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Impact and Correlates of Sub-Optimal Social Support Among Patients in HIV Care

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Abstract

Social support (SS) predicts health outcomes among patients living with HIV. Systematic assessment of SS in routine HIV care is rare. We administered a brief, validated measure of SS, the Multifactorial Assessment of Perceived Social Support, within a patient-reported outcomes assessment of several health domains in routine HIV care at 4 U.S. clinics in English and Spanish (n=708). In univariate analysis, low SS was associated with poorer engagement in care, antiretroviral adherence, and health-related quality of life (HRQL); current methamphetamine/crystal use, depression, anxiety, and HIV stigma (all $p < 0.001$); any use of either methamphetamines/crystal, illicit opioids, or cocaine/crack ($p = 0.001$), current marijuana use ($p = 0.012$), nicotine use ($p = 0.005$), and concern for sexually transmitted infection (STI) exposure ($p = 0.001$). High SS was associated with undetectable viral load ($p = 0.031$). Multivariate analyses found low SS independently associated with depression (risk ratio (RR) 3.72, 95% CI 2.93-4.72), lower adherence (RR 0.76, 95% CI 0.64-0.89), poor engagement in care (RR 2.05, 95% CI 1.44-2.96), and having more symptoms (physical, psychological, and global distress) (RR 2.29, 95% CI 1.92-2.75). Medium SS was independently associated with depression (RR 2.59, 95% CI 2.00-3.36), poor engagement in care (RR 1.62, 95% CI 1.15-2.29) and having more symptoms (RR 1.75, 95% CI 1.44-2.13). SS assessment may help identify patients at risk for these outcomes, and set the stage for a multifaceted approach to improving health that takes the social dimension into account.

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Disclosure Statement

The authors declare no conflicts of interest.

Introduction

Social support is an essential element of human health, protecting from mental ill-health (Garipey, Honkaniemi, & Quesnel-Vallee, 2016), supporting healthful behaviors (Iribarren et al., 2017; Non et al., 2020; Watt et al., 2014) and improving immune, endocrine, and cardiac function (Cohen, 1988; Hawkey, Burtleson, Berntson, & Cacioppo, 2003; Teoh & Hilmert, 2018; Uchino, Cacioppo, & Kiecolt-Glaser, 1996). Poor social support has been shown to increase the risk of morbidity and mortality (Holt-Lunstad, Smith, & Layton, 2010) through both physiological and psychosocial mechanisms (DiMatteo, 2004; Hawkey et al., 2003; Uchino et al., 1996) and has helped mitigate the emotional and practical impact of living with chronic conditions including cancer (Costa et al., 2017; Pinquart & Duberstein, 2010), diabetes (Pamungkas, Chamroonsawasdi, & Vatanasomboon, 2017; Spencer-Bonilla et al., 2017), and HIV (Iribarren et al., 2017).

Among people living with HIV (PLWH), social support plays a uniquely important role in health maintenance. This important role is due, in part, to the anticipation and experience of HIV-related stigma (Nyblade, 2006) which may render it difficult to establish and maintain adequate social support; indeed, HIV-related stigma has been found to be negatively correlated with social support (Smith, Rossetto, & Peterson, 2008). Evidence suggests that social support is protective for depression and HIV-related stigma (Larios, Davis, Gallo, Heinrich, & Talavera, 2009; Rao et al., 2012); it has also been associated with key outcomes in the HIV care continuum including earlier HIV diagnosis, better retention in care, and better adherence to antiretroviral therapy (ART) (Kelly, Hartman, Graham, Kallen, & Giordano, 2014). Insufficient social support, by contrast, has been associated with poorer ART adherence (Scheurer, Choudhry, Swanton, Matlin, & Shrank, 2012), unhealthy coping mechanisms (Iribarren et al., 2017), and denial of illness (Power et al., 2003) among PLWH. PLWH experience high rates of metabolic, cardiovascular, and immunologic complications (Deeks & Phillips, 2009; Willig & Overton, 2016), all of which may be further compromised by insufficient social support. As the population of PLWH grows older and the burden of morbidity and mortality for PLWH continues to shift from AIDS-defining illnesses to non-AIDS-related comorbidities (Justice & Braithwaite, 2012), identifying and addressing insufficient social support may yield broad health benefits.

