



Impact of the Dapivirine Vaginal Ring on Sexual Experiences and Intimate Partnerships of Women in an HIV Prevention Clinical Trial: Managing Ring Detection and Hot Sex

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Abstract

Vaginally-inserted HIV prevention methods have been reported to impact the sexual experience for women and their partners, and hence impacts acceptability of and adherence to the method. We analyzed in-depth interviews and focus group discussions about participants' sexual experiences while wearing the ring, collected during the MTN-020/ASPIRE phase 3 safety and effectiveness trial of a dapivirine vaginal ring for HIV prevention in Malawi, South Africa, Uganda, and Zimbabwe. Most women reported that partners did not feel the ring during sex, however, women felt they had to manage their partners' interaction with or reaction to the ring. In maintaining positive relationships, women were concerned about partners' discovering ring use and about ensuring that partners had a good sexual experience with them. Finally women were concerned about how they themselves experienced sex with the ring. Some found that the ring made the vaginal environment more desirable for their partners and themselves.

Keywords Gender · HIV · Clinical trial · Vaginal ring · Sexual relationship · Sub-Saharan Africa

Introduction

Recent trials show the dapivirine vaginal ring to be an effective female controlled method of HIV prevention [1–3]. Their ease of use, potential for longer acting protection, and

discreet use independent of coitus have helped rings become a focus for development of HIV prevention intervention delivery [4, 5]. Women's interest in and willingness to use these technologies will ultimately determine their success [6, 7]. Among the key factors women consider when choosing a vaginally inserted product, whether for HIV prevention or other purposes, is its impact on sexual experiences for themselves and their partners [7–12].

Gender dynamics and expectations for sexual relationships and experiences are vital aspects of the context within which sex occurs [7, 13, 14] and, as such, for understanding women's experience of the ring. In sub-Saharan Africa, where young women are at especially high risk for contracting HIV [15], there is increasing exposure to and emphasis on "modern," powerful and independent women, especially in urban centers. Nonetheless, predominant feminine identities are associated with "traditional" female roles that accept male authority and comply with requests and desires of male partners [13, 14, 16–18], which extends to male decision making in regard to sexual activity and methods to prevent HIV transmission [14, 19].

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Because of the emphasis on male decision making and the primacy of the male partner's desires in sexual relationships, a central factor for women in assessing how the ring impacts sex is their perception about male partners' opinions and experience of the ring. Indeed, previous microbicide trials have suggested that women are concerned about communication and consensus about HIV prevention in their relationships, about the impact of the prevention method on partner's sexual pleasure, and fear of discovery especially during sex [7, 20–22]. Preparing the vagina for sex to maximize male pleasure is another aspect of upholding gendered expectations. There is a tradition in southern Africa of inserting herbs, cloth or other substances in the vagina to make it more enjoyable during sex [12, 23] and to maintain fidelity in their relationships [24]. Thus, using something that would negatively impact male pleasure can also negatively impact intimate partner relationships [12, 23, 25].

MTN-020/ASPIRE is one of the first studies to date to evaluate the dapivirine vaginal ring and to prove the ring effective for HIV prevention [1]. This trial was conducted across four countries in sub-Saharan Africa and women used the vaginal ring for up to 33 months. Previous research on contraceptive and HIV prevention rings indicates that only about a quarter of women and their partners felt the ring during sex [3, 6, 26, 27], however, the impact on relationship dynamics and sexual experiences more specifically have not been reported. An understanding of these dynamics and experiences will be critical in encouraging uptake of the ring and regular ring use, now that it has been proven effective [1, 3, 28]. This paper aims to explore the impact of the vaginal ring on women's sexual experiences, taking into account the gendered relationship context of sexual experiences.

