Published in final edited form as:

Glob Health Promot. 2015 June ; 22(2): 40–52. doi:10.1177/1757975914537321.

Actor and partner effects of perceived HIV stigma on social network components among people living with HIV/AIDS and their caregivers

Chun Hao¹ and Hongjie Liu¹

¹Department of Epidemiology and Biostatistics, School of Public Health, University of Maryland College Park, USA

Abstract

Background—Few studies have investigated the relationship between HIV stigma and social network components at the dyadic level. The objective of this study was to examine the actor and partner effects of perceived HIV stigma by people living with HIV/AIDS (PLWHAs) and their caregivers on social network variables at the dyadic level.

Method—An egocentric social network study was conducted among 147 dyads consisting of one PLWHA and one caregiver (294 participants) in Nanning, China. The actor-partner interdependence model (APIM) was used to analyze the relationships between perceived HIV stigma and social network components (network relations, network structures, and network functions) at the dyadic level.

Results—We found in this dyadic analysis that: (1) social network components were similar between PLWHAs and their caregivers; (2) HIV stigma perceived by PLWHAs influenced their own social network components, whereas this influence did not exist between caregivers' perceived HIV stigma and their own social network components; (3) a few significant partner effects were observed between HIV stigma and social network components among both PLWHAs and caregivers.

Conclusion—The interrelationships between HIV stigma and social network components were complex at the dyadic level. Future interventions programs targeting HIV stigma should focus on the interpersonal relationship at the dyadic level, beyond the intrapersonal factors.

Keywords

HIV stigma; egocentric social network; Actor-Partner Interdependence Model; China

Copyright © The Author(s) 2014

Correspondence to: Hongjie Liu, Department of Epidemiology and Biostatistics, School of Public Health, University of Maryland College Park, College Park, Maryland 20742, USA. hliu1210@umd.edu.

Reprints and permissions: <http://www.sagepub.co.uk/journalsPermissions.nav>

Conflict of interest: None declared.

Introduction

It is estimated that one in every 50 people living with human immunodeficiency virus/acquired immune deficiency syndrome (HIV/AIDS) (PLWHAs) in the world is Chinese (1), generating a substantial global HIV burden. By the end of 2011, there were approximately 780,000 PLWHAs in China and 48,000 individuals who were newly infected in that year (2). In addition to suffering from the disease itself, PLWHAs face HIV-related stigma and discrimination. Research has documented that perception or experience of HIV stigma leads to social isolation, depression, and low self-esteem among PLWHAs, and prevents them from seeking social support, health care and medical treatment (3), all of which could potentially facilitate fast disease progression and further HIV transmission (4,5).

As PLWHAs usually perceive stigmatizing attitudes or experience discrimination from their peers in their social network, presumably, stigma influences constituents or components of social networks (6,7). According to the theory of social network, social networks comprise of three components: relations, structures and functions (8,9). Network relations refer to the types of network alters (e.g. spouse, parents, friends) and trust in and closeness to alters; network structures characterize the network relationships among ego and two or more alters (e.g. network size and density) (8); network functions refer to social support that the network members provide and receive (10). Social support can take a number of forms, including tangible or emotional support. Tangible support is the provision of financial aid, material resources and essential services (9,11). Emotional support is the expression of positive affect of one person toward another and the affirmation or endorsement of another person's ideas or behaviors (12). HIV stigma has been well recognized as a significant barrier to obtaining social network support (13). It is highly associated with loss of social support among PLWHAs, which leads to deleterious effects on psychological and physical wellbeing (14). However, social support is only one of the three components of a person's social network and the influences of HIV stigma on the other two components are rarely investigated.

HIV stigma does not only affect PLWHAs, but their close associates as well, such as their spouses, parents, children or caregivers (15–17). Due to the Chinese collectivist culture, family members play a significant role in providing care and support for PLWHAs at the family level (15,18). With a dual role as a caregiver and a close associate to a PLWHA, the life of caregivers is influenced by HIV-related stigma as well (19). This phenomenon has been defined as courtesy stigma, which refers to the stigma that targets both the stigmatized person and his or her intimates who are treated as one unit in social situations (20). However, there is a gap in research on the relationship between HIV stigma and social network activities among caregivers.

Furthermore, as HIV stigmatization and social network activities occur among both PLWHAs and their caregivers, the relationships between stigma and social networks are potentially interwoven or interdependent between PLWHAs and their caregivers at the dyadic level. That is, social network components of PLWHAs may not only be influenced by stigma perceived by PLWHAs themselves (defined as actor effect), but also by stigma perceived by their caregivers (defined as partner effect). Similarly, network components of

caregivers may be impacted by stigma perceived by both caregivers themselves (actor effect) and the PLWHAs that they cared for (partner effect). Yet, the majority of studies related to PLWHAs and their caregivers typically focus on intrapersonal relationships, ignoring interpersonal ones. Given the inherent dyadic nature of the relationship between PLWHAs and their caregivers, it is essential to investigate both interpersonal and intrapersonal relationships between these two groups of people.