There is little systematic assessment of patients' social support in primary care, including primary HIV care. Given the strong association of the social dimension of life with health outcomes among PLWH, we incorporated a brief measure of perceived social support into routine HIV care. Using the Multifactorial Assessment of Perceived Social Support (MAPSS) (R. J. Fredericksen et al., 2019), a brief, validated measure of perceived functional social support for PLWH in care that is inclusive of concepts of social support prioritized highly by PLWH, we sought to characterize the relationship between social support and various health outcomes and behaviors in a population of PLWH.

Methods

Population

We administered the MAPSS to PLWH from four HIV primary care clinics within the Centers for AIDS Research Network of Integrated Clinical Systems (CNICS) in the United States which include: Fenway Community Health-Boston, MA; 1917 Clinic at the University of Alabama-Birmingham; Owen Clinic at the University of California-San Diego; and Madison Clinic at Harborview Medical Center/University of Washington-Seattle.

Procedure

In these clinics, as part of clinical care, patients complete a routine, self-administered assessment of patient-reported measures and outcomes (PROs) on touch-screen tablets immediately prior to seeing their provider (Crane et al., 2007; Lawrence et al., 2010). The PRO assessment includes self-reported measures of symptoms and health behaviors; we included the MAPSS as part of the assessment between January and August 2017. PLWH who appear intoxicated, have cognitive impairment, and/or are unable to read English, Spanish, or Amharic are not asked to complete the assessment. We administered the MAPSS to both English and Spanish-speaking patients, the two language groups for whom we have the largest numbers, in their respective languages.

Measures

Demographic data were elicited from the electronic health record (EHR) except sexual orientation and gender identity, which were collected with PRO measures. Other PRO measures included depression (PHQ-9) (Kroenke, Spitzer, & Williams, 2001; Spitzer, Kroenke, & Williams, 1999); anxiety (PHQ-5, three levels-high, some, and no anxiety) (Spitzer et al., 1999); adherence to ART using the Self-Rating Scale (Likert scale, very poor to excellent) and a 30-day visual analog scale (0-100% of medication taken in past month) (Chesney et al., 2000; Lu et al., 2008; Simoni et al., 2006); substance use (AUDIT/AUDIT-C for alcohol use, ASSIST for other substances) (Bradley et al., 2003; Bush, Kivlahan, McDonell, Fihn, & Bradley, 1998; Newcombe, Humeniuk, & Ali, 2005; 2002); current nicotine use; sexual risk behavior [Sexual Risk Behavior Inventory (R. J. Fredericksen et al., 2018), incorporating/using number of recent sex partners, self-reported concern for sexually transmitted infection (STI) exposure, and condomless sex in past three months]; HIV-related stigma (Earnshaw, Smith, Chaudoir, Amico, & Copenhaver, 2013) (5 point Likert scale, level of agreement with one or more of four stigma-related statements, score 1-5, higher score indicates worse stigma); HIV related symptoms (Justice et al., 2001) (number of symptoms for which 'bothers some' or 'bothers a lot' endorsed); and health-related quality of life (HRQL) (EuroQol, 1990) (EQ-5D, scoring range 5-13, lower score indicates better HRQL) and visual analog scale self-assessing health (0-100%, with 100% as best possible health). We used EHR data to determine viral load, CD4 cell count, the presence of hypertension or AIDS-defining illness, and frequency of missed visits. We defined poor engagement in care as one or more missed visits in two consecutive six-month intervals within a two-year time period.