Methods

Qualitative data about participants' sexual experiences while wearing the ring during MTN-020/ASPIRE were analyzed. The trial was a phase 3, placebo-controlled safety and effectiveness trial of a dapivirine vaginal ring (see Fig. 1) developed by the International Partnership for Microbicides for HIV prevention [1]. As a phase 3 trial, half of the women were given placebo rings and half had active rings: women were not aware of which ring they had. Participants attended monthly visits during which they were given a ring to insert at the clinic and instructed to keep the ring inserted until their next visit. Women were also instructed to use condoms during the trial. Qualitative data were collected in a nested qualitative component in each of the four study countries (Malawi, South Africa, Uganda, Zimbabwe) at a total of six sites that were located in a range of rural, urban and suburban settings [2]. Qualitative participants ($n = 214$) were enrolled into a single in-depth interview (IDI) ($n = 34$),



Fig. 1 Dapivirine vaginal ring

3 serial IDIs ($n = 80$), or an exit focus group discussion (FGD) ($n = 100$). Using semi-structured interview guides administered in English or local languages, all interviews were audio-recorded, transcribed, translated, coded, and analyzed. Participants also completed Audio Computer Assisted Self-Interviews (ACASIs) at month 3 and final visits which included questions about experiences with the ring during sex [2].

Institutional or Ethics Review Boards at each site approved the study, and written informed consent was obtained from all participants. Interviews were conducted by trained social science facilitators in English or one of the study languages using semi-structured interview guides. Topics covered a wide range of adherence and acceptability issues, but of particular interest to this analysis were questions related to disclosure, effect of the ring on sex, and attitudes of the male partner toward the ring. In serial IDIs, interviewers assessed how these themes changed during the 2 year study. Participants were reimbursed an equivalent of 5–20 USD, depending on the determination of the institutional review board (IRB) at each site.

Transcripts were uploaded into NVivo11 qualitative software and thematically coded using an inductive and deductive approach. Each transcript was initially reviewed by one of 6 coders at RTI, using a codebook developed by the team. The coding team met weekly for about 14 months to discuss emerging themes and

issues. Inter-coder reliability of > 90% among a set of 10% (n = 26) double-coded interviews was maintained amongst the coding team. For this analysis, codes related to the effect of the use of the ring on sex and disclosure were summarized across sites. Additionally, local social scientists from each site summarized the code report about sex from their data, allowing us to explore similarities and differences between sites. This process also allowed us to compare and corroborate the most salient themes amongst the US based and African researchers from the sites where the data were collected.

Background and demographic characteristics of participants and responses to CASI questions were summarized in SAS (v.9), and statistically compared using Wilcoxon and Fishers exact tests. The study was overseen by the regulatory infrastructure of the U.S. National Institutes of Health and the Microbicide Trials Network. All names of participants included in the manuscript are pseudonyms.

Results

Characteristics of the qualitative study sample are presented in Table 1.

Three of the study sites were in South Africa and participants from these sites comprise the highest proportion of the study sample (46%). Compared to study participants in the other countries, fewer participants in South Africa were married and a higher proportion had completed some secondary school. Almost all women in the study had primary sex partners (husbands included) and 97% of those had the same partner over the 3 months prior to enrolling in the study. Across sites, 17% of women had at least one other sex partner, and this number was considerably higher in Uganda (41%), likely attributed to the study team recruiting sex workers to enroll in the study. Rates of disclosure to partners about study participation and ring use were substantially lower in Uganda (46 and 31%) when compared to Zimbabwe (96 and 87%), Malawi (87 and 82%), and South Africa (68 and 50%).

