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"I have the vaccine in my body": perceptions of female sex workers after enrolling in a phase IIb HIV vaccine and pre-exposure prophylaxis trial in urban Tanzania

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Abstract

Background HIV continues to be a significant global public health problem in low and middle-income countries. Efforts to search for an effective and affordable preventative HIV vaccine are on-going. We investigated the understanding of perceived risk for acquiring HIV and the experience of female sex workers (FSW) in Tanzania, before and after enrolling in an HIV vaccine and Pre-Exposure Prophylaxis Trial.

Methods This was a descriptive qualitative study design nested in a multicentre Phase IIb three-arm, two-stage HIV prophylactic vaccine trial with a second randomization to compare two pre-exposure prophylaxes (PrEPVacc trial) regimens. We present findings from Dar es Salaam site in Tanzania. Fifteen in-depth interviews and four focus group discussions were conducted among FSW who participated in the HIV vaccine and Pre-Exposure Prophylaxis Trial between 2021 and 2023. Data analysis was done manually using the Framework and thematic content analysis approaches.

Results Two themes emerged from the findings: `Apparent risk' of acquiring HIV infection before enrolling in the HIV vaccine trial and `Balancing perceived risk' of acquiring HIV infection and preventive measures after enrolling in the HIV Vaccine and Pre-Exposure Prophylaxis Trial. Before enrolling in the trial, the participants perceived themselves at high risk of acquiring HIV infection. They reported inconsistent condom use in multiple relationships with clients whose HIV status was unknown. After enrolling in the trial, the participants reported improved knowledge of HIV prevention, particularly the use of pre-exposure prophylaxis and compliance with preventive measures. However, some participants perceived that the experimental vaccine was an established HIV preventive measure. In addition, condomless sex was still practiced, mainly to get higher payments from the clients.

Conclusion and recommendations The knowledge gained on HIV preventive measures by FSW after participation in the trial was valued. However, continued engagement in risky sexual practices and poor compliance with HIV

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preventive measures highlights the need for continued risk-reduction interventions while searching for an effective HIV vaccine.

Keywords HIV, Vaccine trial, Female sex workers, Risk, Tanzania

Background

Globally in 2023, 39.9 million adults and children were living with HIV, and 53% of all people living with HIV were women and girls, with these groups contributing 44% of all new infections [1]. The severity of HIV infection across Africa disproportionately affects key and vulnerable populations (KVPs) including women and men who have sex with men [2]. Female sex workers (FSW) are among the most at-risk populations for acquiring HIV infection, and make up 3% of the global median HIV prevalence among the adult population (ages 15–49) [1]. A recent study in Kenya indicates an average of 28% prevalence of HIV among FSW, with the percentage increasing with age [3]. Similarly, in Rwanda, the HIV prevalence among FSW was on average 9% with higher rates among older women [4]. The risk of HIV infection among FSW may be influenced by inadequate access to the prevention and treatment services they need, partly due to police harassment and discrimination from healthcare providers [2]. In Tanzania, FSW acquire HIV infection exclusively from unprotected sexual intercourse. Data published in 2020 showed that the HIV prevalence among FSW in Tanzania was 15.3% [5].

Tanzania is among the countries in Africa conducting HIV vaccine trials. Two phase I/II HIV vaccine trials namely HIVIS-03 and TAMOVAC I and II were successfully conducted between 2007 and 2012 among males and females at low risk for HIV infection [6–9]. The overall incidence rate of HIV-1 among HIVIS-03 population was 8.4 per 1000 person years at risk (PYAR), and was 8.8 and 6.9 among males and females respectively [10]. The conduct of these HIV vaccine trials involved a series of HIV risk-reduction interventions [11], and those who completed the trial visits appreciated the knowledge acquired on the reduction of risky sexual practices [12]. However, some participants from both trials confided that they had acquired HIV infection in the course of a prolonged follow-up period [13]. The incidence rate of HIV among FSW who were initially enrolled in the Registration cohort in 2018 was 3.45 per 100 PYAR [14]. Oral pre-exposure prophylaxis (PrEP) has emerged as one of the most efficacious current approaches in biomedical prevention [15]. Regular PrEP use is effective, with adherent individuals reporting little to no breakthrough infection [16, 17]. In 2015, the World Health Organization (WHO) recommended oral PrEP for individuals at substantial risk for HIV [18]. Following the WHO recommendation, countries with a high HIV burden have implemented PrEP implementation policies for high-risk individuals including FSW [18–20]. In 2019, the Ministry of Health in Tanzania officially published guidelines to roll out PrEP in public sector as part of the government's comprehensive HIV prevention efforts, and the targeted population included sex workers [21].

