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Do Older Adults with HIV Have Distinctive Personal Networks? Stigma, Network Activation, and the Role of Disclosure in South Africa

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Abstract

This study considers whether the personal networks of older South African people living with HIV (PLHIV) differ from those without HIV. Using recent survey data (N = 5059), results suggest that PLHIV reported more core network members than their peers without HIV (IRR 1.08; 95% CI 1.03, 1.13), but were equally likely to receive emotional support from network members (1.21; 95% CI 0.93, 1.58). PLHIV who had yet to disclose their serostatus were more likely than others to have friends and other non-kin in their core network (*B* 0.08; 95% CI 0.02, 0.13) and to maintain networks of non-overlapping members (OR 2.11; 95% CI 1.33, 3.34). Even as HIV remains highly stigmatized in South Africa, PLHIV tend to maintain relatively large and supportive networks. Still, a sizeable proportion of PLHIV do not disclose their illness—these individuals disproportionately inhabit networks marked by non-kin and by high bridging potential.

Keywords HIV · Social networks · South Africa · Stigma

Introduction

People facing serious chronic health problems need dependable social contacts. Ill individuals with limited social networks and inadequate access to support report lower quality of life, show poorer disease management, and die sooner than their well-connected peers [1–3]. Recognizing these high stakes, researchers have devoted considerable attention to understanding how various diseases influence the form and function of people's networks [4–7].

Scholars identify two divergent social network processes that can accompany people's experience of chronic illness. *Network activation* contends that personal troubles—including serious disease—trigger purposive action intended to secure ameliorative resources [8–11]. The activation perspective implies a health-preserving process whereby illness prompts people to expand or reconfigure their networks to optimally deal with their disease. *Social stigma* represents a contrasting perspective. This framework recognizes that certain illnesses, HIV/AIDS above all, are perceived as morally discrediting and taint patients' identities [12–15]. This can have at least two implications for social networks. First, others often distance themselves from the disease sufferer, and second, people with the disease frequently internalize stigma and withdraw from others out of fear [12–14]. These processes ultimately leave the ill individual at risk of isolation and without needed social resources.

Existing research on HIV points to the viability of both stigma and activation processes [16]. One body of evidence suggests that people living with HIV (PLHIV) may be less socially connected than others. Recent estimates, for instance, suggest that nearly a third of older PLHIV in New York City have networks characterized by "isolation" (little contact with family, few friends), a percentage roughly equal to the prevalence of more connected "friend-centered" and "integrated" networks [17]. A recent meta-synthesis of qualitative research points to the commonality of disownment and rejection from immediate family members, relatives, and friends following diagnosis [18]. Social support deficits are often thought to accompany such isolation. Shippy and Karpiak report, for instance, that among a sample of older PLHIV in New York City, 57% receive inadequate emotional support, while 78% need more instrumental support [14].

On the other hand, some studies indicate that PLHIV maintain multifaceted networks that provide needed support.

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Upon receiving a diagnosis of HIV, for example, many older Finnish adults begin to actively establish new relationships with friends, especially with HIV support group members [19]. Several studies describe relatives and neighbors filling significant gaps in support networks, particularly after conflict or estrangement with former ties [20–22].

Existing literature points to two interrelated considerations relevant to stigma and activation processes that will inform the present analysis. First, studies highlight an important distinction between kin-based and voluntary (i.e., deliberately chosen, non-family) social ties. As with many serious health conditions, PLHIV often identify their spouse as a central supporter and companion [23, 24]. Adult children are also often activated as key members of the network [12, 25]. PLHIV that are non-partnered and without children, however, often rely most heavily on friends for support [26]. In some circumstances, incorporating voluntary ties in addition to—or in place of—family members can be a strategic response to stigma [24, 26, 27].

Second, prior studies reveal the importance of HIV disclosure in the maintenance and function of networks [28–32]. Indeed, the stigma of HIV has crucial implications for whether, how, and to whom people disclose having the condition. PLHIV are strategic when revealing their serostatus, often informing spouses, but commonly keeping the information from other immediate family members or friends [21, 30, 31]. From the numbers reported across different contexts, the vast majority of PLHIV appear to inform at least *someone* of their status (e.g., 95% in [29]; 100% in [31]).

Hypotheses for Multiple Dimensions of the Personal Network

Competing Hypotheses

The stigma argument posits that living with HIV/AIDS leads to deficits in personal network size (*Hypothesis 1a*) and availability of emotional support from network members (*Hypothesis 2a*) relative to living without HIV/AIDS. The basic activation argument, on the other hand, anticipates that PLHIV have larger personal networks (*Hypothesis 1b*) and a greater likelihood of receiving emotional support from network members (*Hypothesis 2b*) relative to others.