The actor-partner interdependence model (APIM) is an innovative statistical approach to explore dyadic relationships (21). APIM can be used to simultaneously estimate the actor effect in intrapersonal relations, which is the influence of a person's own predicting variables on his/her own outcome variables, and the partner effect in interpersonal relations, which is the influence of a person's own predicting variables on the outcome variables of partners.

The objective of the study is to assess actor and partner effects of perceived HIV stigma on PLWHAs and their caregivers' social networks in China. Specifically, we address the following research questions: (1) are PLWHAs and their caregivers' social network components the same? (2) what are the effects of PLWHAs/caregivers' perceived HIV stigma on their own social network components (actor effects)? and (3) what are the effects of PLWHAs/caregivers' perceived HIV stigma on their corresponding partners' social network components (partner effects)?

Methods

The study methodology has been previously reported (22). Briefly, this study was conducted among PLWHAs and their caregivers at the dyadic level in Nanning, the capital city of Guangxi province, which is located at the heroin trafficking route in southern China. The province has the second highest rate of HIV infection in China and a major at-risk population of drug users (2). The study protocol and consent procedures were reviewed and approved by the Institutional Review Boards of Virginia Commonwealth University and Guangxi Center for Disease Control and Prevention.

Participants and recruitment

Three study sites which provided HIV care and treatment service in the city were selected. PLWHAs who were at least 18 years old and willing to recruit their caregivers were invited in this project. After participants obtained written informed consent, a face-to-face interview was administered by a trained interviewer in a private room. Caregivers were eligible if they met the following criteria: (a) primary caregiver to the corresponding PLWHA, (b) aged 18 or older, and (c) HIV negative. After their eligibility was confirmed, caregivers received the same face-to-face interviews as the PLWHAs did. A total of 170 dyads were recruited and were screened for eligibility. Twenty dyads were excluded because one member of the dyad refused to participate in the study, two dyads missed information about perceived stigma, and one member of a dyad did not provide social network information, leaving a total of 147 dyads analyzed in this study.

Measures

Measurement scales of perceived HIV stigma and social network have been used and validated in our previous studies in China (9,23). Measurement items and scales were initially drafted in English and then translated into Chinese by research members who were fluent in both languages. The Chinese version of the measurement items was then distributed to research team members who reviewed and modified the wording to make it appropriate for the Chinese context.

Egocentric social network

An individual egocentric network consists of an index person (called 'ego') and his or her network members (alters). The Chinese Social Network Questionnaire (CSNQ) was used to measure three components of egocentric social networks: network relations, networks structures, and network support (9,24). To delineate network components, name-generating questions were used to ask respondents (egos) to list alters who could provide support in two supporting domains (emotional and tangible support) by giving alters' first names or pseudonyms. These alters might be egos' family members, friends, villagers, coworkers, sex partners, or others who could provide each of the two types of support. The two supporting domains were defined as the social support network of PLWHAs and caregivers. The measurements of the three social network components (network relations, network structures and network functions) are described in Table 1.

Perceived HIV stigma

Perceived HIV stigma is the respondents' perception of how the general population thinks about PLWHAs, or how the general population thinks about families with a person infected with HIV. A nine-item instrument scale, which was used and validated in our previous studies (25,26) was used to measure the level of perceived HIV stigma among both PLWHAs and their caregivers (courtesy stigma). An example of an item is 'I feel that others would look down on me if they knew I was HIV positive (for PLWHAs)' or 'if they knew there was a HIV case in my family (for caregivers).' Item scores (0 = strongly disagree, 3 = strongly agree) were summed and ranged from 0 to 27. The Cronbach's alpha was 0.89 in PLWHAs and 0.92 in their caregivers.

Data analysis

Paired-sample *t* test and McNemar's χ^2 test were used to statistically test differences in socio-demographic variables, perceived HIV stigma, and the components of social networks between PLWHAs and caregivers. Bivariate correlations were computed for perceived HIV stigma and social network variables. The Statistical Analysis System was used for descriptive and correlation data analysis (SAS 9.1 for Windows; SAS Institute Inc, NC).

The APIM structural equation model uses the dyad as the unit of analysis and enables simultaneous, but separate estimates of the actor and partner effects (Figure 1). The effect of the PLWHAs' perceived stigma (predictor) on his or her own social network variables (outcome variables) is the actor effect, and the effect of the PLWHAs' perceived stigma on his or her caregivers' social network variables is the partner effect. Similarly, the effect of

the caregivers' perceived stigma on his or her own social network variables is the actor effect, and the effect of the caregivers' perceived stigma on his or her PLWHAs family members' social network variables is the partner effect. The analyses, which involved structure equation models, were conducted using Mplus 6.2 (27).

We performed six APIM structure equation models to assess the relations of PLWHAs' and caregivers' perceived HIV stigma with each of the six social network variables, including trust, closeness, network size, network density, tangible support and emotional support. Each APIM included two predictors (PLWHAs' perceived HIV stigma and caregivers' perceived HIV stigma), six covariates (gender, age and marital status of PLWHAs and caregivers, see Table 2), and two outcome variables (a social network variable of PLWHAs and the same social network variable of caregivers), allowing us to simultaneously explore the actor and partner effects of both PLWHAs and caregivers. Model fit was assessed by χ^2 /degree ratio, the comparative fit index (CFI), and the standardized root mean square residual (SRMR). Good fit was indicated by values greater than or equal to 0.95 for CFI, and less than or equal to 2.00 for χ^2 /degree ratio and 0.08 for SRMR (9,28).