Social support measure (MAPSS)

The MAPSS is a brief, clinically relevant, unidimensional measure of perceived social support we designed in partnership with PLWH (R. Fredericksen et al., 2019). It incorporates concepts of social support prioritized highly by PLWH. The MAPSS has simple response options that are well-understood by both English and Spanish speakers (see Fig. 1). Items include content related to perceived functional support, such as, “How much do you feel loved, liked, or cared about?” and “How much do you feel that people in your personal life support your ability to stay healthy?” Response options are “not enough” and “enough or more than enough.” “Suboptimal” social support is defined as a ‘not enough’ response to any of the eight items, with endorsement of ‘not enough’ for 5-8 items scoring as low social support, 1-4 items as medium social support, and 0 items as high social support. Cronbach’s alpha for the MAPSS was calculated.

CNICS data repository

The CNICS data repository integrates comprehensive clinical data including laboratory test results; ART use and other medications; diagnoses; demographic data; and historical information, including prior ART use, collected at initial clinic visits by standardized intake processes (Kitahata et al., 2008). The repository also includes the PRO data described here.

Data analysis

We divided participating PLWH into three groups based on their MAPSS scores: Low (0 – 3 points), Medium (4 – 7 points) and High (8 points) (R. Fredericksen et al., 2019). The groups were compared using ordinal logistic regression, with high social support as the reference category. Model fit and the assumption of proportional odds were tenable for all models.

In addition, we identified several recent, robust studies with large sample sizes with outcomes known or strongly suspected to be associated with social support. We performed multivariate analyses in CNICS data, based on the covariates and outcomes in these studies, with the addition of social support. Our goal was to better understand whether social support provided independent information about the outcome. We chose studies with the following outcomes: depression (Anagnostopoulos et al., 2015), engagement in care (Hightow-Weidman et al., 2017), medication adherence (Skalski et al., 2015), recent viral load (Rangarajan et al., 2016), health-related quality of life (HRQL) (Armon & Lichtenstein, 2012; Castro et al., 2019), recent drug use (Lightfoot et al., 2005), and number of symptoms (Harding et al., 2012; Lee et al., 2009). Symptoms in this latter category included symptoms of physical, psychological, and global distress as collected by either the Memorial Symptom Assessment Scale (in Lee et al) or its Short Form (in Harding et al)(Chang, Hwang, Feuerman, Kasimis, & Thaler, 2000; Portenoy et al., 1994). We constructed similar models with our data, with the addition of social support. We used Poisson regressions with robust standard errors to obtain risk ratios (RR). All models were controlled for age, sex, and race, in addition to outcome-specific covariates. High social support was the reference category.

Results

We administered the MAPSS to n=708 PLWH (48% age 50, 84% cisgender male, 29% nonwhite, 19% administered survey in Spanish) (see Table 1). Cronbach's alpha for the MAPSS was 0.92. Table 2 summarizes demographic and behavioral characteristics by social support category determined from MAPSS responses. Data on stigma, condom use, and STI concern were only available for a subset of participants (n=201, n=433, and n=439, respectively). Algorithmic skip patterns allow stigma items to be assessed annually, and not at every assessment, to reduce patient burden; furthermore condom use/STI concern items are only asked when relevant, specifically of those having indicated sexual activity with a partner in the past 3 months. A higher proportion of PLWH who took the survey in English report lower levels of social support compared with those who took the survey in Spanish (p=0.015). We did not find differences in social support categories for other demographic groups (age, gender, race, ethnicity (Latino/non-Latino), sexual orientation, or study site).

Among HIV-specific health outcomes, a higher proportion of PLWH indicating the highest levels of social support had detectable viral loads with >400 copies/mL (p=0.031). A higher proportion of people who reported lower levels of social support were less engaged in care, defined as 1 or more missed visits in two consecutive six-month periods over the past two years (p<0.001), reporting more missed doses of ART (p<0.001), and reported "very poor" or "fair" ability to take all of their HIV medication (p=0.001). PLWH reporting less social support reported a higher number of symptoms that were bothersome as reported from the systems review.