The Pre-Exposure Prophylaxis Vaccine (PrEPVacc) Trial, a Phase IIb three-arm, two-stage HIV prophylactic vaccine trial with a second randomisation to compare TAF/FTC to TDF/FTC as pre-exposure prophylaxis, conducted in Dar es Salaam, Tanzania, enrolled FSW aged between 18 and 40 years old, HIV uninfected who demonstrated good uptake of PrEP before the trial. The participants who met the inclusion criteria were randomized into one of the three vaccine arms and one of the two PrEP arms using a single code per participant. The next vaccines were given at weeks 4, 20, and 24 during the trial. PrEP was initiated at the enrolment into the trial and continued up to two weeks after the 3rd vaccination. The participants were advised to continue taking locally available PrEP at the trial site. Subsequently, a number of participants either discontinued or were inconsistent with PrEP use after the PrEP-compulsory phase during the trial. There is limited documentation of how the FSW in Tanzania perceive their risk of acquiring HIV infection particularly during interventions targeting HIV prevention. Knowing the perceptions of such a population can inform the present and future HIV preventive interventions. We describe the perceptions of risk for HIV acquisition and experiences of risky sexual practices before and after enrolling in an HIV vaccine trial among FSW in Dar es Salaam, Tanzania.

Methods

Study design

This was a descriptive qualitative study design nested in the multicenter Phase IIb three-arm, two-stage HIV prophylactic vaccine trial with a second randomization to compare TAF/FTC to TDF/FTC as pre-exposure prophylaxis (PrEPVacc), which was conducted in Tanzania, Uganda and South Africa between 2020 and 2023. In this analysis we aimed to explore the perceived risk for acquiring HIV and experiences among the Tanzanian female sex workers before and after enrolling in the PrEPVacc trial.

Study area and population

This paper draws on data from one trial site in Dar es Salaam, Tanzania's most urbanized and commercial city. Dar es Salaam region covers both urban and peri-urban

areas, contributing to the heterogeneity of the study population. Specifically, the study was conducted at the study site, Muhimbili University of Health and Allied Sciences (MUHAS) in Dar es Salaam, Tanzania.

The study was conducted among FSW aged between 18 and 40 years old, HIV uninfected who were participating in PrEPVacc trial in the Dar es Salaam site. The City of Dar es Salaam hosts 32% of the Tanzanian population; the male/female ratio is 0.93 [22]. The HIV prevalence among FSW who were being prepared for HIV vaccine study in Tanzania was 7.6% and this prevalence was associated with age [14].

Sampling technique

The PrEPVacc Trial Qualitative Component Study Operations Manual (SOM) was used to guide the study sites to purposively sample 5–10% of the trial participants for the qualitative study based on characteristics such as age, sex, work type and PrEP regimen. The characteristics of our participants were age and PrEP regimen. Thus, a pre-determined sample of 15 participants based on 10% of enrolled participants in PrEPvacc trial at the Dar es Salaam-MUHAS site was selected through the help of the data manager. The study social scientist (EAMT) randomly selected the potential 15 participants for interviews; in turn, EAMT requested the counsellors to arrange for an interview appointment. The participants were interviewed at three time points in the trial months 2, 6 and 12 to assess their perception of HIV risk immediately after enrolment, and later as they continued participating. According to the SOM, the participants who did not take part in interviews were invited for focus group discussions (FGD). Furthermore, the FGD participants were sampled according to whether they adhered well to PrEP or not. The study nurse counsellor confirmed the PrEP adherence status using the urine tests results. All study participants were recruited from the HIV vaccine trial clinic.