Results

PLWHAs, caregivers, and alters' social demographic characteristics

Of the 147 PLWHAs, 69.4% (102/147) reported they were infected through sexual contacts, 21.1% (31/147) were through injection drug use, and 9.5% (14/147) were through blood donation or transfusion. Thirty-nine percent of PLWHAs (58/147) had been living with HIV for more than 24 months, 21.8% (32/147) between 12-24 months, and 38.8% (57/147) for less than 12 months. More than half (54.4%) of PLWHAs received antiretroviral therapy (ART). Among 147 caregivers, 38.1% were PLWHAs' spouse, 29.3% were their siblings, 24.4% were their parents, and 8.2% were other relationships, such as grandparents, sister-in-law, or brother-in-law. Compared with caregivers, more PLWHAs were male and older. The education level, marital and employment status were comparable between PLWHAs and caregivers (Table 2).

The 294 egos (PLWHAs and caregivers) nominated a total of 1930 alters, including 940 nominated by PLWHAs and 990 nominated by caregivers. Forty-seven percent of alters were male. About one fourth (25.7%) of network alters were between 18 and 30 years old, 40.1% between 31 and 45 years old, and 34.2% older than 45 years. The majority of alters (81.5%) were married. Only thirty-one percent of alters received a high-school or higher education. PLWHAs' alters and caregivers' alters had similar socio-demographic characteristics, except gender (Table 2).

Perceived HIV stigma and social network components

Compared with caregivers, PLWHAs had a higher level of perceived HIV stigma (6.3 vs. 3.8). The mean score of HIV stigma was similar among male and female PLWHAs (6.1 vs. 6.8; $p = 0.48$). However, female caregivers reported a higher score of HIV stigma than male caregivers did (4.7 vs. 2.5; $p = 0.01$). The difference in the mean score of HIV stigma

between the two major HIV transmission modes (injection drug use and sexual contacts) did not reach statistical significance (8.0 vs. 5.8; $p = 0.07$).

The average size of PLWHAs' networks was 6.4 for PLWHAs and 6.7 for caregivers'. Both networks had a similar level of density. The scores of tangible support were 75.5 for PLWHAs and 78.8 for caregivers. Both PLWHAs and caregivers perceived a similar level of emotional support (71.9 vs. 77.1). There were no statistically significant differences on the scores of six network variables between PLWHAs and their caregivers (Table 2).

Table 3 presents correlations among variables that measured HIV stigma and social network components, which were used in APIM. Four correlations were statistically significant between PLWHAs/caregivers' perceived HIV stigma and their own/their partners' social network components: (1) PLWHAs' perceived HIV stigma and their caregivers' network closeness (correlation coefficient [r] = -0.19); (2) caregivers' perceived HIV stigma and their own perceived network tangible support ($r = -0.16$); (3) caregivers' perceived HIV stigma and PLWHAs' network closeness ($r = -0.24$); and (4) caregivers' perceived HIV stigma and PLWHAs' network size ($r = 0.18$).

Actor and partner effects of perceived stigma on social network components

As indicated in APIM analyses, significant actor effects were observed between PLWHAs' perceived HIV stigma and all social network variables except ego-alter trust. A higher level of HIV stigma perceived by PLWHAs was associated with lower closeness (adjusted $\beta = -0.03$, $p = 0.02$), smaller network size (adjusted $\beta = -0.07$, $p = 0.04$), looser network density (adjusted $\beta = -0.01$, $p = 0.02$), weaker perceived tangible support (adjusted $\beta = -1.13$, $p = 0.02$) and emotional support (adjusted $\beta = -0.95$, $p = 0.03$) within their own networks. In contrast, the actor effects of courtesy stigma perceived by caregivers on social network variables were not statistically significant (Table 4).

With regard to partner effects, there were only a few significant partner effects on network variables for PLWHAs and caregivers. For PLWHAs, significant partner effects were documented between perceived HIV stigma and network size (adjusted $\beta = 0.10$, $p = 0.01$), indicating that the network size of PLWHAs' network might be influenced by courtesy stigma perceived by their caregivers. For caregivers, PLWHAs' perceived HIV stigma exerted statistically significant partner effects on perceived emotional support from caregivers' network (adjusted $\beta = -0.84$, $p = 0.05$) (Table 4).

Discussion

This is one of the first studies that investigated the mutual influence of HIV stigma perceived by both PLWHAs and their caregivers on social network components at the dyadic level. The findings of this egocentric social network study include (1) PLWHAs' social network relations, structures and functions were similar to their caregivers'; (2) there were significant actor effects of perceived HIV stigma on social network variables among PLWHAs, but none among caregivers; and (3) only a few significant partner effects were observed between perceived HIV stigma and social network variables for both PLWHAs and caregivers.

