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Why did I participate in an HIV vaccine study? Experiences of participation in the first phase II HIV vaccine trial in Mozambique: An ancillary study using a mixed-method approach

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ABSTRACT

Introduction: This study recognized the lack of information regarding recruitment and retention factors associated with implementing HIV vaccine trials from the perspective of *de facto* participants. It aimed to describe the motives and experiences of 31 young adults who participated in a phase II HIV vaccine clinical trial conducted in Maputo, Mozambique.

Methods: This was an ancillary study with a mixed-method approach that employed a convergent design, combining both quantitative and qualitative methodologies. Data collection involved questionnaire surveys, in-depth interviews, and focus group discussions. Participants were assessed before and after learning whether they received the experimental vaccine or placebo. Thematic analysis was used for qualitative data, while descriptive analysis and statistical tests such as Fischer's test and McNemar's exact test were applied to quantitative data. The study also utilized the Health Belief Model to understand the decision-making process of participating in an HIV vaccine study.

Results: Most of our participants were young females, single, with limited financial resources. Participants joined the trial with the belief that they had a unique opportunity to help the fight against HIV and contribute to the research for the discovery of an HIV vaccine. Positive experiences related to trial participation include gaining knowledge about HIV and personal health and receiving risk reduction counseling. Participants reported blood collection as a negative experience and that they suffered social harm because of trial participation. Participants felt abandoned after the trial ended.

Conclusion: Preventive HIV vaccine trials should integrate a social-behavioral component to assess reasons for participation and refusal in real-time. Providing ongoing personal attention is crucial for young individuals who have committed 1–2 years to trial participation, extending beyond the trial period. Implementing tailored strategies for HIV risk assessment and reduction during and after the trial is essential. Addressing these factors can enhance preventive HIV vaccine trial implementation.

Introduction

Mozambique has long been recognized as one of the countries heavily affected by the Human Immunodeficiency Virus (HIV) pandemic [1,2]. Despite the implementation of strategies aimed at reducing the number of new HIV infections in the country [3], Mozambique ranks 6th in terms of new infections globally (age 15 – 49 years) [4,5], with approximately 98.000 new HIV infections reported in the country in 2020. This implies that more strategies are required to enhance transmission control efforts [3,6].

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Since 2011, Mozambique has been actively implementing vaccine research to discover a preventive vaccine against HIV [7–9]. This resulted in a notable increase in the number and diversity of HIV vaccine clinical trials conducted in the country [10,11]. Recruiting and retaining a large number of HIV-uninfected volunteers from a source population with a high incidence of the disease is crucial for the successful execution of HIV vaccine clinical trials [12].

According to Koblin et al., it is essential to identify and understand the facilitators and barriers that influence the recruitment and retention of participants in HIV prevention trials. Such insights can inform the development of context-specific strategies for successful trial implementation [13,14]. A widely accepted approach is to conduct behavioral and social science research before, during, and after the implementation of HIV prevention trials [15]. Ancillary studies are highly valuable as they enable the inclusion of additional measurements in an ongoing study to address distinct objectives. This approach proves to be cost-effective and efficient [16].

A review by Inungu et al. highlights the variation in expressed willingness to participate and retention, along with their associated factors, across different countries [17]. A study conducted in Tanzania revealed a moderate expressed willingness (50.6 %) among participants to take part in HIV vaccine trials, which was found to be linked to a positive perception of such trials [18]. Conversely, a study conducted in Uganda demonstrated a significantly higher expressed willingness (99.4 %) among participants, with access to HIV counseling and testing identified as the primary motivating factor [19].

It is important to consider the experiences and expectations of individuals participating in HIV vaccine trials, in addition to their motives related to trial participation. These factors require careful evaluation. Participants in HIV vaccine studies may also have concerns about potential side effects and may face negative experiences during and after their involvement in the trial, including strains on personal relationships [20–23]. Volunteers who have received the experimental vaccine may feel a sense of protection, potentially resulting in engaging in risky sexual behaviors and experiencing discrimination based on their vaccination status [17,24], especially after unblinding [25,26]. Unblinding refers to the process of disclosing the intervention to pertinent parties, which includes participants, investigators, and clinical staff [27].

Numerous behavioral models have been utilized to explore how beliefs and perceptions impact the adoption of HIV preventive strategies in specific populations. These models also provide valuable guidance in developing strategies to promote the adoption of preventive measures against HIV [28,29].

One such model is the Health Belief Model (HBM), developed by Hochbaun. This model provides a systematic framework for explaining and predicting preventive health behavior. The model posits that an individual's likelihood of accepting a preventive health behavior is contingent upon their beliefs regarding the connection between the behavior and subsequent illness. Additionally, it emphasizes the individual's ability to assess and weigh the risks and benefits associated with adopting or abstaining from the preventive behavior, particularly in the absence of disease [30,31].

The HBM proposes that the motivation behind engaging in health behavior can be categorized into five key elements: 1) *Perceived susceptibility:* refers to the individual's subjective perception of their own risk or likelihood of experiencing a particular disease. 2) *Perceived seriousness:* It pertains to the beliefs held by an individual regarding the potential impact, predominantly negative, that a specific disease would have on their life, including social consequences. 3) *Perceived benefits of taking action:* it relates to an individual's decision to adopt or reject a recommended health action, which is influenced by their beliefs about the effectiveness of the action in question. 4) *Barriers to taking action:* these encompass the obstacles or hindrances that may prevent an individual from adopting a recommended health action. 5) *Cues to action:* It involves the stimuli or prompts necessary to initiate the decision-making process and motivate the individual to adopt a recommended health action (Fig. 1) [31]. By considering these five categories, the HBM provides a comprehensive framework for understanding individuals' motivations and behaviors related to health actions [28–30].

This study aims to address the existing knowledge gap concerning the recruitment and retention factors related to HIV vaccine trials from the perspective of *de facto* participants. Specifically, it focuses on describing the motives underlying participation in an HIV vaccine trial using the Health Belief Model. Furthermore, The study investigates the experiences and changes in sexual behaviors of participants in a phase II HIV vaccine clinical trial in Maputo, Mozambique, both before and after unblinding. Its ultimate goal is to offer crucial, context-specific data to guide the development of effective recruitment and retention strategies for future HIV vaccine trials, particularly in Mozambique.

Methods

Study design

An ancillary study with a mixed-method approach was conducted, employing a convergent design [32] that integrated both quantitative and qualitative methodologies. The study aimed to gain a comprehensive understanding of participant motivations, sexual behaviors, and experiences in a phase II randomized, placebo-controlled, double-blinded HIV vaccine clinical trial, TaMoVac II [15]. The research took place at the *Centro de Investigação e Treino em Saúde da Polana Caniço* (CISPOC) in Maputo, the capital city of Mozambique, between February 2017 and March 2018. CISPOC served as the site for the first two Mozambican HIV vaccine trials, TaMoVac I and TaMoVac II [8,33].