Compatible Hypotheses

Stigma and activation converge on similar expectations for whether those living with HIV/AIDS will differ from others with respect to presence of non-kin people in the network and with respect to network bridging potential. Nevertheless, disclosure of the condition is anticipated to differentiate the two theoretical perspectives with respect to these outcomes.

no bridging potential   *bridging potential*
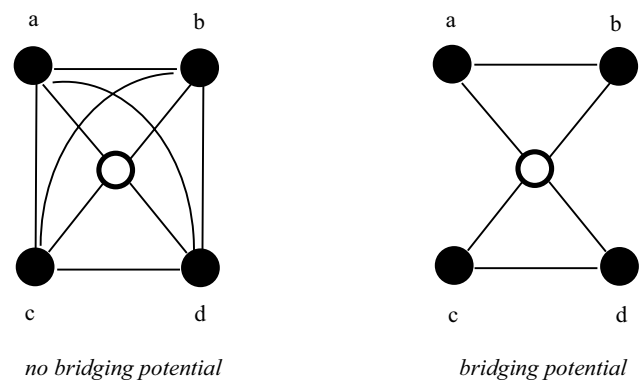
Fig. 1 Illustrating network bridging potential. *Note* The focal individual (ego) is depicted by the middle, empty circle. Black circles depict members of ego's personal network. Lines depict relationships between actors in the network

First, we expect those living with HIV/AIDS to have a relatively high proportion of non-kin network members in their core networks (*Hypothesis 3*) and relatively high bridging potential (*Hypothesis 4*). By "bridging potential," we refer to situations where people maintain network ties between people who are themselves not directly connected and for whom exists no alternative intermediary. Figure 1 illustrates this concept graphically, distinguishing between an individual whose network members all know one another ("no bridging potential") and an individual with a subset of close ties who do not ("bridging potential"; e.g., network members A and C or A and D).

From the perspective of network activation, non-kin ties represent network expansiveness beyond the primary social group. Kin members are often the most dependable care providers for those dealing with chronic health problems [33, 34], but ties to friends, neighbors, and others diversify networks and grant access to more information and resources [35]. Likewise, bridging potential in a network optimizes the availability of unique, non-redundant social resources. Someone who bridges non-overlapping groups will have a network configuration in which their connections are largely unable to control or obstruct the flow of information [36]. Such relational autonomy and empowerment could be important when dealing with sensitive health issues such as HIV/AIDS; someone with bridging potential could discretely seek and receive support to manage their illness, whereas those in fully interconnected networks risk monitoring and unwanted detection.

This reasoning also illustrates the applicability of stigma theory for Hypotheses 3 and 4. Non-kin relationships have the advantage of being voluntary, and so if people need non-judgemental contacts, they likely seek out and retain them from the pool where they have greatest choice. This process would be all the more important to the extent that HIV/AIDS

prompts expressions of shame in families [18]. By the same token, bridging potential is a structural arrangement optimal for stigmatized populations.

Though stigma and activation perspectives each motivate Hypothesis 3 and Hypothesis 4, there is arguably a stronger case for stigma in situations where network composition and bridging potential differ along certain lines of HIV/AIDS disclosure. Evidence that people's networks vary according to whether they reveal or conceal their condition would testify to the discrediting nature of HIV. Increasing one's share of non-kin network members and cultivating bridging potential could be a signal of network activation post-disclosure (to gain needed support or resources), just as these actions could be a response to prejudice (or could reflect that people share their serostatus when they are embedded in a network form most favorable to disclosure). Nevertheless, elevated non-kin composition and higher network bridging among *non*–disclosed PLHIV relative to individuals living without HIV would demonstrate the particularity of stigma over against network activation. This pattern would suggest that internalized or potential stigma leads PLHIV to inhabit distinctive network forms where threat of detection and censure is curtailed. Activation theory, in contrast, offers no reason to expect non-disclosed PLHIV to differ from people living without HIV in these network structural forms.

Summary of Current Study

This paper considers both the stigma and network activation perspective in the empirical context of HIV/AIDS among South Africans aged 40+. South Africa is arguably the epicenter of a global aging HIV/AIDS epidemic, containing an estimated 1.2 million PLHIV aged 50+ in 2017 [37]. Using data from a large community sample in Agincourt, South Africa, this study examines network functionality (regular access to social support) as well as three structural aspects (network size, kin/non-kin composition, and bridging potential) to provide a wholistic portrait of how stigma and activation may operate in varied—perhaps co-occurring—ways depending on outcome. Table 1 summarizes the empirical expectations contained in Hypotheses 1–4. Shaded cells show where the disclosure process disambiguates activation expectations from stigma expectations. Taken together, the full set of hypotheses indicate that the personal networks of those living with HIV may exemplify a complex portrait of theoretical patterns.

Table 1 Summary of empirical expectations

PLHIV compared to people without HIV	Stigma	Activation
Competing hypotheses		
Less availability of support	X	
More availability of support		X
Smaller core networks	X	
Larger core networks		X
Compatible hypotheses		
Higher non-kin composition		
Undisclosed	X	
Disclosed	X	X
Higher bridging potential		
Undisclosed	X	
Disclosed	X	X

Shaded cells show where the disclosure process helps differentiate network activation expectations from stigma expectations. When HIV is disclosed, both perspectives converge on identical prediction. But when HIV is not disclosed (shaded cells), only stigma theory anticipates differences from those without HIV

Methods

Sample

We test our hypotheses with data from a global health surveillance system, the International Network for the Demographic Evaluation of Populations and Their Health (INDEPTH). Researchers affiliated with this network launched Health and Aging in Africa: A Longitudinal Study of an INDEPTH Community in South Africa (HAALSI) in 2014. HAALSI is a population-based cohort study set in rural South Africa designed to study health, aging, and well-being.

The sample is derived from 27 villages located in the MRC/Wits Agincourt Rural Public Health and Health Transitions Research Unit site in Mpumalanga Province, South Africa. This district is similar to much of rural South Africa in several respects, including an underdeveloped education system, limited employment opportunity, insufficient healthcare and sanitation, high rates of labor migration, and a recent improvement to life expectancy since the introduction of antiretroviral treatment to supress HIV/AIDS in 2007 [38].

