseled and supported through the process of disclosure should they choose to disclose. The recent additions of CAB-LA to the HIV prevention toolbox, and other products in the pipeline such as monthly pills, 6-monthly injections and implants may enhance discreet use and could be preferable for those who may not be ready to disclose.

Although younger participants (ages 16–17 years) had similar adherence as older participants (ages 18–21), correlates of adherence differed somewhat for younger participants. In particular, product-related factors such as oral FTC/TDF acceptability and social benefits of ring use were not correlated with adherence among younger participants, but newer primary partnership and cohabitation with their male partner were associated with higher adherence. Young women may retain more independence in newer relationships and may be more likely to have disclosed product use to partners whom they live with, both of which could facilitate adherence. It is surprising that unstable housing was correlated with higher oral FTC/TDF adherence in this

subgroup and was not correlated with higher ring adherence as in the overall sample.

Our study had several strengths. First, we used an innovative study design that allowed the participants to use both the oral FTC/TDF and the ring in a crossover fashion before making a choice. Additionally, the study population was from four sites in three African countries, with a third of participants being aged 16 and 17 years old which provides important adherence insights from the younger population. Data were collected at several time points longitudinally over an 18-month period and adherence was measured objectively for both oral FTC/TDF and the ring in the same setting. There are also two key limitations to note. First, the high adherence in our study could be explained by the comprehensive adherence support interventions during the implementation of the trial, which could have diluted the effect of some correlates [52]. Moreover, the adherence support provided in this study was intended to encourage high adherence to achieve the study objective of measuring safety. In addition, this being a purposively selected sample that agreed to monthly visits and extensive procedures (and so may have been highly motivated) coupled with a narrow age group of 16–21 years may limit the generalizability of our findings.

In conclusion, adherence to oral FTC/TDF and the ring was high during the crossover periods and declined slightly during the choice period, despite participants being able to choose what they preferred after 12 months. Therefore, maintaining a high level of use over an extended period of time may remain a challenge regardless of the product chosen. Notably, the factors associated with high oral FTC/TDF (e.g. having an older partner, rating oral FTC/TDF as highly acceptable) differed from correlates with ring adherence (e.g. unstably housed, disclosure to male partners and social benefits), exemplifying the need to have different HIV prevention product options.

Supplementary Information The online version contains supplementary material available at <https://doi.org/10.1007/s10461-024-04382-3>.

Acknowledgements The authors would like to acknowledge all trial participants for taking time to contribute to this research. Additionally, we would like to thank MTN Leadership (Drs. Sharon Hillier and Jared Baeten) as well as all the research staff at the at four sites (Cape Town and Johannesburg, South Africa; Kampala, Uganda; and Harare, Zimbabwe).

Funding The study was designed and implemented by the Microbicide Trials Network (MTN). The MTN was funded by the National Institute of Allergy and Infectious Diseases through individual grants (UM1AI068633, UM1AI068615 and UM1AI106707), with co-funding from the Eunice Kennedy Shriver National Institute of Child Health and Human Development and the National Institute of Mental Health, all components of the U.S. National Institutes of Health. The International Partnership for Microbicides developed the dapivirine ring and supplied rings for this trial. FTC/TDF tablets were supplied by Gilead Sciences, Inc.

Data Availability The data that support the findings of this study are available for researchers who provide a methodologically sound proposal in accordance with policies of the Microbicide Trials Network (MTN).

Declarations

Conflict of interests The authors have no competing interests to declare that are relevant to the content of this article.