Study population

The study population consisted of all 40 participants who enrolled in the TaMoVac II trial, and they were intentionally selected to participate in this ancillary study. The primary criterion for inclusion in this study was previous participation in the TaMoVac II trial. Clinical trial enrollment-specific criteria included being between 18 and 40 years old, being considered healthy based on clinical and laboratory evaluations conducted by a study physician, testing negative for HIV, and being assessed as having a low risk of acquiring an HIV infection in the past 6 months. Low risk was defined as having only one HIV-negative sexual partner and no history of sexually transmitted infections (STIs). Additionally, participants had to confirm that they were not pregnant, as determined by a dipstick test, and had no plans to become pregnant during the study period [33].

Study procedures

This study was conducted three years after the completion of the TaMoVac II trial. The procedures and methods employed in the TaMoVac II trial have been detailed elsewhere [33]. The participants were contacted by phone and invited to the study site for further explanation of the study's procedures and objectives. Those interested in participating provided informed consent by signing a consent form. Data collection occurred at two-time points (post-trial): before the unblinding process (Visit 1) and after the unblinding process (Visit 2), where participants were informed whether they had received the experimental vaccine or placebo. The median interval between Visit 1 and Visit 2 was approximately 1 year for each participant. Table 1. provides study timelines, including the dates of the last trial visit dates, unblinding visit dates, and study visit dates. During the unblinding process, participants received counseling on HIV risk reduction behavior and had the TaMoVac II study procedures reviewed, including the possibility of a false-positive rapid HIV test result. Counseling was conducted by TaMoVac II counselors and the study physician. The first author developed questionnaires, semi-structured guidelines for in-depth interviews (IDI), and focus group discussions (FGD) based on a literature review

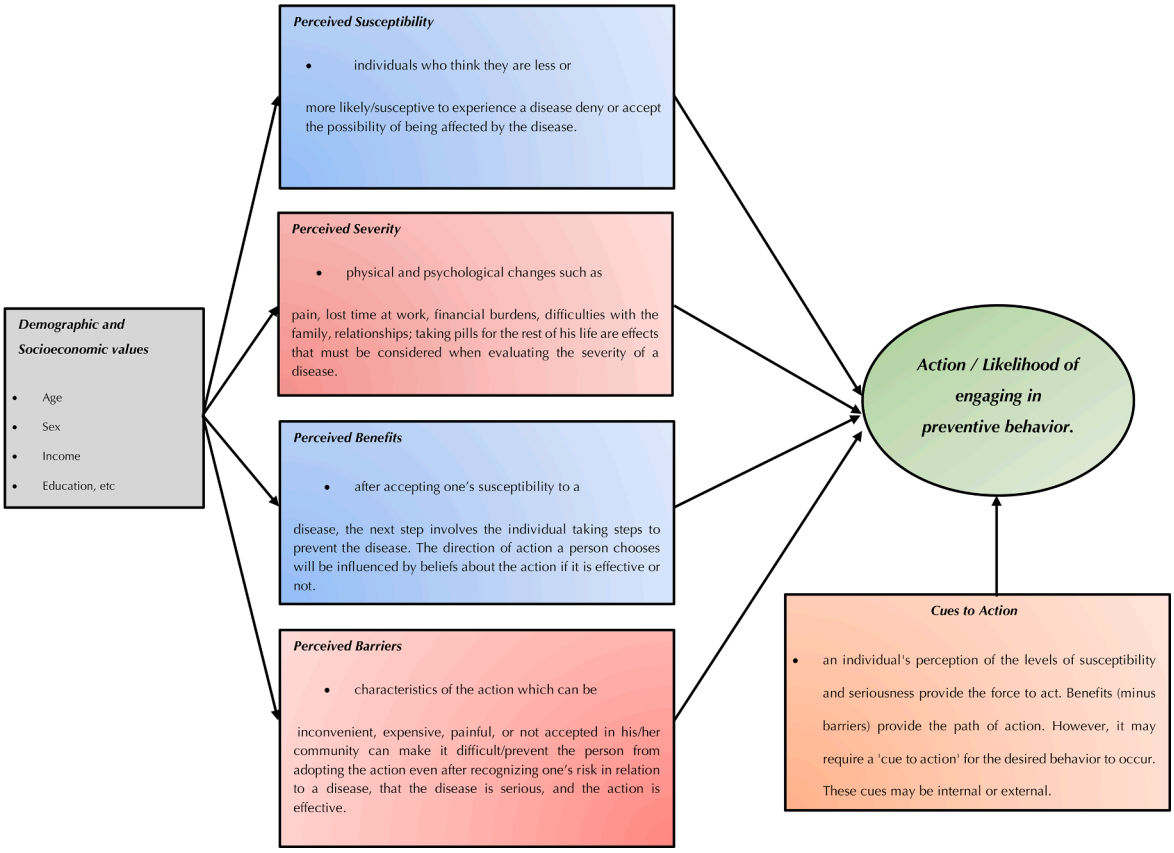

Fig. 1. A graphical representation of the Health Belief Model (HBM).

Table 1
Timeline for TaMoVac II and Ancillary Study Schedule.

TaMoVac II Last Visit (17)	Visit 1 Data Collection Period	TaMoVac II Unblinding Period	Visit 2 Data Collection Period
26/Nov/ 2014	**Feb-Mar/2017**	**May-Jul/2017**	**Feb-Mar/2018**

and adapted to the study context through discussions with site investigators and experienced counselors. Participants first completed a paper-based questionnaire, followed by IDI and FGD, with conversations recorded using voice recorders and notes. Two study counselors familiar with the TaMoVac II trial participants administered questionnaires during Visits 1 and 2, while four social researchers who were not involved in the trial conducted IDI and FGD sessions, lasting around 20 min each, only during Visit 1. To ensure clarity and objectivity and to ensure that the responses addressed the research questions, the first author assessed the first four interviews and discussed them with the team before continuing with the remaining interviews. All interviews were subsequently reviewed for accuracy. Participants were given the choice of being interviewed by a female or male interviewer.

Study materials

Questionnaires. The questionnaires collected data on demographics, knowledge of the HIV vaccine trial, self-report of sexual behavior, and social harm (Annex 1).

