

Men's Comfort to Distribute or Receive HIV Self-Test Kits from Close Male Social Network Members in Tanzania: Baseline Results from the STEP Project

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Research Article

Keywords: HIV, men, HIV self-testing, social networks, Tanzania

Posted Date: April 16th, 2021

DOI: <https://doi.org/10.21203/rs.3.rs-414141/v1>

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Abstract

Background

Few studies have explored alternative strategies for reaching men with HIV self-testing services. In this study, we assessed the factors associated with men's comfort to distribute or receive HIV self-test kits from close male friends among men who socialize in networks locally referred to as "camps" in Tanzania.

Methods

Data are from a cluster-randomized controlled trial conducted in June 2019 in 18 social networks or "camps" in Dar es Salaam, Tanzania. Participants were 18-year-old or older male camp members who were HIV-negative at the time of enrolment. Robust Poisson regression was implemented through the generalized random effect model with the log link to assess the factors associated with being comfortable to receive and/or give out HIV self-test kits to close male members within one's social network.

Results

Of 505 participants, 67.9% ($n = 342$) reported that they would be comfortable giving HIV self-test kits to close male friends while 68.2% ($n = 344$) were comfortable receiving HIV self-test kits from their close male friends. Ever having heard about HIV self-testing (Adjusted Prevalence Rate (Adj. PR): 1.6; 95% Confidence Interval [CI]: 1.3, 1.9), willingness to self-test for HIV in front of a sexual partner (Adj. PR: 3.0; 95%CI: 1.5, 6.1) and exposure to peer-led HIV self-testing education and promotion (Adj. PR: 1.4; 95%CI: 1.2, 1.7) were significantly associated with being comfortable to receive and/or give out HIV self-test kits to close male members within one's social network.

Conclusions

Prior awareness of HIV self-testing, willingness to self-test before one's sexual partner and exposure to peer-led HIV self-testing education and promotion were significantly associated with being comfortable to give or receive HIV self-test kits from close male friends in this population. These findings suggest that distribution of HIV self-test kits through close male friends could improve the proportion of men reached with HIV self-testing services and improve HIV testing rates in this population where uptake remains low.

Background

Globally, HIV testing rates and linkage to HIV care among HIV-positive individuals remain much lower among men than women [1]. It is for this reason that a 2017 UNAIDS report referred to men and boys as the 'blind spot' in the HIV prevention response [2]. Citing survey and program reports from 25 sub-Saharan

African countries, the report indicated that in countries such as Burundi, Côte d'Ivoire, Liberia, Mozambique, Niger, Nigeria, Togo and Uganda, men living with HIV were about a third less likely to know their HIV status, and in Congo, the Gambia, Ghana and Sierra Leone, knowledge of HIV status among men living with HIV was about half the rate found among women [2]. While HIV testing among men has improved [3, 4, 5], their uptake of HIV testing services remain generally below the 90% threshold [6]. Hegemonic masculinity norms [7], coupled with continuing high levels of stigma and discrimination [8], continue to keep men away from getting tested for HIV, coming to terms with their HIV-positive status, taking instructions from nurses and engaging in health enabling behaviours. These dynamics contribute to poorer HIV testing uptake and treatment outcomes for men compared to women in high prevalence settings, calling for innovative approaches to reach men with HIV testing and linkage to HIV care services.

Evidence from sub-Saharan Africa has demonstrated that HIV self-testing can increase uptake of testing services and facilitate linkages to care, especially among persons who are at high risk of HIV infection [9, 10, 11]. Several approaches have been used to reach men with HIV self-testing services, including during household visits by community HIV care providers [12], female-delivered HIV self-testing approaches [4, 13, 14, 15], delivery through existing social networks [16], and distribution through the internet; particularly among men who have sex with men [17, 18, 19]. Using a social network strategy to distribute HIV self-test kits to African American and Latino men who have sex with men, Lightfoot et al. [17] found that individuals reached through a peer-based HIV self-testing strategy were significantly more likely to have never tested for HIV than men who have sex with men reached through community-based HIV testing programs. Similarly, Lippman et al. [18] found that network distribution of HIV self-test kits not only reached first-time men who have sex with men testers but also increased the frequency of HIV testing from 37.8% before to 84.5% after introduction of HIV self-test kits. MacGowan et al. [20] reported 34 infections were found among social network members who received HIV self-test kits from study participants. Tun et al. [19] reported 100% linkage to HIV care among HIV-positive men who have sex with men who were identified through an intervention that involved HIV self-testing through key opinion leaders.

Collectively, these studies suggest that men are willing to use HIV self-test kits to test for HIV [9, 11, 21], with additional evidence suggesting that men are willing to self-test for HIV if they receive HIV self-test kits from their friends or sexual partners [16, 22]. Fleming and other scholars have argued that use of gender-transformative approaches in which men are engaged to reach fellow men with HIV prevention interventions can create safety nets within which men can discuss issues that affect their own health, including HIV testing [6, 23]. Studies among existing social networks of heterosexual men from the general population in Tanzania have found that men already engage in HIV testing conversations with friends in their social networks [21, 24] and that discussing HIV testing with a sexual partner and having been encouraged to test for HIV by a close friend were associated with higher odds of being willing to self-test among men [9, 21]. While these studies have provided preliminary evidence for the potential to leverage men's social networks to deliver HIV self-test kits, no research has been conducted to examine heterosexual men's willingness to distribute HIV self-test kits to fellow men or receive HIV self-test kits

from fellow men in Tanzania, where 51% of men living with HIV were not aware of their HIV status in 2017 [25].

