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Social Networks and Depressive Symptoms among Chinese Older Immigrants: Does Quantity, Quality, and Composition of Social Networks Matter?

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Abstract

Objectives: This study aims to investigate the relationship between quantity, quality, and composition of social networks and depressive symptoms among U.S. Chinese older adults.

Methods: Data were derived from the Population Study of Chinese Elderly (PINE) (N = 3,157), a study of Chinese older adults aged 60 and above in Chicago. We assessed quantitative (network size and volume of contact), qualitative (emotional closeness), and composition (proportion kin, proportion female and proportion coresident) aspects of social networks. Depressive symptoms were measured by the Patient Health Questionnaire-9. Negative binomial and logistic regressions were conducted.

Results: Older adults who had three to five network members with strong ties, a medium level of contact, and a high level of emotional closeness were less likely to experience depression than their counterparts. Quantitative and qualitative dimensions of social networks have stronger protective effects than the composition dimension.

Conclusions: U.S. Chinese older immigrants with different levels of social network characteristics have different risks of depression, suggesting targeted subpopulation assessments to facilitate the delivery of more appropriate and effective treatment to those most in need.

Clinical Implications: Health-care professionals and social service agencies are suggested to develop intervention programs to promote mental health through increasing strong ties and improving the quality of social networks for U.S. Chinese older immigrants.

Keywords

Social networks; depressive symptoms; older adults; Chinese

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Disclosure statement

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Introduction

Social networks describe social relationships that people maintain and from which they gain needed resources and support. They play a critical role in the determination of health and well-being, particularly in older age (Berkman, Glass, Brissette, & Seeman, 2000; Li & Dong, 2018b). Social networks are constructed as multi-dimensional, including quantitative, qualitative, and composition aspects (Antonucci, Ajrouch, & Birditt, 2013). Different aspects of social networks have differential impacts on depressive symptoms of older adults (Litwin, 2011).

There is both theoretical and empirical evidence that the quantity and quality of social networks play a significant role in the psychological well-being of older adults (Antonucci, 2001; Lakey, 2013). Quality of social networks could be more important than the quantity of social networks in the mechanism affecting psychological well-being (Amieva et al., 2010; Blazer, 1982; Fiori, Antonucci, & Cortina, 2006). Meanwhile, many research studies have used network size to measure the quantity of social networks, which may not reflect the amount of individuals' social interactions, for example, small network size can also be associated with a large volume of contact (Fiori et al., 2006).

An increasing amount of research has moved away from examining the quantity and quality of social networks, instead towards network composition. Fiori et al. (2006) found depressive symptoms were highest for older Americans in a nonfriends network and lowest for those in a diverse network. A study conducted in Hong Kong reported older adults with diverse networks were significantly less depressed than those with friend-focused, restricted, and distant family networks and those with family-focused networks were less depressed than those with restricted networks (Cheng, Lee, Chan, Leung, & Lee, 2009).

The relationship between social networks and psychological well-being has not been sufficiently investigated among ethnic minorities (Fiori et al., 2006; Litwin, 2011). Different racial and ethnic groups within the U.S. show distinctive patterns of social networks, addressing the need for future studies on social networks in diverse cultural settings (Antonucci, 2001; Peek & O'Neill, 2001; Shiovitz-Ezra & Litwin, 2015; Tsai & Lopez, 1998; Vega, 1990). Chinese immigrants in the U.S. constitute the largest part of Asian immigrants. Nevertheless, there is a lack of research on the role of social networks in the facilitation of late-life well-being among U.S. Chinese older adults. Filial piety is a prime virtue in Chinese culture and describes fundamental aspects of the parent–child relationship. The value of filial piety requires adult children to take care of their aging parents (Li & Dai, in press; Li & Dong, 2017b). Adult children play a significant role in Chinese older adults' social networks (Dong, Li, & Hua, 2017; Li & Dong, 2018a). As for U.S. Chinese older immigrants, language and cultural barriers increase their reliance on family relations. Family members, particularly adult children, are often the major source of financial, emotional, and instrumental support (e.g. language brokering, and transportation) (Wong, Yoo, & Stewart, 2006). Older immigrants have limited access to community services and have restricted social contacts outside the family. Compared to native-born older adults, immigrant older adults are more dependent on smaller and close-knit social networks (Dong & Chang, 2017).