Table 1 Study participant characteristics

	All participants	Qualitative sample							
		Total	Zimbabwe	Malawi	Uganda	South Africa			
						Total	Durban	Cape Town	Johannesburg
Participants enrolled, N	2629	214	39	38	39	98	35	37	26
Age in years, median (mean, min–max)	26 (27.2, 18–45)	26 (26.4, 18–42)	27 (28.5, 18–40) [39]	24 (24.7, 18–32) [37]	27 (28.2, 18–42) [39]	25 (25.6, 18–42) [98]	25 (25.2, 18–38) [35]	26 (25.6, 18–42) [37]	24 (26, 18–41) [26]
Currently Married	1074 (41%)	96 (45%)	30 (77%)	31 (82%)	28 (72%)	7(7%)	–	4 (11%)	3 (12%)
Ppt earns income of own	1186 (45.1%)	570 (50.8%)	22 (56%)	17 (45%)	29 (74%)	39 (40%)	23 (66%)	11 (30%)	5 (19%)
Completed Secondary School	2225 (85%)	164 (77%)	30 (77%)	18 (47%)	20 (51%)	96 (98%)	35 (100%)	36 (98%)	25 (96%)
Had a primary sex partner during the past 3 months	2616 (100%)	213 (100%)	38 (97%)	38 (100%)	39 (100%)	98 (100%)	35 (100%)	37 (100%)	26 (100%)
Had same primary partner for last 3 months	2538 (97%)	206 (97%)	37 (97%)	36 (95%)	37 (95%)	96 (98%)	35 (100%)	35 (95%)	26 (100%)
Had any other sex partners in the past 3 months	439 (17%)	36 (17%)	4 (10%)	7 (19%)	16 (41%)	9 (9%)	1 (3%)	6 (16%)	2 (8%)
Primary partner knows of participation in the trial	1972 (75%)	153 (72%)	35 (92%)	33 (87%)	18 (46%)	67 (68%)	23 (66%)	25 (68%)	19 (73%)
Primary partner knows has been asked to use ring	1680 (64%)	125 (59%)	33 (87%)	31 (82%)	12 (31%)	49 (50%)	14 (40%)	21 (57%)	14 (54%)

Maintaining Relationships

In the interviews, women were asked directly if the ring affected their sexual life. The majority of women answered no to this question. Overall, their main impression was that sex was not impacted by the ring. However, when they were asked to expand on this topic, or in other parts of the interviews, various themes emerged indicating that there were different ways in which their sexual experiences were indeed affected by ring use, that may at first have seemed peripheral to how the ring impacted the sex. A dominant overarching theme was that women's sexual experience with the ring was dominated by managing her partner's experience of the ring during sex, as a part of her larger efforts to maintain her intimate relationship based on gendered identities and relationship dynamics. Women were concerned about how their partners would react to their ring use and what impact that would have on themselves personally, or on their relationships. They expressed fear of jeopardizing their relationships, their partner's trust, their financial security, and at times their personal safety. Within this, the data suggested that a woman's primary concerns in this regard were: (1) threat of discovery, or making sure her partner did not accidentally discover the ring; (2) creating hot sex and maintaining male pleasure; and (3) her own experience of the ring. Each of these themes will be discussed below.

To Tell or Not to Tell

One of the principal ways in which women related the maintenance of their relationships to her sexual experience with the ring was grappling with the possibility of her partner discovering the ring by feeling it with his penis or his finger while engaged in sexual activities. Responses to CASI questions indicate that among women in ASPIRE who used the ring, 74% ($n = 1537$) never felt the ring during sex, and 69%

($n = 1389$) indicated their partner did not feel the ring during sex (Table 2). The qualitative data also suggests that for the most part, women reported that men did not feel the ring during sex. A partner feeling the ring can have implications both for the man finding out about the ring and the impact of the ring on sex. This section will address the first point and the second point is addressed below. Despite the common experience of men not feeling the ring, women continued to be concerned about the possibility of their partners feeling the ring.

For the most part, women addressed this concern by telling their partners about their use of the ring and/or their participation in the trial. For example, Precious (36y, Uganda, SIDI) stated, "It's better you tell him because you never know he might eventually find out, when he feels it during sex and question you about what you have put there... It would be important to tell your husband, it's just like getting a bank loan without informing your husband... a woman in our village [got a bank loan] and later got problems, they took her to prison." Precious's concern about informing her husband speaks to gendered social structures that discourage her use of the ring (likened to making financial decisions) without her husband's knowledge and to the relationship dynamics that informed her decision.

Noxie (21y, South Africa, SIDI) felt she should tell her boyfriend so that he did not accuse her of witchcraft: "I had to talk about it, how can I not talk about it? ... He would have inserted his hands and found it there, what was he going to think? I think he was going to kick me out of his bed even at 1 in the morning and send me home. You know Xhosa people, they got that assumption that Xhosa girls practice witchcraft, and they have bewitched [their boyfriends]. [Laughter]." Fears of accusation of witchcraft were especially common at South African sites.