Depression, anxiety, poorer reported HRQL, and reported HIV stigma were each associated with lower social support (p<0.001 for each). Poor social support was associated with several types of substance use. It was lower among those who reported smoking/vaping nicotine (p=0.005), current methamphetamine users (p<0.001), current marijuana users (p=0.012), and those indicating any use of methamphetamines, illicit opioids, or cocaine/crack (p=0.001). Notably, there was no association found between perceived social support and current alcohol use.

Social support may have a relationship with sexual risk behavior. Among those reporting having been sexually active in the past 3 months, a higher proportion of PLWH reporting higher levels of social support reported having just one sex partner in the past three months (p=0.008) and a smaller proportion reported being concerned about exposure to STI (p=.001).

In the multivariate replication models, social support was independently associated with many of the seven outcomes (Table 3). Low social support was independently associated with depression (RR 3.72, 95% CI 2.93-4.72), lower adherence (RR 0.76, 95% CI 0.64-0.89), poor engagement in care (RR 2.05, 95% CI 1.44-2.96), and having more symptoms (physical, psychological, and global distress) (RR 2.29, 95% CI 1.92-2.75). Medium social support was independently associated with depression (RR 2.59, 95% CI 2.00-3.36), poor engagement in care (RR 1.62, 95% CI 1.15-2.29) and having more

symptoms (RR 1.75, 95% CI 1.44-2.13). Social support did not provide significant additional explanation for drug use or recent viral load.

Discussion

Perceived social support was significantly associated with health outcomes, consistent with findings among PLWH and other populations (Broadhead et al., 1983; Cassel, 1976; Cohen, 1988; Cohen & Wills, 1985; Hawkey et al., 2003; Iribarren et al., 2017; Kelly et al., 2014; Scheurer et al., 2012; Uchino et al., 1996; Watt et al., 2014). Lower perceived social support was associated with poorer engagement in care, poorer ART adherence, more bothersome symptoms, worse HIV stigma, worse perceived HRQL, depression, anxiety, and the use of most substances, with the exception of alcohol. In addition, lower social support was associated with a higher number of sex partners in the past three months and higher likelihood of concern regarding exposure to STI. Multivariate analyses found lower social support to be associated with higher depression, higher symptom burden, lower engagement in care, lower medication adherence, and lower HRQL.

While the direction of these associations are not known due to the cross-sectional nature of this study, our findings highlight the extent to which the social lives of PLWH intertwine with health behaviors and outcomes. Longitudinal studies can help determine whether changes corresponding to improvements in perceived social support are associated with improvements in these health outcomes. This hypothesis is plausible, as positive changes in social support among PLWH may support reductions in health behaviors that impact viral replication, such as poor adherence to ART and substance use, as well as supporting behaviors that reduce the risk of HIV/STI transmission.

Our findings build on those of prior studies across the life span linking health behaviors and outcomes to the dimension of social support (Hawkey et al., 2003; Hussen et al., 2017; Mackin, Perlman, Davila, Kotov, & Klein, 2017; Watt et al., 2014). These include several studies comprised primarily of HIV-uninfected populations, yet relevant to PLWH, such as the positive impact of practical social support on medication adherence (Scheurer et al., 2012) and the benefit of social support on cardiovascular, endocrine, and immune functioning (Uchino et al., 1996). Studies specific to PLWH have found higher social support to be linked to both cognitive and behavioral resilience (Hussen et al., 2017) and, that among the newly diagnosed, the positive relationship between social support and earlier diagnosis, timely linkage to care, and ART adherence (Kelly et al., 2014).