The relationship between different dimensions of social networks and depressive symptoms has been well documented in the literature. However, there is a paucity of research which uses a comprehensive framework to compare the relationships between multiple dimensions of social networks (quantity, quality, and composition) and depressive symptoms. In addition, measuring social networks both numerically and categorically could provide a more nuanced understanding of the impact of social networks on depressive symptoms. Different levels of social relations were associated with different health outcomes. Earlier studies mainly focused on different levels of social support, social engagement or integration (Berkman et al., 2000; Li, Mao, Chi, & Lou, in press; Zamora-Macorra et al., 2017), while less is known about the relationship between different levels of social networks and depressive symptoms. Research on different levels of social networks and depressive symptoms could advance knowledge by testing the existence of threshold effects and inform interventions by identifying the optimal level of social network attributes against depressive symptoms.

In addition, many existing studies count the number of depressive symptoms, which allows us to test the spectrum of depressive symptoms with great statistical power (Fiori, Smith, & Antonucci, 2007). However, the lack of research using the clinical cut-off score for the diagnosis of probable or major depression disorder leaves us with an incomplete understanding of the role of social networks in protecting older adults from a high level of depressive symptoms (Cappeliez et al., 2007).

In an attempt to extend knowledge pertaining to the relationship between social networks and depressive symptoms among minority older immigrants in the U.S., this study uses a comprehensive approach and aims to 1) compare the associations between quantity, quality, and composition of social networks and depressive symptoms; and 2) examine the associations between social networks (by numerical and categorical measures) and depressive symptoms (by numerical and categorical measures) among U.S. Chinese older adults.

Methods

Data

The Population Study of Chinese Elderly in Chicago (PINE) is a community-engaged, population-based epidemiological study of U.S. Chinese older adults aged 60 and above in the Greater Chicago area. The PINE study is a representative of the Chinese aging population in the Greater Chicago area with a sample size of 3,157 (Dong, 2014; Dong, Wong, & Simon, 2014). Culturally appropriate community recruitment strategies guided by community-based participatory research (CBPR) approach were used to ensure community participation (Dong, Chang, Simon, & Wong, 2011; Dong, Chang, Wong, & Simon, 2011). Face-to-face home interviews were conducted by trained multicultural and multilingual interviewers. The study has been approved by the Institutional Review Board of the Rush University Medical Center.

Measures

Depressive symptoms and depression—Depressive symptoms were measured by the Patient Health Questionnaire-9 (PHQ-9) (American Psychiatric Association, 1994). Participants were asked if they had the following symptoms in the last 2 weeks: (i) changes in sleep; (ii) changes in appetite; (iii) fatigue; (iv) feelings of sadness or irritability; (v) loss of interest in activities; (vi) inability to experience pleasure, feelings of guilt or worthlessness; (vii) inability to concentrate or making decisions; (viii) feeling restless or slowed down; and (ix) suicidal thoughts. The response on each item had four categories ranging from 0 = not at all to 3 = nearly every day. Depressive symptoms were assessed by a total score of PHQ-9, ranging from 0 to 27. The Cronbach's alpha of PHQ-9 in the PINE study was 0.82 (Dong, Chen, Li, & Simon, 2014; Li & Dong, 2017a).

The presence of depression was defined as the total score of PHQ-9 equal to or above 5 (0 = no depression; 1 = presence of depression). The cut-off score of 5 in PHQ-9 for depression screening has been widely used in Asian older adults. One study in Japan older adults showed a cut-off 5 had a preferable sensitivity of 0.86 and a specificity of 0.85 in screening for major depressive disorders (Inagaki et al., 2013). A score of 5 was the most appropriate cut-off and offered the best trade-off when screening for depression in Korean older adults, with a sensitivity of 0.8 and a specificity of 0.78 (Han et al., 2008).

