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Social connectedness, depression symptoms, and health service utilization: a longitudinal study of Veterans Health Administration patients

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Abstract

Purpose—Our study explored whether aspects of veterans' social connectedness (social support, interpersonal conflict, loneliness, social norms, number of confidants) are associated with change in their depression symptoms and health services utilization over 1 year.

Methods—We conducted a prospective, longitudinal study of 262 military veterans who obtained primary care and other services at a Veterans Health Administration (VHA) facility and screened positive for depression. Participants completed surveys at baseline and 12-month follow-up. We measured social connectedness variables using the NIH Toolbox Adult Social Relationship Scales. We used the Patient Health Questionnaire to assess depression symptoms and suicidal ideation and administrative medical record data for health services utilization. We calculated change scores to model outcomes over time using multivariable regressions.

Results—We found that higher levels of baseline loneliness were associated with decreased depression severity over 1 year ($B = -1.55$, 95% CI $[-2.53, -.56]$, $p < .01$). We found a similar association for suicidal ideation. In contrast, higher baseline number of confidants was associated with increased depression ($B = .55$, 95% CI $[.18, .92]$, $p < .01$). Higher levels of emotional support were associated with decreased mental health visits ($B = -3.88$, 95% CI $[-6.80, -.96]$, $p < .01$). No significant associations were found between social connectedness variables and primary care visits.

Conclusions—Emotional support may play an important role in reducing mental health treatment utilization among VHA-using veterans. Additional investigation as to how and why

loneliness and number of confidants might be paradoxically associated with depression symptoms remains necessary.

Keywords

Major depression; Suicide; Veterans; Social support; Health services

Introduction

Extensive literature has supported the impact of social determinants on mental health conditions such as depression [1]. One of the most important social determinants of health is social connectedness. There are a number of social factors and processes that act as meaningful markers of social connectedness. For instance, past studies have shown individuals' depression symptoms are strongly correlated with those of their social network [2]. In addition, individuals' perceived availability of social support and access to social networks that include presence of confidants can be protective against depression [3]. Loneliness, defined as distress associated with the inability to develop and maintain wanted social relationships [4], is also closely associated with depression. Prior longitudinal research has suggested that loneliness is a unique predictor of depression severity over time [5, 6].

Social connectedness is also associated with improved treatment utilization. As the majority of individuals with depression do not seek professional care, strategies for improving treatment utilization may have broad population-level mental health effects [7, 8]. Past studies show social support and encouragement are among the best predictors of mental health treatment initiation, help-seeking, and treatment adherence [9, 10]. However, to date, there are few interventions that directly target social connectedness as a mechanism for increasing help-seeking.

One important group to examine these issues in is military veterans. Veterans report challenges with connecting to supportive others due to a variety of reasons such as difficulties reintegrating into civilian culture and mental health symptoms [11]. Cross-sectional research among veterans identifies loneliness as a unique predictor among other markers of social connectedness for depression symptoms and suicidal ideation [12]. Veterans also have higher rates of depression and suicide than the general population [13, 14]. To address these types of concerns, interventions utilizing peers and veteran-specific programs have been developed [15, 16]. Such approaches may strengthen social connectedness and encourage at-risk individuals to obtain formal treatment. However, research is limited and the "active ingredients" of social connectedness among veterans' extant social networks remain unknown.

In summary, the extant literature supports the general importance of social connectedness in depression, but much remains unknown about which aspects of social connectedness have the most significance longitudinally [17, 18]. Furthermore, increasing our knowledge on which types of social connectedness have the greatest impact on outcomes such as depression severity, suicidal ideation, and healthcare utilization may help identify and refine the most promising intervention targets.

Our current study focused on exploring the association between social connectedness and change in depression symptoms as well as treatment utilization over time in veterans. To achieve this, we conducted a prospective, longitudinal study with a cohort of veterans with depression. We hypothesized that higher levels of positive indicators of social connectedness (e.g. emotional support) and lower levels of negative markers of social connectedness (e.g. hostility) at baseline would be associated with greater decrease in depression symptoms (Hypothesis 1) and suicidal ideation (Hypothesis 2). In addition, we hypothesized that similar associations to those predicted for change in mental health outcomes would be seen for treatment utilization (e.g. mental health visits; Hypothesis 3).