Data collection procedure and tools

Data were collected from 45 participants who participated in in-depth interviews (IDI = 15) and Focus Group Discussions (FGD = 30). Fifteen IDI were conducted between 12th November 2021 and 8th May 2023. Four FGDs, each comprising 7–8 participants, were conducted between 6th September 2022 and 24th July 2023. Two experienced male researchers collected the data using the IDI/FGD guide. The reason for using male researchers is that FSW in Tanzania appears more free to talk about their sex work with men. The IDI and FGD guides comprised five and four topics respectively. Each topic consisted of two to six questions with probes (Appendices 1 and 2). The present data were based on topics number four and two from the IDI and FGD guides, respectively, and the following questions were asked: (1) Do you feel at risk of acquiring HIV? Explain your answer; (2) How is your perception of risk now compared to when you started the study (3)? Does the pill protect against HIV/AIDS/STIs? Reasons? All interviews and FGD were conducted in Kiswahili and were audio-recorded. The IDI and FGD took between 28 and 40 min and 90–120 min, respectively.

Data management

The quality assurance procedure was carefully followed. All data were audio-recorded after obtaining written consent to use the recorders from the participants. The information was transferred to a password-protected computer immediately after each IDI or FGD. Each audio was given a number before being sent to the transcriber. All audio recordings were transcribed verbatim, by eight experienced transcribers. The principal investigator EAMT checked all the transcripts against the audio-recorded information to ensure quality. The transcripts were anonymously given a number and sent to an independent researcher who translated all the transcripts from Kiswahili to English. A team of four researchers who were familiar with the study checked the quality of the translation to ensure that the meaning was not distorted during the translation. The transcripts were assigned unique identification numbers for each participant. The principle investigator ensured no mix-up of the transcripts by ensuring each transcript's number corresponded to the audio number in an excel sheet. Both Kiswahili and English transcripts were saved on the password-protected desktop computer.

Data analysis

Framework and thematic content analysis approaches were done manually. The Framework analysis approach [23] was used because it is suitable for use by a team of people undertaking manual coding and analysis. After identifying themes, and drawing up a list of codes, indexing (coding) and charting (copying and pasting data according to thematic areas) were done simultaneously. Mapping (visual display of data) was done to allow researchers to identify patterns, associations, and concepts. The thematic content analysis approach [24] was applied. The first four authors independently coded the data. After independent coding, the authors checked the codes, discussed and reached a consensus on overarching themes.

Findings

Socio-demographic characteristics

All IDI and FGD participants were healthy female, aged between 20 and 37 years.

Table 1 Themes, sub-themes and condensed meaning units

Theme	Sub-theme	Condensed meaning unit Interpretation of the underlying meaning
Apparent risk of acquiring HIV infection before enrolling in an HIV vaccine and Pre-Exposure Prophylaxis Trial	Engaging in risky sexual practices	Monetary-driven condomless sex
		Condomless sex due to a prolonged relationship with one customer
		Inability to protect against HIV transmission
	Encountering limited knowledge of HIV preventive measures	Limited knowledge of HIV prevention methods, including PrEP
		Lack of knowledge about the HIV testing schedule
Balancing the perceived risk of acquiring HIV infection and use of preventive measures after enrolling in the HIV vaccine and Pre-Exposure Prophylaxis Trial	Perceived reduced risk of HIV due to knowledge gained	Gained knowledge of HIV prevention
		Increased knowledge in self-protection
		Acquired knowledge in performing HIV test
	The belief that the study products (vaccines and PrEP) protect against HIV	Compliance with HIV preventive measures
		Exposure to unprotected sex using unreliable preventive methods

The majority (eight) of the IDI participants attained secondary level education, six studied up to seven years of primary school, while only one stopped in fourth year. Besides sex work, a few IDI participants engaged in other income-generating activities such as hairdresser, barmaid, petty business, and master of ceremony responsible for overseeing social events. Half of the FGD participants were educated for up to four years of secondary education, and another half stopped after seven years of primary school.

Themes and sub-themes

Two themes emerged from the thematic content analysis: the 'Apparent risk' of acquiring HIV infection before enrolling in the HIV vaccine and Pre-Exposure Trial and the 'Balancing the perceived risk' of acquiring HIV infection and preventive measures after enrolling in the HIV vaccine and Pre-Exposure Trial. Each theme is supported by subsequent sub-themes, as described in Table 1.