In 2018, there were 72,000 new cases of HIV infection among adults aged 15 years and older in Tanzania [25]. Women are disproportionately affected by HIV in Tanzania, with a 6.3% prevalence in 2018 compared with a 3.4% prevalence among men [25]. Other populations in Tanzania who are significantly affected by HIV include people who inject drugs, mobile populations, young people, and men who have sex with men [26]. Mobile male populations, including truck drivers, plantation workers, and fishermen have also been found to be at increased risk of HIV infection [24]. However, men are less likely than women to test for HIV. In response, the government of Tanzania developed national strategies, including HIV self-testing, [27] and launched a national Test and Treat campaign focused on increasing HIV testing among men [28]. At the time of the campaign launch, however, the Tanzanian government had not yet approved a policy to support HIV self-test implementation. Thus, there is limited evidence in Tanzania and elsewhere of how best to reach heterosexual men with HIV self-testing through male peer-delivered approaches. The majority of male peer-delivered HIV self-testing studies that have been conducted were among men who have sex with men [18, 29, 30, 31] or in small, isolated populations living in the fishing communities instead of the general population [16].

In an effort to address the HIV self-testing research gap in Tanzania for heterosexual men, the Tanzania Self-Testing Education and Promotion (Tanzania STEP) project for men was launched in 2018 [32]. Since then, the Government of Tanzania also started a national HIV self-testing demonstration project focused on men who have sex with men and female sex workers (FSWs) as part of *Sauti* (meaning “voice of the people”), a five-year implementation science community-based HIV prevention program funded by the U.S. President’s Emergency Plan for AIDS Relief and U.S. Agency for International Development (PEPFAR/USAID) [33, 34]. The overall aim of the Tanzania STEP and national HIV self-testing demonstration projects was to generate country-specific data on the implementation models, uptake, feasibility and acceptability HIV self-testing in order to inform policy development and future implementation and scale-up of HIV self-testing in Tanzania. Based on the evidence from these projects and other countries, a policy to support HIV self-testing implementation in Tanzania was approved in November 2019 [2]. In this study, we use baseline data from the Tanzania STEP project to investigate factors associated with men’s comfort to distribute or receive HIV self-test kits from close male friends among heterosexual men who socialize in networks locally referred to as “camps” in Dar es Salaam, Tanzania in order to inform implementation of social network-based HIV self-test kits distribution among heterosexual men. This paper also describes the design, sampling methods, male peer educators selection and training, and data collection for the Tanzania STEP Project locally known as *Mate Yako Afya Yako* (Your Saliva Your Health) [32].

Methods

STEP project overview

The Self-Testing Education and Promotion (STEP) project was a five-year study funded by the University of North Carolina Center for AIDS Research and the National Institute of Mental Health (NIMH) that was developed as part of a collaboration between the University of South Carolina, Jhpiego Tanzania, Tanzania Commission for AIDS (TACAIDS), University of North Carolina at Chapel Hill, Muhimbili University of Health and Allied University, EngenderHealth, and the National AIDS Control Programme of the Tanzanian Ministry of Health, Community Development, Gender, Elderly and Children (MoHCDGEC).

Study site, population, and design

The study was conducted among heterosexual young (18–24 years) and adult men (25 years or older) recruited from social networks or “camps” in Tanzania. Camps have been described in previous publications [35, 36]. Briefly, they are social groups, comprising mostly young men, that have been in existence for close to a decade [35]. Mixed-method formative research was conducted with camp members to inform the development and implementation of the STEP project, which was a pilot cluster-randomized controlled trial (cRCT) designed to assess the efficacy of a community-based HIV self-testing distribution intervention on HIV testing uptake among heterosexual men in social networks in Dar es Salaam. Secondary outcomes included the acceptability and uptake of HIV self-testing in the intervention group and linkage to care.

Camp recruitment and verification

To be eligible for the Tanzania STEP project, camps were required to have participated as one of 30 control-group camps in a previous larger cRCT [37] and to have between 10 and 70 members. Control-group camps from two wards (Manzese and Tandale), which are similar to U.S. census tracts, were selected to be assessed for eligibility because they had a high proportion of men who reported that they had not been tested for HIV in the past twelve months and did not provide blood for HIV testing during the endline survey of the previous cRCT in 2017 [37]. To verify that the camps were still active at the time the STEP project began, the study team visited the camps between August and September 2018 to collect a roster of active camp members. The roster included information about each camp member, including first and last name, nickname, birth date, gender, and phone numbers. The roster served as the sampling frame for potential participants in the STEP project.