Methods

Participants

We recruited participants from a large, western, Veterans Health Administration (VHA) facility. After obtaining written consent, we invited eligible veterans to complete a baseline survey on mental health symptoms and social connectedness. To determine positive depression screen, we used a two-stage process: (1) Initial positive depression screen based on the Patient Health Questionnaire-2 (PHQ-2) (an inclusion criteria); (2) Positive depression screen during enrollment interview (PHQ-8 > 9; the PHQ-8 is identical to the PHQ-9 with the exception of item 9 on suicidal ideation) (classification as depressed at baseline). All participants were enrolled for the baseline survey between September 2015 and February 2017 (see Teo et al. [12] for full details on participant recruitment). In total, 302 participants completed the baseline survey. One year following the baseline survey, we contacted participants to complete a brief follow-up survey on mental health symptoms and health services utilization. All study procedures were approved by our local institutional review board. Of the 272 (90.1%) that responded, 6 participants were excluded for missing data. Another four participants were excluded for missing depression and suicidal ideation data. Thus, analyses with treatment utilization outcomes had an analytic sample of 266 veterans, and analyses with depression severity and suicidal ideation outcomes included 262 veterans.

Measures

Social connectedness—We utilized the NIH Toolbox Adult Social Relationship Scales, which have previously been shown to be reliable and valid measures of these processes [19], to assess social support (emotional support, instrumental support, friendship), interpersonal conflict (perceived rejection, perceived hostility) and loneliness at baseline. All items were rated on a 1–5 scale with higher numbers indicating greater endorsement of the construct. We also evaluated perceived social norms regarding depression treatment using items adapted from the literature. Social norm items assess both distal (“people your age”) and proximal (“people who are important to you”) social relationships, as well as descriptive and injunctive norms. Higher scores indicate greater perceived approval of seeking treatment for depression (please see Teo et al. [12] for full details). Finally, we measured number of confidants using an item adapted from the General Social Survey questionnaire asking participant for a count of total number of close confidants (i.e. “people with whom you discussed matters that are important to you.”) [20]. All social connectedness measures were

collected at baseline. If a participant responded to 80% or more of the component questions of a social process score, we imputed their average score for analysis.

Primary outcomes

Change in depression severity—Participants' depression score was calculated as the sum of their nine-item Patient Health Questionnaire (PHQ-9) responses. Depression score change was calculated by subtracting their PHQ-9 score at baseline from their PHQ-9 score at 12-month follow-up.

Change in mental health visits—Participants' number of mental health visits for the 12 months preceding baseline and follow-up were extracted from the Veteran Health Administration's Corporate Data Warehouse (CDW) which is a collection of national clinical and administrative data. Mental health visits included in-person, outpatient individual and group visits and phone visits. Change in number of visits was calculated by subtracting the number of visits in the 12 months before baseline from the number of visits in the 12 months before follow-up.

Secondary outcomes

Change in suicidal ideation (SI)—Change in suicidal ideation was calculated from responses to item 9 on the PHQ-9 (*Thoughts that you would be better off dead, or of hurting yourself*). Responses on this item ranged from 0 to 3 with higher scores indicating greater SI severity. SI score change was calculated similarly to depression score change.

Change in primary care visits—Change in primary care visits was calculated in a similar manner to change in mental health visits utilizing CDW data, and included in-person, outpatient individual visits, and phone visits [21].

Covariates—All covariates were self-reported at baseline. For our analyses, we used *age* as a continuous variable and *gender* (male or female) and *race/ethnicity* (minority or non-minority) as binary. *PTSD screening score* was calculated using the Primary Care PTSD Screen (PC-PTSD) [22]. *Alcohol use screening score* was calculated using the Alcohol Use Disorders Identification Test-Concise (AUDIT-C) [23]. We used both screening scores as continuous variables to account for common mental health comorbidities in veteran populations. *Comorbidity score* was evaluated using the Selim comorbidity index which is calculated as a summary score of 30 common medical comorbidities [24]. *Financial hardship* was collapsed from a 5-category response into a binary variable in response to the question, "How hard is it for you to pay for the very basics like food, housing, medical care, and heating?"

Statistical analysis

In descriptive analyses, we examined participant characteristics at baseline and statistical assumptions. Histogram plots were used to visualize the distribution of outcome variables at baseline and follow-up, as well as the change in values between baseline and follow-up. Prior to analysis, change in mental health visits was truncated to $\pm 2SD$ ($n = 14$ were truncated to minimum and maximum values $[-54.08, 49.26]$) to correct for potential

outliers and to make the outcome normally distributed. All other outcome variables were normally distributed. Pearson's correlation coefficients (r) were calculated to assess for correlation among social process scores, as well as between social process scores and our outcomes of interest.