Theme 1: Apparent risk of acquiring HIV infection before enrolling in HIV vaccine and pre-exposure prophylaxis trial

Engaging in risky sexual practices

Monetary-driven condomless sex Before enrolling in the HIV vaccine study, many participants reported practising condomless sex to meet the client's wishes as well as the desire to get more money. They said it was very tempting to practice sex without using condoms because they depended on the sex work as their primary source of income. One participant said:

> *I used to have sex without protection with people who had a large amount of money, I used to focus on the amount of money that I would be paid; if the money was good enough, I went with them without a condom (P10, IDI).*

Condomless sex due to a prolonged relationship with one client Many participants said they stopped using condoms with permanent clients [a client who was viewed as a husband; could live and have unlimited sexual intercourse with the FSW]. They reasoned that those long-term relationships with male clients provided assurance of faithfulness and that the client could not be living with HIV. One participant narrated:

> *You know we women, after seeing a man for the first time, the second time, and the third time, think that I am used to this one, I mean you believe that he is not infected (P15, IDI).*

Despite the expressed fact that participants were aware of HIV prevention methods, they said sometimes they practiced condomless sex to fulfil the clients' preferences. Some men disliked condoms:

> *Not all men want to use protection; some want without condoms, I did have education on how to protect myself against infection, but I used to do it [condomless] while my conscience told me that I was at risk and it increased my fear; (P11, IDI)*

Inability to protect against HIV transmission The participants reported a lack of seriousness when it comes to protecting themselves against HIV transmission. They perceived themselves at risk of acquiring HIV infection before enrolling in the vaccine trial because of sex work without using condom. They suspected that even if they were careful, their clients could have unprotected sex with women living with HIV and in turn transmit the infection to them. Some of the participants complained about not knowing the routes of HIV transmission and identifying healthy clients. They also engaged in unprotected sex because the clients paid them well.

One participant emphasized:

> *In many cases the people we have sex with without condom give us good payment. So there is a time we say, to hell with! (IDI, P1).*

Encountering limited knowledge of HIV preventive measures

Limited knowledge of HIV prevention methods, including PrEP Participants said they lacked knowledge

about HIV prevention including PrEP. They reported seeing people in the community taking prophylaxis but they did not know from where they got them. As a result, they exposed themselves to the risk of acquiring HIV infection without knowing where to get the preventive medicines. They said:

> *I didn't know what does preventive medicine helps. I mean I didn't know anything, even when I see a person taking the medicine, I was among people who would say that she is HIV positive, and other myths. I used to see people in the street taking preventive medicines but didn't know where they get them (P7, IDI).*

Some of the participants argued that they were at risk of HIV infection because of a lack of education on prevention. They lamented that a limited understanding of preventive measures was a big problem for many of them:

> *I did not have education on how to protect myself against infection [HIV]. So I used to do it [sex] while my conscious tells me that I am at risk, and that increased my fear (P10, IDI).*
> *I was at a high risk of getting HIV infection because I did not have education; I was doing things [unprotected sex] that I didn't understand (P11, IDI).*

Also, the participants stated that before joining the study they had limited knowledge about the condoms' expiring dates. They said that clients could just tell them that they had the condom, and they engaged in sexual intercourse while not being sure about the condom's viability. One participant said:

> *You might find someone carrying an expired condom of 2010. Yes, you see it has required quality; you see but you use it without knowing [the expiring date]; hence, ending up infected because you have not read the expiring date. I have come to know these issues [condom expiring date] at Muhimbili [Trial site] (P1, IDI).*

Lack of knowledge about the HIV testing schedule The lack of knowledge about the HIV testing was reported as one of the gaps in HIV prevention. The participants reported that before joining the study, they were less knowledgeable about HIV testing issues including the schedules. They did not know when to test and after how long they should do the test. One participant said:

> *In the beginning, I didn't know about HIV well; after how many months are you supposed to test [re-test] for HIV, I didn't know that [re-test for HIV]. (P7, IDI).*

Theme 2: Balancing the perceived risk of acquiring HIV infection and use of preventive measures after enrolling in the HIV vaccine and pre-exposure prophylaxis trial

Perceived reduced risk of HIV due to knowledge gained

Gained knowledge of HIV prevention After participating in the HIV vaccine trial, testimonies emerged on improved FSW's knowledge regarding HIV prevention. They embraced the knowledge gained on the meaning of HIV infection, how HIV is transmitted, and available prevention methods. They said:

> *The risk [HIV infection] is there, but currently [after joining the trial] not much because I am using Pills [PrEP]... the pills make me feel comfortable...I mean it [knowledge about HIV] has greatly changed (P5, IDI).*
> *I am using PrEP, and I know that PrEP are pills which prevent HIV infection 100%. Even if the virus will be attacking, its attack would be different if you are using PrEP (P11, IDI).*
> *I cannot have sex with a client without condom because I know the meaning of HIV, and how it is transmitted. I know the importance of condom, So there is a difference between now and in the beginning [before joining the trial] (P13, IDI).*

They declared that although the risk of acquiring HIV was still there even after participating in the study, it was not that much because they were using pills [PrEP] that made them feel protected. They reasoned that the pills made them feel free and comfortable to continue with their sex work even to those clients who refused to use condoms.