In-depth interviews. The semi-structured guide for the IDI consisted of four main questions: 1. *What is HIV, how is it transmitted, and how do you assess your risk of HIV infection acquisition?* 2. *Why did you participate in the TaMoVac II trial?* 3. *How was your experience of participating in an HIV vaccine trial? and 4. Do you think members of your community would support research to find preventive measures against HIV, including conducting clinical trials of HIV vaccines, and why?*

Focus group discussion. The main questions for the FGD were: 1. *What is research, and what are the goals of an HIV vaccine clinical trial*? 2. *Why, despite having received counseling, do some participants acquire STIs*? 3. *What do members of your community think about the participation of young people from the community in clinical trials of HIV vaccines, and what would their comments be?*

Data analysis

Qualitative analysis: Thematic analysis was utilized as the methodological approach to analyze the collected data. The analysis followed the six steps outlined by Braun & Clark in 2006: familiarization with the data, generating initial codes, searching for themes, reviewing themes, defining and naming themes, and producing the final report [34]. The data were transcribed and entered into MAXQDA 2020 (VERBI Software, 2019) for analysis. An initial codebook was created by IC based on an inductive process using the analysis of the first two interviews [35]. Two researchers (IC and AM) independently conducted the coding process, holding regular meetings to discuss code agreements and the emergence of new codes. IC developed the framework for the identified themes, which was then discussed with AM and PT until a complete agreement was reached. The analysis was initially conducted in Portuguese, and the codes, sub-themes, themes, and quotes were later translated into English. Qualitative quotes will be presented separately in Table 2.

Quantitative analysis: The data was inputted into Epi Info 7™ (CDC, 2015) and analyzed using STATA 15 (STATACORP Software, 2017). Descriptive analyses were performed to examine the socio-demographic characteristics, knowledge, sexual behavior, and social

Table 2
Summary of themes and sub-themes on HIV vaccine research and HIV vaccine trial experience.

Theme	Sub-Theme	Quote
HIV Research Knowledge	HIV Knowledge	"*It is a virus that, a virus that when it is not treated, with time, that is, when it is not discovered in time, it ehhh how it is, it grows until it reaches a very complicated phase … is that it is, HIV/AIDS, isn't?*" – Male participant (IDI)
		"*anyone can get HIV, as long as they are in a vulnerable situation…, unprotected relationships, contact with blood, contaminated objects, needles, etc. blood transfusion too*" – Female participant (IDI)
		"*I think that women have to be more aware, especially pregnant women, because sometimes they have HIV-AIDS and sometimes they have so much psychological damage, they even think that if the child is born with a virus HIV, whether born or not, does not change anything and then as for teenagers, I believe they are the most affected"* – Female participant (IDI)
	HIV Research Knowledge	"*they explained it well, they had the patience to explain, from what I realized, I participated in TaMoVac II. TaMoVac I, was to study if the vaccine candidate was safe, now at TaMoVac II, it́s also to know if it was safe and to know when they give the vaccine to someone, if it́s possible to know if that vaccine candidate produces antibodies or antibodies in the body of that person*" – Male participant (mixed FGD)
		"*From what I remember they explained that ahh, this study was to study the safety of the vaccine to see the immune response of the organism, how will the organism react to the vaccine, also know what the dosage would be for each person, depending on the immune system of each one*" – Female participant (mixed FGD)
HIV Stigma	HIV infection perception	*"Because you are going to die taking pills, you are going to die taking pills and the society, I think it is the way the disease was disseminated nor, there is still a lot of preconceptions, when… someone knows that you have HIV, it was because you had unprotected sex, but there are many other ways of contracting HIV, but people all stop right there and discriminate against people who have HIV, they have many problems to socialize with, is it a problem because the people when they have that disease never feel good, never have support from people, so it's a problem*" – Female participant (IDI)
	Stigma as a barrier for trial participation	"*Even in hospitals there are people who are afraid to take the condoms away… Humm, because there are a lot of people who will see them, and they are afraid, if I take the condom what will those people think"* – Male participant (IDI)
		"*They will not understand (referring to clinical trials), they will say hmm this guy has AIDS, they are injecting this guy with something, because the vaccine application comes with… how you call it … comes with … there are some let's say, HIV substance in it, is what they explained to us"* – Male participant (IDI)
		"*There is still a lot of taboo in relation to the disease, so for people to accept it (referring to clinical trials) would be a little difficult"* – Female participant (IDI)
Sexual Behavior	Risk Behavior	"*In my opinion the people who are most at risk are people who have risky behaviors, and what are risky behaviors, and have multiple partners … people who share piercing objects, in this case I mean people who consume injectable drugs in this case and also, to some extent, sex workers these are the potential potentials"* – Male participant (IDI)
		"*…unprotected relationships, contact with blood, contaminated objects, needles, etc. blood transfusion too… If I am going to have unprotected sex with my boyfriend from the moment, I go unprotected I am vulnerable"* – Female participant (IDI)
		"*…We people like things a lot you know, people like things a lot, I think there are a lot of people who do … Especially girls … They like things, a girl that at home, for example, does not receive any value, … then a guy promises I'll give you 100 metical's, 500 meticais', she will be able to show her friends that she has lunch, she'll buy a hamburger she'll also buy*" – Male participant (IDI)
		"*Some people think of themselves as superheroes, super men, … They can't catch these diseases,, they do and undo … people who say like this, I can be with that woman, I can be with this one, I do whatever I want, I have nothing to do with protection, whatever, … Whatever I want, as I want*" – Male participant (IDI)
	HIV Risk Assessment	"*I currently evaluate myself as a low risk person… before I was part of the study, or rather, before being part of the study, I could consider myself a middle-level person because ready, I didn't have, I didn't have several partners but I was one person who had relationships, relationships with a short time span that involved several partners, even though they were not multiple, but because they were several, that already put me in this situation… Nowadays I have a single partner, a person who lives with me and with the knowledge I have acquired allows me to make a self-assessment, analyze to better evaluate the conditions so that I do not expose myself*" – Male participant (IDI)
Clinical Trial Participation	Interest towards HIV Trial	"*… I believe that first, if I'm not mistaken, I received an invitation from my colleagues because … I received a little idea, let's participate in the lecture, it is something*

(*continued on next page*)

Table 2 (*continued*)