Social networks and levels of social networks—Quantity of social networks includes network size and volume of contact (Fiorillo & Sabatini, 2011; Fuller-Iglesias, 2015). Participants were asked to list up to five network members with whom they discuss important things. The number of network members listed by the participant was considered as the network size. Volume of contact was the average contact frequencies that a participant talked to network members in the past one year. The answer was rated from 1 = less than once a year to 8 = every day. Quality of social networks was evaluated by the average emotional closeness with network members (Cornwell, Schumm, Laumann, & Graber, 2009). We asked participants "How close do you feel is your relationship to this person?", with ordinal responses ranging from 1 = not very close to 4 = extremely close. Network composition was determined by the calculations of the network being proportion kin, proportion female, and proportion coresident (Cornwell et al., 2009). We collected information for each network member listed by the participants: 1) relationship with network member (e.g. spouse, son, daughter, grandson, granddaughter, friend, and neighbor), 2) gender of network member, and 3) whether living with a network member.

Level of network size had three categories (0 = zero network member, 1 = one to two network members, 2 = three to five network members). Level of volume of contact included a low, medium and high level of contact. Emotional closeness was divided by low and high level of closeness.

Confounding variables—Socio-demographic factors were controlled in data analysis, including age (in years), gender, education, annual income, years in the U.S., years in the community, medical comorbidities, overall health status and health change in the last year. Medical comorbidities were evaluated by the number of diseases (Dong, Chen, & Simon,

2014; Dong et al., 2016; Li, Liang, & Dong, in press). Overall health status was rated on a 4-point scale (1 = very good, 2 = good, 3 = fair, 4 = poor). Health change in the last year was evaluated on a 5-point scale (1 = much better, 2 = somewhat better, 3 = about the same, 4 = somewhat worse, 5 = much worse).

Analytic strategy

We used descriptive analysis to assess social network characteristics of the sample. Negative binomial regression was used to test the association between social networks/different levels of social networks and depressive symptoms. Logistic regression was applied to examine the association between social networks/different levels of social networks and depression. Model A was adjusted for age and gender. Education and income were added in Model B. Years in the U.S. and years in the community were added in Model C. Medical comorbidities were added to model D. In Model E, overall health status and health change in the last year were added to previous models. In addition, we tested the association between social network dimensions (i.e., quantitative, composition, and qualitative dimensions of social networks) and depressive symptoms to assess the relative importance of the various dimensions of social networks in depressive symptoms. Model A contained all covariates. Quantitative dimension of social networks was added to Model B. Composition dimension of social networks was added to Model C. Qualitative dimension of social networks was added to Model D. All statistical analyses were conducted using SAS, version 9.4 (SAS Institute Inc., Cary, NC, USA).

Results

In the study sample, about 58% of older adults were female. Most participants (78.9%) had equal or less than a high school education. The majority of them (85.1%) had an annual income of less than USD 10,000. About a quarter (26.7%) of participants have lived in the U.S. for less than 10 years, and 57.5% of them have lived in their community for less than 10 years.

Older adults on average had 3.25 (*SD* ± 1.49) network members with strong ties. A majority (95.2%) of network members were kin, 54.7% were female, and 35.0% of network members coresided with participants. Participants had a mean of 3.40 (*SD* ± 0.60) emotional closeness and total contacts of 675.86 (*SD* ± 357.66) times per year with network members.

Table 1 shows the association between social network dimensions and depressive symptoms. In Model B, both network size and volume of contact in the quantitative dimension were significantly associated with depressive symptoms. However, the relationship between the volume of contact and depressive symptoms became non-significant after the qualitative dimension (i.e. emotional closeness) was added in Model D. In other words, the significant relationship between volume of contact and depressive symptoms could be explained by emotional closeness. The composition dimension of social networks was not significant in Model C, while proportion coresident became significant after emotional closeness was added in Model D. In the full model (Model D), a larger network size, higher proportion coresident, and higher emotional closeness were associated with lower depressive symptoms.