References

1. “UNAIDS 2021. Global HIV & AIDS statistics — Fact sheet.” [Online]. Available: <https://www.unaids.org/en/resources/fact-sheet>
2. George G, et al. Determining HIV risk for Adolescent Girls and Young Women (AGYW) in relationships with “Blessers” and age-disparate partners: a cross-sectional survey in four districts in South Africa. *BMC Public Health*. 2022;22(1):973. <https://doi.org/10.1186/s12889-022-13394-4>.
3. Kamire V, et al. HIV risk factors and risk perception among adolescent girls and young women: results from a population-based survey in Western Kenya, 2018. *J Acquir Immune Defic Syndr*. 2022;91(1):17–25. <https://doi.org/10.1097/qai.00000000000003021>.
4. J. B. Marrazzo, M.; Bekker LG, Celum, C.; Kiragu, M.; Leech, A.A.; Taylor, A.; Ussery, F.; Yang, J.; de Boer, M.; Carter, C.; Das, M.; Baeten, J.M.; Tao, L. 8+ years pooled analysis: Adherence and HIV incidence in >6000 women on F/TDF for PrEP. Oral presentation at the 30th Conference on Retroviruses and Opportunistic Infections (CROI), Seattle, WA, 2023: Abstract 163.
5. Tapsoba JD, et al. Continued attendance in a PrEP program despite low adherence and non-protective drug levels among adolescent girls and young women in Kenya: results from a prospective cohort study. *PLoS Med*. 2022;19(9): e1004097. <https://doi.org/10.1371/journal.pmed.1004097>.
6. Were D, et al. Using a HIV prevention cascade for identifying missed opportunities in PrEP delivery in Kenya: results from a programmatic surveillance study. *J Int AIDS Soc*. 2020;23(3): e25537. <https://doi.org/10.1002/jia2.25537>.
7. Baeten JM, et al. Antiretroviral prophylaxis for HIV prevention in heterosexual men and women. *N Engl J Med*. 2012;367(5):399–410. <https://doi.org/10.1056/NEJMoa1108524>.
8. Baeten JM, et al. Safety, uptake, and use of a dapivirine vaginal ring for HIV-1 prevention in African women (HOPE): an open-label, extension study. *Lancet HIV*. 2021;8(2):e87–95. [https://doi.org/10.1016/s2352-3018\(20\)30304-0](https://doi.org/10.1016/s2352-3018(20)30304-0).
9. Heffron R, et al. Pre-exposure prophylaxis for HIV-negative persons with partners living with HIV: uptake, use, and effectiveness in an open-label demonstration project in East Africa. *Gates Open Res*. 2017;1:3. <https://doi.org/10.12688/gatesopenres.12752.2>.
10. Thigpen MC, et al. Antiretroviral preexposure prophylaxis for heterosexual HIV transmission in Botswana. *N Engl J Med*. 2012;367(5):423–34. <https://doi.org/10.1056/NEJMoa1110711>.
11. Nel A, et al. Safety and efficacy of a dapivirine vaginal ring for HIV prevention in women. *N Engl J Med*. 2016;375(22):2133–43. <https://doi.org/10.1056/NEJMoa1602046>.
12. Fonner VA, et al. Effectiveness and safety of oral HIV preexposure prophylaxis for all populations. *AIDS*. 2016;30(12):1973–83. <https://doi.org/10.1097/qad.0000000000001145>.
13. Celum C, et al. PrEP uptake, persistence, adherence, and effect of retrospective drug level feedback on PrEP adherence among young women in southern Africa: results from HPTN 082, a randomized controlled trial. *PLoS Med*. 2021;18(6): e1003670. <https://doi.org/10.1371/journal.pmed.1003670>.
14. Celum CL, et al. PrEP use and HIV seroconversion rates in adolescent girls and young women from Kenya and South Africa: the POWER demonstration project. *J Int AIDS Soc*. 2022;25(7): e25962. <https://doi.org/10.1002/jia2.25962>.