Theme	Sub-Theme	Quote
		interesting, I went there too, I heard the lecture, I was interested in wanting to have more detailed information about it and that's when I decided that I want to enter this study too" – Male participant (mixed FGD)
		" … *I, I arrived at CISPOC, an invitation from a TAMOVACH II participant who is part of the study, even at the beginning, talking in college she said she was taking part in the study and it would be good for me to participate and said she had an appointment scheduled for a few minutes later and said come on, I said come on, I got here, they treated me very well and explained it to me and I stayed*" – Female participant (mixed FGD)
	Motives for trial participation	*"For me, since I was a kid, I always had that thing about watching superhero movies, Super Man, BatMan, so when this opportunity came I said, I can't be born in this world here and go ashore without doing something positive, I said no, this is also an opportunity to be a super hero, a super hero is not only one who has powers, he is one who helps researchers or helps professionals. collaborating for a certain just cause, you can also be considered a superhero, no matter how much people say ehh no… are you going to be a guinea pig?*" – Male participant (mixed FGD)
		"*At first ehhh I didn't know that there would be any compensation, I came for my own motivation after I saw that there would be a hallelujah compensation is an advantage. Tomorrow, I don't have to complain that I don't have money (for transportation)*" – Female participant (mixed FGD)
		"*Yes, I can say that It was it the reason, yes, to have or know someone close to them who was suffering from this disease that served as motivation for them to stay … I met some relatives who are unfortunately suffering from the same disease*" – Male participants (mixed FGD)
	Positive experiences of participating in a HIV vaccine trial	"*No, they were always very good, … that is attention because that is a commitment that we have and we have to honor it, they always treated me very well Dr. Igor, Dr. Patrícia…*" – Female participant (IDI)
		" *because when there are normally two young people many times the conversation is better, the conversation is better*" – Male participant (IDI)
		"… before participating in the study… That's it, is hearing about it and thinking it is a utopia (HIV infection), and then arriving here to receive explanation – Humhm… concrete examples and simple examples, say look this can be contaminated unprotected, contaminated and everything and call my responsibility…" – Female participant (IDI)
		"*One of the rights we had was to know that we could leave the study at any time. We are not in prison, simply because we sign the consent, it does not mean that we should be in prison, we are free to make our own choices*" – Male participant (male FGD)
	Negative experiences of participating in a HIV vaccine trial	"*I don't know if it's still the lady who stayed there, for the collection (blood collection) … and that hurt … you know that there was a time when she even had to prick both arms, to be able to draw blood and it wasn't nice… You had to take a needle and return it to the same arm. I will never forget that day… It was terrible… then the person who is going to do the collection should be skilled"* – Male participant (IDI)
		"I have a friend she was outside the country she came back last year when she came back when she came across me the first thing that she asked me, was how was it?… I said I am disappointed, because, the study happened, and we simply serve their interests, the rest no longer matters if they reached those objectives … they should continue to give us that warmth even if it is once a monthly call …, call us and invite us to come here sit discuss and talk about our experiences" – Female participant (IDI)
	Social Harm	"*They called me a coward. I went to this hospital with my boyfriend to do HIV tests and they asked me why you don't do it, I explained if I do it I will be positive because I am participating in TAMOVACH, so they said you are guinea pigs … that will not do anything, they are just making animals of you… they were nurses: Yes, it happens (another female participant). It happened to me too (another female participant)"* – Female participant (female FGD)
		"(*Wowww. Ahhhh.) Are you crazy (mothers' reaction)? What are you thinking about life? What do you want?" – Female participant (IDI)*
		"some schoolmates with the time, because sometimes I had to leave a bit early to get there, and I couldn't do some work with them, so when I told them, they just said you agreed to be a guinea pig … sometimes they even called me a guinea pig" – Female participant (mixed FGD)

harm among the participants. Fischer's test was used to assess the independence of variables, while McNemar's exact test was employed to determine differences between the first and second visits.

The HBM guided the decision-making process behind participating in an HIV vaccine study (Fig. 1).

The results are presented in a convergent way, emphasizing similarities across different perspectives, with themes illustrated by both sets of data. Integration took place in the development of the model at the level of interpretation and reporting [36,37].

Trustworthiness and rigor

To ensure trustworthiness and rigor in this study, we adhered to the guidelines proposed by Nowell et al. [34]. The following actions were taken to enhance the credibility and reliability of the research: 1. Triangulation of data collection methods (interviews, focus group discussion, and questionnaire) and triangulation of interviewers (counselors who knew the participants and social researchers who did not know the participants); 2. Peer debriefing during data collection, data analysis, and article writing with the study team to provide an external check on the research process; 3. Audit trial of all the documents and decision-making process during the study to ensure rigor. We also followed the consolidated criteria for reporting qualitative research (COREQ) to conduct and report this study [38].

Ethical approval

This study received ethical approval from the National Health Bioethics Committee of Mozambique (IRB00002657) and administrative approval from the Ministry of Health of Mozambique. Permission to contact trial participants was obtained from the trial sponsor. Participants were informed that their participation in this study was voluntary and distinct from the clinical trial procedures. All participants provided signed consent forms to participate and received a compensation of 150 MZN (approximately USD 2.5) [39] for transportation expenses.

Results

Participants characteristics

A total of 31 out of the 40 participants contacted (78 %) enrolled in the study and completed the questionnaire at visit 1. However, 10 participants did not return for visit 2, resulting in 21 participants who answered the same questionnaire at visit 2. During visit 1, 12 in-depth interviews (six female and six male participants) were conducted, along with three focus group discussions involving 15 participants out of 31 (48 %): one FGD with women only (four participants), one with men only (six participants), and a mixed group consisting of two female and three male participants. Out of the 31 participants, 11 (35 %) were men, with a median age of 24 years (interquartile range, IQR = 23–25). The majority of participants, 23 (74 %), were single, with 15 (65 %) being women. Nearly half of the participants, 15 (48 %), reported having no source of income. Among the 11 participants attending or having completed university, seven (64 %) were women. When contacted by the study team, 10 (32 %) out of 31 participants reported a lack of time as the reason for not participating in visit 2, including six (60 %) women under 24 years old (Table 3).

Table 3
Sociodemographic variables of 31 previous participants of a Phase-II HIV vaccine clinical trial conducted in Maputo City.

Socio Demographic Variables		Visit 1 N = 31	Visit Status [b])	
			Drop-out (n = 10)	Completed Visit 2 (n = 21)
Mean age in years		24.2	23.6	24.5
Age, categorized	21–24	21 (68 %)	7 (70 %)	14 (67 %)
	25–31	10 (32 %)	3 (30 %)	7 (33 %)
Sex	Male	11 (35 %)	1 (10 %)	10 (48 %)
	Female	20 (65 %)	9 (90 %)	11 (52 %)
Marital status	Single	23 (74 %)	8 (80 %)	15 (71 %)
	Cohabiting/ Married	8 (26 %)	2 (20 %)	6 (29 %)
Monthly Income (metical's)	None	15 (48 %)	6 (60 %)	9 (43 %)
	2.500 – 20.000	11 (36 %)	4 (40 %)	7 (33 %)
	> 20.000	4 (13 %)	0	4 (19 %)
	Refused to answer	1 (3 %)	0	1 (5 %)
Level of Education [a])	Primary	1 (3 %)	1 (10 %)	0
	Secondary	19 (61 %)	8 (80 %)	11 (52 %)
	University	11 (36 %)	1 (10 %)	10 (48 %)

[a] For the primary and secondary levels – those who completed that level and were not enrolled in any further level were included. For the university level – those who completed secondary school and were enrolled in a university course or already had one were included.
[b] Visit status – between participants who did not return for the second visit (dropouts) and those who returned (completed visit 2).