The strength of these associations prompts us to ask: what factors influence one's perceived level of social support, and to what extent can providers in a clinical setting help modify these factors? Identification and treatment of depression is one clear opportunity: depressive disorders, highly prevalent among PLWH (Rabkin, 2008), are characterized by the presence of several symptoms that may increase social isolation, such as diminished interest in pleasurable activity, as well as feelings of worthlessness (American Psychiatric Association, 2013). Low self-worth may cause PLWH to feel diminished social connections and friendships, or to perceive such relationships as inauthentic. Antidepressants are known to improve self-perceptions of social functioning (Venditti et al., 2000; Young, Moskowitz,

& aan het Rot, 2014), and evidence suggests that cognitive behavioral therapy may improve perceptions of social support (Berkman et al., 2003; Stice, Rohde, Gau, & Ochner, 2011), supporting an argument for routine screening for clinical depression in HIV care and its subsequent treatment. It is also possible that low social support may, in itself, trigger or exacerbate depression in vulnerable PLWH. Directly targeting perceptions of available social support with psychotherapy, group therapy, or other formalized peer-based support may more directly improve perceived social support.

We considered three sub-populations of PLWH who may particularly benefit from standardized assessment of social support: the elderly, the disabled, and those that are newly diagnosed with HIV. Among elderly PLWH, inadequate social support may have a more profound health impact relative to other populations given the higher prevalence and earlier onset of chronic comorbidities (Gallant, Hsue, Shreay, & Meyer, 2017; Guaraldi et al., 2011). Among the general population of physically disabled adults, inadequate social support is a common problem (Burholt, Windle, Morgan, & team, 2017; Scope, 2017); again, health impacts among physically disabled PLWH may be more severe. PLWH recently diagnosed with HIV may also benefit from at least initial assessment of social support, given that the social dimension of living with HIV is complicated by the anticipation and experience of HIV-related stigma. For newly-diagnosed PLWH, assessing and managing the social dimension of living with HIV has been described as an overwhelming and isolating experience (R. J. Fredericksen et al., 2015). Newly diagnosed PLWH suddenly face myriad decisions surrounding disclosure of their HIV status: who to tell, at what point, in what way, and at what potential cost. The health burden of such pressures have been associated with feelings of worthlessness, depressive symptoms, increased sexual risk behavior, substance use, poorer social functioning, and lower overall quality of life (Logie & Gadalla, 2009; Venable, Carey, Blair, & Littlewood, 2006; Wolitski, Pals, Kidder, Courtenay-Quirk, & Holtgrave, 2009). Identifying lower levels of social support among newly diagnosed PLWH may lead to actions that lessen these outcomes at a particularly challenging time.

Referrals to support groups and clinic-based interventions that address coping with anticipated and actual HIV-related stigma may help bolster social support, both by generating community among newly-diagnosed PLWH, as well as helping to develop strategies and skills for navigating outside relationships. PLWH have noted that addressing social issues (i.e., HIV-related stigma) in the context of HIV care is essential to help address adverse health behaviors (R. J. Fredericksen et al., 2015), for example, in reducing a perceived need to use drugs or alcohol to cope with social isolation.

Both HIV-related stigma and social support have been top concerns among PLWH relative to other health-related topics (R. Fredericksen et al., 2016; R. J. Fredericksen et al., 2015). Assessment of perceived social support and HIV-related stigma, in conjunction with assessment of depression, drug and alcohol use, medication adherence and HIV/STI transmission risk behavior may help initiate conversations with PLWH about the interrelationships between these factors, and help set the stage for a multifaceted approach to improving health outcomes that takes the social dimension into account.

Strengths

We included a geographically, clinically, and demographically diverse patient sample from multiple sites across the US. In addition, we selected a measure that was developed with careful consideration of PLWH priorities and that is brief enough to potentially incorporate into clinical care visits.

Limitations

Due to the cross-sectional nature of this study, it is not possible to determine the directionality of cause/effect between social support and outcomes or if there may be a different cause. We identified in multivariate models the importance of factors such as depression and HRQL, but it is difficult to determine from this data whether these factors impact social support, the reverse, or both. Future studies with longitudinal data may focus on exploring this directionality.