> *Now I don't think I am at risk because I use the preventive pills [PrEP] even if I skip the pill in a day, I don't think it will be dangerous [acquire HIV] (P15, IDI).*
> *To be honest, the study has helped me; first of all the study has removed the fear, second it has removed me from the risk because now I have self-awareness (P11, IDI).*

Increased knowledge of self-protection The participants' confidence in self-protection increased because they felt that they had gained adequate knowledge about HIV prevention and had all the essential protective gear.

> *Now I am not at risk because I have received an education, and I know how to use this and that [protection such as condom and PrEP] so that I cannot get HIV infection (P8, IDI).*

They emphasized how important it was to carry condoms with them. One participant said:

Now I am not at risk of getting the infection because I have protective gear and I am good… now I use condoms, condoms to me now are like a teacher who cannot go to school without a stick and a pen (P6, IDI).

They said they were taught all about HIV and that education increased their knowledge on not having sex haphazardly because they could acquire the HIV infection. The free condoms provided at the study site were essential to support the participants in self-protection:

Now I am confident; I know that I have taken my pills [PrEP], although we were advised not to have much confidence [having sex without protection], and that is why we were advised to use condoms (P14, IDI).

The benefits of joining the study were evidenced by the reduction of risk perceptions among the participants. Some participants reported that they became more careful by avoiding having sex with clients without condoms. They emphasized that if the clients refused to use condoms, they asked them to go for HIV tests:

Since I joined the study and received education and know the importance of my health, I cannot have sex without a condom...so even if you show me three hundred thousand shillings without a condom. I would say no, or if you want sex without a condom, we have to go and check our health [HIV status] (P10, IDI).

The risk of getting HIV infection was considered low because the participants felt confident that they could abandon the clients who would refuse to use condoms:

I also protect myself and the person that I have sex with, ...I trust myself and when I meet a person I dare to tell him that, I cannot have sex with you without a condom because I know the meaning of HIV and how is it transmitted (P13, IDI)

The benefits of condoms were well known because of the experience of prevention of infections such as Sexually Transmitted Infections (STIs), HIV, and unplanned pregnancies. One participant emphasised and said:

I always carry condom because it prevents against STIs, HIV and unplanned pregnancies like the child I am taking care of myself; now I am preventing unplanned pregnancies…When I go to my business, I know that I must protect myself (P10, IDI)

The provision of free prophylaxis at the study site increased confidence in not getting HIV infection among the participants. Many participants appreciated being given protection such as PrEP and condoms.

Acquired confidence in performing HIV test After enrolling in the study, the participants reported that they gained confidence about performing an HIV test. They did not fear testing for HIV, and envisioned themselves as being more careful as compared to before they enrolled in the study. They said:

I don't fear testing for HIV, and I have confidence now compared to the beginning... the study has helped me; first of all, the study has removed the fear, (P11, IDI).

The confidence in HIV testing after enrolling in the trial provided the participants with assurance of their health status. They acknowledged the frequency of taking HIV tests at the trial sites helped to reduce their fear.

The belief that the study products (vaccines and PrEP) protect against HIV

Compliance with HIV preventive measures The knowledge gained during the study increased compliance with HIV preventive measures including PrEP. They perceived themselves at low risk of acquiring HIV infection because they used PrEP. Some were confident that full use of PrEP protects them from HIV infection.

They evidenced that using PrEP pills could prevent HIV infection 100 per cent.

When we use the pills even if we suffer from minor injuries, we are sure that we have immunity in our bodies. That is why we request that the size of the pills should be reduced and the pills be made available (P8, FGD 2).