As expected, compared with caregivers, PLWHAs reported a higher level of HIV stigma than their caregivers, as it was PLWHAs who possessed the stigmatizing attributes (i.e. HIV infection and behavior through which they were infected). One new finding is that the degree of perceived stigma differs between female caregivers and male caregivers. The difference could be due to the gender role of family responsibility (6,30,31) and gender role of resilience to health-related problems (32,33). The majority of caregivers in this study were female, which is consistent with other studies about the gender roles among caregivers in China (6,31). Women in China are expected to undertake more family responsibility than men, and their mental health problems are closely attached to their family (30). On the other hand, women's emotional well-being is more likely to be affected by environmental conditions, while well-being of men is influenced mainly by their own conditions (34), therefore, men usually have higher levels of resilience and hardiness than women in front of health-related issues (32,33). As the gender factor plays an important role in stigmatization, future research is needed to explore its role in the development of stigma and the potential consequences of stigma among males and females.

We investigated deservingness of HIV stigma, that is, those who contact HIV through illegal drug use may be more likely to perceive greater stigma than those who contacted it through sexual contact or other transmission modes. Although the difference in HIV stigma between those who acquired HIV through injection drug use and those through sexual contact did not reach statistical significance (maybe due to the small sample size), HIV stigma perceived by PLWHAs who contracted HIV through injection drug use exhibited a higher level of stigma than PLWHAs who were infected via sexual contacts. Unfortunately, information that distinguishes commercial sex contacts and spousal sexual contacts was not asked, which further limited our analysis. The major HIV transmission mode in China has changed from injection drug use to sexual contacts, even in the high heroin trafficking regions (2). For example, more than 60% of HIV cases were infected through sexual contacts in Guangxi (35). Further studies need to investigate how the two stigmatized risks (injection drug use and commercial sex contacts) influence perception of stigma.

In contrast to our expectation, the social network components were comparable between PLWHAs and their caregivers. Some previous studies report that either PLWHAs or caregivers lack social support (36,37), but few directly compared the social network components between the two closely-connected groups at the dyadic level. As caregivers are usually PLWHAs' close family members (e.g. spouse, parents, or brothers/sisters), caregivers and their cared for PLWHAs may have the same or similar alters in their social networks and practice similar social activities for addressing the challenges due to HIV infection. It is also possible that both PLWHAs and their family members have changed the components of social networks as a result of HIV infection. To avoid stigma and discrimination, they may maintain friendships with those who could provide social support and keep confidentiality of their HIV status. In our previous report, we found that PLWHAs selectively disclosed their HIV status to their trusted and frequently contacted alters who provided tangible support (38). Longitudinal studies are needed to investigate the dynamic changes of social network components and activities among both PLWHAs and their family members.

We found significant actor effects of PLWHAs' perceived HIV stigma on their own network closeness, network size, density and social support. Specifically, compared to PLWHAs who perceived a lower level of HIV stigma, those with a higher level of HIV stigma had fewer close peers, smaller network size, looser density, and weaker tangible support and emotional support. Our finding regarding HIV stigma on social support among PLWHAs is consistent with studies in other countries (39,40). As an ethnographic study delineated, a higher level of HIV stigma limited the social interaction and social support, thus increased reluctance to seek social support, health care, and medication adherence (41). PLWHAs might limit their social network size and activities within their families and depend on their family members for emotional or tangible support, not on outsiders for avoidance of stigma. This expectation was supported from our data as PLWHAs perceived to receive higher tangible and emotional support from their spouse or other family members than from other network peers.

In contradiction to our expectation, the actor effect of stigma perceived by caregivers had limited impact on their social network components, although the associations measured by β s were all negative. While further large-scale studies are needed to investigate the potential reasons, it is possible that the limited actor-effect of HIV stigma perceived by caregivers was due to their critical role that they played at the family level. That is, although caregivers perceived courtesy stigma, they might maintain and rely on their social networks to seek social support for their loved ones who were HIV infected, regardless of perceived HIV stigma. In fact, caregivers bear dual challenges, courtesy stigma and provision of support for HIV-infected family members. Coping with these challenges may attenuate the relationship between courtesy stigma and social network support.

Consistent with other APIM studies, the partner effects were relatively weak (21,42,43); only a few significant partner effects were found in this study. For caregivers, their perceived emotional support from network alters might be influenced by PLWHAs' stigma. Possibly, after realizing that their HIV-infected family members faced HIV stigma, caregivers might not share their emotional feelings to their network peers for avoidance of additional negative feelings. Paradoxically, PLWHAs' social network size increased as the levels of courtesy stigma perceived by their caregivers increased. This cross-sectional study could not explore the reasons for this paradox. Since few studies have previously investigated partner effects, future studies, especially mixed quantitative and qualitative approaches, are need to explore these partner effects.

Limitation

Findings from this study need to be interpreted in the context of some methodological and contextual limitations. First, because it is a cross-sectional study, the observed associations cannot be interpreted as causality. Findings reported here need to be confirmed in cohort studies with repeated measures. Second, self-report bias or recall bias might exist as questions were asked retrospectively. Finally, the study sample was recruited in a high heroin trafficking area in China, therefore the stigma for PLWHAs may not be only related HIV/AIDS, but mixed with their stained social identities, such as drug users or sex workers. Further research needs to be conducted to investigate the issue of stigma deservingness.