Eligible HAALSI participants were required to be 40 or older as of July 1, 2014 and must have lived in the study site for the year prior to the 2013 local census. A random sample of eligible men and women was obtained with an 87% response rate ($n = 5059$). Additional details about sampling procedure and ethics approval is described in Gómez-Olivé et al. [39] and Harling et al. [40].

HAALSI survey data follow measurement strategies from well-established studies of aging, including the Health and Retirement Study and the National Social Life, Health and

Aging Project (NSHAP). Social network measures (discussed below) were adapted from the latter study's specialized network module. Network questions were asked during the structured in-home interview, which was conducted by local survey staff in the xiTsonga language.

The analytic sample for this study differs depending on outcome. All 5059 respondents have valid scores for social network size and availability of emotional support. For proportion network that is non-kin, only respondents with at least one network member are eligible for analysis. This restricts the sample to 4807 individuals (i.e., 252 people reporting having no one in their network). Bridging potential requires a network size of least two, and so this further restricts our sample to 4231 for selected analyses.

Measures

Dependent Variables

Network members (alters) were enumerated through a name generator, the standard technique for measuring personal (egocentric) networks in social surveys [41]. In brief, "egocentric network data focus on the network surrounding one node, known as the ego. Data are on nodes that share the chosen relation(s) with the ego and on relations between those nodes" [42]. Respondents were first given the following prompt: "Please tell me the names of 6 adults with whom you have been in communication either in person or by phone or by internet in the past 6 months, starting with the person who is most important to you for any reason." For a comparison to the questions initiated by the NSAHP, see [43]. Respondents were free to list fewer than six names, and spouses were then auto-filled as an additional network member if not initially included among the alters. As with NSAHP, once the network was established, respondents were asked a series of follow-up questions about the members. This information includes the frequency with which each network member provides emotional support, the role relationship of alter to ego, and the frequency with which the alter is believed to communicate with each other alter.

Based on questions from this network module, we created four outcome variables. *Network size* is the simple sum of all identified network members. *Availability of emotional support* is a dichotomous variable denoting whether the respondent has any network member who has been

emotionally supportive at least "a few times in the past 6 months" (0 = any and all network members have done so "not at all").[1] To determine *proportion non-kin* in network, we identify which network members are described as something other than marital partners, children, or other relatives, take the sum, and divide by overall network size. Our measure of *network bridging potential* conveys whether respondents have at least one pair of network alters believed to not have spoken together in the past 6 months and who are not connected indirectly via other network members.[2] This is a binary indicator of whether the focal individual "serves as the sole intermediary" (pg. 137) between any of his or her close contacts [44].

Independent Variable

HAALSI respondents were asked a series of questions about HIV. We identified people as living with the condition if they indicated ever having "tested positive for HIV" (1 = yes, 0 = no). Respondents who did not know or refused to answer were counted as missing. Selected analyses further differentiate PLHIV who have disclosed their condition from those who have not. This information was obtained from a survey question in which the respondent was asked "have you ever informed anyone about your HIV status" (1 = yes, 0 = no). Analyses assessing disclosure therefore incorporate a three-category variable: 0 = non-HIV+, 1 = HIV+ disclosed, and 2 = HIV+ non-disclosed.

Covariates

Many factors characterizing the population of PLHIV may associate with South Africans' social network characteristics. Our analysis therefore controls for numerous demographic and health variables to minimize spurious differences from the PLHIV and others. Age is coded categorically in decade sets (40–49, 50–59, 60–69, 70–79, 80+) and gender and partnership status are both dichotomous covariates.[3] Educational levels are coded as categories based on years of formal schooling (no education, 1–7 years, 8–11 years, 12+ years). We used the household asset index, as provided by the HAALSI team, to account for wealth. The index is based on a principal components analysis, which weighted 42 household variables based on consumer durables (e.g.,

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[1] The complete set of response options for emotional support includes "every day or almost every day", "a few times per week", "once per week", "a few times in the past 6 months", and "not at all." Dichotomizing availability of emotional support at more stringent cut-points (e.g., "once per week") lowers the overall prevalence of the variable but does not affect conclusions when comparing PLHIV to people living without HIV.

[2] When reporting whether network alters knew one another, respondents could select "every day or almost every day", "a few times per week", "once per week", a few times per month", "once per month, "a few times in the past 6 months", or "not at all". Bridging potential implies disconnected alters, which is why we dichotomized "not at all" from all other response options.

[3] Age categories were used to examine potential non-linear age patterns. Results were consistent when age was coded in years.

number of cars, computers, electric fans), livestock (e.g., number of cows), and housing characteristics (e.g., brick wall material, toilet location) (see [45] for further details). In a separate section of the survey, respondents were asked for their household size; given the large right skew we re-coded this lives alone (reference), lives with one other person, living in a 3–6 person household, and living in a 7+ person household [46]. We further control for number of living children which is coded as a count variable, top-coded at 10 children. General health is measured with two variables. The first is self-rated physical health, which includes the categories of very good, good, moderate, bad, and very bad health (reference). The second health variable captures physical functioning, and is a count of difficulties people report with the activities of daily life (ADLs): bathing, getting in or out of bed, dressing, eating, using the toilet, and walking across a room (each ADL measured as $0=$ no difficulty, $1=$ difficulty). Finally, we adjust for number of lifetime sexual partners, as this could influence both the likelihood of having HIV and the form and composition of people's networks. Following previous research using HAALSI [47], we coded this as a three-category variable: 0 or 1 lifetime sexual partner (reference), 2–4 sexual partners, and 5 or more lifetime sexual partners.

