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ORIGINAL PAPER

Changes in Stigma and Social Support among Participants in a Randomized Trial of a Novel Expanded Social Network-based HIV Testing Intervention in KwaZulu-Natal, South Africa

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Abstract

HIV-related stigma is a well-documented barrier to HIV testing in South Africa, and may be particularly likely to create reluctance to test among South African men, who have reported feeling blamed for HIV by their partners and communities. The present study presents a novel expanded social network recruitment to HIV testing (E-SNRHT) intervention explicitly designed to reduce stigma as a barrier to testing by asking people to recruit anyone they know to testing, thus allowing them to avoid the potential for increased stigma and/or blame associated with direct risk partner recruitment, and helping to normalize openly discussing HIV among social networks. We examined baseline and 6-10-week follow-up data from a 2022–2023 randomized trial in KwaZulu-Natal, South Africa that recruited 110 individuals who had been newly diagnosed with HIV and randomly assigned them to recruit people to HIV testing either via the E-SNRHT intervention or via risk network recruitment. Participants in the E-SNRHT intervention reported significant decreases in anticipated and enacted HIV-related stigma between baseline and follow-up; and the E-SNRHT intervention was more effective at decreasing enacted HIV-related stigma than was risk network recruitment. Individuals newly diagnosed with HIV by the E-SNRHT intervention reported significant increases in social support between intervention enrollment and follow-up, and all of these individuals reported participating in positive conversations about HIV services with peers in the 6–10 weeks after intervention enrollment. These findings suggest that E-SNRHT is a potentially important strategy to reduce HIV-related stigma as a barrier to HIV testing among peer networks in KwaZulu-Natal.

Keywords HIV-related stigma · HIV-related social support · Expanded social network recruitment to HIV testing (E-SNRHT) · HIV testing intervention · South Africa

Introduction

HIV-related stigma is a globally recognized challenge to diagnosing and treating people living with HIV (PLWH) [1]. In the context of South Africa's generalized HIV epidemic – which is characterized by high HIV prevalence and incidence [2, 3] – HIV-related stigma is a well-documented barrier to HIV testing among both men and women [4–7], but may be an especially large barrier to testing South African men. Men in South Africa seek HIV testing at clinics at much lower rates than women [8–11], and are thus much more likely to be diagnosed at a late stage of HIV progression [12, 13]. This has contributed to a large gender disparity in undiagnosed cases of HIV in South Africa: up to 21.8% of male PLWH in South Africa are estimated to

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be still undiagnosed, compared to an estimated 11.3% of female PLWH [14]. South African men are often viewed as more likely to have multiple concurrent partnerships; and have reported that they feel they are viewed as perpetrators of HIV transmission and sexual violence, and that they feel blamed for HIV by their communities and partners [8, 15, 16]. Anticipation of such stigma or blame may cause or increase reluctance among men to seek HIV testing in traditional clinic settings (where they may be seen by others) [16], or to discuss HIV testing or serostatus with their sexual partners [8, 17, 18], which may decrease the ability of standard contact-tracing to reach them. HIV-related stigma must therefore be addressed in this setting in order to improve HIV testing and service engagement among men and other people for whom it has been a barrier.

Several types of interventions have been widely implemented and evaluated to try to increase HIV testing among men (and other groups who have been "hard to reach" for testing and/or have been reluctant to test) in South Africa and elsewhere in Sub-Saharan Africa, including couples-based testing [19] and home-based testing [20–22]. However, couples-based testing may not be optimal in South Africa because men may be reluctant to speak openly about HIV with their partners, due to both gender norms [8, 17, 18] and anticipated HIV-related stigma, as discussed above. Additionally, although findings on home-based testing have been more promising in terms of increasing testing among men [22, 23], home-based testing may inadvertently reinforce the idea that HIV testing should be a clandestine behavior that is not acceptable to do publicly, and could thus inadvertently *increase* HIV-related stigma in the long term. Since HIV-related stigma limits health service access in this context [4, 24–26], it is therefore likely to limit the care linkage of men with high levels of anticipated stigma who test positive [27] using home-based tests [28]. For example, one South African study found that only 31% of men aged ≥ 30 and only 18% of men < 30 linked to care within 6 months of a home testing HIV diagnosis [29]; and there is no evidence to our knowledge that men in South Africa who test negative at home seek future HIV testing.