Conclusion

This study provides valuable information about actor and partner effects of perceived HIV stigma on social networks among PLWHAs and their caregivers. This mutual relationship has seldom been simultaneously studied among both PLWHAs and their caregivers at a dyadic level. As PLWHAs and their caregivers shared similar functions of social networks, the development of HIV intervention programs should target both PLWHAs and their caregivers and help both members to cope with challenges they face. Current national campaigns and interventions in China usually focus on the individual level or the community level, such as to eliminate discrimination from professional health workers and the general population (2,44,45), but these programs lack awareness of the dynamic interaction between PLWHAs and caregivers under the family principles of Chinese collectivist culture. As caregivers have double-challenges, courtesy stigma and provision of support to their HIV-infected family members, HIV intervention programs including treatments and care supports should consider involving the participation of both patients and caregivers as the dyads throughout the intervention process. Furthermore, research efforts for the investigation of the influence of HIV stigma on distal health outcomes, such as mental health problems, quality of life and even life-expectancy, should be pursued at the dyadic level as well.

Acknowledgments

We are grateful to the staff from Nanning Center for Disease and Control for participation in the study and to all the participants who gave so willingly of their time to provide the study data.

Funding: This work was partially supported by a research grant (R01 HD068305-01) from the National Institutes of Health-National Institute of Child Health and Human Development and a research grant from the Virginia Commonwealth University School of Medicine.

References

1. Zhang Y, Zhang X, Hanco Aleong T, Fuller-Thomson E. Impact of HIV/AIDS on social relationships in rural China. *Open AIDS J.* 2011; 5:67–73. [PubMed: 21792384]
2. China AIDS response progress report. Beijing: 2012. The Ministry of Health of People's Republic of China. 2012 March 31 Available from: [https://www.unaids.org/en/dataanalysis/knowyourresponse/countryprogressreports/2012countries/ce_CN_Narrative_Report\[1\].pdf](https://www.unaids.org/en/dataanalysis/knowyourresponse/countryprogressreports/2012countries/ce_CN_Narrative_Report[1].pdf) [accessed 22 October 2013]
3. Valdiserri RO. HIV/AIDS stigma: an impediment to public health. *Am J Public Health.* 2002; 92:341–342. [PubMed: 11867303]
4. Earnshaw VA, Chaudoir SR. From conceptualizing to measuring HIV stigma: a review of HIV stigma mechanism measures. *AIDS Behav.* 2009; 13:1160–1177. [PubMed: 19636699]
5. Brown L, Macintyre K, Trujillo L. Interventions to reduce HIV/AIDS stigma: what have we learned? *AIDS Educ Prev.* 2003; 15:49–69. [PubMed: 12627743]
6. Greene MC, Zhang J, Li J, Desai M, Kershaw T. Mental health and social support among HIV-positive injection drug users and their caregivers in China. *AIDS Behav.* 2013; 17:1775–1784. [PubMed: 23283579]
7. Jagannath V, Unnikrishnan B, Hegde S, Ramapuram JT, Rao S, Achappa B, et al. Association of depression with social support and self-esteem among HIV positives. *Asian J Psychiatr.* 2011; 4:288–292. [PubMed: 23051164]
8. House JS. Social support and social structure. *Sociol Forum.* 1987; 2:135–146.