Other women feared that their partners would accuse them of infidelity and decided not to tell them about the

Table 2 Feeling the ring during sex

		All sites [$n = 2270$ (%)]	Qualitative sample [$n = 193$ (%)]
How often women felt the ring inside during sex (last 3 months)	Most of the time	63 (3)	8 (4)
	Sometimes	411 (20)	24 (13)
	Never	1537 (74)	142 (80)
	Did not have sex in the past 3 months	63 (3)	4 (2)
Did any partners feel the ring inside during sex (last 3 months)	Yes	348 (17)	30 (17)
	No	1389 (69)	115 (66)
	Don't know	273 (14)	29 (17)
How ring affects her sexual pleasure	Increases her sexual pleasure	878 (39)	76 (40)
	Does not change her sexual pleasure	1311 (58)	114 (60)
	Decreases her sexual pleasure	61 (3)	1 (1)

Among women who wore the ring in the past 3 months at the final visit

ring. Nanteza (26y, Uganda, SIDI) had not told her partner for this reason. “Well...I think if I explained to him that the research carried out on the ring is to see if it can’t prevent us from acquiring the HIV virus...he would say that maybe I am seeing other men and that I don’t trust him and that I am afraid my other boyfriends might infect me.”

Some women did not feel any obligation to tell their partners, especially if they were shorter term, less serious relationships, or transactional partners. For example, Sibongile (21y, South Africa, SIDI) was a student in a boarding school and she and her partner did not have sex very frequently. She reported that she didn’t tell him about her study participation partially because she did not have the same obligation to share her “personal stuff” with her boyfriend that she would with a husband. Chisomo (21y, Malawi, SIDI) told her primary partner about the ring, but also had transactional partners who she did not feel she needed to tell. “That’s why I told him so that he knows I enrolled in the study of the ring that protects against the transmission of HIV...this one is the one I regard as my regular partner but the rest I meet them today then they leave as some have wives.... such that I can’t be open with them like I do with my regular partner.”

Threat of Discovery

Women who decided not to tell their partners were often afraid of his discovering the ring during sex especially in the early months of their ring use. In an effort to avoid detection of the ring, women engaged in various strategies like avoiding sex, avoiding certain positions, stopping partners from inserting fingers vaginally, or removing the ring before sex.

Precious (introduced above) indicated that, before she had told her partner about the ring, she was anxious about his feeling it: “The first time I was worried, I thought that he could feel it, or that I could even feel pain myself, so I kept on dodging him, but finally I accepted [to have sex with him], though I was still worried that he could feel it. But he didn’t feel it, because if he had, then he would have told me.”

For Doreen (25y, South Africa, SIDI), her concern was about her partner feeling the ring when he inserted his finger into her vagina. “It was difficult sometimes because some partners would want to insert the finger before he inserts the penis. You wouldn’t want your partner to insert the finger because they would feel the ring... I have so many tricks to prevent him from going inside there [she giggles]. I would touch him somewhere else sometimes just to distract him or maybe hug him [she’s still laughing].”

Nanteza, (introduced above) explained her strategy. “After inserting the ring, I decided to lie on my back and insert a finger to feel it but I could not at all feel it. Then I proved that it was right that the man cannot feel the ring when I have sex lying on my back. So I always insist on using that sex style and when he tries to change to another sex style, I tell him

that I do not enjoy it; when I actually know what I am after. I do not want him to feel the ring.”

Some women simply removed the ring during sex to avoid detection and further negative consequences. Brono’s (26y, South Africa, SIDI) partner felt the ring while they were having sex and she told him about her study participation “We argued and he would say that I must remove it when we are having sex... and I would ask ‘how is that going to help,’ but I would end up removing it because I was scared of losing him.”

Managing Ring Awareness and Detection

Deciding to tell partners about the ring was not a one-time decision, but a process that often resulted in women managing their partner’s awareness of the ring over the course of the study. Some men, on learning about the ring, were angry or unsupportive, which might in turn have led to the woman pretending to discontinue ring use.

Becky (22y, Uganda, FGD) described her experience with her partner after having disclosed ring use to him: “It reached a time and we wanted to have sex but he asked me; ‘Do you still have the ring?’ and I told him yes. He told me; ‘I am not going to have sex with you and I am not going to give you any of my money because you are using drugs (investigational drug in ring) that I do not understand.’ Then I said [to myself], ‘The [partner] is going to abandon me because of the ring?’ Shamim’s (28y, Uganda, FGD) partner felt the ring while having sex and pulled the ring out of her vagina. He told her that the ring might inject HIV into her body and also indicated that it made him lose his erection. “He said that whenever we are having sex and he knocks on it, he loses his manhood [erection].”