Over the past 5–10 years, risk network recruitment has gained traction as a strategy to recruit individuals who have been "hard to reach" for testing and/or reluctant to test and to broaden the reach of HIV testing beyond clinic testing. Risk network recruitment involves asking individuals newly diagnosed with HIV to recruit their direct sex and/or injection partners to HIV testing. Those recruited are then also asked to recruit their own sex and/or injection partners, in an effort to try to recruit and test the entire network through which HIV transmission may have occurred [30, 31]. Though risk network recruitment has been found to increase rates of testing and diagnosis of previously HIV-unaware individuals among some populations in some global settings (e.g., sex workers, people who inject drugs, men who have sex with men) [30–33], it has some key limitations that may make it less successful at recruiting men and other individuals who have been "hard to reach" for testing and/or reluctant to test in South Africa's generalized heterosexual epidemic. One such major limitation is that risk network recruitment may actually increase the role of HIV-related stigma as a barrier to testing, particularly for those with higher levels of anticipated stigma. This is because recruiting one's direct sex or injection partners can often trigger suspicion, blame, and/or other relationship difficulties as discussed above [34–36]. Expectations of or fear of such relational challenges can create or increase reluctance to test for HIV among individuals with higher levels of anticipated stigma [37–39], thereby limiting the potential efficacy of a risk network recruitment approach in South Africa and other settings where reluctant-to-test individuals have high levels of anticipated stigma.

We developed a novel expanded social network recruitment to HIV testing (E-SNRHT) intervention to address the issues of stigma that are most likely to serve as a barrier to men's recruitment to testing via risk network recruitment or traditional testing mechanisms. E-SNRHT recruits individuals newly diagnosed with HIV as "seeds" (i.e., initial participants) and asks them to recruit anyone they know (e.g., friends, family members, peers) whom they think might benefit from HIV testing or whom (after a brief educational session on HIV risk and transmission through networks) they think might be at risk of having an HIV infection but being unaware of it. By allowing participants to recruit anyone they know to HIV testing instead of requiring them to ask only their direct sex partners (as risk network recruitment does), E-SNRHT allows participants to avoid blame and stigmatization associated with discussing HIV with one's own risk partner.

Additionally, as participants have discussions with their peers and other network members to recruit them to HIV testing, norms around discussing HIV within the social network change. This may lead to reductions in HIV-related stigma and/or increases in HIV-related social support. Theoretically, the reason E-SNRHT has the potential to reduce stigma and increase social support is that the social processes of recruiting or being recruited by one's network members for HIV testing can help to normalize open discussion about HIV-related health issues. (See Fig. 1.) In other words, the process of network-based recruitment facilitates (or even requires) conversations about HIV and HIV services among network members, and in many cases these may be conversations that they might otherwise not have had. This increased openness/discussion is likely to increase HIV-related social support among participants (e.g., network