We used multiple linear regression models to examine the association between social process scores and our outcomes of interest. Fully adjusted models included age, gender, race/ethnicity, AUDIT-C screening score, PTSD screening score, medical comorbidity score, and financial hardship. Variance inflation factors were calculated to assess for collinearity among independent variables in each model. We ran the following models for each outcome variable. Model 1 evaluated the role of each social process in a separate analysis (e.g. association between loneliness and depression change) to evaluate associations between individual social process predictors and outcomes and Model 2 (i.e. test of independence) which modeled all social connectedness variables in one model to evaluate the unique variance explained by each respective social process. All models were fully adjusted for the covariates described above. We present Model 2 as our final model for each outcome due to our interest in identifying variables predicting unique variance in our outcomes of interest.

Results

Demographics

Our participants were on average 55.6 ($\pm$ 13.8) years old. Our sample was predominantly male (82.4%) and non-Hispanic white (75.6%). Ninety-two percent reported a history of psychiatric diagnosis, 73.3% reported that they had used a psychiatric medication in the previous 6 months, and 18% reported a past suicide attempt. Participants had an average of 3.1 ($\pm$ 4.0) confidants at baseline. See Table 1 for full details.

Initial correlations

Our correlational analyses showed some expected associations between social connectedness variables (See Supplemental Tables 1 and 2). Lower levels of loneliness at baseline were associated with increased depression scores at 12-month follow-up. Lower levels of emotional support were associated with increased number of mental health visits, while higher levels of perceived hostility were associated with increased mental health visits at 12-month follow-up. However, higher number of confidants was associated with increased depression, and lower levels of loneliness and higher levels of friendship were associated with increased SI. No social connectedness variables were associated with change in primary care visits (see Table 2 for full descriptive statistics).

Primary outcomes

Change in depression severity—In Model 1, we found that number of confidants and loneliness were significantly associated with change in depression. Model 2 (i.e. test for independence) showed similar findings to Model 1 identifying that number of confidants and loneliness were unique predictors of change in depression. In Table 3, we show that loneliness and number of confidants are significantly associated with change in depression. For each additional confidant reported at baseline, there was an average 0.55-point increase

in PHQ-9 score. For each additional point in loneliness score at baseline, there was an average 1.55-point decrease in PHQ-9 score. These results were similar to initial correlational analyses. Overall, Model 2 explained 6% of the variance in change in depression. As these findings were opposite in direction to what was expected based on the extant literature, we conducted additional sensitivity analyses to evaluate potential statistical factors that may have affected results. These analyses included exploring issues of multicollinearity, suppressor variables, evaluation of potential confounders (e.g. medication usage, number of confidants), and unexpected interaction effects involving potential confounding variables. Following these analyses, results remained unchanged leading us to retain Model 2 as the final model for depression change (see Appendix for sensitivity analyses).

Change in mental health visits—For Model 1, we found a significant association between hostility and change in mental health visits. In Model 2, only emotional support was a unique predictor of change in mental health visits (see Table 4). For each additional point in emotional support at baseline, there was an average decrease of 3.88 visits. These results were similar to initial correlational analyses. Overall, Model 2 explained 5% of the variance in change in mental health visits.

Secondary outcomes

Change in suicidal ideation—In Model 1, we found that number of confidants, friendship, and loneliness was significantly associated with suicidal ideation. In Model 2, only loneliness remained a significant predictor of change in suicidal ideation. For each additional point in loneliness score at baseline, there was an average 0.21-point decrease in SI score. These results were similar to initial correlational analyses. Overall, Model 2 explained 3.5% of the variance in change in suicidal ideation.

Change in primary care visits—For both Models 1 and 2, we found no significant associations between social connectedness and change in primary care visits. These results were similar to our initial correlational analyses.

Discussion

The current study was an exploration of prospective longitudinal associations between social connectedness, and mental health services utilization outcomes in a sample of primary care patients with new positive screens for depression. Contrary to hypotheses, we found higher levels of loneliness at baseline were associated with greater decrease in depression symptoms and suicidal ideation over time. This contrasts with past research suggesting that loneliness is positively associated with depression and suicidality [5, 25]. However, it is possible that our results are driven, in part, by clinical characteristics that differ between our sample and those of past studies. For example, past research utilized general population samples with limited mental health burden. In contrast, our sample had markedly higher levels of depression symptoms (moderately severe range vs. minimal range) and antidepressant utilization (64.5% vs. 7.5%) compared with past research [5]. In addition, veteran-focused research shows depression is significantly associated with disease burden

over time [26]. Consequently, social connectedness variables may operate differently among individuals with more severe depression.