Other participants emphasized the benefits of PrEP during their sex work. They said that when taking the pills for seven days consecutively, it could stay in the body and hence provide effective protection even if they have sex without a condom with a person living with HIV. They also described that PrEP had resolved the risk of condom-less sex that was practised before joining the study.

When you get a client who tells you that he doesn't want to use condoms and that he will pay you more money, you will not refuse it, you will accept it. So when I take the medicine, I know that I have taken my pill [PrEP] in the morning and now I am free (FGD 6, P6).

Exposure to unprotected sex using unreliable preventive methods After participating in the study some participants continued to expose themselves to the risk of acquiring HIV infection despite the availability of modern preventive methods. They used locally perceived preventive methods without condoms as exemplified below:

> *I had sex with a man without a condom, and when I suffered from itching I took hot water and put it there [in the vagina]; when I felt fresh, I went and had sex with another client, and I didn't advise them to put on condoms, I didn't use condoms a lot (P6, IDI)*

Some continued to engage in unsafe sex by relying on the physical inspection of the clients as an assurance of their HIV status:

> *I don't have an HIV infection now, then I meet a client who has bruises [minor injuries] then I can get an infection eeh, so even if you [client] say you will pay me a large amount of money when we go in the room I must inspect you, that is the first thing I will do. (P10, IDI)*

Many participants believed that they had been given a preventive vaccine in the study. Some of them felt more protected because they received both the vaccine and PrEP. Some also relied on their individual beliefs against the risk of acquiring HIV infection:

> *I believe I am at risk but not much...Still, I have the vaccine in my body now; I still use the pills. So, I trust myself that I am not a great risk... So I believe that I can't get the infection (P15, IDI)*

I trust myself because I still have the vaccine in my body, so I know the vaccine will help me also, it is not a hundred percent; we live by hope, as I have told you, and hope helps. (P14, IDI)

The use of combined HIV preventive methods was reported to increase confidence in self-protection among the participants. They reasoned that it would be difficult to get HIV because they used condoms, and pills, and sometimes they used lubricants to prevent bruises and regular health check-ups. Some participants were cautious that they might still be at risk of acquiring HIV in the future.

> *I am not at risk of getting HIV. One of the reasons is that I use condom; second, I believe in pills [PrEP] that I am using; third sometimes I use lubricant to prevent bruises... (P13, IDI).*

Overall, the participants believed that the trial products would protect them. However, potentially some participants might be re-engaged in risky sexual practices including condomless sex to get more money from the clients. Having the 'belief' that trial products [HIV prophylactic vaccine plus TAF and TDF as Pre-Exposure prophylaxis] will protect them and the need for money, means condomless sex.

Discussion

In the present study, this interplay is obvious. Before the participants enrolled in the HIV vaccine study, they perceived themselves at risk of acquiring HIV infection because they were engaging in unprotected sex. The unprotected sex was either due to clients' preferences or trust developed from a prolonged relationship. At the same time, self-protection against HIV transmission was not a priority because of limited knowledge of available HIV preventive measures. The limited understanding of the importance of HIV testing, as well as fears of undergoing HIV testing accelerated the risk of getting infected. After enrolling in the HIV vaccine study, the risk perception and experiences were mixed. Many participants strived to balance the gained knowledge and use of available HIV preventive measures. They used the knowledge gained to improve self-protection and confidence in performing HIV testing. However, a controversy emerged about compliance with HIV preventive measures and re-engaging in risky sexual practices. Re-engaging in risky sexual practices, particularly condom-less sex was fuelled by the desire to get more money from the clients.

The community organization of sex work can predict risky sexual practices [25]. The fact that the participants declared the practice of engaging in unprotected sex before enrolling in the vaccine trial implies that FSW are highly vulnerable to HIV infection and thus form a suitable cohort for efficacy vaccine trials. Many participants were not complying with the available HIV preventive measures due to the client's preferences and fulfilment of their own financial needs. In Tanzania, the HIV prevalence in adults who reported engaging in paid sexual intercourse in the 12 months preceding the previous survey was higher than those who did not. Females who reported having engaged in paid sexual intercourse had nearly twice the HIV prevalence compared to males [26]. The economic influence contributes to HIV infection because sex workers anticipate to be offered more money if they accept condom less sex [27]. In South Africa, sex workers engage in condom less sex to increase their earnings [28]. Also, FSW are at higher risk of acquiring HIV infection than the general population because of the influence of alcohol [29]. In the present study, the practice of condom-less sex due to prolonged relationships suggests that lack of knowledge of one's HIV status

may increase chances of acquiring the infection without knowing. The practice of condom-less sex increases the chances of HIV transmission among the FSW. In Kenya, condom use with intimate partners was lower as compared to use at last sex with a client [3]. In Tanzania, low condom use with nonmarital partners has been low for many years [26] suggesting more effort is needed in condom marketing, and education towards behaviour change. In South Africa, while commercial sex contributes to 6.9% new HIV infections, clients of FSW largely contribute in HIV transmission [30].