15. Celum CL, et al. Incentives conditioned on tenofovir levels to support PrEP adherence among young South African women: a randomized trial. *J Int AIDS Soc*. 2020;23(11): e25636. <https://doi.org/10.1002/jia2.25636>.
16. de Dieutapsoba J, et al. Persistence of oral pre-exposure prophylaxis (PrEP) among adolescent girls and young women initiating PrEP for HIV prevention in Kenya. *AIDS Care*. 2021;33(6):712–20. <https://doi.org/10.1080/09540121.2020.1822505>.
17. Haberer JE, et al. Effect of SMS reminders on PrEP adherence in young Kenyan women (MPYA study): a randomised controlled trial. *Lancet HIV*. 2021;8(3):e130–7. [https://doi.org/10.1016/s2352-3018\(20\)30307-6](https://doi.org/10.1016/s2352-3018(20)30307-6).
18. Irungu E, Khoza N, Velloza J. Multi-level interventions to promote oral pre-exposure prophylaxis use among adolescent girls and young women: a review of recent research. *Curr HIV/AIDS Rep*. 2021;18(6):490–9. <https://doi.org/10.1007/s11904-021-00576-9>.
19. Baeten JM, et al. Use of a vaginal ring containing dapivirine for HIV-1 prevention in women. *N Engl J Med*. 2016;375(22):2121–32. <https://doi.org/10.1056/NEJMoa1506110>.
20. Nel A, et al. Safety, adherence, and HIV-1 seroconversion among women using the dapivirine vaginal ring (DREAM): an open-label, extension study. *Lancet HIV*. 2021;8(2):e77–86. [https://doi.org/10.1016/s2352-3018\(20\)30300-3](https://doi.org/10.1016/s2352-3018(20)30300-3).
21. Brown ER, et al. Greater dapivirine release from the dapivirine vaginal ring is correlated with lower risk of HIV-1 acquisition: a secondary analysis from a randomized, placebo-controlled trial. *J Int AIDS Soc*. 2020;23(11): e25634. <https://doi.org/10.1002/jia2.25634>.
22. Haberer JE, et al. Understanding pre-exposure prophylaxis adherence in young women in Kenya. *J Acquir Immune Defic Syndr*. 2022;89(3):251–60. <https://doi.org/10.1097/qai.00000000000002876>.
23. Haberer JE, Mujugira A, Mayer KH. The future of HIV pre-exposure prophylaxis adherence: reducing barriers and increasing opportunities. *Lancet HIV*. 2023. [https://doi.org/10.1016/s2352-3018\(23\)00079-6](https://doi.org/10.1016/s2352-3018(23)00079-6).
24. Mayanja Y, et al. Oral pre-exposure prophylaxis preference, uptake, adherence and continuation among adolescent girls and young women in Kampala, Uganda: a prospective cohort study. *J Int AIDS Soc*. 2022;25(5): e25909. <https://doi.org/10.1002/jia2.25909>.
25. Velloza J, et al. The influence of HIV-related stigma on PrEP disclosure and adherence among adolescent girls and young women in HPTN 082: a qualitative study. *J Int AIDS Soc*. 2020;23(3): e25463. <https://doi.org/10.1002/jia2.25463>.
26. Husnik MJ, et al. Correlates of adherence to the dapivirine vaginal ring for HIV-1 prevention. *AIDS Behav*. 2021;25(9):2801–14. <https://doi.org/10.1007/s10461-021-03231-x>.
27. Nair G, et al. Adherence, safety, and choice of the monthly dapivirine vaginal ring or oral emtricitabine plus tenofovir disoproxil fumarate for HIV pre-exposure prophylaxis among African adolescent girls and young women: a randomised, open-label, crossover trial. *Lancet HIV*. 2023. [https://doi.org/10.1016/s2352-3018\(23\)00227-8](https://doi.org/10.1016/s2352-3018(23)00227-8).
28. Ngure K, et al. Baseline preferences for oral pre-exposure prophylaxis (PrEP) or dapivirine intravaginal ring for HIV prevention among adolescent girls and young women in South Africa, Uganda and Zimbabwe (MTN-034/IPM-045 study). *PLoS ONE*.