Some women whose partners discovered the ring during sex or were unsupportive of ring use decided to tell their partners that they had stopped using it. Deshi (33y, South Africa, SIDI) explained, “He was discouraging me from using the ring, I was tired of the things he was saying. He said the ring was going to cause me cancer. So I decided to lie to him and say I was no longer participating in the study.”

Once they had indicated they were no longer using the ring, women would attempt to ensure partners did not feel it, in similar ways to those avoiding their partner’s detection of the ring, such as changing positions, removing the ring before sex or not allowing partners to insert fingers vaginally. Similarly, women whose partners were unhappy about their ring use would attempt to avoid partners coming into contact with the ring. One manner of doing this was simply to confirm that the ring was inserted properly and deeply to prevent detection. Neo (23y, South Africa, SIDI) explained, “He doesn’t feel the ring. He was feeling it before, I am clever now. He felt it because I was incorrectly inserting it

at times. Everything now is sorted and it doesn't affect my sexual life."

Women often reported that if their partners initially had a negative reaction to the ring, they would eventually become accustomed to it. Agnes's (22y, Malawi, SIDI) partner was angry about the ring when she first told him about it and she told him she would remove it, but she continued to talk to him about it. "We spoke about it [the ring] and we agreed to each other [that she will continue using the ring]. We were happy and life was going well at home. We did not get angry at each other anymore." Agnes related the success of this negotiation process to her general work of maintaining a positive relationship with her partner. "I also don't know. Maybe it's because of my good behaviour because every time when he comes back from work I would be finished cooking. We ate, watched TV [television] and we were all happy." She reflects that maybe because she was performing her other responsibilities in a way that pleased her partner, he was more amenable to her wearing the ring.

Creating Hot Sex/Maintaining Male Pleasure

The second concern that women discussed as part of maintaining their relationships was ensuring that their partners had a good sexual experience with them. As a part of preserving the partner's pleasure, women would not want their partners to be aware of the ring, and they would want to create an optimal vaginal environment.

For many women in the study, ensuring that their partner enjoyed having sex with them was important for finding and keeping partners. This was socially reinforced, as with Lebo's (27y, South Africa, IDI) sister who was surprised that she was using an IUD and the ring. "[She said] 'You like to put things in your vagina. No wonder you don't last with your boys. Your affair only last for 3 months and then get another boy, it's because of these things you put in your vagina.'" In her sister's interpretation, Lebo was chasing away partners because she was inserting too many things in her vagina, which would make sex unfavorable.

A similar logic applied for women whose partners said they were not enjoying sex with the ring. Florence (24y, Malawi, SIDI) said that her husband was complaining about the ring, "It is giving him pain... what what!... To say the truth it was really making me feel uncomfortable...it was like the man who was keeping me in this town is complaining...ya! So I was not having any peace..." Florence's discomfort speaks to the obligation she felt to make sure that her partner was sexually pleased and to the fear that she was causing him harm and might lose his material support.

By contrast, a few women reported that their partners really enjoyed feeling the ring during sex. Vini (39y, Uganda, FGD) indicated that even though she had not told her partner about the ring he told her, 'I very much like

to reach the other thing that I hit on (inside the vagina). He said; 'I enjoy it.' He always tried to look for it inside the vagina. (Laughter).' If the partner was enjoying how the ring felt when he touched it with his penis, it made the endeavor of pleasing him much easier.

Maintaining an Ideal Vagina

Whether or not male partners reached and felt the ring and how they experienced this was one aspect of managing male pleasure. The other prominent aspect was how the ring impacted the vaginal state, or the feeling of the vagina for the penis, during sex. In some cases, the presence of the ring altered the vaginal state, sometimes for the worse, but often for the better.