Only one of the sites included in this study was located in the southern United States, which is currently the area of highest incidence of HIV as well as a region with the highest number of deaths in PLWH (CDC, 2017). The interplay of social support and HIV infection in this region merits further investigation.

Conclusions

Low social support is a common issue among PLWH and is associated with poor health outcomes. The use of the MAPSS, a well-tolerated and brief patient-reported measure of perceived social support that can be completed by PLWH electronically at the beginning of provider visits, may help identify PLWH at risk for these outcomes. Availing PLWH of resources for bolstering social support may help improve health outcomes.

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1	How much do you feel loved, liked, or cared about?
2	How much do you feel that you can trust those in your personal life?
3	How much do you feel listened to by those in your personal life?
4	How much do you feel that people in your personal life support your ability to stay healthy?
5	How much do you feel accepted for who you are by those important to you?
6	How much do you feel that there are people in your life who understand your problems?
7	How much do you feel that there are people who would help you if you needed help?
8	How satisfied are you with the kinds of relationships you have with your family and friends?

Scoring:
Selection of “enough or more than enough” in only 0-3 instances = low,
in 4-7 instances = moderate, in 8 instances = high

Figure 1.
Multifactorial Assessment of Perceived Social Support (MAPSS)

Demographic and clinical characteristics of people living with HIV (n=708) who completed the MAPSS as part of routine clinical care visits in CNICS

Table 1.

Characteristics	N (%)
Present sex male	598 (84%)
Gender identity	
Male	591 (83%)
Female	101 (14%)
Transgender woman (male sex at birth)	8 (1%)
Transgender man (female sex at birth)	1 (0%)
Other/Unknown	7 (1%)
Sexual orientation	
Lesbian/gay/other non-heterosexual identity	464 (66%)
Straight or heterosexual	158 (22%)
Bisexual	54 (8%)
Something else	10 (1%)
Don't know/unknown	22 (3%)
Age	
<30	46 (7%)
30-39	144 (20%)
40-49	175 (25%)
50	343 (48%)
Race	
White	502 (71%)
Black	130 (18%)
American Indian	4 (1%)
Asian/Pacific Islander	24 (3%)
Multiracial	15 (2%)
Other/unknown	33 (5%)
Hispanic	
Yes	210 (30%)
No	498 (70%)

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Characteristics	N (%)
Survey language Spanish	136 (19%)
HIV risk factor	
MSM *	473 (67%)
IDU **	64 (9%)
MSM + IDU	9 (1%)
Heterosexual	129 (18%)
Other/unknown	33 (5%)
Currently taking HIV medications	
Yes	660 (93%)
No	48 (6%)
Most recent CD4 count	
<200	47 (7%)
200 - 349	91 (13%)
350	565 (80%)
Unknown	5 (1%)
Recent viral load	
0-400	646 (91%)
Over 400	52 (7%)
Unknown	10 (1%)
Over 6 years in care	358 (51%)

* men who have sex with men

** injection drug user

Demographic, clinical and behavioral attributes by levels of social support among people living with HIV in CNICS; n (%) or median (interquartile range).

Table 2.