The limited knowledge of HIV prevention among the studied participants may be compounded by their educational background. The fact that more than half of the participants were not educated up to four years of secondary education suggests that the studied cohort possesses limited updates on HIV transmission through the school curricula. A previous study in Rwanda showed that the HIV prevalence decreased with education [4]. The acquisition of HIV knowledge can be accessed through various social media. However, the observed busy schedule of selling sex in this study and the context of the business itself may limit time to access publicly available HIV education including the use of PrEP.

The practice of HIV testing is one of the self-protection measures to control the transmission of the virus; however, the uptake of the test has not been promising for adults aged 15 years and older [26]. While HIV testing is a gateway to link those with negative results to HIV preventive services or to care and treatment for those who seroconvert, female sex workers reported fear of the test. A previous study in Uganda among FSWs, revealed that the perceived good quality of health services with same-day results and immediate initiation of treatment, individual's need to remain healthy, and having alternative sources of income facilitated linkage to HIV testing. However, perceived stigma, fear of being seen at HIV clinics, myths about antiretroviral therapy, and financial constraints hindered the linkage to HIV testing [31].

The reported knowledge change and perceived HIV preventive measures after participating in the HIV vaccine study reflect the possibility of changing risky sexual behaviour among the FSW. The acquired knowledge appeared to improve self-protection while the participants increased their confidence in HIV testing. A previous study among FSWs showed that risk reduction counselling was associated with decreased risk behaviour but was insufficient to change the behaviours of all those at the highest risk [32]. The fact that compliance with condom use was low among FSW, the PrEP use could be a game changer to ensure protection before engaging in unprotected sex. However, acceptance to use PrEP is not common among FSWs in many parts of Africa. In Kenya, only one-quarter of the studied FSW reported taking PrEP [3]. The mixed messages from health care workers, conflict with intimate sexual partners, stigma and inability to differentiate people taking PrEP from those taking anti-retroviral therapy reduced uptake of PrEP among FSW in South Africa [33]. In Tanzania, the majority of FSW who used PrEP stopped because of side effects, and condom were infrequently used [34], In addition, the FSW feared that if the clients found their PrEP pills, they would mistake them for HIV treatment, and could chase them away assuming they are living with HIV [35].

The relationship between individuals and macro-structural levels plays an important role in HIV prevention [25]. Thus, the challenge for compliance with HIV preventive measures and re-engaging in unprotected sex among FSW in this study is worth noting. Previous studies have documented that participants in HIV vaccine trials may continue to engage in risky sexual practices partly due to false hope of high efficacy from the experimental vaccine [36, 37]. In the present study, exposure to unprotected sex, despite the gained knowledge, access to condoms, and PrEP hamper the efforts to prevent new HIV infection among the FSW. The condom could be the most promising non-biomedical widely available HIV prevention method, but breakage during sexual encounters has been reported, and the FSW continued to have sex without it [38, 39]. A systematic review concluded that condom promotion in Africa and the Middle East needs to incorporate gender-based power in relationships [40]. In Tanzania, less condom use has been reported among FSW who were potential participants for HIV vaccine trial [14]. The fact that the participants in the present study were worrying about losing a client, and his money if they insist to use condom implies that re-engaging in unprotected sex is not surprising. Even the identified low risk participants in the previous HIV vaccine trials engaged in risky sexual practices [41], and some of them acquired HIV infection after a prolonged follow up [13].

Strength and limitations

This study is based on a cohort of FSW who were involved in HIV prevention efforts. The study was conducted outside the clinical trial setting to ensure a comfortable and pressure-free zone during both the interviews and focus group discussions. This setting helped to create a respectful atmosphere for the FSWs, facilitating open and honest responses. In addition, the use of both In-depth interviews and focus group discussions generated large sample for a qualitative study. However, this study has some limitations. The findings may not be transferred to FSW in other settings. The results may shed light on the perceptions of FSW in Tanzania and may not be directly related to the general population due to different lifestyles. Nevertheless, these limitations do not interfere with the trustworthiness of the current study results.