Analysis

Our analysis first describes how dependent variables and covariates are distributed differently between those who report being HIV+ and those who report not having HIV. Second, we focus on the subsample of PLHIV respondents and examine potential covariate differences between those who have disclosed and those who have not disclosed their condition to anyone.

Multivariable regression analyses test the hypotheses derived from stigma and activation theories while adjusting for covariates. Models 1 and 2 assess competing hypotheses. Poisson estimation was used for network size, as the dependent variable is a count. The variable's standard deviation is less than its mean, and tests showed no evidence of superior model fit from a negative binomial regression. Access to emotional support from network, a binary variable, uses binomial logistic regression.

Models 3 and 4 examine proportion network that is non-kin and network bridging potential, respectively. As indicated in Table 1, disclosure status is what helps distinguish expectations from each theory; hence, after estimating an initial model which treats PLHIV as a homogenous group, we provide estimates comparing both disclosing PLHIV and non-disclosing PLHIV to those living without HIV. Proportion non-kin is a continuous variable. The variable displayed a negative skew (mean$=$.21; SD$=$.31; skewness$=$0.71), but residual plots did not indicate violations of ordinary least

squares regression assumptions. Hence, we follow the precedent of earlier egocentric analyses and estimate proportion kin with linear regression [48, 49]. Bridging potential is dichotomous, so we use binomial logistic regression.

Missing data is minimal, as less than 2 percent of cases on all covariates were missing. All regression analyses use data multiply imputed by chained equations (MICE) [50] ($m=20$). We included our dependent variables in the imputation models, but then excluded cases missing on the dependent variable from all analyses [51]. Results were consistent whether using listwise deletion or multiple imputation.

Results

Descriptive Patterns

General characteristics of the HAALSI sample have been previously reported [39], so we focus our descriptive analysis on the variables most pertinent to the current study. Briefly, however, just over half are between the ages of 50 and 69 (54%), with 18% in their 40 s and 28% 70 and older. About half of the sample is currently partnered, and 54% are women. As indicated in Table 2, HAALSI respondents recount an average of just over three close network members. Over 80% respondents had access to support from their network connections, while one in five of such members came from outside the family, on average. Network bridging potential was evidenced by 12% of the overall sample (among those listing two or more ties). Table 2 also indicates statistically significant mean or proportion differences according to HIV status for three of the four network measures. Though such comparisons are provisional because they lack adjustment for key covariates, we observe that PLHIV have .12 more ties than others ($p=.04$). Their networks are also more bridgeable and more likely to be populated by non-kin alters ($p=.001$).

About 12% of the HAALSI sample indicated that they had HIV, 75% of whom reported having disclosed their HIV status. PLHIV differed from their peers on a number of traits. They were less likely to be currently partnered ($p=.000$), yet reported more lifetime sexual partners ($p=.000$). They were also less likely to live in large households ($p=.04$) or to be concentrated in the oldest age categories ($p=.000$). PLHIV tended to have lower household assets than those not living with HIV ($p=.000$). There were no discernable health or gender differences by HIV status.

Table 3 considers whether, among those living with HIV, certain traits predicted disclosure. There were no statistically significant differences between disclosing

Table 2 Descriptive statistics HAALSI study (HIV+ vs. Non-HIV+)

	Total sample (N = 5059)			HIV+ (N = 623)		Non-HIV+ (N = 4436)		Difference Test	
	Range	N(%), Mean	SD	N(%), Mean	SD	N(%), Mean	SD	|t|/χ²	(p value)
Network size *(n = 5059)*	0–7	3.07	1.69	3.18	1.69	3.06	1.69	1.65	p = .04
Emotional support *(n = 5059)*		4300(85%)		542(87%)		3771(85%)		1.67	p = .20
Proportion non-kin in network*(n = 4807)*	0–1	0.21	0.31	0.24	0.33	0.20	0.31	2.79	p = .001
Network bridging potential *(n = 4231)*		592(14%)		106(17%)		577(13%)		10.11	p = .001
HIV status									
No HIV		4436(89%)							
HIV		623(11%)							
Female		2732(54%)		336(54%)		2395(54%)		.01	p = .94
Partnered		2581(51%)		249(40%)		2351(53%)		35.56	p = .000
Number of lifetime sexual partners								76.15	p = .000
0–1		1467(29%)		93(15%)		1375(31%)			
2–4		1720(34%)		231(37%)		1508(34%)			
5 or more		1872(37%)		29,948%		1553(35%)			
Age group								192.45	p = .000
40–49 Years		911(18%)		174(28%)		737(17%)			
50–59 Years		1417(28%)		255(41%)		1153(26%)			
60–69 Years		1315(26%)		143(23%)		1152(26%)			
70–79 Years		860(17%)		50(8%)		843(19%)			
80+ Years		556(11%)		6(1%)		531(12%)			
Education								23.42	p = .000
No formal education		2327(46%)		237(38%)		2085(47%)			
Some primary (1–7 years)		1720(34%)		231(37%)		1508(34%)			
Some secondary (8–11 years)		557(11%)		100(16%)		489(11%)			
Secondary or more (12+ years)		455(9%)		55(9%)		354(8%)			
Household assets index	− 4.53 to 11.2	0.03	2.36	− 0.32	2.12	0.07	2.40	3.85	p = .000
Household size								8.34	p = .04
Lives alone		556(11%)		81(13%)		443(10%)			
Lives with one other person		556(11%)		69(11%)		489(11%)			
Living in 3–6 person household		2428(48%)		318(51%)		2129(48%)			
Living in 7+ person household		1569(31%)		155(25%)		1375(31%)			
Number of children	0–10	4.45	2.55	4.30	2.44	4.48	2.57	1.55	p = .12
Self-rated health								3.44	p = .49
Very bad		101(2%)		12(2%)		89(2%)			
Bad		860(17%)		93(15%)		754(17%)			
Moderate		658(13%)		75(12%)		577(13%)			
Good		2428(48%)		312(50%)		2129(48%)			
Very good		1012(20%)		131(21%)		887(20%)			
Functional limitations (count of ADLs)	0–6	0.22	0.88	0.21	0.87	0.22	0.86	0.47	p = .64