The association between social network characteristics and depressive symptoms is presented in Table 2. After controlling age, gender, education, income, years in the U.S., years in the community, medical comorbidities, overall health status and health change over the last year, every one additional network member (rate ratio [RR], 0.92; 95% confidence interval [CI], 0.89–0.95), and every one point higher in volume of contact (RR, 0.88; 95% CI, 0.83–0.94) and emotional closeness (RR, 0.64; 95%CI, 0.59–0.70) were associated with lower depressive symptoms.

Then, we examined the association between different levels of social networks and depressive symptoms (Table 3). The results showed that, compared with having zero network members with strong ties, having three to five network members was associated with lower depressive symptoms (RR, 0.59; 95%CI, 0.41–0.85). Compared with low level of contact, medium level of contact (RR, 0.80; 95%CI, 0.70–0.92) and high level of contact (RR, 0.81; 95%CI, 0.71–0.93) were protective factors against depressive symptoms. Compared with low level of emotional closeness, high level of emotional closeness was associated with lower depressive symptoms (RR, 0.66; 95%CI, 0.59–0.73).

We used a cut-off score of 5 in PHQ-9 for defining depression. Table 4 shows the association between social networks and depression. Older adults with every one additional network member (odds ratio [OR], 0.83; 95%CI, 0.77–0.88), and one point higher in volume of contact (OR, 0.87; 95% CI, 0.79–0.97) and emotional closeness (OR, 0.51; 95%CI, 0.43–0.59) were less likely to experience depression. As for different levels of social network attributes and depression, compared with zero network members with strong ties, older adults with three to five network members were less likely to have depression (OR, 0.36; 95%CI, 0.20–0.66). Compared with low level of contact, older adults with medium level of contact (OR, 0.71; 95%CI, 0.56–0.90) were less likely to be associated with depression. Compared with low level of emotional closeness, older adults with high level of emotional closeness were less likely to screen positive for depression (OR, 0.57; 95%CI, 0.47–0.70).

We tested the associations between network composition and depressive symptoms, including proportion kin, proportion female, and proportion coresident. However, none of these associations were significant in our study.

Discussion

The social networks of U.S. Chinese older adults were featured by a small network size and a high level of volume of contact, kin proportion, and emotional closeness. In terms of social networks and depressive symptoms, our study found that a larger network size, a higher volume of contact, and higher emotional closeness were associated with lower depressive symptoms among U.S. Chinese older adults. Specifically, older adults with three to five network members with strong ties, a medium level of contact, and a high level of emotional closeness with network members have the lowest risk of depression. The protective effect of quantitative and qualitative aspects of social networks was stronger than the composition aspect.

The present study captured the strong ties with frequently accessed and long-term network members who are particularly influential in older adults' lives. The social network measurement utilized in our study was more restrictive than previous social network studies including both strong and weak ties (Cheng et al., 2009; Granovetter, 1973), which partially explain the small network size in our sample. In addition, U.S. Chinese older adults have limited English proficiency and have less engagement in community activities, resulting in smaller network size compared with non-immigrant samples (Antonucci, Fuhrer, & Dartigues, 1997; Dong, Bergren, & Chang, 2015). Our study goes beyond existing literature by comparing the associations between different levels of network size and depressive symptoms. We found that, compared with zero network members, three to five network members with strong ties were associated with lower depressive symptoms, which could inform interventions on improving network size of U.S. Chinese older immigrants.

Volume of contact can complement network size and provide additional information on social relationships. It is assumed that network size shrinks when people grow older. According to the socioemotional selectivity theory, with less time left, older adults retain limited relationships they are most willing to invest and from which they get the most pleasure (Carstensen, Gross, & Fung, 1997). Thus, network size may be less informative, and it is necessary to consider the volume of contact when investigating the quantity of social networks of older adults. The present study found a medium level of contact was a protective factor against depression in later life while a high level of contact was not. An appropriate amount of contacts could benefit older adults' psychological well-being. Our findings challenged the protective role of high contact frequency in mental health existing in the literature (Chi & Chou, 2001).