Random assignment of camps

Eleven (11) camps in Manzese and seven (7) in Tandale were eligible for randomization. The number of male members (which we refer to as the camp size) differs in each camp. The median camp size was 20 (range 13–56) in Manzese and 37 (range 13–41) in Tandale. We balanced the camp-size effect in randomization using the constrained randomization procedure [38, 39]. The balanced design was used for each site to account for differences by geographical location. Constrained randomization with respect to camp size and geographical location was implemented through the “Efficient Design and Analysis of Cluster Randomized Trials” (“cvcrand”) package in R, which can calculate all randomization schemes and identify those with the minimum difference in camp size and geographical location between the intervention and control groups. In Manzese, all 462 possible randomization schemes were investigated,

with 5:6 (6:5) ratio between intervention and control groups; in Tandale, all 35 possible schemes were investigated, with 3:4 (4:3) ratio between intervention and control groups. Finally, two groups with five or six camps each in Manzese and two groups with three or four camps each in Tandale were randomized into either the intervention group (N = 9) or the control group (N = 9).

Peer training and HIV self-testing education and promotion

During the formative research period, most of the camp members were not aware of HIV self-testing and recommended that the research team first educate them about HIV self-testing before distributing HIV self-test kits to camp members [21, 32]. To accomplish this objective, we built on our prior experience with engaging male camp members as community health leaders [40] to develop a peer-led HIV self-testing education and promotion campaign [41] guided by the diffusion of innovations theory [42]. In April 2019, following random assignment, the research team organized meetings with camp leaders and members in the 9 intervention camps to update them about developments in the study since the camp verification process in September 2018 and to facilitate the peer-educator nomination process. Through the *Sauti* national HIV self-testing demonstration project implemented by Jhpiego Tanzania, we collaborated with three program officers from EngenderHealth and one officer from a local civil society organization to facilitate the peer-educator nomination and training process. Collaboration with the *Sauti* officers ensured that the identified and trained peer educators for the Tanzania STEP project met criteria similar to those met by peer educators who were involved in ongoing national projects sponsored by the MoHCDGEC. After describing the project to camp members and discussing the importance of HIV prevention and testing, the officers described the criteria for peer educators and asked camp members to nominate two to three peers from their camp who met the criteria. In total, the research team met with 166 camp members from the nine intervention camps, and camp members nominated 26 peer educators.

The research team invited 25 of the 26 nominated peer educators to attend a five-day training held during the last week of April 2019. The training manual was adapted from the *Sauti* project and allowed peer educators to self-reflect and discuss with each other how to promote HIV self-testing among their camp members, understand stigma and discrimination related to HIV testing and linkage to care, discuss the concept of HIV self-testing and the benefits of confirmatory testing, and examine the benefits and possible challenges of using HIV self-test kits among the camp members. Group discussions, role plays, self-reflection, PowerPoint presentations, question-and-answer sessions, brainstorming, action-plan development, and group presentations were employed to engage the peer educators. After the training, intervention-arm peer educators had approximately one (1) month (May 2019) to educate and promote HIV self-testing among their peers to create demand for HIV self-testing and inform them about the STEP project. The peer educators were instructed to use the social influence and communication strategies they had learned during their training to engage in conversations with their peers about HIV self-testing and related topics. Peer educators were not enrolled in the project as participants, but each received one (1) HIV self-test kit for their personal use.

Participant recruitment

In June 2019, participants in the intervention group were recruited by peer educators and those in the control group by the research team and camp leaders. Peer educators referred potential participants to the study team. In the control-group camps, potential participants were recruited during camp visits to inform members about the study. Using the updated rosters completed after the camp-verification process, the study team conducted screening to ensure that potential participants were active camp members and met the study inclusion criteria, which included being male, aged 18 years or older, a camp member for at least three months, and HIV-negative at enrollment. Based on a recommendation from our formative research that participants should be screened for suicidal ideation to prevent self-harm in case of a positive HIV self-test result at home, camp members were screened for suicidal ideation. Individuals were excluded if they did not meet all inclusion criteria; were unable to participate due to psychological disturbance, cognitive impairment, or threatening behavior; or if they reported positive HIV status. Written informed consent was obtained from all participants prior to administration of the baseline survey.

Baseline survey

Participants completed a quantitative questionnaire administered by a research assistant. The survey was uploaded on Qualtrics and administered in the Kiswahili language via a Samsung Tablet. Data were collected from June 10–30, 2019. A total of 508 participants were screened; three participants did not meet eligibility criteria and 505 consented to participate into the study. During data collection, participants were asked if they had ever heard of HIV self-testing. All participants received an explanation of HIV self-testing before being asked about their comfort level with distributing or receiving an HIV self-test kit from a close male friend. All assessments were conducted in a private area in two pop-up tents placed near the camps to make it convenient for participants and in line with the *Sauti* community-based HIV services model. The baseline survey covered broad topics including demographics, HIV testing history, knowledge of HIV self-testing, and prior HIV self-test use. Based on previous findings showing the influence of social networks on willingness to self-test for HIV [9], participants were asked if they had a close male friend in the camp. If they responded yes, they were asked if this close friend had ever encouraged them to self-test for HIV and if they had ever encouraged this close friend to self-test for HIV (descriptive or injunctive norms). Participants' attitudes toward receiving an HIV self-test kit from this close friend and/or delivering an HIV self-test kit to them were also examined. Data were collected on the number of sexual partners that participants had had in the past twelve months, whether participants had a current sexual partner at the time of the survey, knowledge of a current partner's HIV status, and participants' attitudes toward receiving an HIV self-test kit from the partner or delivering an HIV self-test kit to the partner. Participants also provided data about their ownership of a cellular phone; experience with receiving and sending text messages about HIV and HIV testing; attitudes toward sending a text message to their close friend about HIV self-testing and their HIV self-test result; and preferences for receiving additional instructions for HIV self-testing over the phone from a counselor and/or from the National HIV Hotline. Peer educators and camp leaders received compensation equivalent to \$14 USD for helping with recruitment; participants received compensation equivalent to \$4.5 USD.