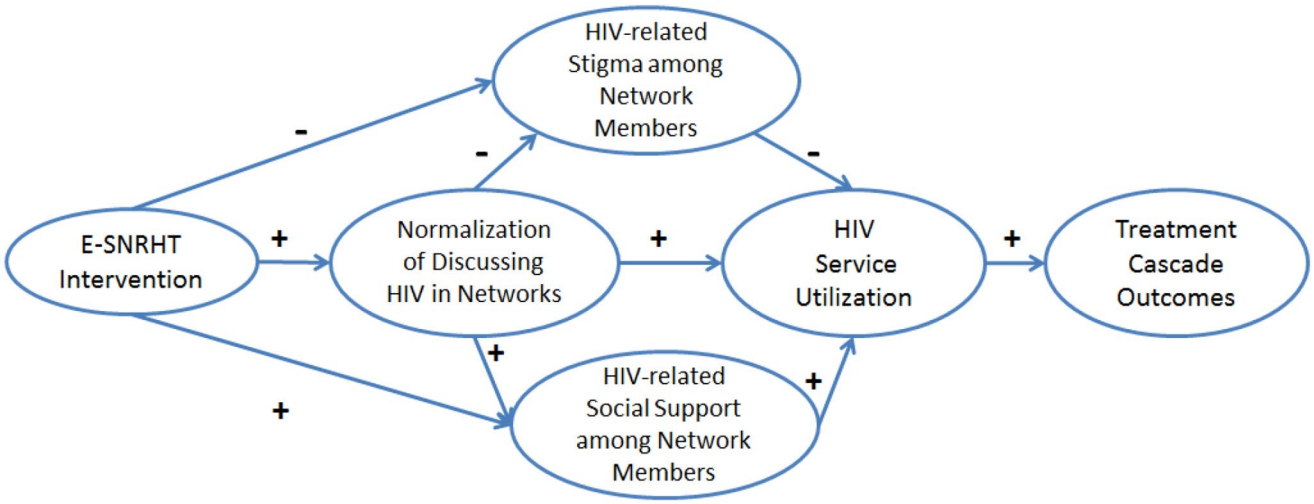

Fig. 1 Theoretical model of the potential impact of the E-SNRHT intervention on HIV-related stigma and social support

members visiting clinics together or helping each other navigate the treatment process) and to reduce HIV-related stigma within networks. These relationships are supported by Williams' theoretical framework for understanding HIV-related stigma, health service use, and HIV outcomes in Sub-Saharan Africa [40], which posits a negative relationship between HIV-related stigma and open discussion about HIV status or services [40]. They are also supported by Friedman et al.'s transdisciplinary theory of networks [30, 41], which posits that norms about HIV testing vary between networks, and uptake of HIV testing moves through networks [41], changing these norms.

Preliminary support for the relationship between network-based recruitment to HIV testing and reduced HIV-related stigma was also found by the TRIP study: an evaluation of a risk network recruitment-based HIV testing intervention conducted in Athens, Greece; Odessa, Ukraine; and Chicago, United States [37]. However, we hypothesize that due to the potentially stigma-increasing complications of recruiting one's own sexual or injection partners, and given the high levels of HIV-related stigma experienced by men and others in South Africa – discussed above – our E-SNRHT intervention should have larger impacts on stigma than risk network recruitment in South African settings. To our knowledge, there have not yet been any studies of the relationship between network-based recruitment to HIV services and HIV-related stigma (or HIV-related social support) in Sub-Saharan African settings, where there is a great need to reduce stigma as a barrier to HIV service engagement in order to increase service access and thereby reduce HIV transmission and improve the health outcomes of people living with HIV.

The Present Study

The present study will examine baseline and 6–10 week follow-up data from a 2022–2023 randomized trial in KwaZulu-Natal, South Africa that recruited 110 individuals newly diagnosed with HIV from three Department of Health clinics and two drug treatment centers and randomly assigned them to recruit people they knew to HIV testing either via the E-SNRHT intervention or via risk network recruitment, in order to compare the ability of these two network strategies to reduce HIV-related stigma and increase HIV-related social support. It will address the following research questions:

1) Did E-SNRHT intervention participants experience significant decreases in stigma and/or increases in social support? Did the subsample of participants who were newly diagnosed by the intervention experience these changes?
2) Were changes in stigma and support significantly greater among E-SNRHT intervention participants than among risk network recruitment participants?

Methods

Setting

The study was conducted in the uMgungundlovu district municipality, within the South African province of KwaZulu-Natal. This district, located about 150 km from Durban, is served by 55 Department of Health primary care clinics (all of which offer HIV testing and treatment). This district

contains urban, suburban, and rural locations (including the mid-sized city Pietermaritzburg). It is comprised predominantly of isiZulu- and English-speaking populations of Zulu heritage, but includes some areas with large white and Indian populations. The uMgungundlovu district is characterized by high rates of unemployment (43% in 2020) [42] and low average household income (about 40% of households reported an annual income < $1,050 during the most recent Census for which data are publicly available) [43]. HIV prevalence is also high, and was estimated at 27% for KwaZulu-Natal overall in 2017 [2]. There is a gender disparity in testing rates at clinics, with men accounting for only 28–36% of HIV tests at Department of Health clinics in the uMgungundlovu district [44].

Sample and Recruitment Procedures

To recruit "seeds" (i.e., initial participants), we asked clinic staff at three Department of Health clinics and two drug treatment centers in KwaZulu-Natal to refer to us any adult whom the clinic newly diagnosed with HIV during the seed recruitment period, between July 2022 and March 2023 (i.e., any adult newly diagnosed with HIV at each study clinic, where a newly diagnosed individual is defined as a person who tested positive for HIV, had no recorded previous positive HIV test, and indicated to clinic staff that he or she had never received a positive HIV test result before). To refer these individuals, clinic nurses briefly told them about the study, gave them a referral coupon, and told them to use the contact information on the coupon if they were interested in participating. Clinic-referred newly-diagnosed individuals were eligible to be seeds if they presented a referral coupon, were ≥ 18 years old, able to understand and be interviewed in isiZulu or English, and able to give written informed consent.