Another potential explanation for our surprising results may be measurement phenomena. Here, it is important to note that the overall severity of depression in our sample decreased over time. Thus, our results may reflect decreases in loneliness due to regression to the mean in loneliness scores. Because we only measured social connectedness variables, including loneliness, at baseline, it is impossible to know for certain how this may have influenced our results. In addition, as our participants all had at least one confidant, our findings may differ from past research involving participants with no reported confidants. For example, past research shows individuals with higher levels of depression symptoms and social withdrawal who have at least one confidant have greater decreases in depression symptoms over time [27]. Future studies may wish to explore clinical characteristics that may influence the degree to which patients are impacted by loneliness to inform targeted intervention strategies.

Unexpectedly, we found the number of confidants at baseline was associated with greater increase in depression symptoms over time. Past research shows larger social network size is associated with lower levels of depression [5]. One possible explanation for this finding is that participants had decreases in the number of confidants available to them during the yearlong period between baseline and follow-up assessment, leading to higher levels of depression symptoms. Other research shows that individuals with depression report experiencing more negative interactions with supportive others than the general population [28]. Consequently, findings may also be due to the quality of relationships with confidants as opposed to quantity. The quality of relationships appears to be especially important as individuals' age. Carmichael and colleagues found that quality of relationships was prospectively associated with depression later life [17]. Future research should further explore potential factors (e.g. quality of relationships with confidants, types of social contact with confidants) that may affect veterans' symptoms of depression over time.

As expected, higher levels of emotional support were associated with decreased mental health symptoms which may decrease need for mental health visits. Our study replicates findings from the past literature suggesting emotional support may be protective against mental health difficulties [29, 30]. These findings suggest interventions focused on improving social support may positively influence mental health services outcomes over time.

Based on our study design, our results should be interpreted in light of several limitations. All measures of mental health symptoms were self-reported and thus subject to social desirability and other self-report biases. Although we had objective measurement of services utilization through administrative data, this was limited to care received within VHA. As the study was an observational, longitudinal cohort study, we cannot make causal inferences based on our results. In addition, as alluded to above, we are unable to characterize changes in these social connectedness variables over time. As well, more nuanced understandings of social connectedness may be needed (e.g. quality versus quantity of social relationships) to best inform intervention development. Finally, our findings may have limited

generalizability to other populations with limited representation in our sample, including female and minority veterans.

Despite these limitations, this study provides novel prospective data on the extent to which different facets of social connectedness impact mental health and health services utilization outcomes in a sample of VHA-using veterans who had a positive depression screen. Our findings suggest the potentially complex consequences of modifying social connectedness, including the possibilities of variation between populations as well as both beneficial and unanticipated impacts on depression-related outcomes. Future research should consider exploring the relationship between social connectedness and mental health and services utilization outcomes in greater depth to determine specific variables for intervention.

Supplementary Material

Refer to Web version on PubMed Central for supplementary material.

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References

1. Allen J, Balfour R, Bell R, Marmot M (2014) Social determinants of mental health. *Int Rev Psychiatry* 26(4):392–407 [PubMed: 25137105]
2. Rosenquist JN, Fowler JH, Christakis NA (2011) Social network determinants of depression. *Mol Psychiatry* 16(3):273–281. 10.1038/mp.2010.13 [PubMed: 20231839]
3. Santini ZI, Koyanagi A, Tyrovolas S, Mason C, Haro JM (2015) The association between social relationships and depression: a systematic review. *J Affect Disord* 175:53–65 [PubMed: 25594512]
4. Perlman D, Peplau LA (1982) Theoretical approaches to loneliness. *Loneliness: a sourcebook of current theory, research and therapy*. Wiley, Hoboken, NJ, pp 123–134
5. Cacioppo JT, Hawkley LC, Thisted RA (2010) Perceived social isolation makes me sad: five year cross-lagged analyses of loneliness and depressive symptomatology in the Chicago health, aging, and social relations study. *Psychol Aging* 25(2):453–463 [PubMed: 20545429]
6. American Psychological Association (2010) Perceived social isolation makes me sad: 5-year cross-lagged analyses of loneliness and depressive symptomatology in the Chicago Health, Aging, and Social Relations Study [press release]. American Psychological Association, USA
7. Mojtabai R, Olfson M, Mechanic D (2002) Perceived need and help-seeking in adults with mood, anxiety, or substance use disorders. *Arch Gen Psychiatry* 59(1):77–84 [PubMed: 11779286]
8. Mojtabai R, Olfson M, Sampson NA et al. (2011) Barriers to mental health treatment: results from the National Comorbidity Survey Replication (NCS-R). *Psychol Med* 41(8):1751–1761 [PubMed: 21134315]
9. Fröjd S, Marttunen M, Pelkonen M, von der Pahlen B, Kaltiala-Heino R (2007) Adult and peer involvement in help-seeking for depression in adolescent population. *Soc Psychiatry Psychiatr Epidemiol* 42(12):945–952 [PubMed: 17846696]