Outcome measures

Outcome measures used in the analyses were whether a participant was comfortable (1) giving an HIV self-test kit to a close male friend in their social network, and (2) receiving an HIV self-test kit from a close male friend in their social network. Outcome variables were measured with the following no/yes questions: (1) *Would you feel comfortable giving an HIV self-test kit to your friend?* and (2) *Would you feel comfortable receiving an HIV self-test kit from your friend?*

Demographic and HIV testing measures

Demographic measures included age, education, and marital status. Age was categorized into three groups (18–24 years, 25–34 years, and 35 years or older). Education was classified as no formal education, primary education, or secondary education or more. Marital status was categorized as single, married/cohabiting, or divorced/widowed. Whether a participant was in a camp that participated in the peer-led HIV self-testing promotion intervention was also recorded. Participants were asked if they had ever been tested for HIV and if they had ever heard of HIV self-testing; these variables were categorized as no/yes.

Social and sexual network measures

Participants were asked if their close male friend had ever encouraged them to self-test for HIV; this variable was categorized as no/yes. Because our previous formative research had identified an association between discussing HIV testing with a sexual partner and willingness to self-test [9], participants were asked if they had ever discussed HIV self-testing with a sexual partner and if they were willing to use an HIV self-test kit in front of a sexual partner; these variables were categorized as no/yes.

Statistical analysis

Data were analyzed using STATA software version 15.0 (Stata Statistical Software: Release 15. 2017. College Station, TX: StataCorp LLC.) Following data cleaning and checking for consistency and completeness, descriptive statistics were summarized. Measures of central tendency (median) and respective measures of dispersion (interquartile range) were used to summarize continuous variables (i.e., age), which provide the evidence for categorization. Frequency and percentages were used to summarize categorical variables. The distribution of independent variables with the two main outcome variables (comfortable giving HIV self-test kits to a close male friend and comfortable receiving HIV self-test kits from a close male friend) were investigated with a Chi-square test. The robust Poisson regression model was used to model the relationship between the main outcome variables and the independent variables where the clustering effect was included by the random intercept. The model was estimated through the Generalized Estimating Equations (GEE) approach. All independent variables with a significance association ($p < 0.05$) with the outcome variable in the crude analysis were incorporated into the multivariable regression model. Crude and adjusted prevalence rate and respective 95% confidence intervals were used to interpret the magnitude of association; the criterion for statistical significance was set at a p value of < 0.05 .

Results

Table 1 shows the background characteristics of the participants. The median age is 27 years (interquartile range = 22, 34) with 40% in age 18–24 and 40% in age 25–34. Ninety-six per cent of the participants ($n = 485$) had primary or higher education. Majority of participants (60.2%) were single. Nearly nine of every ten participants (90.3%, $n = 456$) had ever tested for HIV while 42.6% ($n = 215$) had ever heard about HIV self-test kits. Thirty-eight per cent ($n = 190$) reported that their close male friends had encouraged them to self-test for HIV. Eighty-three per cent ($n = 353$) reported that they were willing to use HIV self-test kits in front of their sexual partners. Of the 505 participants surveyed, 50.1% ($n = 253$) are assigned to intervention group, who had received peer-led HIV self-test education and promotion.

Table 1

Background characteristics and proportion of study participants who were comfortable to give/receive HIV self-test kits to close male friends

Characteristic	Background Characteristics of study participants (N = 505)	Proportion of study participants who were comfortable to give HIV self-test kits to close male friends (N = 505)		Proportion of study participants who were comfortable to receive HIV self-test from close male friends (N = 505)	
	n (%)	n (%)	p-value	n (%)	p-value
Age	200 (38.6)	127 (63.5)	0.025	127 (63.5)	0.016
18–24	201 (39.8)	134 (66.7)		135 (67.2)	
25–34	104 (20.6)	81 (78.6)		82 (79.6)	
35+					
Education level	20 (4.0)	14 (73.7)	0.843	16 (84.2)	0.233
No formal education	247 (48.9)	168 (68.0)		171 (69.2)	
Primary education	238 (47.1)	160 (67.2)		157 (66.0)	
Secondary & above					
Marital Status	304 (60.2)	199 (65.7)	0.399	200 (66.0)	0.368
Single	183 (36.2)	131 (71.6)		132 (72.1)	
Married/Cohabiting	18 (3.6)	18 (66.7)		12 (66.7)	
Divorced/ Widowed					
Ever tested for HIV	49 (9.7)	32 (66.7)	0.853	33 (68.8)	0.938
No	456 (90.3)	310 (68.0)		311 (68.2)	
Yes					
Ever heard of HIV self-testing	290 (57.4)	133 (46.0)	< 0.001	133 (46.0)	< 0.001
No	215 (42.6)	209 (97.2)		211(98.1)	
Yes					
Ever been encouraged by close male friend to self-test for HIV	314 (62.3)	159 (50.6)	< 0.001	158 (50.3)	< 0.001
No	190 (37.7)	183 (96.3)		186 (98.0)	
Yes					