HIV research knowledge

HIV knowledge. Participants emphasized that the absence of treatment and engaging in detrimental habits such as drinking and smoking contribute to the progression of Acquired Immunodeficiency Syndrome (AIDS). Modes of transmission frequently cited included sexual intercourse without condom usage and the use of contaminated sharp objects. Furthermore, participants highlighted that HIV disproportionately affects vulnerable populations, including children, young women, and pregnant women (Table 2).

HIV research knowledge. Overall, the participants demonstrated a strong awareness of research and exhibited a solid understanding of the objectives and procedures of clinical trials (Tables 2 and 4).

HIV vaccine trial knowledge. Participants' perceptions of the potential outcomes of receiving the experimental HIV vaccine varied. Six participants (19 %) believed it could offer protection against HIV infection, while five participants (16 %) expressed concerns about the risk of contracting HIV. Additionally, three participants (10 %) thought that a positive result in a rapid HIV test among trial participants indicated protection against HIV infection (Table 4). Regarding their expressed willingness to be vaccinated if a vaccine protecting against HIV infection was discovered, three participants (10 %) declined, citing reasons such as personal aversion to vaccines and considering themselves at low risk for HIV infection. Conversely, the majority (90 %) expressed interest in vaccination, desiring some level of protection against HIV infection, with nine participants (29 %) seeking complete protection against non-sexual modes of HIV transmission. There was no significant difference in HIV vaccine knowledge between visit 1 and visit 2 (Table 4).

HIV Stigma

HIV infection perception. Participants and society perceive HIV infection more as a significant issue than merely a serious disease, influenced by several factors. Firstly, unprotected sexual intercourse with multiple partners is widely recognized as a primary mode of transmission. Secondly, societal taboos surrounding discussions about sexual relations hinder open conversations about HIV, exacerbating the perception of its significance. Additionally, the absence of a cure and the necessity for individuals living with HIV to make long-term behavioral changes and adhere to lifelong medication to prevent progression to AIDS contribute to the perception of HIV as a persistent problem. Specifically, participants regard AIDS as a serious disease, viewing this stage as the most vulnerable period for individuals in terms of mortality (Table 2).

Stigma as a barrier to trial participation. The negative societal

Table 4
Independence analysis of HIV vaccine knowledge and sexual behaviors by visit status among 31 participants of a previous Phase-II HIV vaccine trial.

HIV Vaccine Knowledge Variables – *ref: No* [a], [b])	Visit 1 N = 31	Visit Status (N = 21)		p-value[c])
		Visit 1	Visit 2	
It has been proven that the HIV vaccine candidates used in TaMoVac II can protect against HIV infection?	6 (19 %)	2 (10 %)	1 (5 %)	0.564
Phase I and II clinical trials of HIV vaccine candidates can include people who are HIV negative?	26 (84 %)	17 (81 %)	20 (95 %)	0.179
Phase I and II clinical trials of HIV vaccine candidates can include people who are HIV negative, but at risk of becoming infected with HIV?	10 (32 %)	7 (33 %)	5 (24 %)	0.527
Phase III clinical trials of HIV vaccine candidates can include people who are HIV negative, but at risk of getting infected with HIV?	13 (42 %)	10 (48 %)	5 (24 %)	0.132
Phase III clinical trials of HIV vaccine candidates can include people who are HIV –positive?	6 (19 %)	3 (14 %)	2 (10 %)	0.655
The goal of clinical trials of HIV vaccine candidates, is to find a HIV vaccine that can protect against HIV infection?	30 (97 %)	20 (95 %)	21 (100 %)	0.317
Can a preventive HIV vaccine be used to cure people infected with HIV?	4 (13 %)	2 (10 %)	2 (10 %)	1.000
In clinical trials, can placebo be used as research product?	25 (81 %)	16 (76 %)	19 (90 %)	0.257
In clinical trials, can candidate vaccines be used as research products?	29 (94 %)	21 (100 %)	21 (100 %)	1.000
One of the goals of clinical trials, is to evaluate if the vaccines are safe?	30 (97 %)	21 (100 %)	20 (95 %)	0.317
The fact that you received a candidate for HIV vaccine, makes it easier for you to become HIV infected?	5 (16 %)	3 (14 %)	2 (10 %)	0.655
Is it very likely that because you received a HIV vaccine candidate, you may have health problems caused by the candidate vaccine?	4 (13 %)	2 (10 %)	1 (5 %)	0.317
A person who has received the HIV vaccine candidate may test positive for HIV in rapid tests, even if not infected?	27 (87 %)	18 (86 %)	20 (95 %)	0.317
If a TaMoVaC II participant test positive for HIV in rapid tests, is the same as saying that he is protected by the vaccine against HIV infection?	3 (10 %)	0	2 (10 %)	0.157
If a TaMoVaC II participant test positive for HIV in rapid tests, is the same as saying that he is infected with HIV?	3 (10 %)	2 (10 %)	1 (5 %)	0.564
A positive rapid test result for HIV in a volunteer who received a HIV vaccine during the trial, can last for more than 5 years?	6 (19 %)	5 (24 %)	2 (11 %)	0.257
If a TaMoVaC II participant has test positive for HIV in rapid tests, is the same as saying that is sexual partner is protected?	3 (10 %)	2 (10 %)	2 (10 %)	1.000
If a TaMoVaC II participant has test positive for HIV in rapid tests, it means that his children may be protected by against HIV infection?	5 (16 %)	4 (19 %)	1 (5 %)	0.1780
If a TaMoVaC II participant has an HIV-positive result in the rapid test, it means that his children may have malformations at birth?	3 (10 %)	2 (10 %)	21 (100 %)	0.157
If a vaccine that protects against HIV infection was discovered, would you like to be vaccinated?	28 (90 %)	19 (91 %)	21 (100 %)	0.157
Sexual Behavior *ref: No* [a)]	**Visit 1 N = 31**	**Visit Status (N = 21)**		**p-value[c)]**
		Visit 1	**Visit 2**	
In the past 3 months have you had vaginal or anal sexual intercourse?	31 (100 %)	21 (100 %)	20 (95 %)	1.000
In the past 3 months have you had sex with more than one sexual partner?	4 (13 %)	4 (19 %)	2 (10 %)	0.4142
In the past 3 months, did you use condom during sexual intercourse?				0.566
Never	4 (13 %)	2 (10 %)	2 (10 %)	
Rarely (less than half of sexual intercourse)	1 (3 %)	1 (5 %)	3 (15 %)	
Sometimes (half of sexual intercourse)	15 (48 %)	9 (43 %)	7 (35 %)	
Always (all sexual relations)	11 (35 %)	9 (43 %)	8 (40 %)	
The reason why you did not use a condom:				
Sexual partner does not want to use a condom	2 (6 %)	0	2 (10 %)	1.000
Because you trust your partner	13 (42 %)	8 (38 %)	8 (38 %)	1.000
Doṅt know	2 (6 %)	1 (5 %)	0	1.000
In the last 3 months of the people with whom you had sex, was there someone who was HIV positive or who you suspected?				
Yes	1 (3 %)	11 (5 %)	0	1.000
Doṅt know	2 (6 %)	2 (10 %)	3 (15 %)	
In the past 3 months, have you been diagnosed with any sexually transmitted infections?	1 (3 %)	1 (5 %)	0	0.3173
Regularly drink alcohol [d]	6 (19 %)	5 (24 %)	0	0.0253
During the past 3 months, have you had sex while under?				
The effect of alcohol	10 (32 %)	7 (33 %)	3 (14 %)	1.000
The effect of drugs	0	0	0	1.000
During the past 3 months, how would you rate your risk of acquiring HIV infection?				
None	2 (7 %)	1 (5 %)	1 (5 %)	1.000
Low	20 (67 %)	13 (65 %)	12 (57 %)	