The effect of the quality of social networks is controversial in the existing literature. Some studies indicated the quality of social networks could be more important than the quantity of social networks in psychological well-being (Amieva et al., 2010; Blazer, 1982; Fiori et al., 2006), while another study found the quality of social networks was unrelated to the presence of a high level of depressive symptoms (Litwin, 2011). Our study provided evidence for U.S. Chinese older adults and found emotional closeness was a protective factor against depressive symptoms. Moreover, the findings showed the quality of social networks could partially explain the impact of the quantity of social networks on depressive symptoms. A prior study suggested the emotional quality of relations can be linked to well-being (Wellman & Wortley, 1990). Positive perception of relationships may provide a sense of security that fosters individuals feeling positive about themselves and their lives. Better quality social ties were more significantly associated with well-being than a simple count of the number of social ties (Blazer, 1982). Older adults who have high emotional closeness with participants are more likely to receive social support and experience self-efficacy, which is beneficial for their psychological well-being (Antonucci, 2001). Our study focused on social networks of U.S. Chinese older adults, featured by a small network size and a high proportion of kin. Emotional closeness with network members, most likely spouse and adult children in our sample, meet older adults' traditional values of family harmony and filial piety, which in turn promote their psychological well-being (Dong et al., 2017; Li, Guo, Stensland, Silverstein, & Dong, in press).

Prior studies have rarely examined the association between social networks and a high level of depressive symptoms (Fiori et al., 2006, 2007). This study advances social network research by exploring the role of different levels of social networks in depression in later life. We found older adults with zero network members with strong ties, a low level of contact, and a low level of emotional closeness were more likely to experience depression than other older adults. These mental health risk indicators could facilitate the delivery of more appropriate and effective treatment to those most in need.

This research was conducted among U.S. Chinese older adults in the Greater Chicago area. Due to language and cultural barriers, older immigrants have less engagement in community activities, which in turn restricted the formation of their new social networks. Kin constitutes the largest proportion in the social networks of U.S. Chinese older adults (Dong & Chang, 2017; Guo, Stensland, Li, Dong, & Tiwari, 2018). A prior study of U.S. Chinese older adults reported that some older immigrants did not have any social contacts in the U.S. except for co-residing family members (Dong, Chang, Wong, & Simon, 2012). Future research may compare the social networks of U.S. Chinese older adults with the same cohort living in China to advance the understanding of how immigration impacts social networks and psychological well-being of older adults.

The results of this study should be interpreted with caution. First, the operationalized definition of social networks varies across different social network research. As we focused on the strong ties of U.S. Chinese older adults, the network member inclusion criterion in our study is the person with whom participant discusses important things. In turn, the network size could be smaller than studies measuring both strong and weak ties. Second, this was a cross-sectional study, and the direction of causality would be strengthened by a longitudinal study. Future longitudinal studies could explore the change of social networks and its relevance to the psychological well-being of older adults. Third, although our study examined a representative sample of Chinese older adults in Chicago, the findings may not be generalizable to Chinese older adults in other geographic areas. Fourth, the qualitative dimension of social networks was evaluated by one item in this study. Single-item measure underperforms than using multiple items in terms of predictive validity under most conditions (Diamantopoulos, Sarstedt, Fuchs, Wilczynski, & Kaiser, 2012).

Despite the limitations, our study has important theoretical and policy implications. This study uses a comprehensive framework of social networks and depressive symptoms by assessing the relative importance of quantitative, composition, and qualitative dimensions of social networks in depressive symptoms. It investigated the association between social network attributes (in both continuous and categorical forms) and depressive symptoms (in both continuous and categorical forms) among U.S. Chinese older adults. The potential role of social networks, particularly quantitative and qualitative dimensions, in preventing later life depression was supported in our study. This study also provides insight into existing research by using different levels of social network attributes to identify the optimal level in each dimension to protect against depressive symptoms.