Characteristic	Background Characteristics of study participants (N = 505)	Proportion of study participants who were comfortable to give HIV self-test kits to close male friends (N = 505)		Proportion of study participants who were comfortable to receive HIV self-test from close male friends (N = 505)	
	n (%)	n (%)	p-value	n (%)	p-value
Willingness to use HIV self-test kits in front of sexual partner	71 (16.8)	11 (15.5)	< 0.001	11 (15.5)	< 0.001
	353 (83.2)	276 (78.2)		280 (79.3)	
No					
Yes					
Exposure to HIV self-testing promotion	252 (49.9)	120 (47.6)	< 0.001	119 (47.2)	< 0.001
	253 (50.1)	222 (88.1)		225 (89.3)	
No					
Yes					
Comfortable giving HIV self-test to a close male friend	162 (32.1)				
	342 (67.9)				
No					
Yes					
Comfortable receiving HIV self-test from a close male friend	160 (31.8)				
	344 (68.2)				
No					
Yes					

Table 1 shows the distribution of study participants who reported that they would be comfortable to give HIV self-test kits to their close male friends by background characteristics. Sixty-eight per cent ($n = 342$) of the participants reported that they would be comfortable giving HIV self-test kits to their close male friends. As shown, a higher proportion of individuals aged 35 years or older (78.6%, $n = 81$) reported that they would be willing to give HIV self-test kits to their close male friends than those aged 25–34 years (66.7%, $n = 134$) and those aged 18–24 years (63.5%, $n = 127$). As shown, a higher proportion of individuals that had ever heard about HIV self-testing (97.2%, $n = 209$) and those that were encouraged to self-test for HIV by their male friends (96.3%, $n = 183$) were significantly more likely to report that they would be comfortable to give HIV self-test kits to their close male friends than their counterparts ($P < 0.001$). Similarly, participants who reported that they were willing to use the kits in front of their sexual partners (78.2%, $n = 276$) and those that received peer-led HIV self-testing education and promotion

(88.1%, $n = 222$) were also significantly more likely to report that they would be comfortable to give HIV self-test kits to their close male friends than their counterparts ($P < 0.001$). There was no significant difference in being comfortable to give HIV self-test kits to close male friends between those that had ever tested for HIV (68%, $n = 310$) and those that had never tested for HIV (66.7%, $n = 32$), $P = 0.85$.

Table 1 also shows the distribution of study participants who reported that they would be willing to receive HIV self-test kits from their close male friends by background characteristics. Sixty-eight per cent ($n = 344$) reported that they would be comfortable receiving HIV self-test kits from their close male friends. A higher proportion of individuals aged 35 years or older were significantly more likely to report that they would be comfortable to receive HIV self-test kits from a close male friend than those aged 25–34 years (67.2%, $n = 135$) and those aged 18–24 years (63.5%, $n = 127$). Individuals that had ever heard about HIV self-testing (98.1%, $n = 211$), those that had been encouraged to self-test for HIV by their male friends (98%, $n = 186$), and those that were willing to use the HIV self-test kit in front of their sexual partners (79.3%, $n = 280$) were significantly more likely to report that they would be comfortable receiving HIV self-test kits from their close male friends than their counterparts (Prevalence Rate [PR]: 5.1; 95% CI: 2.1, 12.2; $P < 0.001$). As expected, participants who were exposed to peer-led HIV self-testing education and promotion were significantly more likely to report that they were willing to receive HIV self-test kits from their close male friends than their control-arm counterparts (89.3% vs. 47.2%, PR: 2.1; 95% CI: 1.8, 2.4; $P < 0.001$). However, there was no significant difference in being comfortable to receive HIV self-test kits between those that had ever tested for HIV and those that had never tested for HIV (68.2% vs. 68.8%, PR: 0.99; 95% CI: 0.8, 1.2; $P = 0.94$).

Table 2 shows the crude prevalence rates associated with being comfortable to give and/or receive HIV self-test kits from a close male friend. In the crude analysis, while taking clustering into account, we found that participants that have ever heard about HIV self-testing were twice as likely to report that they were comfortable to give HIV self-test kits to a close male friend (PR: 2.1; 95% CI: 1.4, 3.1) and twice as likely to report that they were comfortable to receive HIV self-test kits from a close male friend (PR: 2.1; 95% CI: 1.5, 3.1) compared to those that have not ever heard about HIV self-testing.