We also recruited network members for all enrolled seeds. (Network member type varied as a function of study arm; see Intervention Procedures below.) Seeds were given recruitment coupons to recruit their network members by distributing coupons to them. Coupons contained unique, confidential alphanumeric codes with no identifying information. These codes were used to link seeds' network members to them for analytic purposes. Network members referred to us by seeds were eligible if they presented a study recruitment coupon, were at least 18 years old, able to understand and be interviewed in isiZulu or English, and able to give written informed consent.

A "two steps" algorithm of network member recruitment was followed, meaning that all participants who were recruited by seeds (Step 1) were also asked to help us recruit additional participants (Step 2) who were their own additional network members. Step 2 network members were enrolled in the study but were not asked to recruit anyone else to the study. All network members received HIV testing and counseling, and all participants who tested positive for HIV were referred to care.

Intervention Procedures

Seeds were randomly assigned to either the E-SNRHT intervention arm or to the risk network recruitment arm, using randomization software on a mobile phone app (Random Number Generator Plus; RandomAppsInc). All members of each seed's network were automatically assigned to the study arm to which the seed was randomly assigned (such that each seed's entire network was in the same study arm). In the E-SNRHT intervention arm, we used a diagram to briefly refresh participants' knowledge of how HIV infection is transmitted through networks, briefly reminded them of HIV transmission risks, and then asked them to recruit anyone they knew (i.e., friends, family members, other peers) whom they thought might be at risk of having HIV but being unaware of it, based on their knowledge of their network members' behaviors and testing history. We asked them to enumerate people who they could think of who they might want to recruit, given these instructions. We then gave them one recruitment coupon for each potential recruitee they enumerated, plus 5 extra coupons for people they forgot to count or might think of later. Recruited network members (Step 1) received HIV testing and counseling and were interviewed and asked to recruit their own network members, following the same brief education and instructions that the seeds received. Step 2 network members received HIV testing and counseling and were interviewed, but were not asked to recruit their own network members. All participants who tested positive for HIV were linked to care.

In the risk network recruitment arm, we asked seeds to recruit all of their direct sexual and/or injection partners from the last six months to participate in the study and to get tested for HIV. The number of recruitment coupons given to each seed corresponded to the number of sexual and/or injection partners they reported. The participants they recruited (Step 1 network members) received HIV testing and counseling, were interviewed, and were asked to recruit all of their additional sexual and/or injection partners (Step 2 network members). Step 2 network members who participated received HIV testing and counseling and were interviewed, but were not asked to recruit their own network members. All participants who tested positive for HIV were linked to care.

Follow-up Interviews and Participant Retention

We conducted follow-up interviews with participants in both study arms approximately 6–10 weeks after their baseline interviews. We asked participants to report on their anticipated HIV-related stigma and HIV-related social support, and on their recently enacted HIV-related stigma and support (i.e., experiences of stigma and support that they had between baseline and follow-up). We retained 92.8% (337 of 363) of participants in the E-SNRHT intervention arm, and 90.7% (97 of 107) of participants in the risk network recruitment arm for follow-up.

Measures

HIV-related Stigma was measured as both anticipated HIV-related stigma and enacted HIV-related stigma, separately. *Anticipated HIV-related stigma* was measured using 6 items adapted from our previous studies of stigmatized drug use behaviors [45] and HIV-related stigma and support [37] that asked participants to rate "how likely most of the people you know" would be to engage in six specific behaviors that are stigmatizing against people with HIV, such as making nasty comments, excluding someone from social gatherings, and being uncomfortable around someone with HIV. Participants responded on a 4-point Likert scale ranging from "very unlikely" to "very likely." This measure had an internal consistency of $\alpha = 0.81$ among the present sample. *Enacted HIV-related stigma* was measured using three items adapted from the TRIP study [37] that asked participants whether or not they had experienced specific stigmatizing behaviors or discriminatory limitations (e.g., nasty comments, denied access to events) in the last three months (when asked at baseline) and in the time since their baseline interviews (when asked at follow-up) due to someone suspecting or knowing they were living with HIV. We operationalized enacted HIV-related stigma as the count of affirmative responses to these items (i.e., number of types of enacted stigmatizing experiences).