10. Spoont Michele R, Nelson David B, Murdoch Maureen et al. (2014) Impact of treatment beliefs and social network encouragement on initiation of care by va service users with PTSD. *Psychiatr Serv* 65(5):654–662 [PubMed: 24488502]
11. Demers A (2011) When veterans return: the role of community in reintegration. *J Loss Trauma* 16(2):160–179
12. Teo AR, Marsh HE, Forsberg CW et al. (2018) Loneliness is closely associated with depression outcomes and suicidal ideation among military veterans in primary care. *J Affect Disord* 230:42–49 [PubMed: 29407537]
13. Trivedi RB, Post EP, Sun H et al. (2015) Prevalence, comorbidity, and prognosis of mental health among US veterans. *Am J Public Health* 105(12):2564–2569 [PubMed: 26474009]
14. Office of Mental Health and Suicide Prevention (2016) Suicide among veterans and other Americans, 2001–2014. US Department of Veterans Affairs, Washington, DC
15. Goetter EM, Bui E, Weiner TP, Lakin L, Furlong T, Simon NM (2017) Pilot data of a brief veteran peer intervention and its relationship to mental health treatment engagement. *Psychol Serv* 15(4):453–456. 10.1037/ser0000151 [PubMed: 28493731]
16. Greden JF, Valenstein M, Spinner J et al. (2010) Buddy-to-Buddy, a citizen soldier peer support program to counteract stigma, PTSD, depression, and suicide. *Ann N Y Acad Sci* 1208(1):90–97 [PubMed: 20955330]
17. Carmichael CL, Reis HT, Duberstein PR (2015) In your 20s it's quantity, in your 30s it's quality: the prognostic value of social activity across 30 years of adulthood. *Psychol Aging* 30(1):95–105 [PubMed: 25774426]
18. Wrzus C, Hänel M, Wagner J, Neyer FJ (2013) Social network changes and life events across the life span: a meta-analysis. *Psychol Bull* 139(1):53–80 [PubMed: 22642230]
19. Cyranowski JM, Zill N, Bode R et al. (2013) Assessing social support, companionship, and distress: NIH toolbox adult social relationship scales. *Health Psychol* 32(3):293–301 [PubMed: 23437856]
20. Burt RS (1984) Network items and the general social survey. *Soc Netw* 6(4):293–339
21. McMillan D, Gilbody S, Richards D (2010) Defining successful treatment outcome in depression using the PHQ-9: a comparison of methods. *J Affect Disord* 127(1):122–129 [PubMed: 20569992]
22. Ouimette P, Wade M, Prins A, Schohn M (2008) Identifying PTSD in primary care: comparison of the primary care-PTSD screen (PC-PTSD) and the general health questionnaire-12 (GHQ). *J Anxiety Disord* 22(2):337–343 [PubMed: 17383853]
23. Bradley KA, DeBenedetti AF, Volk RJ, Williams EC, Frank D, Kivlahan DR (2007) AUDIT-C as a brief screen for alcohol misuse in primary care. *Alcoholism* 31(7):1208–1217 [PubMed: 17451397]
24. Selim AJ, Fincke BG, Ren XS et al. (2004) Comorbidity assessments based on patient report: results from the veterans health study. *J Ambul Care Manag* 27(3):281–295
25. Van Orden KA, Cukrowicz KC, Witte TK, Joiner TE Jr (2012) Thwarted belongingness and perceived burdensomeness: construct validity and psychometric properties of the interpersonal needs questionnaire. *Psychol Assess* 24(1):197–215 [PubMed: 21928908]
26. Possemato K, Wade M, Andersen J, Ouimette P (2010) The impact of PTSD, depression, and substance use disorders on disease burden and health care utilization among OEF/OIF veterans. *Psychol Trauma* 2(3):218–223
27. Markovic A, Bowker JC (2017) Friends also matter: examining friendship adjustment indices as moderators of anxious-withdrawal and trajectories of change in psychological maladjustment. *Dev Psychol* 53(8):1462–1473 [PubMed: 28530435]
28. Zlotnick C, Kohn R, Keitner G, Della Grotta SA (2000) The relationship between quality of interpersonal relationships and major depressive disorder: findings from the national comorbidity survey. *J Affect Disord* 59(3):205–215 [PubMed: 10854637]
29. Cohen S (2004) Social relationships and health. *Am Psychol* 59(8):676–684 [PubMed: 15554821]
30. Umberson D, Karas Montez J (2010) Social relationships and health: a flashpoint for health policy. *J Health Soc Behav* 51(1_suppl):S54–S66 [PubMed: 20943583]