9. Liu H, Feng T, Feng H, Cai Y, Rhodes AG, Grusky O. Egocentric networks of Chinese men who have sex with men: network components, condom use norms, and safer sex. *AIDS Patient Care STDS*. 2009; 23:885–893. [PubMed: 19803695]
10. Valente T. Social network influences on adolescent substance use: an introduction. *Connections. Connect*. 2003; 25:11–16.
11. Cohen, S.; Mermelstein, R.; Kamarck, T.; Hoberman, HM. Measuring the functional components of social support. In: Sarason, IG.; Sarason, BR., editors. *Social report: theory, research and application*. Boston, MA: Martinus Nijhoff; 1985. p. 73-94.
12. Kahn, RL. Aging and social support. In: Riley, MW., editor. *Aging from birth to death: interdisciplinary perspectives*. Boulder, CO: Westview Press; 1979. p. 79-91.
13. Yebei VN, Fortenberry JD, Ayuku DO. Felt stigma among people living with HIV/AIDS in rural and urban Kenya. *Afr Health Sci*. 2008; 8:97–102. [PubMed: 19357758]
14. Chaudoir SR, Norton WE, Earnshaw VA, Moneyham L, Mugavero MJ, Hiers KM. Coping with HIV stigma: do proactive coping and spiritual peace buffer the effect of stigma on depression? *AIDS Behav*. 2012; 16:2382–2391. [PubMed: 21956644]
15. Ji G, Li L, Lin C, Sun S. The impact of HIV/AIDS on families and children—a study in China. *AIDS*. 2007; 21(Suppl 8):S157–S161. [PubMed: 18172385]
16. Brown, MA.; Powell-Cop, GM. *Caring for a loved one with AIDS: the experience of families, lovers, and friends*. Seattle, WA: University of Washington Press; 1992.
17. Engler P, Anderson B, Herman D, Bishop D, Miller I, Pirraglia P, et al. Coping and burden among informal HIV caregivers. *Psychosom Med*. 2006; 68:985–992. [PubMed: 17132844]
18. Yang H, Wu Z, Duan S, Li Z, Li X, Shen M, et al. Living environment and schooling of children with HIV-infected parents in southwest China. *AIDS Care*. 2006; 18:647–655. [PubMed: 16971271]
19. Alonzo AA, Reynolds NR. Stigma, HIV and AIDS: an exploration and elaboration of a stigma trajectory. *Soc Sci Med*. 1995; 41:303–315. [PubMed: 7481925]
20. Goffman, E. *Stigma: notes on the management of spoiled identity*. Cliffs, E., editor. NJ: Prentice-Hall; 1963.
21. Kenny, DA.; Kashy, DA.; Cook, WL. *Dyadic data analysis*. New York, NY: Guildford Press; 2006.
22. Liu H, Xu Y, Lin X, Shi J, Chen S. Associations between perceived HIV stigma and quality of life at the dyadic level: the actor-partner interdependence model. *PLoS One*. 2013; 8:e55680. [PubMed: 23383343]
23. Li J, Liu H, Luo J, Koram N, Detels R. Sexual transmissibility of HIV among opiate users with concurrent sexual partnerships: an egocentric network study in Yunnan, China. *Addiction*. 2011; 106:1780–1787. [PubMed: 21457169]
24. Koram N, Liu H, Li J, Luo J, Nield J. Role of social network dimensions in the transition to injection drug use: actions speak louder than words. *AIDS Behav*. 2011; 15:1579–1588. [PubMed: 21431412]
25. Liu H, Detels R, Li X, Ma E, Yin Y. Stigma, delayed treatment, and spousal notification among male patients with sexually transmitted disease in China. *Sex Transm Dis*. 2002; 29:335–343. [PubMed: 12035023]
26. Liu H, Feng T, Rhodes AG. Assessment of the Chinese version of HIV and homosexuality-related stigma scales. *Sex Transm Infect*. 2009; 85:65–69. [PubMed: 18790858]
27. Muthén, LK.; Muthén, BO. *Mplus user's guide*. S, editor. Los Angeles, CA: Muthén & Muthén;; 2011.
28. Hu L, Bentler PM. Fit indices in covariance structure modeling: Sensitivity to underparameterized model misspecification. *Psychol Methods*. 1998; 3:424–453.
29. MacCallum RC, Austin JT. Applications of structural equation modeling in psychological research. *Annu Rev Psychol*. 2000; 51:201–226. [PubMed: 10751970]
30. Lai G. Work and family roles and psychological well-being in urban China. *J Health Soc Behav*. 1995; 36:11–37. [PubMed: 7738326]

31. Zhan HJ. Through gendered lens: explaining Chinese caregivers' task performance and care reward. *J Women Aging*. 2004; 16:123–142. [PubMed: 15149928]
32. Akechi T, Okamura H, Nakano T, Akizuki N, Okamura M, Shimizu K, et al. Gender differences in factors associated with suicidal ideation in major depression among cancer patients. *Psychooncology*. 2010; 19:384–389. [PubMed: 19472294]
33. Hamama-Raz Y. Does psychological adjustment of melanoma survivors differ between genders? *Psychooncology*. 2012; 21:255–263. [PubMed: 22383267]
34. Northouse LL, Mood D, Templin T, Mellon S, George T. Couples' patterns of adjustment to colon cancer. *Soc Sci Med*. 2000; 50:271–284. [PubMed: 10619695]
35. Wang L, Qin Q, Ding W, Li P, Hei F, Wang L, et al. The description of data from the web-based real-time China national HIV/AIDS information system in 2010 [article in Chinese]. *Chinese Journal of AIDS & STDs*. 2011:275–278.
36. Neuman M, Obermeyer CM. Experiences of stigma, discrimination, care and support among people living with HIV: a four country study. *AIDS Behav*. 2013; 17:1796–1808. [PubMed: 23479002]
37. Pirraglia PA, Bishop D, Herman DS, Trisvan E, Lopez RA, Torgersen CS, et al. Caregiver burden and depression among informal caregivers of HIV-infected individuals. *J Gen Intern Med*. 2005; 20:510–514. [PubMed: 15987325]
38. Zang C, He X, Liu H. Selective disclosure of HIV status in egocentric social networks. *J Epidemiol*. Submitted. 2013
39. White W, Grant JS, Pryor ER, Keltner NL, Vance DE, Raper JL. Do social support, stigma, and social problem-solving skills predict depressive symptoms in people living with HIV? A mediation analysis. *Res Theory Nurs Pract*. 2012; 26:182–204. [PubMed: 23156207]
40. Colbert AM, Kim KH, Sereika SM, Erlen JA. An examination of the relationships among gender, health status, social support, and HIV-related stigma. *J Assoc Nurses AIDS Care*. 2010; 21:302–313. [PubMed: 20116295]
41. Carr RL, Gramling LF. Stigma: a health barrier for women with HIV/AIDS. *J Assoc Nurses AIDS Care*. 2004; 15:30–39. [PubMed: 15358923]
42. Kenny DA, Ledermann T. Detecting, measuring, and testing dyadic patterns in the actor-partner interdependence model. *J Fam Psychol*. 2010; 24:359–366. [PubMed: 20545409]
43. Kenny DA, Cook WL. Partner effects in relationship research: Conceptual issues, analytic difficulties, and illustrations. *Pers Relatsh*. 1999; 6:433–448.
44. Wu S, Li L, Wu Z, Liang LJ, Cao H, Yan Z, et al. A brief HIV stigma reduction intervention for service providers in China. *AIDS Patient Care STDs*. 2008; 22:513–520. [PubMed: 18462076]
45. Deng R, Li J, Sringernyuang L, Zhang K. Drug abuse, HIV/AIDS and stigmatisation in a Dai community in Yunnan, China. *Soc Sci Med*. 2007; 64:1560–1571. [PubMed: 17257727]