- 2023;18(6): e0287525. <https://doi.org/10.1371/journal.pone.0287525>.
29. Castillo-Mancilla JR, et al. Tenofovir, emtricitabine, and tenofovir diphosphate in dried blood spots for determining recent and cumulative drug exposure. *AIDS Res Hum Retroviruses*. 2013;29(2):384–90. <https://doi.org/10.1089/aid.2012.0089>.
30. Baron EC, Davies T, Lund C. Validation of the 10-item centre for epidemiological studies depression scale (CES-D-10) in Zulu, Xhosa and Afrikaans populations in South Africa. *BMC Psychiatry*. 2017. <https://doi.org/10.1186/s12888-016-1178-x>.
31. Johnson NA, et al. “Effect of electronic screening and brief intervention on hazardous or harmful drinking among adults in the hospital outpatient setting: a randomized, double-blind, controlled trial. *Drug Alcohol Depend*. 2018;191:78–85. <https://doi.org/10.1016/j.drugalcdep.2018.06.030>.
32. Bruwer B, Emsley R, Kidd M, Lochner C, Seedat S. Psychometric properties of the multidimensional scale of perceived social support in youth. *Compr Psychiatry*. 2008;49(2):195–201. <https://doi.org/10.1016/j.comppsy.2007.09.002>.
33. Morean ME, et al. Psychometrically improved, abbreviated versions of three classic measures of impulsivity and self-control. *Psychol Assess*. 2014;26(3):1003–20. <https://doi.org/10.1037/pas0000003>.
34. Nakigudde J, Musisi S, Ehnvall A, Airaksinen E, Agren H. Adaptation of the multidimensional scale of perceived social support in a Ugandan setting. *Afr Health Sci*. 2009;9:35–41.
35. Zimet GD, Dahlem NW, Zimet SG, Farley GK. The multidimensional scale of perceived social support. *J Pers Assess*. 1988;52(1):30–41. https://doi.org/10.1207/s15327752jpa5201_2.
36. B. A. F. Kenneth Ngure, Daniel W. Szydlo, Sarah T. Roberts, Morgan Garcia, Lisa Levy, Carolyn A. Akello, Krishnaveni Reddy, Thesla Palanee-Phillips, Pippa Macdonald, Bekezela Siziba, Lydia Soto-Torres, Sybil Hosek, Sharon L. Hillier, Gonasagrie Nair, Connie Celum, Ariane van der Straten., “Baseline Preferences for Oral Pre-exposure Prophylaxis (PrEP) or Dapivirine Intravaginal Ring for HIV Prevention among Adolescent Girls and Young Women in South Africa, Uganda and Zimbabwe (MTN-034/IPM-045 Study) (*In Press*).” *PLoS ONE*.
37. D. C. Division of AIDS Cross-Network Transgender Working Group Guidance on the Use of Gender-Inclusive HIV Research Practices: Protocol Design, and Data Reporting. March 2020. https://daidslearningportal.niaid.nih.gov/pluginfile.php/1/local_pages/pagecontent/Guidance%20on%20the%20Use%20of%20Gender-Inclusive%20HIV%20Research%20Practices.docx
38. Maughan-Brown B, Evans M, George G. Sexual behaviour of men and women within age-disparate partnerships in South Africa: implications for Young Women’s HIV Risk. *PLoS ONE*. 2016;11(8): e0159162. <https://doi.org/10.1371/journal.pone.0159162>.
39. Wamoyi J, Stobeanau K, Bobrova N, Abramsky T, Watts C. “Transactional sex and risk for HIV infection in sub-Saharan Africa: a systematic review and meta-analysis. *J Int AIDS Soc*. 2016;19(1):20992. <https://doi.org/10.7448/ias.19.1.20992>.
40. Glick JL, et al. The PrEP care continuum among cisgender women who sell sex and/or use drugs globally: a systematic review. *AIDS Behav*. 2020;24(5):1312–33. <https://doi.org/10.1007/s10461-019-02733-z>.