Standard deviations omitted for categorical variables

and non-disclosing PLHIV across the full set of covariates considered in this study.

Multivariable Regression

We present the results of hypothesis tests in Table 4. Columns 1 and 2 assess the competing expectations derived from the stigma and activation perspectives. The incident rate ratio in Column 1 indicates that relative to those without HIV, living with HIV increases the count of network members by 8% (IRR = 1.08, 95% CI 1.03, 1.13, p = .000). To enhance interpretability, we present predicted count values based on this model in Fig. 2. Panel A indicates that PLHIV have, on average, nearly ¼ additional network members

Table 3 Descriptive statistics, HAASLI study (non-disclosing PLHIV vs. disclosing PLHIV)

	HIV+ non-disclosed (N = 144) N(%), mean	SD	HIV+ disclosed (N = 432) N(%), mean	SD	$|t|/\chi^2$	Difference test (p value)
Female	73(51%)		242(56%)		1.03	p = .31
Partnered	48(33%)		177(41%)		2.34	p = .12
Number of lifetime sexual partners					2.17	p = .34
0–1	19(13%)		82(19%)			
2–4	53(37%)		160(37%)			
5 or more	72(50%)		190(44%)			
Age group					0.29	p = .99
40–49 Years	42(29%)		116(27%)			
50–59 Years	60(42%)		181(42%)			
60–69 Years	30(21%)		95(22%)			
70–79 Years	10(7%)		35(8%)			
80+ Years	2(1%)		5(1%)			
Education					3.61	p = .31
No formal education	55(38%)		160(37%)			
Some primary (1–7 years)	48(33%)		177(41%)			
Some secondary (8–11 years)	26(18%)		65(15%)			
Secondary or more (12+ years)	16(11%)		30(7%)			
Household assets index	− 0.20	2.08	− 0.34	2.15	0.69	p = .49
Household size					1.06	p = .79
Lives alone	(14%)		52(12%)			
Lives with one other person	(11%)		43(10%)			
Living in 3–6 person household	(52%)		220(51%)			
Living in 7+ person household	(23%)		116(27%)			
Number of children	4.41	2.34	4.31	2.40	0.42	p = .68
Self-rated health					8.46	p = .08
Very bad	(1%)		4(1%)			
Bad	(17%)		65(15%)			
Moderate	(13%)		52(12%)			
Good	(56%)		207(48%)			
Very good	(15%)		104(24%)			
Functional limitations (count of ADLs)	0.14	0.57	0.21	0.89	0.82	p = .41

Standard deviations omitted for categorical variables

(3.21 vs. 2.98). The second column of Table 4, however, suggests that living with HIV means neither surplus nor absence of emotional support (OR 1.21, 95% CI 0.93, 1.58, p = .15). This is confirmed by the predicted probability values in Panel B of Fig. 2: PLHIV and those without HIV alike have a 90% likelihood of reporting regular access to emotional support from network members.

Moving to the third and fourth outcomes in the right half of Table 4, regression models reveal that when homogenized, PLHIV are not statistically distinct from other participants on both outcomes (models a). However, the linear regression coefficient and the logistic regression odds ratio comparing the *non-disclosing* PLHIV to those without HIV (models b) are both statistically significant,

net of covariates (B = 0.08, 95% CI 0.02, 0.13, p = .004 for proportion of non-kin, and OR 2.11, 95% CI 1.33, 3.34, p = .002 for network bridging potential). Coefficients for disclosing PLHIV, on the other hand, are insufficient to reject the null hypothesis (B = − 0.02, 95% CI − 0.05, 0.01, p = .22 for proportion of non-kin, and OR 1.03, 95% CI 0.75, 1.41, p = .86 for network bridging potential).