Figure 1.

Actor-partner interdependence model of perceived HIV stigma predicting social network components. Subscripts of variables denote whether the variable belongs to the PLWHAs or the caregivers. a_{PLWHA} = actor effect of PLWHAs' perceived HIV stigma on own social network variables; $a_{\text{caregivers}}$ = actor effect of caregivers' perceived HIV stigma on own social network variables; p_{PLWHA} = partner effect of caregivers' perceived HIV stigma on PLWHAs' social network variables; $p_{\text{caregivers}}$ = partner effect of PLWHAs' perceived HIV stigma on caregivers' social network variables. HIV: human immunodeficiency virus; PLWHAs: people living with human immunodeficiency virus/acquired immune deficiency syndrome (HIV/AIDS).

Table 1
Measurement scales of three components of social networks

Social network components	Indicators or domains	Measurements
Network relations	Trust in alters	Question: to what extent do you (an ego) trust each of the alters who are perceived to provide you tangible and/or emotional support? Scored from 0 = no trust at all to 6 = trust very much A composite score was calculated to measure the level of an ego's trust in all alters
	Closeness to alters	Question: how close are you to each of your network alters who are perceived to provide you tangible and/or emotional support? Scored from 0 = not close at all to 4 = very close A composite score was calculated to measure the level of an ego's closeness to alters
Network structures	Total network size	The total number of network alters who were perceived to provide tangible or emotional support.
	Network density	Measures the extent to which network alters know one another. Respondents (egos) were given a matrix with the names of their network alters shown in both dimensions and were asked to indicate the alters in their personal network who knew each other. Density was calculated as the proportion of network alters who knew each other as reported by egos.
Network functions	Tangible support	Measures the level of tangible support that an ego perceived to receive from alters Question 1: who would lend the ego 50 Chinese Yuan (equivalent to \$8 US dollars), accompany the ego to see a doctor, or give immediate help if the ego needed it; Question 2: who would take care of the ego if the ego was sick and confined to bed for 2–3 weeks; Question 3: who would provide help or advice if the ego had problems regarding family or personal issues, or health concerns. Scored from 0 = not possible at all to 4 = quite sure that the alter could provide the support A composite score was calculated to measure the total tangible support by summarizing the three individual scores from all alters.
	Emotional support	Measures the level of emotional support that an ego perceived to receive from alters. Question 1: who would agree with or support the ego's actions or thoughts; Question 2: who would make the ego feel respected or admired; Question 3: who would make the ego feel safe to confide in the alter. Scored from 0 = not possible at all to 4 = quite sure that the alter could provide the support A composite score was calculated to measure the total emotional support by summarizing the three individual scores from all alters.

Table 2
Comparison between PLWHAs and caregivers on demographics, perceived stigma and social network variables

	PLWHAs	Caregivers	<i>p</i> -value
	n (%) or Mean (SD)	n (%) or Mean (SD)	
<i>Ego's socio-demographics</i>	N=147	N=147	
Gender			<0.01
Female	44 (29.9)	89 (60.5)	
Male	103 (70.1)	58 (39.5)	
Marriage status			0.06
Currently unmarried	44 (29.9)	30 (20.4)	
Married	103 (70.1)	117 (79.6)	
Primary school or higher			0.50
No	38 (25.9)	33 (22.5)	
Yes	109 (74.1)	114 (77.5)	
Employment status			0.14
No	42 (28.6)	31 (21.1)	
Yes	105 (71.4)	116 (78.9)	
Age (Mean, SD)	41.2 (11.6)	37.9 (11.2)	0.01
<i>Ego's perceived stigma</i>	6.3 (5.8)	3.8 (5.3)	< 0.01
<i>Ego's network components</i>			
Network relations			
Trust in alters	5.2 (0.7)	5.1 (0.8)	0.28
Closeness to alters	3.4 (0.7)	3.4 (0.6)	0.85
Network structures			
Total network size	6.4 (2.4)	6.7 (2.4)	0.28
Network density	0.8 (0.2)	0.8 (0.3)	0.80
Network functions			
Tangible support	75.5 (32.1)	78.8 (33.4)	0.38
Emotional support	71.9 (31.1)	77.1 (33.6)	0.16
<i>Alters' socio-demographics</i>	N=940	N=990	
Alters' gender			0.04
Female	520 (55.3)	501 (50.6)	
Male	420 (44.7)	489 (49.4)	
Alters' age (years)			0.50
30	239 (25.4)	257 (26.0)	
31-45	372 (39.6)	402 (40.6)	
> 45	329 (35.0)	331 (33.4)	
Alters' marriage status			0.49
Currently unmarried	168 (17.9)	189 (19.1)	
Married	772 (82.1)	801 (80.9)	
Alters' education level			0.69