	Total (n=708)	Social Support			p-value ^a
		Low (0-3 points) (n=105)	Medium (4-7 points) (n=146)	High (8 points) (n=457)	
Survey language Spanish					0.015
Yes	136 (19%)	15 (14%)	21 (14%)	100 (22%)	
No	572 (81%)	90 (86%)	125 (86%)	357 (78%)	
5 years or less since initial visit					0.64
Yes	304 (43%)	49 (47%)	61 (42%)	194 (43%)	
No	404 (57%)	56 (53%)	85 (58%)	263 (58%)	
Most recent viral load					0.031
Detectable	52 (8%)	11 (11%)	15 (11%)	26 (6%)	
Undetectable	646 (93%)	93 (89%)	128 (90%)	425 (94%)	
Recent CD4					
<200	47 (7%)	12 (11%)	4 (3%)	31 (7%)	0.39
200 to <30	91 (13%)	18 (17%)	19 (13%)	54 (12%)	
350+	565 (80%)	75 (71%)	122 (84%)	368 (81%)	
Any AIDS-defining illness					0.95
Yes	204 (29%)	32 (328%)	40 (27%)	132 (29%)	
No	504 (71%)	73 (70%)	106 (73%)	325 (71%)	
Any hypertension diagnosis					0.8
Yes	180 (25%)	23 (22%)	44 (30%)	113 (25%)	
No	528 (75%)	82 (78%)	102 (70%)	344 (75%)	
Engagement in care					<0.001
Yes	528 (75%)	61 (58%)	97 (66%)	370 (81%)	
No	180 (25%)	44 (42%)	49 (34%)	87 (19%)	
Adherence to ART* (Self-rating scale)					0.001
Very poor-fair	37 (6%)	12 (13%)	9 (7%)	16 (4%)	
Good-Excellent	621 (94%)	81 (87%)	125 (93%)	415 (96%)	

	Total (n=708)	Social Support			p-value ^d
		Low (0-3 points) (n=105)	Medium (4-7 points) (n=146)	High (8 points) (n=457)	
Adherence (VAS ^{**})	99 (95-100)	96 (90-99)	98 (93-100)	99 (96.5-100)	< 0.001
Number of symptoms bothered by, some or a lot	1 (0-4)	5 (1-9)	2 (0-7)	0 (0-3)	< 0.001
HRQL ^{***} (VAS ^{**})	80 (67-91)	66 (47-80)	75 (61-90)	86 (70-95)	< 0.001
HRQL (EQ-5D)	6 (5-7)	7 (6-8.5)	6 (5-7)	5 (5-7)	< 0.001
Depression (PHQ-9)	3 (0.5-8)	8.5 (5-15)	6 (2-11)	2 (0-5)	< 0.001
Anxiety (PHQ-5)					< 0.001
None	528 (75%)	58 (56%)	92 (63%)	378 (83%)	
Some	94 (13%)	18 (17%)	30 (21%)	46 (10%)	
High	82 (12%)	28 (27%)	23 (16%)	31 (7%)	
HIV stigma	1.5 (1-2.5)	2.5 (1.5-3.5)	2 (1.5-3)	1 (1-2)	<0.001
Current smoke or vape					0.005
Yes	218 (31%)	42 (40%)	51 (35%)	125 (27%)	
No	487 (69%)	62 (60%)	94 (65%)	331 (73%)	
Any cocaine/crack past 3 months					0.51
Yes	34 (5%)	5 (5%)	9 (6%)	20 (5%)	
No	657 (95%)	94 (95%)	134 (94%)	429 (96%)	
Any methamphetamines/crystal past 3 months					< 0.001
Yes	72 (11%)	20 (19%)	25 (18%)	27 (6%)	
No	615 (90%)	83 (81%)	115 (82%)	417 (94%)	
Any heroin past 3 months					0.002
Yes	7 (1%)	3 (3%)	4 (3%)	0 (0%)	
No	671 (99%)	95 (97%)	134 (97%)	442(100%)	
Any prescription opioids taken not as prescribed past 3 months					0.95
Yes	11 (2%)	1 (1%)	3 (2%)	7 (2%)	
No	670 (98%)	100 (99%)	135 (98%)	435 (98%)	
Used any of the above drugs, past 3 months					0.001
Yes	224 (33%)	43 (42%)	56 (40%)	125 (29%)	
No	458 (67%)	60 (58%)	84 (60%)	314 (72%)	
Any sedatives past 3 months					0.21