Table 2
 Factors associated with being comfortable to give to or receive HIV self-test kits from a close male friend
 (Crude Analysis)

Variable	Giving HIV self-test kits to a close male friend		Receiving HIV self-test kits from a close male friend	
	PR (95% CI)	p-value	PR (95% CI)	p-value
Age categories	1	0.697	1	0.667
18–24	1.0 (0.8, 1.3)	0.118	1.1 (0.8, 1.4)	0.105
25–34	1.2 (0.9, 1.6)		1.3 (1.0, 1.6)	
35+				
Education level	1	0.506	1	0.089
No formal education	0.9 (0.7, 1.1)	0.505	0.8 (0.7, 1.0)	0.079
Primary education	0.9 (0.7, 1.2)		0.8 (0.6, 1.0)	
Secondary and above				
Marital Status	1	0.372	1	0.341
Single	1.1 (0.9, 1.3)	0.940	1.1 (0.9, 1.3)	0.968
Married/ Cohabiting	1.0 (0.7, 1.5)		1.0 (0.6, 1.6)	
Divorced/ Widowed				
Ever tested for HIV	1	0.811	1	0.921
No	1.0 (0.9, 1.2)		1.0 (0.8, 1.2)	
Yes				
Ever heard about HIV self-testing	1	< 0.001	1	< 0.001
No	2.1 (1.4, 3.1)		2.1 (1.5, 3.1)	
Yes				
Male friend influence on HIV self-testing	1	0.001	1	0.001
No	1.9 (1.3, 2.8)		1.9 (1.3, 2.9)	
Yes				
Willing to use HIV self-test kits in front of a sexual partner	1	< 0.001	1	< 0.001
No	5.0 (2.1, 12.2)		5.1 (2.1, 12.2)	
Yes				

	Giving HIV self-test kits to a close male friend		Receiving HIV self-test kits from a close male friend	
Exposure to HIV self-testing promotion	1	< 0.001	1	< 0.001
No	1.9 (1.4, 2.4)		1.9 (1.4, 2.5)	
Yes				

Also, participants who had been encouraged to self-test for HIV by their close male friends had a significantly higher (90%) prevalence rate of being comfortable to give HIV self-test kits to a close male friend (PR: 1.9; 95% CI: 1.3, 2.8) and 90% higher prevalence rate of being comfortable to receive HIV self-test kits from a close male friend (PR: 1.9; 95% CI: 1.3, 2.9) compared to their counterparts. Participants willing to use HIV self-test kits in front of their sexual partners had five times higher prevalence rate of being comfortable to give HIV self-test kits to a close male friend (PR: 5.0; 95% CI: 2.1, 12.2) and five times higher prevalence rate of being comfortable to receive HIV self-test kits from a close male friend (PR: 5.1; 95% CI: 2.1, 12.2) compared to their counterparts. Furthermore, participants that were exposed to peer-led HIV self-testing promotion had a significantly higher (90%) prevalence rate of being comfortable to give HIV self-test kits to a close male friend (PR: 1.9; 95% CI: 1.4, 2.4) and 90% higher prevalence rate of being comfortable to receive HIV self-test kits from a close male friend (PR: 1.9; 95% CI: 1.4, 2.5) than their control-arm counterparts.

Table 3 shows the adjusted prevalence rate associated with being comfortable to give and/or receive HIV self-test kits from a close male friend. After controlling for other factors and taking clustering into account, having ever heard about HIV self-testing (adjusted [Adj.] PR = 1.6; 95%CI: 1.3, 1.9), male friend's influence on HIV self-testing (Adj. PR: 1.5; 95%CI: 1.2, 1.8), willing to use HIV self-test kits in front of a sexual partner (Adj. PR: 3.0; 95%CI: 1.5, 6.1) and exposure to peer-led HIV self-testing education and promotion (Adj. PR: 1.4; 95%CI: 1.2, 1.7) remained significant factors associated with being comfortable to give HIV self-test kits to a close male friend. Similarly, having ever heard about HIV self-testing (Adj. PR: 1.5; 95%CI: 1.3, 1.8), male friend's influence on HIV self-testing (Adj. PR: 1.5; 95%CI: 1.3, 1.9), willingness to use HIV self-test kits in front of a sexual partner (Adj. PR: 3.0; 95%CI: 1.5, 6.0) and exposure to peer-led HIV self-testing education and promotion (Adj. PR: 1.5; 95%CI: 1.2, 1.8) were significantly associated with being comfortable to receive HIV self-test kits from a close male friend.

Table 3
**Factors associated with being comfortable to give to or receive HIV self-test kits from a close male friend
 (Adjusted Analysis)**

Factor	Giving HIV self-test kits to a close male friend		Receiving HIV self-test kits from a close male friend	
	PR (95% CI)	p-value	PR (95% CI)	p-value
Ever heard about HIV self-testing	1	< 0.001	1	< 0.001
No	1.6 (1.3, 1.9)		1.5 (1.3, 1.8)	
Yes				
Male friend influence on HIV self-testing	1	< 0.001	1	< 0.001
No	1.5 (1.2, 1.8)		1.5 (1.3, 1.9)	
Yes				
Willing to use HIV self-test kits in front of a sexual partner	1	0.002	1	0.001
No	3.0 (1.5, 6.1)		3.0 (1.5, 6.0)	
Yes				
Exposure to HIV self-testing promotion	1	< 0.001	1	< 0.001
No	1.4 (1.2, 1.7)		1.5 (1.2, 1.8)	
Yes				