As shown in Fig. 2, Panel C, disclosing PLHIV are statistically indistinguishable from those without HIV, with both groups averaging about 1 in 5 network members from outside their family. PLHIV who have *not* disclosed their condition, however, average nearly .30 for non-kin network composition. We observe a similar pattern for network bridging potential, where only the non-disclosing PLHIV

Table 4 Estimates from regression models predicting network outcomes

	Network size (Poisson)[a]	Emotional support (Logit)[b]	Proportion of non-kin in network (OLS)[c]		Network bridging potential (Logit)[b]	
			Model a	Model b	Model a	Model b
HIV+[d]	1.08 (1.03 to 1.13)	1.21 (0.93 to 1.58)	0.01 (− 0.02 to 0.03)		1.25 (0.96 to 1.63)	
HIV disclosure status						
HIV+ non-disclosed[d]				0.08 (0.02 to 0.13)		2.11 (1.33 to 3.34)
HIV+-disclosed[d]				− 0.02 (− 0.05 to 0.01)		1.03 (0.75 to 1.41)
Female	1.13 (1.08 to 1.18)	0.91 (0.74 to 1.12)	− 0.04 (− 0.06 to − 0.01)	− 0.03 (− 0.06 to − 0.01)	0.83 (0.65 to 1.06)	0.84 (0.66 to 1.08)
Partnered	1.38 (1.33 to 1.43)	2.12 (1.71 to 2.62)	− 0.08 (− .010 to − 0.06)	− 0.08 (− 0.10 to − 0.05)	0.91 (0.72 to 1.13)	0.91 (0.73 to 1.14)
Number of lifetime sexual partners						
2–4[e]	1.03 (0.99 to 1.08)	1.19 (0.96 to 1.49)	0.05 (0.02 to 0.07)	0.05 (0.02 to 0.07)	1.06 (0.83 to 1.36)	1.07 (0.84 to 1.37)
5 or more[e]	1.09 (1.04 to 1.14)	0.70 (0.55 to 0.89)	0.04 (0.02 to 0.07)	0.05 (0.02 to 0.07)	0.85 (0.64 to 1.14)	0.86 (0.64 to 1.15)
Age group						
50–59 Years[f]	1.02 (0.97 to 1.07)	1.23 (0.94 to 1.60)	− 0.02 (− 0.05 to 0.01)	− 0.02 (− 0.05 to 0.01)	0.79 (0.61 to .104)	0.80 (0.61 to 1.04)
60–69 Years[f]	1.06 (1.00 to 1.12)	1.09 (0.82 to 1.45)	−0.04 (− 0.07 to − 0.01)	− 0.04 (− 0.07 to − 0.01)	0.67 (0.49 to 0.90)	0.67 (0.50 to 0.91)
70–79 Years[f]	1.04 (0.98 to 1.10)	0.87 (0.64 to 1.17)	− 0.06 (− 0.09 to − 0.03)	− 0.07 (− 0.10 to − 0.03)	0.45 (0.31 to 0.66)	0.46 (0.32 to 0.67)
80+ Years[f]	1.03 (0.95 to 1.10)	1.04 (0.73 to 1.48)	− 0.10 (− 0.14 to − 0.06)	− 0.10 (− 0.14 to − 0.06)	0.60 (0.39 to 0.92)	0.61 (0.40 to 0.93)
Education						
Some primary[g]	1.05 (1.01 to 1.09)	1.12 (0.92 to 1.37)	− 0.01 (− 0.02 to 0.01)	− 0.01 (− 0.03 to 0.01)	1.08 (0.86 to 1.35)	1.09 (0.87 to 1.36)
Some secondary[g]	1.05 (1.00 to 1.11)	1.16 (0.85 to 1.58)	− 0.01 (− 0.03 to 0.03)	− 0.002 (− 0.03 to 0.03)	1.28 (0.93 to 1.76)	1.27 (0.92 to 1.75)
Secondary or more[g]	1.01 (0.94 to 1.09)	1.28 (0.88 to 1.86)	− 0.01 (− 0.05 to 0.03)	− 0.01 (− 0.03 to 0.03)	1.18 (0.80 to 1.74)	1.18 (0.80 to 1.74)
Household assets index	1.01 (1.00 to 1.01)	0.96 (0.92 to 1.00)	− 0.001 (− 0.01 to 0.01)	− 0.001 (− 0.01 to 0.01)	1.00 (0.95 to 1.04)	0.99 (0.95 to 1.04)
Household size						
Living with one other person[h]	1.07 (0.99 to 1.15)	1.30 (0.94 to 1.79)	− 0.04 (− 0.08 to − 0.01)	− 0.04 (− 0.08 to to 0.01)	0.60 (0.38 to 0.93)	0.61 (0.39 to 0.94)
Living in 3–6 person household[h]	1.05 (0.99 to 1.12)	1.43 (1.10 to 1.84)	− 0.01 (− 0.04 to 0.02)	− 0.01 (− 0.04 to 0.02)	0.74 (0.52 to 1.05)	0.75 (0.53 to 1.06)
Living in 7+ person household[h]	1.05 (0.98 to 1.13)	1.53 (1.14 to 2.05)	− 0.01 (− 0.05 to 0.02)	− 0.01 (− 0.05 to 0.02)	0.72 (0.49 to 1.06)	0.73 (0.50 to 1.07)
Number of children	1.02 (1.02 to 1.03)	1.03 (0.99 to 1.06)	− 0.002 (− 0.01 to 0.01)	− 0.002 (− 0.01 to 0.01)	0.97 (0.94 to 1.02)	0.97 (0.93 to 1.02)
Self-rated health						
Bad[i]	1.21 (1.05 to 1.39)	1.94 (1.16 to 3.22)	− 0.04 (− 0.12 to 0.04)	− 0.04 (− 0.12 to 0.03)	0.65 (0.30 to 1.40)	0.63 (0.29 to 1.37)
Moderate[i]	1.22 (1.05 to 1.40)	2.20 (1.32 to 3.84)	− 0.04 (− 0.11 to 0.04)	− 0.03 (− 0.12 to 0.04)	0.55 (0.25 to 1.21)	0.54 (0.25 to 1.19)
Good[i]	1.27 (1.09 to 1.45)	1.68 (1.02 to 2.78)	− 0.05 (− 0.12 to 0.03)	− 0.05 (− 0.13 to 0.03)	0.55 (0.26 to 1.17)	0.54 (0.25 to 1.14)
Very good[i]	1.20 (1.05 to 1.40)	1.03 (0.61 to 1.73)	− 0.05 (− 0.13 to 0.03)	−0.05 (− 0.13 to 0.03)	0.71 (0.33 to 1.53)	0.70 (0.32 to 1.52)