HIV-related Social Support was measured as both anticipated HIV-related social support and enacted (i.e., experiences of) HIV-related social support, separately. *Anticipated HIV-related social support* was measured using 4 items adapted from our previous studies of stigmatized drug use behaviors [45] and HIV-related stigma and support [37] that asked participants to rate "how likely most of the people you know" would be to engage in four specific behaviors that are supportive of or helpful to people with HIV, such as offering emotional support, offering logistic support such as cooking or transportation, and helping them with going to appointments or remembering to take medication. Participants responded on a 4-point Likert scale ranging from "very unlikely" to "very likely." This measure had an internal consistency of $\alpha = 0.73$ among the present sample. *Enacted HIV-related social support* was measured using five items used by the TRIP study [37] that asked participants whether or not they had experienced specific supportive behaviors (e.g., offering emotional support, providing information on where to access HIV services, offering concrete or financial assistance) in the last three months (when asked at baseline) and in the time since their baseline interviews (when asked at follow-up) due to someone suspecting or knowing they were living with HIV. We operationalized enacted HIV-related social support as the count of affirmative responses to these items (i.e., number of types of enacted socially supportive experiences).

All sociodemographic characteristics and substance use behaviors were measured using participant self-report. Gender was operationalized as a binary variable, as all participants reported being either cis-gender men or cis-gender women. Participants were asked whether or not they used a list of specific drugs recreationally in the last 6 months. *Hard drug use* was operationalized as having used a drug other than alcohol or marijuana recreationally in the last 6 months.

Substance Use-related Stigma was measured at baseline using the Substance Use Stigma Mechanisms Scale (SU-SMS) [46], because there is intersectionality among different stigmatized identities, and the relationships between experiences of stigmatization of different identity aspects can be interactive or multiplicative [47–49]. This 18-item scale measures anticipated, enacted, and internalized stigma related to use of alcohol or drugs, and has been found to have good reliability and validity among samples with diverse histories of substance use (including low levels of substance or alcohol use) [46]. The SU-SMS had an internal consistency of $\alpha = 0.91$ among the present sample.

Analysis

Descriptive statistics of participants' sociodemographic characteristics and substance use behaviors were computed, and Chi-square tests (for categorical variables) and t-tests (for continuous variables) were conducted to test for balance between the E-SNRHT intervention arm and the risk network recruitment arm.

Paired-samples t-tests were used among participants in the E-SNRHT intervention arm ($N = 337$) to address Research Question 1 (i.e., to examine whether there were significant changes over time in stigma and support among E-SNRHT intervention participants). One-tailed significance values were presented given the directional hypotheses (i.e., expected decreases in stigma and expected increases in social support) for Research Question 1. These

Table 1 Descriptive statistics of baseline sample characteristics by study arm, among participants in analytic sample (i.e., participants retained at follow-up)

	E-SNRHT Participants ($N=337$)	E-SNRHT Newly Diagnosed Individuals ($N=43$)	Risk Network Participants ($N=97$)	Risk Network Newly Diagnosed Individuals ($N=4$)
Gender: Man	219 (65.0%)***	18 (41.9%)	42 (43.3%)***	2 (50.0%)
Age: Mean (S.D.)	32.28 (9.28)	32.21 (7.82)	34.02 (10.71)	35.25 (4.99)
Completed High School	165 (49.0%)	16 (37.2%)	41 (42.3%)	3 (75.0%)
Employed	49 (14.5%)†	4 (9.3%)	21 (21.6%)†	0 (0.0%)
Number of Household Members: Mean (S.D.)	5.57 (3.47)	5.76 (3.27)	5.34 (3.30)	2.25 (0.96)
Primary Language: isiZulu	333 (98.8%)	43 (100.0%)	92 (94.8%)	4 (100.0%)
Hard Drug Use	44 (13.1%)***	6 (14.0%)	1 (1.0%)***	0 (0.0%)
Substance Use-related Stigma: Mean (S.D.)	1.48 (0.74)***	1.60 (0.76)	1.10 (0.56)***	0.61 (0.26)

Table 2 Paired-samples *t*-tests examining change over time in HIV-related stigma and HIV-related support among E-SNRHT intervention participants