[a] One answer per question. Presented the participants who answered yes.
[b] Correct answers (a = yes; b = no): 1b; 2a; 3b; 4a; 5b; 6a; 7b; 8a; 9a; 10a; 11b; 12a; 13a; 14b; 15b; 16a; 17b; 18b; 19b (we doṅt know).
[c] McNemar's exact test applied to those who participated in visits 1 and 2.
[d] defined as more than 35 units per week for men or 14 units per week for women. 1 unit = 1 beer or 1 glass of wine or a measure of strong alcohol.

perception and attitudes towards individuals living with HIV created a significant barrier to the adoption of preventive measures and participation in experimental HIV vaccine studies. The participants voiced concerns that society may perceive them as being HIV positive or harbor distrust towards the objectives and procedures of experimental HIV vaccine studies (Table 2).

Sexual behavior

Risk behavior. Participants identified several high-risk behaviors for HIV infection, including engaging in unprotected sex, having multiple sexual partners, exchanging sex for money, and using injectable drugs. Notably, female adolescents were highlighted as a particularly vulnerable group due to perceived economic vulnerability and dependence on partners, making it difficult for them to negotiate condom use. Additionally, young men who maintain multiple sexual partners under peer pressure were identified as another high-risk group, as this behavior is viewed as a way to maintain a perceived virile status in society (Table 2).

HIV risk Assessment. Participants in the study acknowledged their susceptibility to HIV infection, particularly emphasizing that they

perceived this susceptibility to be higher before joining the study. Some participants self-reported irregular condom use and engagement in multiple sexual partnerships (Table 2). The questionnaire data supported these observations, revealing that four participants (13 %) admitted to having more than one sexual partner, and 20 participants (65 %) reported inconsistent condom use. However, participation in the study had a significant impact on their behavior, with 24 participants (77 %) reporting a decrease in sexual partners and increased condom use for the majority (Table 4). Fig. 3 provides a comprehensive summary of the participants' sexual behavior.

Clinical trial participation

Interest in HIV trial. The decision to participate was individual; however, some participants noted being motivated by invitations from friends or peers, along with their curiosity to learn more about the ongoing HIV vaccine trial in the country (TaMoVac II). This curiosity prompted them to seek additional information about the trial (Table 2).

Motives for trial participation. Participants expressed the desire to actively contribute to reducing HIV infections in their communities and country and the opportunity to support ongoing HIV vaccine research as the primary motivations for trial participation. Additionally, knowing someone living with HIV and receiving monetary compensation to cover transportation costs to the study site were identified as influential factors for participation and adherence to study visits (Table 2).

Positive experiences of participating in an HIV vaccine trial. Participation in the TaMoVac II trial proved to be a positive experience for the participants. They were warmly welcomed by a friendly and youthful research team, received free counseling, and gained extensive knowledge about HIV prevention. The act of signing the informed consent document was particularly meaningful to the participants, signifying a mutual agreement between themselves and the research center. The research team's commitment to respecting the participants' autonomy, rights, and responsibilities throughout their involvement in the vaccine trial significantly contributed to this positive experience (Table 2).

Negative experiences of participating in an HIV vaccine trial. Participants frequently reported two negative experiences: discomfort during blood collection and concerns about the duration of study visits. Additionally, participants expressed a sense of abandonment by the TaMoVac II study team at the conclusion of the study, as indicated in Table 2.

Social harm. Nearly all participants, 30 out of 31 (97 %), shared their involvement in the HIV vaccine trial with someone. Among these participants, 21 (70 %) revealed it to their parents, while 17 (57 %) disclosed it to their siblings. Seven participants (22 %) encountered negative comments and reactions due to disclosing their participation (Table 4). These negative comments included being labeled as a *"guinea pig"* involved in an experiment with foreign scientists, as reported by four participants (13 %). Furthermore, one participant (3 %) experienced the loss of a close relationship, and another participant (3 %) faced workplace discrimination from colleagues (Table 5). An in-depth analysis revealed that negative comments and experiences were not limited to family members, as peers, colleagues, and healthcare professionals also contributed to such instances (Table 2). For a comprehensive overview of participants' experiences throughout their involvement in the HIV vaccine trial, refer to Fig. 3.

Discussion

This study investigated the motivations and experiences of young adults who participated in a previous HIV vaccine trial in Maputo, Mozambique. Participants joined the trial with the belief that it allowed them to contribute to the fight against HIV. Overall, they had a positive perception of their involvement, but some individuals encountered social harm from significant people in their lives.

Table 5
Social Harm descriptive analysis of 31 participants of a previous Phase-II HIV vaccine clinical trial.