Table 4 (continued)

	Network size (Poisson)[a]	Emotional support (Logit)[b]	Proportion of non-kin in network (OLS)[c]		Network bridging potential (Logit)[b]	
			Model a	Model b	Model a	Model b
Functional limitations (ADLs)	0.90 (0.95 to 0.99)	0.85 (0.77 to 0.91)	− 0.01 (− 0.03 to − 0.01)	− 0.02 (− 0.03 to − 0.01)	0.96 (0.84 to 1.11)	0.97 (0.84 to 1.11)
N	5059	5059	4807	4807	4231	4231

[a]Incident risk ratios shown. 95% confidence intervals shown in parentheses

[b]Odds ratios shown. 95% confidence intervals shown in parentheses. Estimates are adjusted for network size

[c]Unstandardized regression coefficients shown. 95% confidence intervals shown in parentheses. Estimates are adjusted for network size

[d]Compared to non-HIV+ individuals

[e]Compared to 0–1 lifetime sexual partners

[f]Compared to 40–49 years

[g]Compared to no formal education

[h]Compared to living alone

[i]Compared to very bad health
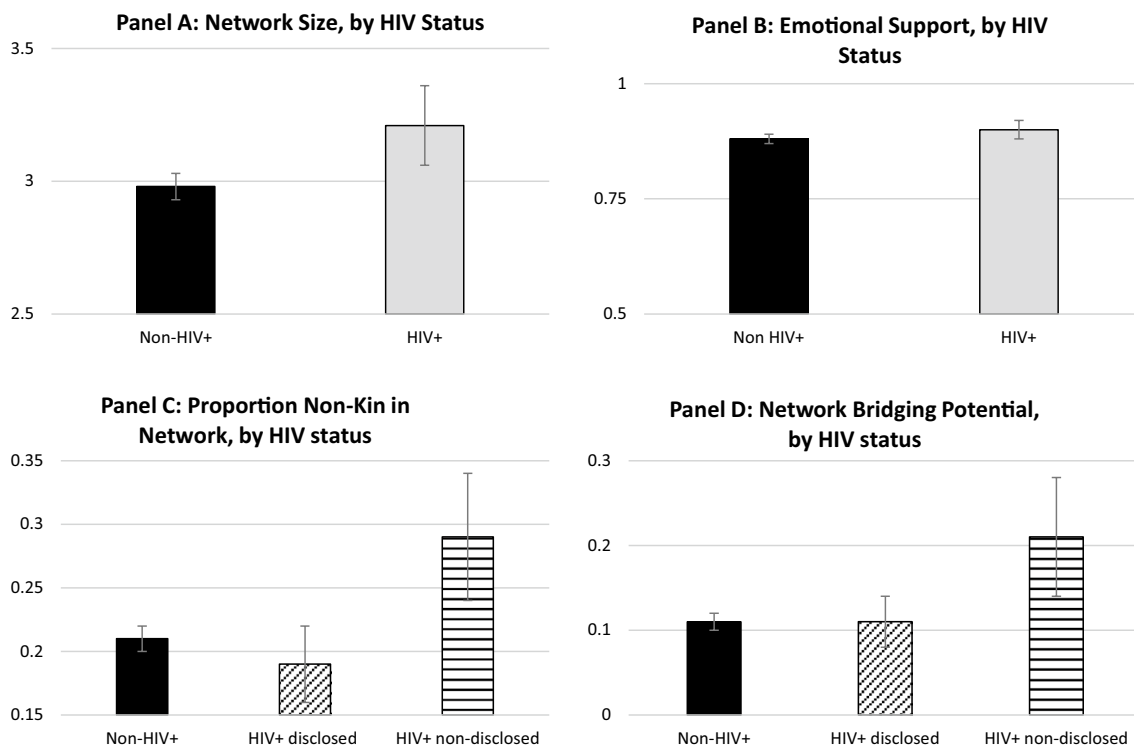
Fig. 2 Predicted probabilities for network outcomes by HIV status. *Note* Estimates are derived from multivariable regression models in Table 3. All covariates are held at their respective means

differ from those without HIV. As shown in Panel D, only 11% of those without HIV are estimated to have network bridging potential, approximately half the likelihood that characterizes non-disclosing PLHIV (21%).

In supplementary analyses, we examined whether the associations shown in Table 4 differed by gender, age, and education. Results of interaction terms did not reveal any evidence that any of these variables

moderated the associations between HIV status and network characteristics.