	Baseline Mean	Follow-up Mean	Mean Difference (S.E.)	*t*-statistic
Anticipated HIV-related stigma (full sample, $N=337$)	0.56	0.37	0.20 (0.03)	5.63***
Anticipated HIV-related stigma (Newly diagnosed individuals only, $N=43$)	0.66	0.31	0.35 (0.11)	3.08**
Enacted HIV-related stigma (full sample, $N=337$)	0.31	0.15	0.16 (0.03)	5.22***
Enacted HIV-related stigma (Newly diagnosed individuals only, $N=43$)	0.37	0.19	0.19 (0.09)	2.08*
Anticipated HIV-related social support (full sample, $N=337$)	2.11	2.08	0.03 (0.03)	1.14
Anticipated HIV-related social support Newly diagnosed individuals only, $N=43$)	2.19	2.18	0.01 (0.12)	0.10
Enacted HIV-related social support (full sample, $N=337$)	3.05	3.02	0.03 (0.06)	0.48
Enacted HIV-related social support (Newly diagnosed individuals only, $N=43$)	3.05	3.35	-0.30 (0.16)	-1.91*

One-tailed significance: *** $p<.0005$; ** $p<.01$; * $p<.05$; † $p<.10$

paired-samples t-tests were repeated among the subsample of newly diagnosed network members recruited in the E-SNRHT intervention arm (i.e., individuals diagnosed with HIV for the first time based on their HIV test that was part of the intervention), to examine whether newly diagnosed participants, specifically, experienced significant changes over time in HIV-related stigma and support.

A series of multiple linear regression models were used to address Research Question 2 (i.e., to test for a relationship between study arm and the size of the changes in stigma and support between baseline and follow-up). Characteristics that were found to be unbalanced between the E-SNRHT intervention arm and the risk network recruitment arm during descriptive analysis were included in the multiple linear regression models as covariates.

Results

Descriptive statistics for the demographic characteristics of E-SNRHT participants, risk network recruitment participants, and newly diagnosed individuals in each condition are presented in Table 1. Statistical comparisons of sociodemographic and substance use characteristics between the two arms (i.e., of the full sample for each arm) found that there were significantly more men ($X^2=14.78$, $p<.0005$) and people who used hard drugs ($X^2=11.72$, $p<.0005$) in the last six months - and higher levels of substance use-related stigma ($t=3.79$, $p<.0005$) - in the E-SNRHT intervention arm than in the risk network recruitment arm. To address these study arm imbalances, these constructs were included as covariates in the multiple regression analyses below.

Table 2 presents results from paired-samples t-tests addressing whether or not there were significant changes over time in stigma and support among E-SNRHT intervention participants. E-SNRHT participants reported significant decreases in both anticipated (mean$\Delta=0.20$; S.E. $= 0.03$; $t=5.63$; $p<.0005$) and enacted (mean$\Delta=0.16$; S.E. $= 0.03$; $t=5.22$; $p<.0005$) HIV-related stigma between baseline and follow-up. These decreases in both anticipated (mean$\Delta=$ -0.35; S.E. $= 0.11$; $t=3.08$; $p=.002$) and enacted (mean$\Delta=0.19$; S.E. $= 0.09$; $t=2.08$; $p=.022$) stigma over time were also significant for the subsample of participants who were newly diagnosed with HIV. There were no significant differences in reported social support between baseline and follow-up among the full sample of E-SNRHT participants. However, among the subsample of E-SNRHT participants who were newly diagnosed, there was a significant increase between baseline and follow-up in enacted

HIV-related social support (meanΔ = -0.30; S.E. = 0.16; t = -1.91; p = .031).

Table 3 presents results from multiple linear regression models testing for a relationship between network recruitment type and the size of the changes in stigma and support between baseline and follow-up. E-SNRHT participants experienced significantly larger decreases in enacted HIV-related stigma (B = 0.14; S.E. = 0.09; p = .046) between baseline and follow-up than did risk network recruitment participants. Although E-SNRHT participants did experience larger decreases (meanΔ = 0.20) in anticipated HIV-related stigma between baseline and follow-up than did risk network recruitment participants (meanΔ = 0.15), this difference was not statistically significant. There were no significant differences between E-SNRHT participants and risk network recruitment participants in terms of experienced changes in HIV-related support. We did not have sufficient statistical power to examine this relationship among the subsample of newly diagnosed individuals, as there were only 4 newly diagnosed individuals in the risk network recruitment arm for whom follow-up data was available (out of 6 newly diagnosed individuals in the risk network recruitment arm at baseline).