One of the concerns that some participants and their partners experienced was that the ring would make their vagina loose, which would negatively impact sexual experience. Brono's (introduced previously) partner felt that her vagina had stretched because of ring use, "He then said, 'Your thing is big now'. I was so disappointed." In response, she started ingesting a substance that was known to tighten the vagina, Umlilo: "He was feeling like it has been stretched, now there are these things that I'm using which makes it smaller... I [take] it in order to be right... Your vagina becomes hot, that is why I use Umlilo." When asked to explain what she meant by hot, she explained, "It's when your boyfriend enjoys sex with you."

By contrast, other participants felt that the ring made their vagina's tight, which improved sex, as described by Joyce (unknown age, Malawi, FGD) "I had some change, when I started using the ring, my husband told me that my vagina was tight as opposed in the past; and at that time, he was struggling with me as though I was a young girl [laughter from the group] and so he was appreciating that the ring was good."

Some women observed that the ring made their vaginas drier, which was also considered a positive state for sex. June (39y, Zimbabwe, IDI) told the interviewer that she and other participants "were 'sharing' [experiences] and some were saying that using the ring is good in that it improves sex. 'Plus' they said that their vagina became dry," which was preferable: "Yes it is good because there won't be fluids during sex [...] there shouldn't be lots of fluid."

In contrast, some women found that the ring made the vagina "wetter," which for the most part was experienced as either a neutral or positive change. Rose (unknown age, Uganda, FGD) liked the increased wetness, "I think it increased a lot of fluids, I think I was dry before I started using it but these days my husband has been enjoying sex so much and I have really liked the vaginal ring a lot."

Women's Experience of the Ring

Participants' own experience of wearing the ring during sex was a less dominant theme, which could be largely attributed to its having little impact on their physical experience of sex. For the most part, they indicated that they did not feel the ring.

Women's mental awareness of the ring sometimes got in the way of enjoying sex because she was worried about whether her partner would detect it. Terisa (25y, Uganda, SIDI) initially experienced dryness when she used the ring, which she later attributed to her worries about the ring. "I was worried about my lack of fluids [dry state] because I hadn't opened up to him [about the ring] and had kept it to myself. When he asked me what was wrong, I told him that I had no appetite for sex. But when I stopped thinking about it and concentrated on what I was supposed to do I became normal again." A few noted that they initially had pain when having sex while using the ring, but that the pain later resolved. Kabelo (25y, South Africa, SIDI) noted that her vagina felt very tight and painful on the second round of sex, which she had not experienced before, however this improved over time.

Increasing Hotness

One positive side effect of ring use that was described in some interviews was increased sexual pleasure. Thirty-nine percent ($n = 878$) of ASPIRE participants in ACASI responses indicated that the ring increased pleasure for them, while 3% ($n = 61$) reported that it decreased pleasure. It was often difficult to distinguish in their narratives their own sexual pleasure from their partner's pleasure. There appeared to be a positive feedback loop such that if male partners experienced increased pleasure, the women also felt more pleasure.

Memory (24y, Malawi, SIDI), for example commented in her final interview, "Oh let me say the truth, since I started using the ring I used to feel very good indeed, because I feel the ring tightens the vagina and things moves on very well... Yes! Even my sexual partner was recommending me that I was good in bed (laughs), I don't know if things will change now that I have stopped using the ring but all in all things were fabulous."

Women talked about the ring making their vagina hot or warm, which increased the pleasure for their partners, and at times, themselves. Paida (20y, Zimbabwe, SIDI) said, "My husband could feel that I was warmer... It pleased him... I would feel sexually excited far more than what I felt when I was not using the ring." Lizzie (27y, South Africa, SIDI) also liked having the ring because it improved sex. "I noticed a difference before I had the ring and after I had the ring, I enjoy [sex] now, and my partner enjoys it." She thinks that sex improved because, "Since I started using the ring, I can

feel that when my partner and I are having sex, when he penetrates, I can feel the difference, because it [vagina] is tightened, you see." She also indicates her partner is enjoying sex, "[H]e says, 'Eish these days it's hot, this ring of yours (laughs)'" She added, "Maybe it tickles him inside... because it really drives him crazy... [N]ow when we do it, eish he thanks me."