Conclusion

The findings of this study conclude that there is a clear interplay between individual, interpersonal, and macro-structural factors in HIV transmission among FSW. The FSW are at high risk of acquiring HIV infection because of non-compliance with available HIV prevention methods. The education and other HIV prevention interventions during the vaccine trial appear to be useful to the FSW, but many are facing difficulties in complying with the interventions because of financial challenges and clients' preferences forcing them to practice sex without a condom. However, the misconceptions about reduced risk by being in an HIV vaccine trial are a concern. Unprotected sex with multiple clients whose HIV status is unknown increases the risk of infection. As such, many HIV-negative FSW in Tanzania will remain at high risk of HIV infection until an effective preventive and affordable vaccine is made available or unless they adhere to PrEP. This study calls for the continuation, and strengthening of targeted education programs for the KVP. In particular, our findings highlight the importance of providing adequate education to FSW and emphasize compliance with HIV preventive measures even in participating in an HIV vaccine trial. Also, various organizations may intervene by offering income-generating activities to the FSW because many of them appear to engage in risky sexual practices in the spirit of gaining money.

Abbreviations

AIDS	Acquired Immune Deficiency Syndrome
FGD	Focus Group Discussion
FSW	Female sex worker
HIV	Human Immune–deficiency Virus
IDI	In–depth Interview
KVP	Key Vulnerable Population
KVP	Key Vulnerable Population
LIC	Low Income Countries
MUHAS	Muhimbili University of Health and Allied Sciences
PrEP	Pre–Exposure Prophylaxis
PrEPVacc	Pre–Exposure Vaccine
TACAIDS	Tanzania Commission for AIDS
THIS	Tanzania HIV Indicator Survey

Supplementary Information

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Supplementary Material 1.

Supplementary Material 2.

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Authors' contributions

EAMT, MI, JSA, GGL, PM, MB, EFL, SA, RK, JS: Responsible for conceptualising the projectEAMT: Performed data curation EAMT, MI, JSA, GGL: Performed data analysisPrEPVacc social science team: Participated in the methodological aspects of the projectSA: Was responsible for Project administrationSA, MB, EFL: Supervised the project All authors: Validated data and manuscriptEAMT: Wrote the original manuscript draftEAMT, MI, JSA, GGL, PM, MB, EFL, SA, RK, JS, PrEPVacc Trial Team: Reviewed, edited and approved the final draft.

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Data availability

Data is available from the corresponding author on reasonable request.

Declarations

Ethics approval and consent to participate

The PrEPVacc study received ethical approval from the National Ethics Committee in Tanzania (Approval number: NIMR/HQ/R.8a/Vol.IX/3333) and from the Muhimbili University of Health and Allied Sciences (Approval number: MUHAS-REC-11-2019-066), and it was conducted per the Declaration of Helsinki. Before commencement of data collection, the interviewer and the participants revisited the study information shared at previous visits to ensure the participants still recall what the qualitative study is about. They were assured of the confidentiality that even the clinic team would not get to know what they shared, unless with their permission. Clarification was made for anything they did not understand, and they were answered any question they had. When the interviewer was satisfied that the information has been understood and the participant(s) was in agreement, the participant was given two copies (one for the study and another one for the participant) of informed consent to sign and date. The participants in FGDs were taken through the same process in groups. In addition, the participants were requested that the interview would be audio-recorded, and the audios would be transcribed without disclosing their personal information. This anonymity was ensured by giving each participant a number from the start of IDI of FGD. Thus, written informed consent was obtained from all the potential study participants. The participants were assured of their freedom to participate or withdraw from the study at any time and that by doing so, they would not compromise the services they were entitled to during the study. Also all the participants were assured of their privacy. They were informed that the knowledge generated from the shared information will be disseminated in various forums anonymously without disclosing their personal identification. All the participants received transport compensation in 30,000 Tanzanian Shillings equivalent to $12 US Dollars. Also, the participants were reminded about available referral services if they needed health care or other support.

Consent for publication

Not applicable.

Competing interests

The authors declare no competing interests.

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