Social Harm Variables [a])	**Visit 1 N = 31**
The following questions refer to the period during your participation in the trial (from the beginning to the end of the study)	
Have you ever told anyone that you participated in a he HIV vaccine candidate's clinical trial?	30 (97 %)
Father/Mother	21 (70 %)
Siblings	17 (57 %)
Cousins	3 (10 %)
Partner (Boyfriend/Husband)	16 (52 %)
Classmate	11 (37 %)
Work Colleague	2 (7 %)
Boss	0
Doctor	2 (7 %)
Nurse	2 (7 %)
Church / Religion / Worship Staff	2 (7 %)
The person you told, agreed with your participation in the HIV vaccine clinical trial?	28 (93 %)
Was there anyone you did not tell about your participation in the HIV vaccine clinical trial, but you would have like it to?	13 (42 %)
The reason you did not tell that you participated was because the person could think that:	
You were infected with HIV / AIDS, because you participated in the trial vaccine clinical trial	6 (19 %)
That you had a promiscuous behavior, such as exchanging goods, money or services by sex, because of your participation in a HIV Vaccine clinical trial	2 (7 %)
That you have multiple sexual partners	1 (3 %)
That you could be infected because of your participation in a HIV Vaccine clinical trial	7 (23 %)
That you could have health problems because of your participation in a HIV Vaccine clinical trial	2 (7 %)
That you are being a "guinea pig" in an experiment, with foreign scientists	4 (13 %)
Would not be able to explain that you could have a positive result in the HIV rapid test and not being infected with HIV	1 (3 %)
It is a personal matter, and it does not concern other people	1 (3 %)
What could have been the consequences if you had revealed that you participated in *in a HIV Vaccine clinical trial*?	
Being rejected by family members	2 (7 %)
Be rejected by your partner	2 (7 %)
Failing to have a new relationship	1 (3 %)
During your participation in a HIV Vaccine clinical trial have you received/ heard any negative comments or reactions for example?	
Your principal sexual partner left you because of your participation in the HIV Vaccine clinical trial	1 (3 %)
Jokes of you being a "guinea pig" in an experiment, with foreign scientists	4 (13 %)
Being discriminated in your workplace, your colleagues not wanting to interact with you because of having participated in the HIV vaccine clinical trial or losing your job	1 (3 %)
Community comments on the negative effects of the HIV vaccine candidate	1 (3 %)
The following questions cover the period from the end of the HIV Vaccine clinical trial until the time of the interview	
After the completion of the HIV vaccine clinical trial, did you tell someone about your participation in the HIV vaccine clinical trial?	17 (55 %)
Father/Mother	1 (3 %)
Siblings	3 (10 %)
Cousins	1 (3 %)
Partner (Boyfriend/Husband)	4 (13 %)
Classmate	2 (7 %)
Work Colleague	3 (10 %)
Boss	0
Doctor	0
Nurse	0
Church / Religion / Worship Staff	1 (3 %)
In your opinion the reaction was	
Positive (approval or other positive comment)	4 (13 %)
Neutral (did not express any feelings or opinions)	10 (32 %)
Negative (did not express any feelings or opinions)	3 (10 %)

[a] One answer per question. Presented the participants who answered yes.

HIV vaccine trials conducted in Africa prioritize the recruitment of young women due to their disproportionate vulnerability to the HIV pandemic [40–43]. Ensuring adequate participation of young women in clinical trials not only promotes gender equity but also generates essential scientific evidence for the licensing of future preventive HIV vaccines [44]. In our study, the majority of participants were young, single females with limited financial resources.

Fig. 2 provides a comprehensive overview of the components of the Health Belief Model and illustrates its application in understanding the reasoning behind young uninfected participants' decision to participate in an HIV vaccine trial. In our study, participants acknowledged their susceptibility to HIV infection before trial enrollment. Although they did not perceive HIV infection as a serious disease, they recognized the importance of prevention due to its progression to the serious stage of AIDS. Personal benefits, such as access to medical care, emerged as significant facilitators for trial participation. Close relationships with someone living with HIV and the opportunity to contribute to reducing HIV infections outweighed any distrust regarding HIV vaccine research. A study conducted in Kenya involving both males and females (61.6 % vs. 38.4 %) found a positive association between perceived susceptibility and the desire to participate in an HIV vaccine trial, with altruism and the desire for medical care identified as the primary and secondary motivators for trial participation [45]. In contrast, a study conducted with black men who have sex with men and transwomen in the USA revealed that those who reported engaging in risky behaviors were less likely to participate in HIV vaccine trials [46].

Participation in a clinical trial can evoke positive and negative experiences for participants. Positive aspects may include gaining knowledge about HIV and personal health, as well as receiving risk reduction counseling. Negative experiences often relate to blood collection, trial duration, frequency, and duration of visits. Participants may also face negative comments from family, partners, and colleagues regarding their involvement in the trial, both during and after the trial. These findings are consistent with studies conducted in various countries [47]. Addressing participant experiences and concerns from an institutional perspective is crucial for enhancing the trial process. Integrating social behavioral studies into trials can help address concerns and questions, as demonstrated by Valente et al. [48]. Educational materials developed based on IDI with study participants in a US phase I trial of broadly neutralizing antibodies effectively addressed participants' concerns, as reported in follow-up interviews with participants and trial staff. Proactively addressing participant experiences and concerns can improve trial recruitment and retention rates.

Participants of this study demonstrated an improved understanding of risk behavior and perceived themselves as having a lower risk of HIV infection compared to before their participation. However, despite this perception, some participants engaged in unprotected sex and had multiple partners. The decrease in risk perception was attributed to factors such as being in a stable relationship due to receiving risk reduction counseling during the trial. It is important to note that while some participants may have engaged in risky behavior, the majority were aware that the trial did not protect against HIV infection. This suggests the absence of risk compensation behavior, where individuals engage in riskier behavior due to a false sense of security. Similar findings from other studies in Africa support the role of counseling in reducing risky behavior, although individual responses varied [49,50].

Participants in the vaccine clinical trial reported positive experiences during their participation but expressed feeling abandoned after the trial ended. The lack of post-trial information dissemination has been a common concern, as highlighted in the STEP trial [51] and emphasized by Tanzanian participants in another study [23]. To address these issues, it is important to ensure that participants have access to post-trial information and support. Additionally, involving them as advocates for trial participation can help address concerns and misconceptions.