For other women, it was the feeling of protection from the ring that made them enjoy their sexual experiences more (some women felt the ring protected them though they had been counseled that they may have a placebo). Agnes, introduced previously, was worried that her partner had many other partners who were HIV positive. "Because most of the times when coming home, he would ask me to have sex with him. But when I offer him condoms, he would refuse to use them; as a result he would force me into sex. When I joined the study, I now have sex freely with him because I no longer have any worries." Another woman (31y, Zimbabwe, SIDI) indicated that since joining the study she and her boyfriend are having sex more frequently. "[Since] we started using the ring even if he says twice or thrice I agree ... 'because' I am satisfied that the ring I have is protecting me."

For the most part, women themselves did not experience any difficulties with the ring during sex. In fact, for many women in the study, the ring increased their own pleasure, and that of their partners.

Discussion

This analysis reveals that, for most women and their partners, the vaginal ring was not felt during sex. However, the hypothetical possibility that men might feel it during sex meant that women had to manage their partners' interaction with, or reaction to, the ring. A primary concern was for male partners not to discover the ring during sex, which could jeopardize the woman's relationship and even her safety. Many women avoided this by informing their partners about ring use, others manipulated their sexual experiences to avoid positions and practices where the ring was likely to be felt, and some removed the ring during sex. In some cases, partners were told about the ring or discovered the ring and were unsupportive, and so women began to use similar practices to avoid the ring's detection. The second concern women commonly expressed was that their partners had a good sexual experience with her, again to maintain relationships and to avoid partners seeking pleasure elsewhere. This goal also involved avoiding his feeling the ring (unless he specifically enjoyed feeling the ring) and ensuring that the vaginal environment was in a state that he would enjoy. Women found that the ring often made the vaginal environment more desirable. The last concern was how she herself experienced sex with the ring. Most women did not

mention their own experience at all, but for some women, wearing the ring increased the pleasure they experienced during sex. This had to do in part with their partners finding them more desirable, or with women feeling more protected during sex.

In this analysis, since most partners did not feel the ring during sex, it was likely that women could (physically) wear the ring without telling their partners. However, the majority chose to disclose ring use to their partners as a part of their desire to maintain positive intimate relationships. Previous studies of female initiated HIV prevention technologies have also highlighted the important role of male partner influence in women's trial participation and use of prevention technologies [19, 20, 29, 30]. In the MTN VOICE-C study, a qualitative study at the Johannesburg site of the VOICE trial, male partners' understanding (comprehension and support) was one of the most important themes that emerged about male partner influence on trial participation and product adherence [20]. Disclosure is not a simple matter of telling or not telling partners about trial participation and ring use. In this analysis, it was found that women limited or distorted their disclosures, e.g. they may have told partners about trial participation but not ring use, or told him about ring use but indicated that it was for contraception, or if the partner objected to the ring, they may have said they had stopped participation. Previous studies describe in more detail a similar process of disclosure wherein women use disclosure to manage partners' reactions and to manage their relationships more generally [31, 32].

Some women will need and want to use the ring without telling their male partner, which would necessitate his not feeling it. We found in this study that men could feel the ring on occasion, and this was not restricted to men who knew it was there. Some women attributed this to improper insertions, but this was not true for everyone. It will be important to have a better understanding of how and when men can feel the ring in order to better counsel women, possibly through studies of couples. In some cases, women may want to remove the ring for short periods to avoid detection during sex, so future studies would need to address how long the ring can be safely removed for sex in partnerships where disclosure is not possible.

Women in this study prioritized managing their intimate partner relationships by controlling their partners' interactions with the ring—by ensuring he would not feel it, or choosing how and when to tell him about the ring. This relationship management could have immediate benefits and consequences socially. Women as much as men are deeply invested in dominant gender norms and expected relationship dynamics. They often agree with and help to shape unequal structuring of relationships that organize and make sense of cultural and political life. In turn they are socially rewarded with status, a sense of moral propriety,

and at times material gain [13, 33]. High unemployment, geographic mobility, and low marriage rates contribute to a sexual economy in which women may be involved with multiple partners who will provide financial support [34]. In addition to material and social benefits, intimate relationships also can provide care, love, and intimacy, which offer further incentives for protecting the relationship [35]. Thus, the relationship is a priority that women do not want their ring use to jeopardize or threaten.