Table 1Participant demographic characteristics ($n = 262$)

	M (SD) or n (%)
Age	55.6 (13.8)
Sex	
Male	216 (82.4)
Female	46 (17.6)
Race/ethnicity	
White	198 (75.6)
Black	17 (6.5)
Latino	15 (5.7)
AI/AN	22 (8.4)
Other	10 (3.8)
Education	
Some high school	6 (2.3)
GED or HS diploma	36 (13.7)
Some college	97 (37.0)
Associates degree	64 (24.4)
College degree+	59 (22.5)
Financial hardship	
Not at all difficult	64 (24.4)
Not very difficult	56 (21.4)
Somewhat difficult	74 (28.2)
Difficult	37 (14.1)
Very difficult	31 (11.8)
Household income	
< \$15,000	51 (19.8)
\$15,000 to \$29,999	60 (23.3)
\$30,000 to \$49,999	66 (25.7)
\$50,000 to \$74,999	47 (18.3)
\$75,000 to \$99,999	15 (5.8)

\$100,000+	18 (7.0)
Urban/rural	
Urban	215 (82.4)
Rural	46 (17.6)
Stable housing	240 (91.6)
Own a house	108 (41.4)
Household characteristics	n (%)
Living alone (time 1)	81 (30.9)
Marital status (time 1)	
Married or living with partner	130 (49.6)
Divorced or separated	88 (33.6)
Widowed	14 (5.3)
Never married	30 (11.5)
Clinical characteristics	M (SD) or n (%)
PHQ-9 total score ^a	14.8 (5.7)
Antidepressant usage (%) ^b	169 (64.5)
Number of mental health visits ^c	16.4 (36.5)
Positive suicidal ideation (%) ^d	98 (37.7)
Depression severity (baseline)^e	n (%)
None-minimal	10 (3.8)
Mild	39 (14.9)
Moderate	79 (30.2)
Moderately severe	74 (28.2)
Severe	60 (22.9)
Depressive severity change	n (%)
Worse (1+ category worse at follow-up)	65 (24.8)
Same (same category)	89 (34.0)
Better (1+ category better at follow-up)	108 (41.2)
Clinically significant change ^f	28 (13)

Results presented as n (%) or mean (SD). Scores are based on data from participants with at least 80% completed of a given measure

^aBaseline patient health questionnaire-9 total score

^bVHA Corporate Data Warehouse pharmacy record data

^cVHA Corporate Data Warehouse clinical encounters data

^dPercentage of participants endorsing “1” or higher on PHQ-9 item 9 for participants with non-missing data on this item ($n = 260$)

^eAs defined by clinical cut-offs on the PHQ-9 scoring instructions

^fClinically significant change in depression was defined as follow-up PHQ-9 total score 9 combined with 50% decrease in total score among participants who had PHQ-9 score > 9 at baseline ($n = 213$; see McMillan et al. [21] for full details)

Table 2Descriptive statistics for social connectedness variables ($n = 262$)