Discussion

The present study found that E-SNRHT participants experienced significant decreases between baseline and a 6–10 week follow-up in both anticipated HIV-related stigma and enacted HIV-related stigma. These significant decreases in stigma over time also held true for the subsample of newly diagnosed individuals recruited by the E-SNRHT intervention. The present study also found that E-SNRHT participants experienced larger decreases in enacted HIV-related stigma than did risk network recruitment participants. These findings are consistent with data from an earlier pilot of the E-SNRHT intervention that we conducted in 2017–2018, in which E-SNRHT participants reported in qualitative follow-up interviews that they thought E-SNRHT reduced stigma and made it easier for them to talk to their own partners about HIV testing because they had also talked to their friends and others about it [50]. The present study's findings are also consistent with our previous findings of an association between reduction over time in stigma and participation in a risk network intervention among key HIV risk populations in Athens, Odessa, and Chicago [37]; and with our theoretical conceptualization of the E-SNRHT intervention. Additional research is needed to test our theoretical understanding of the mechanisms and processes through which the E-SNRHT intervention reduces stigma (i.e., whether it is through normalization of having discussions about HIV, through other changes in network-level norms, or through other mechanisms entirely), and in what conditions, situations, or settings it has the largest impact. Such research should include both quantitative examination of potential pathways, and qualitative examination of the interpersonal dynamics involved in the recruitment process and how they may affect stigma and support.

The present study also found that E-SNRHT participants who were newly diagnosed with HIV experienced significant increases in enacted HIV-related social support (i.e., in the number of types of HIV-related support they experienced) between baseline and follow-up. These individuals were diagnosed with HIV just after providing their baseline responses, so it is both logical and encouraging that they experienced increased HIV-related support from their peers. All of the newly diagnosed individuals in the E-SNRHT arm indicated that they had had "positive conversations with people you know about HIV safety or prevention, or about accessing HIV testing or other services" between baseline and follow-up.

The fact that no significant differences were found between the E-SNRHT and risk network recruitment arms in terms of the amount of change over time in social support is not surprising given that significant changes over time in social support were not found in either study arm when analyzed separately. This could in part be explained by the fact that reported HIV-related social support was very high at baseline. It is very plausible that participants with higher

Table 3 Multiple linear regression models testing for a relationship between network recruitment type and the size of the difference between baseline and follow-up in stigma and support (N = 434)

	Decrease in Anticipated HIV-related stigma	Decrease in Enacted HIV-related stigma	Increase in Anticipated HIV-related social support	Increase in Enacted HIV-related social support
E-SNRHT	0.04 (0.09)	0.14 (0.09)*	0.02 (0.09)	0.06 (0.17)
Male	0.04 (0.08) †	-0.13 (0.08) †	-0.22 (0.08)**	-0.23 (0.15) †
Hard Drug Use	0.18 (0.11)*	0.12 (0.10)	0.03 (0.10)	-0.03 (0.19)
Substance Use-related Stigma at Baseline	0.11 (0.05)*	0.04 (0.05)	0.10 (0.05)*	-0.04 (0.10)
Anticipated Social Support at Baseline	0.18 (0.05)**	0.10 (0.05)*	--------	--------
Anticipated Stigma at Baseline	--------	--------	-0.15 (0.06)	-0.13 (0.11)

One-tailed significance: *** p < .0005; ** p < .01; * p < .05; † p < .10

levels of social support are more likely to self-select into a social network-based HIV testing study. Future research should compare levels of and changes in social support among E-SNRHT participants to those among people who test via more traditional HIV testing mechanisms, to assess whether E-SNHRT is better at improving social support (and/or stigma) than standard clinic care or standard contact tracing.

Since significant increases in enacted social support between baseline and follow-up were observed among the subsample of newly diagnosed individuals, it would have been ideal to have been able to test for significant differences in change over time in social support between the subsamples of newly diagnosed individuals in each study arm. Unfortunately, however, not enough newly diagnosed individuals were recruited in the risk network recruitment arm to facilitate an adequate statistical comparison between these groups. It is possible that increases in social support among newly diagnosed E-SNRHT intervention participants were larger than increases in social support among newly diagnosed risk network recruitment arm participants, but future research is needed with larger samples to make this comparison.