Another area in which women wanted to protect their intimate partnerships was in providing sexual pleasure. Women in this study were concerned with how the ring would affect their partners' sexual pleasure, including the impact it had on the feeling of the vagina during sex. In VOICE, women alternately praised or complained about the gel inserted into the vagina because of the impact it had on their vaginal state for sex [25]. Women aim to make the vagina tight and dry, as described in the narratives in this study. Tightness has been described in other studies as being closer to a virginal state with loose vaginas being associated with aging, disease and promiscuity [8, 12]. Dryness has been characterized as the lack of unhealthy wetness in the vagina, so it is not necessarily in contradiction to lubrication in the vagina [8]. Use of the vaginal ring—including the contraceptive ring—can increase vaginal secretions according to self-reported data [36–38], however any increased lubrication was generally received positively among women in ASPIRE, and may have been linked to the idea of hotness. We are not aware of any clinical findings related to increased tightness or dryness in the vagina related to the vaginal ring.

Women in this study indicated that the ring increased pleasure, both for themselves and their partners. This increased pleasure was often described as being hot, and previous research on vaginal practices has found that hotness is another desired state that women seek to achieve by inserting a variety of products [23]. In KwaZulu Natal, discussions of hot sex were combined with references to increasing male sex drive [24]. In this study, some women indicated that their own pleasure had increased, but for the most part, mentions of increased pleasure and hotness either referred explicitly to male pleasure or were closely intertwined with male pleasure. This is not to say, however, that this was to the exclusion of female pleasure.

Some evidence here suggested that male partners viewed (or the women expected them to view) the vaginal ring as a threat to his trust, their relationship or to his authority. Narratives emerged of the ring as an object to bewitch and control him, or as an indication of infidelity. However, the ring was also presented as something that brought pleasure into a relationship. The notion of female and male pleasure with ring use should be explored in more detail in future studies. The positive sexual pleasure attributes of the ring can be used in the future to market

the ring, if approved by regulatory agencies. This may encourage uptake of a novel HIV prevention method, while focusing on a less-clinical and more sex-positive aspect of its use. That said, it has been suggested here and in other studies that men are wary of female-initiated HIV prevention methods for fear that they will encourage promiscuity or that their partner has underlying trust concerns leading her to try and protect herself, so marketing would need to be done in a careful and culturally-appropriate way that did not lead to unintended backlash [20, 39].

Through in-depth interviewing, a more complicated picture of women's sexual experience with the ring than could have been derived solely from the close-ended questionnaires was drawn out. Also, because data were collected longitudinally, we were able to see how the experience changed over time. That said, there are a number of limitations that should be considered. Women in trial settings have not always been forthcoming in talking about their use of trial products [39]. We know that nonadherence, for example, was more widespread in ASPIRE than women reported in ACASI or in qualitative interviews [1, 28]. Qualitative interviewers are trained at establishing rapport with participants and encouraging honest, open discussion. Nevertheless, there may have been social desirability bias in responses, and women may have under-reported problems using the ring during sex. Additionally, women in the ASPIRE trial may have been different than other women in their communities in important ways. For example, women who opt to join a study of the vaginal ring may be more comfortable with sex, or more tolerant of vaginal sensations and insertions, less fearful of a partner, or more at risk than other women.

The data presented here indicate that the vaginal ring generally does not physically impede sexual intercourse, and that overall, women felt positively about the use of the ring during sexual activities. Given the importance of the sexual experience to the use of vaginally inserted products, these are promising findings. It is also important to note that male partners have a strong influence over the female experience of using the ring during sex, impacting adherence and acceptability of the ring. Identifying effective strategies to engage male partners in ring use and women's HIV prevention, while still preserving women's agency, are important priorities for the success of the vaginal ring. Offering a prevention method that can be used discreetly or without a negative impact on sex will provide an important choice for women in stemming the spread of HIV.

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Compliance with Ethical Standards

Conflict of interest All authors declare that they have no conflict of interest.

Ethical Approval All procedures performed in studies involving human participants were in accordance with the ethical standards of the institutional and/or national research committee and with the 1964 Helsinki Declaration and its later amendments or comparable ethical standards.

Informed Consent Informed consent was obtained from all individual participants included in the study.

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