NIH toolbox scales	Mean ($\pm$ SD)	Median [IQR]
Emotional support ^a	3.5 ($\pm$ 1.0)	3.5 [2.9, 4.1]
Instrumental support ^b	3.2 ($\pm$ 1.2)	3.1 [2.3, 4.3]
Perceived rejection ^c	2.3 ($\pm$.9)	2.2 [1.5, 2.9]
Perceived hostility ^d	2.2 ($\pm$.8)	2.3 [1.6, 2.8]
Friendship ^e	2.5 ($\pm$.9)	2.5 [1.9, 3.1]
Loneliness ^f	3.3 ($\pm$.9)	3.4 [2.8, 4.0]
Social norms		
Distal peer descriptive norms ^g	2.7 ($\pm$.9)	2.8 [2.0, 3.5]
Distal peer injunctive norms ^h	3.1 ($\pm$ 1.1)	3.0 [2.5, 4.0]
Proximal peer descriptive norms ⁱ	2.9 ($\pm$ 1.0)	3.0 [2.0, 3.5]
Proximal peer injunctive norms ^j	3.6 ($\pm$ 1.0)	4.0 [3.0, 4.0]
Confidants		
Number of confidants (Time 1) ^k	3.1 ($\pm$ 4.0)	2.0 [1.0, 3.0]

Results presented as mean ($\pm$ SD) or median [IQR] unless otherwise noted ($n = 262$)^aBased on the NIH toolbox adult social relationship scale on emotional support; scores range from 1 to 5^bBased on the NIH toolbox adult social relationship scale on instrumental support; scores range from 1 to 5^cBased on the NIH toolbox adult social relationship scale on perceived rejection; scores range from 1 to 5^dBased on the NIH toolbox adult social relationship scale on perceived hostility; scores range from 1 to 5^eBased on the NIH toolbox adult social relationship scale on friendship; scores range from 1 to 5^fBased on the NIH toolbox adult social relationship scale on loneliness; scores range from 1 to 5^gBased on three items, "How likely would most people your age be to seek treatment if depressed?"; "How likely would most people your age be to ask for help if depressed?"; "How likely would most people your age be to consider having depression a weakness?"

- h* Based on two items: “How likely would most people your age be to approve of you asking for help if depressed?”
- i* Based on two items: “How would most people who are important to you be to seek treatment if depressed?” and “How likely would most people who are important to you be to ask for help if depressed?”; scores range from 1 to 5
- j* Based on two items: “How would most people who are important to you approve of you getting treatment if depressed?”; “How would most people who are important to you approve of you asking for help if depressed?”; scores range from 1 to 5
- k* Number of “people with whom you discussed matters that are important to you”

Table 3

Associations between social connectedness variables and change in depression ($N = 262$; adjusted $R^2 = .06$)

Variable	<i>B</i>	<i>SE</i>	95% CI
Number of confidants **	.55	.19	.18, .92
Emotional support	– .55	.50	– 1.54, .45
Instrumental support	– .10	.38	– .86, .65
Friendship	.03	.56	– 1.08, 1.13
Perceived rejection	– .34	.58	– 1.48, .79
Perceived hostility	.80	.57	– .31, 1.91
Loneliness **	– 1.55	.50	– 2.53, – .56
Distal descriptive norms	.56	.58	– .58, 1.70
Distal injunctive norms	– .50	.52	– 1.52, .51
Proximal descriptive norms	.09	.47	– .84, 1.02
Proximal injunctive norms	– .39	.55	– 1.48, .70

This model was fully adjusted for age, gender, minority status, AUDIT-C screening score, PTSD screening score, medical comorbidity score, and financial hardship

* $p < .05$,

** $p < .01$

Table 4

Associations between social connectedness variables and change in mental health visits ($N=266$; adjusted $R^2 = .05$)

Variable	<i>B</i>	<i>SE</i>	95% CI
Number of confidants	1.09	.55	.01, 2.17
Emotional support **	− 3.88	1.48	− 6.80, − .96
Instrumental support	.27	1.11	− 1.92, 2.46
Friendship	− .20	1.65	− 3.44, 3.04
Perceived rejection	.28	1.70	− 3.07, 3.62
Perceived hostility	3.22	1.66	− .04, 6.48
Loneliness	− .51	1.47	− 3.40, 2.39
Distal descriptive norms	− 2.64	1.71	− 6.00, .72
Distal injunctive norms	1.20	1.53	− 1.80, 4.21
Proximal descriptive norms	.04	1.39	− 2.69, 2.78
Proximal injunctive norms	2.59	1.63	− .61, 5.79

This model was fully adjusted for age, gender, minority status, AUDIT-C screening score, PTSD screening score, medical comorbidity score, and financial hardship

* $p < .05$,

** $p < .01$