Limitations

The study has limitations regarding generalizability to other trial

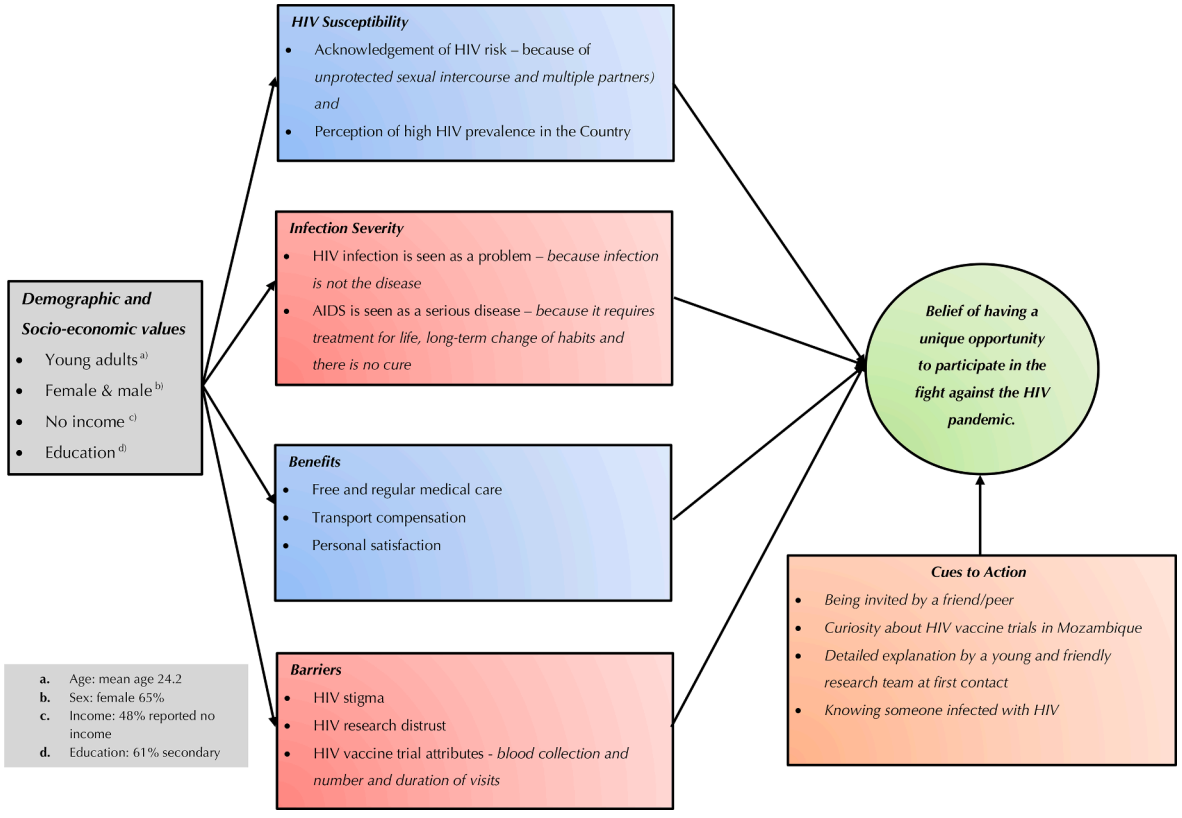

Fig. 2. Decision process for participation in a phase II HIV vaccine trial, using the components of a Health Belief Model among 31 previous participants.

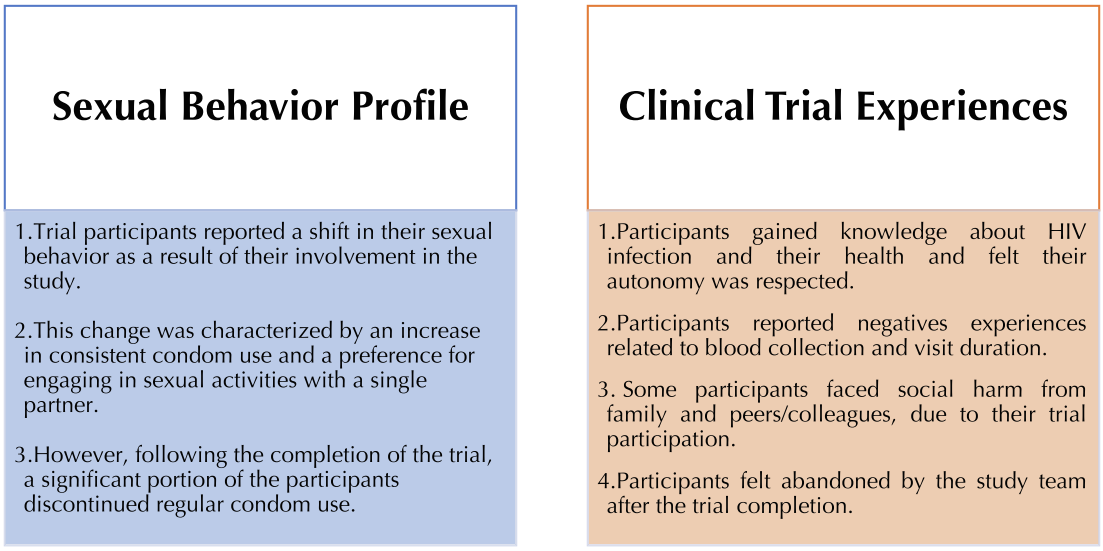

Fig. 3. Summary of sexual behavior profile and HIV vaccine trial experiences of 31 participants of a previous phase II HIV vaccine trial.

participants and future HIV vaccine trials, as it focused on a specific phase II trial with a limited sample size in Mozambique. This limitation is further exacerbated when we consider the participants who dropped out between visits. Additionally, given that this study was conducted three years after the trial, there is potential for recall bias to influence participants' reported motives and experiences. Social desirability bias may have influenced responses due to participants' familiarity with the study staff. To address this concern, independent social researchers who were not part of the study were involved, and participants could choose between a male or female interviewer. Confidentiality was strongly emphasized throughout the study. Translation from Portuguese to English introduces the risk of losing meaning, but efforts were made to minimize this issue. The first author, fluent in both languages, handled the translation. The Health Belief Model was initially designed to explain and predict preventive health behavior, assuming knowledge of the intervention's effectiveness and safety. In our study, the safety and efficacy of the vaccine remain unknown. Furthermore, the model has limitations in considering environmental factors and lacks specific strategies for behavior change. These limitations should be considered when interpreting the findings, and future research should address them to enhance generalizability.

Conclusion

Preventive HIV vaccine trials should integrate a social-behavioral component to assess reasons for participation and refusal in real-time. This evaluation informs ongoing recruitment and guides future study recruitment processes. The Health Belief Model provided valuable insights into trial participation motives. However, we advocate for further studies using the HBM, alternative models, or hybrid approaches to better understand individuals' expressed willingness to participate in future preventive HIV vaccine trials. Institutional factors and continuous personal attention are crucial for participant retention, a process that should extend beyond the trial period. We emphasize the importance of strengthening community discussions on trial objectives and procedures to address distrust and enhance participant retention rates, with an emphasis on leveraging social media platforms. Individual and community engagement strategies may include keeping in touch with former vaccine volunteers through birthday cards, organizing events during *HIV Awareness Day*, and inviting them to participate in local HIV prevention initiatives. Furthermore, tailored strategies for HIV risk assessment and reduction are essential. These strategies should prioritize target populations and integrate social behavioral change models for risk reduction during and after the trial. Taking these factors into account can improve recruitment, retention, and the overall participant experience in HIV vaccine trials.

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CRediT authorship contribution statement

Igor P. Ubisse Capitine: Conceptualization, Formal analysis, Investigation, Methodology, Project administration, Resources, Supervision, Writing – original draft, Writing – review & editing. **Álvaro Marcela Manhiça:** Data curation, Formal analysis, Investigation, Writing – review & editing. **Paulo Tembe Júnior:** Data curation, Formal analysis, Investigation, Writing – review & editing. **Patrícia M. Ramgi:** Data curation, Formal analysis, Investigation, Writing – review & editing. **Sérgio Chicumbe:** Methodology, Resources. **Arne Kroidl:** Supervision, Validation, Writing – review & editing. **Martin R. Fischer:** Supervision, Validation, Writing – review & editing. **Caroline De Schacht:** Supervision, Validation, Writing – review & editing.

Declaration of competing interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

Data availability

Data will be made available on request.

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Appendix A. Supplementary data

Supplementary data to this article can be found online at https://doi.

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