	Total (n=708)	Social Support			p-value ^a
		Low (0 – 3 points) (n=105)	Medium (4-7 points) (n=146)	High (8 points) (n=457)	
Yes	147 (21%)	24 (24%)	35 (24%)	88 (20%)	
No	546 (79%)	78 (77%)	109 (76%)	359 (80%)	0.47
Any prescription stimulants past 3 months					
Yes	89 (13%)	13 (13%)	22 (15%)	54 (12%)	
No	600 (87%)	87 (87%)	121 (85%)	392 (88%)	0.012
Any marijuana past 3 months					
Yes	205 (29%)	34 (33%)	54 (38%)	117 (26%)	
No	429 (71%)	68 (67%)	89 (62%)	335 (74%)	0.65
Alcohol risk, AUDIT					
No drinking	233 (34%)	38 (37%)	44 (31%)	151 (34%)	
Not high risk	338 (49%)	47 (46%)	67 (48%)	224 (50%)	
High risk	120 (17%)	17 (17%)	30 (21%)	73 (16%)	0.008
Approximately how many sex partners, past 3 months					
None	261 (37%)	40 (39%)	52 (36%)	169 (37%)	
1	271 (39%)	33 (32%)	45 (31%)	193 (42%)	
2 to 5	144 (20%)	26 (25%)	39 (27%)	79 (17%)	
6	28 (4%)	4 (4%)	10 (7%)	14 (3%)	0.001
Concerned might have been exposed to STI ^{****} or re-exposed to HIV					
Yes	80 (18%)	18 (29%)	23 (25%)	39 (14%)	
No	359 (82%)	45 (71%)	69 (75%)	245 (86%)	0.08
Any unprotected vaginal or anal sex					
Yes	228 (53%)	36 (59%)	52 (58%)	140 (50%)	
No	205 (47%)	25 (41%)	38 (42%)	142 (50%)	

^a. Univariate p-value from ordinal logistic regression.

* antiretroviral treatment

** visual analog scale

*** health-related quality of life

sexually transmitted infection

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Risk ratios (RR) (with 95% confidence intervals) for adding social support to models similar to those found in recent selected robust studies. All models were controlled for age, sex, and race and covariates in the right column. High social support was the reference category.

Table 3.

Outcome	Association of Social Support with outcome in PLWH in CNICS cohort			Example study from the literature	Covariates
	High	Medium	Low		
Depression (PHQ9; 4 categories)	Ref	2.59 (2.00, 3.36)	3.72 (2.93, 4.72)	Anagnostopoulos 2015	Viral load, recent cd4 count, drug use, sexually active, alcohol use
Poor engagement in care		1.62 (1.15, 2.29)	2.05 (1.44, 2.96)	Hightow-Weidman 2017	Depression, substance use
Adherence (4 categories)		0.91 (0.81, 1.01)	0.76 (0.64, 0.89)	Skalski 2015	Depression, substance use
Recent viral load undetectable*		1.01 (0.94, 1.11)	1.00 (0.90, 1.10)	Rangarajan 2016	Depression, stigma, substance use, adherence, engagement in care
Health-related quality of life (4 categories)		0.97 (0.89, 1.05)	0.86 (0.75, 0.97)	Armon 2012	Substance use, recent CD4 cell count, symptoms, depression
Health-related quality of life (4 categories)		0.97 (0.89, 1.06)	0.85 (0.75, 0.97)	Castro 2018	Depression, substance use, viral load, recent cd4 count
Recent drug use		1.11 (0.84, 1.46)	1.11 (0.81, 1.52)	Lightfoot 2005	Depression, health-related quality of life
Number of symptoms (4 categories)		1.75 (1.44, 2.13)	2.29 (1.92, 2.75)	Lee 2009, Harding 2012	Recent CD4 cell count, viral load

* A model for recent viral load that did not control for adherence or engagement in care gave similarly null findings for social support, with RR of 0.97 (0.86, 1.08) for medium support and 0.97 (0.86, 1.10) for low.