Limitations

The present study was limited by its short follow-up period. To the extent that the E-SNRHT intervention is capable of changing social norms around discussing HIV (as suggested by our theoretical model), and improving levels of HIV-related stigma and social support at a network level as more conversations about HIV are facilitated throughout networks, it is quite likely that this process would take longer than 6 weeks. In other words, it is possible that greater improvements in stigma and support among the E-SNRHT intervention participants might be observed if data were also collected at a later time point, and it is also possible that larger improvements, if observed, could result in differences in reported stigma and support between the E-SNRHT and risk network recruitment arms. Future research should therefore examine changes in stigma and social support at least several months after participation in the E-SNRHT intervention in order to allow for improved understanding of the degree to which our theoretical conceptualization of this intervention can be supported empirically. The present study was also limited by its small sample size of newly diagnosed individuals, particularly in the risk network recruitment arm, which only recruited a total of 6 newly diagnosed individuals (4 of whom were retained at follow-up) for comparison to the 47 newly diagnosed individuals recruited by E-SNRHT (43 of whom were retained at follow-up). Future studies should recruit larger samples of seed participants in order to obtain a larger sample in the comparison arm and increase statistical power to compare newly diagnosed individuals across recruitment types. This is of particular importance to understanding potential differences in stigma and social support between the E-SNRHT and risk network recruitment methods, because we might theoretically expect any changes in social norms generated by E-SNRHT to have the largest effect on the experiences of newly diagnosed individuals, who likely become acutely aware of the possibility of HIV-related stigma and their need for HIV-related support at the time of their diagnosis.

This study is also limited by its use of participant self-report to measure change over time in stigma and support experiences, and the potential for social desirability bias to affect these self-report measures. Because participants in both study arms know they are participating in an intervention, they could potentially underreport experiences of stigma or over-report experiences of support to try to provide answers that they think study staff want to hear (since verbal interviews were used), or because they want the intervention to "succeed." It is possible that participants in the risk network recruitment arm actually experienced more stigma between baseline and follow-up than they reported (i.e., that there were actually differences in stigma between the E-SNRHT and risk network recruitment arms), but minimized these experiences during their interviews due to social desirability bias. However, such underreporting of stigma (or over-reporting of support) could have occurred in either or both study arms.

Another important limitation of the present study is its low external validity. We only recruited seeds from three clinics (and two drug treatment centers) in the study region, which has 55 Department of Health clinics. The clinics in our sample serve a somewhat socioculturally homogeneous population of clients, and so our findings cannot be generalized to other populations, or even to other clinic sites in the study region. Additionally, about 10% of our total sample (and 13% of participants in the E-SNRHT intervention arm) reported using hard drugs at least once in the last six months. Our findings are therefore also not generalizable to groups with dissimilar rates of substance use. Future research should implement and evaluate E-SNRHT among a larger and more diverse sample of clinics, and/or among different sociocultural groups and in different regions of South Africa and other countries.

Finally, the present study is limited in that we did not measure implementation differences at the clinic or individual level. Future research on E-SNRHT should examine the setting-level and individual-level conditions under which E-SNRHT is most successful at reducing HIV-related stigma and increasing HIV-related social support, in order to better understand the mechanisms by which E-SNRHT

is effective and to develop a set of best practices to improve and expand its implementation.

Conclusion

The present study found that participants in the E-SNRHT intervention reported significant decreases in both anticipated and enacted HIV-related stigma between intervention enrollment and follow-up, and that the E-SNRHT intervention was more effective at decreasing enacted HIV-related stigma than was risk network recruitment to HIV testing. It also found that individuals newly diagnosed with HIV by the E-SNRHT intervention experienced significant increases in social support between intervention enrollment and follow-up, and that all of these individuals reported participating in positive conversations about HIV services with peers in the 6–10 weeks after intervention enrollment. These findings suggest that E-SNRHT is an important strategy to reduce HIV-related stigma among peer networks in KwaZulu-Natal, South Africa. Additionally, E-SNRHT could have potentially important implications for HIV service engagement. Since HIV-related stigma is a well-known barrier to accessing HIV treatment and prevention services, it is possible that reductions in stigma facilitated by E-SNRHT could in turn improve service access among members of the social networks of E-SNRHT participants. E-SNRHT could thereby indirectly help to make progress towards reaching 95-95-95 goals in this context by stimulating changes in stigma that could move through networks and communities.

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