41. Joshi S, et al. PrEP uptake and persistence amongst HIV-negative women who exchange sex for money or commodities in Kampala, Uganda: a qualitative inquiry assessing the influence of pregnancy. *PLOS Glob Public Health*. 2023;3(6): e0000434. <https://doi.org/10.1371/journal.pgph.0000434>.
42. Giovenco D, et al. Experiences of oral pre-exposure prophylaxis (PrEP) use disclosure among South African adolescent girls and young women and its perceived impact on adherence. *PLoS ONE*. 2021;16(3): e0248307. <https://doi.org/10.1371/journal.pone.0248307>.
43. Katz AWK, et al. Qualitative analysis using social maps to explore young women’s experiences with social support of their oral PrEP use in Kenya and South Africa. *J Assoc Nurses AIDS Care*. 2023;34(1):45–57. <https://doi.org/10.1097/jnc.0000000000000363>.
44. Young AM, et al. Adolescent girls and young women’s experiences with disclosing Oral PrEP or dapivirine vaginal ring use: a multi-country qualitative analysis. *AIDS Behav*. 2023. <https://doi.org/10.1007/s10461-023-04109-w>.
45. Ngure K, et al. Pills, injections, rings, or implants? PrEP formulation preferences of PrEP-experienced African women for HIV prevention. *J Acquir Immune Defic Syndr*. 2021;88(4):e30–2. <https://doi.org/10.1097/qai.0000000000002793>.
46. Gichane MW, et al. Impact of women’s home environment on use of the dapivirine vaginal ring for HIV prevention in Sub-Saharan Africa. *AIDS Behav*. 2021;25(12):3847–57. <https://doi.org/10.1007/s10461-021-03311-y>.
47. Rousseau E, et al. Adolescent girls and young women’s PrEP-user journey during an implementation science study in South Africa and Kenya. *PLoS ONE*. 2021;16(10): e0258542. <https://doi.org/10.1371/journal.pone.0258542>.
48. Ortblad KF, Mogere P, Bukusi E, Ngure K, Baeten JM. Pharmacy delivery to expand the reach of PrEP in Africa. *J Int AIDS Soc*. 2020;23(9): e25619. <https://doi.org/10.1002/jia2.25619>.
49. Lanham M, et al. Engaging male partners in women’s microbicide use: evidence from clinical trials and implications for future research and microbicide introduction. *J Int AIDS Soc*. 2014;17(3 Suppl 2):19159. <https://doi.org/10.7448/ias.17.3.19159>.
50. Montgomery ET, et al. Male partner influence on women’s HIV prevention trial participation and use of pre-exposure prophylaxis: the importance of “understanding.” *AIDS Behav*. 2015;19(5):784–93. <https://doi.org/10.1007/s10461-014-0950-5>.
51. Giovenco D, et al. The effect of PrEP use disclosure on adherence in a cohort of adolescent girls and young women in South Africa. *AIDS Behav*. 2022;26(4):1007–16. <https://doi.org/10.1007/s10461-021-03455-x>.
52. Roberts ST, Mancuso N, Williams K, Kalule HN, Mposula H, Mugocha C, Mvinjelwa P, Garcia M, Szydlo D, Soto-Torres L, Ngure K, Hosek S. Strategies to support effective use of the vaginal ring and oral PrEP among adolescent girls and young women in sub-Saharan Africa: Qualitative findings from MTN-034/REACH. *J Int AIDS Soc*. 2022;25:183–4.

Publisher's Note Springer Nature remains neutral with regard to jurisdictional claims in published maps and institutional affiliations.

Springer Nature or its licensor (e.g. a society or other partner) holds exclusive rights to this article under a publishing agreement with the author(s) or other rightsholder(s); author self-archiving of the accepted manuscript version of this article is solely governed by the terms of such publishing agreement and applicable law.