Discussion

Our results from the baseline study of the STEP Project showed a high level of comfort among men with receiving and/or giving HIV self-test kits to close male friends: 68% of participants indicated that they would be willing to receive and/or give out HIV self-test kits to their close male friends. These findings suggest the potential for peer-led HIV self-testing to reach men through fellow social network members and improve HIV testing rates among men who have never tested for HIV as well as among HIV-negative repeat HIV testers. The need for repeat HIV testing is particularly important because compared to prior studies documenting low HIV testing rates among men in Tanzania [24, 43], most of the men in this study had been tested for HIV due to the ongoing national Test and Treat campaign focused on increasing HIV testing rates among men [28]. Formative qualitative research revealed that men perceived HIV self-testing as a facilitator for repeat HIV testing among HIV-negative testers because testing at home would save time compared to the commute and long queues associated with facility-based HIV testing [32].

Although we found that a high proportion (68%) of men were willing to give an HIV self-test kit to their friend, another study conducted among men who have sex with men in the U.S. found a much higher

proportion, with at least 90% of men who have sex with men reporting they would be comfortable to distribute HIV self-test kits within their social networks [30]. The lower proportion of men in Tanzania who reported being comfortable to distribute an HIV self-test kit to their social network peers may be explained by the lack of familiarity with HIV self-testing for some of the men. This is supported by the fact that among men who had received peer-led HIV self-testing education and promotion, a much higher proportion (88%) of them reported being willing to distribute an HIV self-test kit to their peers compared to only 48% of men who had not been exposed to peer-led HIV self-testing education and promotion. These findings are supported by past research demonstrating that prior engagement with peer educators was associated with willingness to use pre-exposure prophylaxis among male sex workers in Vietnam [44].

Peer educators have been engaged in promoting uptake of HIV self-testing in several prior studies. Chanda et al. used peer educators for an HIV self-test cluster randomized controlled trial [45]. In the study, peer educators served to either directly distribute HIV self-test kits or distribute an HIV self-test coupon for female sex workers to collect the HIV self-test kit at a certain distribution point [45]. The peer educators, who were current or former female sex workers, were recruited by the study staff and participated in a two-day training. Throughout the study, the peer educators met with participants a minimum of four times in order to provide general related health education, provide knowledge on how to use the kits, and conduct follow-up visits after the women had tested [46]. Peer educators proved to have a positive effect on HIV self-testing among this population, pointing to the possibility that they served to decrease participant concerns about HIV-related stigma [46]. Results from another study conducted to assess the effect of peer-based distribution of HIV self-test kits among fishermen in Buliisa, Uganda, found that 82% (n = 95) of the fishermen accepted to receive HIV self-test kits from their peers; of these, 29 (25.8%) had never tested for HIV while 42 (44.2%) had tested more than a year ago [16]. In this study, 19 peers were recruited from patients attending health services at a facility as well as from community members and trained in how to distribute HIV self-test kits. Each peer received up to five HIV self-test kits for distribution to eligible social network members (i.e. those aged 18 years and above and who had not recently tested for HIV).

Taken together, these studies demonstrate that network-based distribution of HIV self-test kits can improve HIV testing rates, particularly in hard-to-reach populations, including men. However, the majority of peer-led HIV self-test kits distribution studies have not assessed the willingness to distribute HIV self-test kits among the peers who are reached by peer educators. Engaging peers who are reached by trained peer educators provides an opportunity to not only assess the effect of receiving peer-led HIV self-testing promotion but also an opportunity to leverage their knowledge of and use of HIV self-test kits to reach additional social and sexual network members that originally trained peer educators may not be able to reach. For example, we found that men who reported that their close male friends had encouraged them to self-test for HIV were more comfortable with receiving an HIV self-test kit from a close male friend than their counterparts. In the event that this close male friend is not a peer educator but may know the peer educator, this close male friend can receive two to three HIV self-test kits from a peer educator and then distribute them among his other friends who may not be close to the peer educators. Qualitative findings from the same group of men revealed that men, who were not peer educators, engage in HIV testing

conversations with their friends and were willing to distribute HIV self-test kits to their close friends who may not want to seek HIV testing at the clinic [21]. Thus, more research is needed to explore the feasibility of expanding peer-based HIV self-test distribution to peers who are not reached by the peer educators.