Discussion

Drawing from network activation and stigma perspectives, this study considered whether older PLHIV in South Africa have distinctive personal networks. The overall patterning of evidence—some supporting activation, some hinting at stigma—underscores that the two theoretical perspectives are not necessarily at odds with one another. Even as HIV remains highly stigmatized in many contexts, including the region considered in our study [32], PLHIV appear capable of maintaining networks whose size and supportiveness meet or exceed conditions of the local norm. Yet even while potential sources of support and the ready availability of such resources show no signs of deficit, people most affected by stigma—those who have not disclosed their HIV+ status—inhabit networks characterized by non-kin and by high bridging potential. Such networks may provide a favorable structure to meet the needs of people subjected to stigma.

In line with network activation, PLHIV had more close discussion partners than their non-infected peers in the HAALSI sample. Activation theory specifies that large networks cultivated by people with pressing health needs act as conduits for needed support and ultimately serve as coping mechanisms in dealing with duress [8–11]. Some previous studies have supported the activation perspective, reporting that PLHIV actively establish accommodating relationships with friends [19] and fill gaps in their networks with relatives and neighbors after conflict or estrangement with former ties [19–22]. Other studies, however, have highlighted the commonality of social isolation and rejection from immediate family members, relatives, and friends among PLHIV [17, 52, 53]. Still, the vast majority of such studies feature analyses of small convenience samples drawn from populations of PLHIV. Our results, supporting network activation, extend this existing literature by comparing network size between PLHIV and those not living with HIV.

That said, the theoretical corollary of network size—likelihood of receiving social support from network ties—did not follow the same trend. The HAALSI sample tended to have high access to at least *some* emotional aid from their network; we therefore speculate that the high ceiling may have obstructed our ability to detect whether PLHIV are especially supported. In any event, the findings on network size and availability of support rule out the possibility of a network functional deficit. PLHIV's large networks, coupled with high levels of support matching

those without HIV, contradict stigma theory and suggest only network activation.

Stigma theory, however, was supported for a subset of PLHIV when it came to compositional and triadic-structural elements of personal networks. Specifically, the 25% of people who knew they were HIV+ yet did not disclose their condition were far more likely than others to have friends, neighbors, and other non-kin in their core network and to maintain networks of non-overlapping members. Non-kin-centered, bridgeable network forms offer more autonomy and privacy than denser, family-oriented structures [54], and so the fact that non-disclosing PLHIV occupy such relational arrangements implies the endurance of stigma. Indeed, HIV remains stigmatized within many families in the South African context, leading some PLHIV to fear abandonment, rejection, and condemnation from family members [55].We are unaware of any previous studies investigating the structural form of PLHIV in the region, though some studies in Australia [26] and Canada [53] report the importance of non-kin network members. Still, these studies do not offer a comparison between PLHIV and others.

It is important to note that for most PLHIV, stigma did not appear to manifest in people's network form. This is not to assert that those who disclosed their serostatus were immune from discrimination. Yet in the extent to which their network included family vs. non-family members and in their bridging potential, there was no distinguishing the HIV-disclosers from those who did not have the virus.

Results suggest several avenues for future research. For instance, qualitative research could explore non-disclosing PLHIV in more detail. Previous studies report smaller proportions of non-disclosers [31, 56, 57], possibly because most sample from patient populations. Indeed, serostatus non-disclosers are relatively unlikely to get recruited into many studies which recruit only HIV patients, thus presenting a possible form of upward selection bias for estimating disclosure. In any event, more research could inspect how people construct and navigate their networks while living secretly with HIV/AIDS.

Future research can also leverage longitudinal data to investigate processes assumed by our theoretical frameworks and to strengthen causal reasoning. One strategy would be to examine changes in the short-term aftermath of HIV diagnosis. Presumably some portion of the HAALSI sample testing negative for the virus will have received an HIV diagnosis by the follow-up interview (field work currently underway), and so scholars may observe pre- and post- diagnosis network characteristics. Tracking network change over the longer-term can also refine existing frameworks. Foundational studies on activation theory, for instance, find that certain individuals emerge as core network members in the aftermath of a mental health diagnosis, but then often recede

as people gain competence in managing their condition [7, 58, 59]. We will be able to more thoroughly address these forms of responsive action as future waves of HAALSI are conducted (planned for 2021 and beyond).

These considerations emphasize that the current study is limited in its ability to reach causal conclusions. Given the cross-sectional nature of existing data, for instance, empirical patterns for network form could be interpreted in several ways. One plausible explanation is that people who are wary of disclosing their condition maintain networks that are optimal for safeguarding secrecy. Another account is that experiencing certain network formations shape people's inclination to disclose. Though the present study is unable to resolve this issue, there appears to be an affinity between network structure and disclosure status that resonates with the continuing stigma of HIV/AIDS.

Another limitation is that we lack an exhaustive inventory of respondents' social connections. The name generator tool used to construct networks prompts people to list up to six of their closest ties. People derive support and information from those outside their core network [11] and so such ties are only a subset of all possible meaningful contacts in their lives.

Conclusion

The present study helps advance the study of HIV/AIDS in sub-Saharan Africa and points to the potential complementarity of two theoretical perspectives related to illness and personal networks. To our knowledge, this is the first study to use a large-scale, community-based probability sample to assess how HIV status is linked to the form and function of older people's core networks. Social networks are key informal mechanisms for sharing information, enhancing mental health, and encouraging compliance with medical treatment, all of which is crucial for people living with HIV. The HIV pandemic will increasingly affect the aging populations of many countries in the global South, and so ongoing efforts to gather and examine data on network outcomes associated with this disease will yield important insights.

Compliance with Ethical Standards

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