	PLWHAs	Caregivers	<i>p</i> -value
	n (%) or Mean (SD)	n (%) or Mean (SD)	
Primary school or less	166 (17.7)	216 (21.8)	
Middle school	489 (52.0)	456 (46.1)	
High school or above	285 (30.3)	318 (32.1)	

PLWHAs: people living with human immunodeficiency virus/acquired immune deficiency syndrome (HIV/AIDS).

Table 3
Correlation between social network and perceived HIV stigma

Variables	2	3	4	5	6	7	8	9	10	11	12	13	14
People living with HIV													
1. Trust in alters	0.69 ^a	-0.05	0.28 ^a	0.17 ^a	0.15	-0.14	0.35 ^a	0.37 ^a	0.09	0.15	0.17 ^a	0.19 ^a	-0.16
2. Closeness to alters		0.04	0.37 ^a	0.31 ^a	0.28 ^a	-0.22	0.34 ^a	0.44 ^a	0.12	0.13	0.25 ^a	0.27 ^a	-0.24 ^a
3. Total network size			-0.09	0.88 ^a	0.88 ^a	-0.12	0.04	0.05	0.33 ^a	-0.04	0.26 ^a	0.28 ^a	0.18 ^a
4. Network density				0.12	0.07	-0.21	0.13	0.18 ^a	-0.10	0.22 ^a	0.01	0.01	-0.15
5. Tangible support					0.92 ^a	-0.19	0.10	0.16 ^a	0.33 ^a	0.01	0.33 ^a	0.35 ^a	0.05
6. Emotional support						-0.19	0.08	0.16	0.31 ^a	0.06	0.30 ^a	0.32 ^a	0.08
7. Perceived stigma							-0.15	-0.19 ^a	-0.04	-0.01	-0.12	-0.15	0.15
Caregiver													
8. Trust in alters								0.69 ^a	-0.03	0.25 ^a	0.21 ^a	0.27 ^a	-0.11
9. Closeness to alters									0.04	0.34 ^a	0.28 ^a	0.32 ^a	-0.15
10. Total network size										-0.20 ^a	0.86 ^a	0.86 ^a	-0.04
11. Network density											0.01	-0.01	-0.01
12. Tangible support												0.95 ^a	-0.16 ^a
13. Emotional support													-0.12
14. Perceived stigma													

HIV: human immunodeficiency virus.

^a $p < .05$.

Table 4
Actor and partner relationship of perceived stigma to dimensions of social network among 147 dyads

Dependent variables	PLWHAs		Caregiver		Model fit		
	Actor's perceived stigma $\alpha\beta_1$ (95% CI)	Partner's perceived stigma $\alpha\beta_2$ (95% CI)	Actor's perceived stigma $\alpha\beta_1$ (95% CI)	Partner's perceived stigma $\alpha\beta_2$ (95% CI)	χ^2/df	CFI ^a	SRMR ^b
Network relations							
Trust in alters	-0.01 (-0.05, 0.01)	-0.02 (-0.05, 0.004)	-0.01 (-0.04, 0.01)	-0.02 (-0.05, 0.01)	0.64	1.00	0.02
Closeness to alters	-0.03 (-0.05, -0.003) ^c	-0.02 (-0.04, 0.001)	-0.01 (-0.04, 0.003)	-0.02 (-0.04, 0.002)	1.07	0.98	0.03
Network structures							
Network size	-0.07 (-0.14, -0.003) ^c	0.10 (0.03, 0.18) ^c	0.001 (-0.08, 0.08)	-0.02 (-0.08, 0.05)	0.52	1.00	0.02
Network density	-0.01 (-0.02, -0.002) ^c	-0.003 (-0.01, 0.005)	0.00 (-0.01, 0.01)	-0.002 (-0.01, 0.005)	2.36	0.82	0.04
Network functions							
Tangible support	-1.13 (-2.08, -0.16) ^c	0.62 (-0.44, 1.73)	-0.82 (-1.98, 0.23)	-0.57 (-1.41, 0.42)	0.89	1.00	0.02
Emotional support	-0.95 (-1.80, -0.09) ^c	0.70 (-0.23, 1.81)	-0.57 (-1.71, 0.48)	-0.84 (-1.66, -0.001) ^c	0.86	1.00	0.02

PLWHAs: people living with human immunodeficiency virus/acquired immune deficiency syndrome (HIV/AIDS); df: degree of freedom; CI: confidence interval.

^aThe comparative fit index.

^bStandardized root mean square residual.

^c $p < 0.05$.