We also found that men who are willing to use an HIV self-test kit in front of a sexual partner were more likely to be comfortable to receive an HIV self-test kit from a close male friend than their counterparts. This finding supports the potential for men to receive multiple HIV self-test kits from a close friend instead of only a peer educator for them to use with their sexual partners. A close male friend compared to a peer educator may have more information about another friend's risky sexual behavior. This knowledge of close friend's risky sexual behavior played a role in men encouraging their friends to test for HIV in Tanzania [21] and can be leveraged to have men distribute HIV self-test kits to their friends to also test their sexual partners. To our knowledge, there are no network-based studies that have provided heterosexual men with multiple HIV self-test kits to use with their female sexual partners. Rather, the existing studies have focused only on providing women multiple HIV self-test kits to use with their male sexual partners [4, 5, 13, 15]. These studies have shown that providing women with HIV self-test kits to use with their male partners can help to identify men who are unaware of their positive HIV status and reduce HIV risk for the female partner [4, 15]. In the same vein, if men receive multiple HIV self-test kits to use with their sexual partners, it can help them assess their female partner's HIV status and potentially prevent HIV acquisition from female partners who may be unaware of their positive HIV status. This is particularly important because an earlier study conducted among men in Tanzania found that the majority of them were not aware of their sexual partner's HIV status and that men who had two or more sexual partners were significantly less likely to be aware of their partner's HIV [43]. In addition, men who use condoms inconsistently were less likely to be aware of their sexual partner's HIV status [43]. Thus, men, especially those with multiple sexual partners, can benefit from receiving multiple HIV self-test kits and proper guidance on how to self-test with their sexual partners as an HIV prevention strategy.

Although our study has several strengths, there are a few limitations worth highlighting, including the fact that data originated from a cross-sectional survey and were not collected to assess the causal relationship between variables of interest. Therefore, measures of the relationships described in this paper should be viewed as associations captured at a moment in time and not causal in nature. Given the hypothetical nature of the outcome variables examined, the responses may vary in the future with more or fewer men willing to give or receive an HIV self-test kit from a close friend. In addition, these findings are not generalizable to other men in the country since the data were collected among men in Dar es Salaam who are members of specific social networks called 'camps'. However, this is one of the first studies to reach men who were exposed to peer-led HIV self-testing education and promotion to assess their willingness to give to or receive HIV self-test kits from close male social network members. The findings support the potential for network-based HIV self-testing distribution strategies to reach men who may not be close friends with peer educators.

Conclusion

Our study showed that nearly seven out of ten men were willing to receive and/or give out HIV self-test kits to their close male friends within a social network setting. Having ever heard about HIV self-testing, willingness to self-test in front of one's sexual partner, and exposure to peer-led HIV self-testing education and promotion were significantly associated with being comfortable to give to or receive HIV self-test kits from close male friends within the social network. These findings suggest that distribution of HIV self-test kits through close male friends could improve the proportion of men reached with HIV self-testing services and improve HIV testing rates in this population where uptake of HIV testing among men remains low.

List Of Abbreviations

AIDS Acquired Immune Deficiency Syndrome

cRCT Cluster Randomized Controlled Trial

FSW Female Sex Worker

HIV Human Immunodeficiency Virus

JHPIEGO Johns Hopkins Program for International Education in Gynecology and Obstetrics

MoHCDGEC Ministry of Health, Community Development, Gender, Elderly and Children

NIMH National Institute of Mental Health

PEPFAR President's Emergency Plan for AIDS Relief

PR Prevalence Rate

STEP Self-Testing Education and Promotion

TACAIDS Tanzania Commission for AIDS

US United States

USAID United States Agency for International Development

Declarations

Ethics approval and consent to participate

This study was reviewed and approved by the institutional review boards of the University of South Carolina and the National Institute of Medical Research of Tanzania (NIMR/HQ/R.8c/Vol.I/1170). All respondents provided written informed consent prior to participation in the study. All study procedures were performed in accordance with the ethical standards of the institutional and/or national research

committees and with the 1964 Helsinki declaration and its later amendments or comparable ethical standards.

Consent for publication

Not applicable

Availability of data and materials

The datasets used and/or analysed during the current study are available from the corresponding author on reasonable request.

Competing interests

Authors have declared that no competing interests exist.

Funding

This study was supported by grants from the National Institute of Mental Health (Grant #R00MH110343: PI: DFC) and Minority Health International Research Training (MHIRT) (Grant T37-MD001448) from the National Institute on Minority Health and Health Disparities, National Institutes of Health (NIH), Bethesda, MD, USA. DFC was also supported by the HIV Dissemination Science Training Program for Underrepresented Investigators grant award #R25MH080665, and the BSM PRIDE program #R25HL105444. JKBM was supported by a grant (FIC D43TW010540, PI: Riley LW) from the National Institutes of Health Global Health Equity Scholars Fellowship Program and another grant from the Africa Research Excellence Fund (RF-1570024-F-MATOV). AH thanks the Southern Regional Education Board (SREB) and the Grace Jordan McFadden Professor's Program at the University of South Carolina for their continued financial support. The funders had no role in study design, data collection and analysis, decision to publish, or preparation of the manuscript.

Authors' contributions

D.F.C, G.M. and A.H. conceived the study; G.M., D.F.C. and J.Z. conducted data analysis; J.K.B.M., G.M., D.F.C., N.T., A.N.K., J.L. and N.Z. wrote the main manuscript; J.K.B.M., G.M., N.T., A.N.K., J.L., T.v.d.A., N.Z., D.D., and D.F.C. reviewed the manuscript for substantial intellectual content. All authors reviewed the manuscript and approved it for submission.

Acknowledgements

We would like to thank the camp members who participated in the study. We are also grateful to the research assistants for the support during data collection. We thank the reviewers for their positive comments that helped to improve the structure of the paper in general and clarity of the study findings in particular.

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