Our study suggests considering the impact of social networks when assessing and managing depressive symptoms among older Chinese immigrants. In the assessment of depression,

health-care professionals are suggested to stress social network indicators in quantitative, composition and qualitative aspects. Older adults with zero network members with strong ties, a low level of contact, and a low level of closeness have the highest risk of depression. Such information is important in the context of allocating limited resources and targeting the most vulnerable populations. The optimal level of social network attributes identified in each dimension could inform mental health interventions to increase network size in members with strong ties and enhance interpersonal relationships for ethnic minority older immigrants. Depressive symptoms of older adults could enter into remission through the process of strengthening social relations in later life.

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Clinical implications

- When assessing and treating depression, it may be useful to consider the role of social networks.
- Small changes in social networks (e.g., an additional network member, or enhancing the emotional closeness with an existing member) may help reduce depressive symptoms.
- Developing multiple network members with medium contact and closeness may be useful in protecting older adults from depression.

Table 1.

Association between social network dimensions and depressive symptoms.

	Outcome: Depressive Symptoms			
	Model A	**Model B**	**Model C**	**Model D**
Age	1.01 (1.01,1.02) ***	1.01 (1.01, 1.02) ***	1.01 (1.00,1.02) **	1.01 (1.00,1.02) **
Female	1.33 (1.19,1.49) ***	1.35 (1.20, 1.51) ***	1.32 (1.17,1.49) ***	1.38 (1.22,1.55) ***
Education	1.01 (1.00,1.02)	1.00 (0.99,1.01)	1.00 (0.99,1.01)	1.01 (1.00,1.02)
Income	0.93 (0.88,0.98) *	0.94 (0.89,0.99) *	0.94 (0.89,0.99) *	0.94 (0.89,0.99) *
Years in the U.S.	1.00 (1.00,1.01)	1.00 (0.99,1.00)	1.00 (0.99,1.00)	1.00 (0.99,1.00)
Years in the Community	1.00 (0.99,1.00)	1.00 (0.99,1.00)	1.00 (0.99,1.00)	1.00 (0.99,1.00)
Medical Comorbidities	1.04 (1.00,1.08)	1.04 (1.00,1.08)	1.04 (1.00,1.08)	1.04 (1.00,1.08)
Overall Health Status	1.82 (1.70,1.95) ***	1.83 (1.70,1.96) ***	1.83 (1.70,1.96) ***	1.76 (1.65,1.89) ***
Health Change in the Past Year	1.33 (1.24,1.43) ***	1.33 (1.24,1.42) ***	1.33 (1.24,1.42) ***	1.36 (1.27,1.45) ***
Network Size		0.89 (0.85, 0.92) ***	0.88 (0.84,0.92) ***	0.89 (0.85,0.93) ***
Volume of Contact		0.83 (0.78,0.88) ***	0.84 (0.79,0.90) ***	0.94 (0.87,1.01)
Proportion Kin			0.98 (0.69,1.39)	1.19 (0.84,1.70)
Proportion Female			0.97 (0.80,1.17)	1.00 (0.83,1.20)
Proportion Coresident			0.88 (0.72,1.07)	0.77 (0.63,0.94) **
Emotional Closeness				0.65 (0.59,0.71) ***

RR = rate ratio; CI = confidence interval. Depressive symptoms were measured by PHQ-9, ranging from 0 to 27.

* $p < .05$,

** $p < .01$,

*** $p < .001$.

Table 2.

Association between social network characteristics and depressive symptoms.

	Outcome: Depressive Symptoms RR (95% CI)				
	Model A	**Model B**	**Model C**	**Model D**	**Model E**
			Social Network Size		
Age	1.02 (1.01, 1.02) ***	1.02 (1.01, 1.03) ***	1.02 (1.01, 1.03) ***	1.01 (1.01, 1.02) ***	1.01 (1.01, 1.02) ***
Female	1.43 (1.27, 1.61) ***	1.44 (1.28, 1.63) ***	1.45 (1.28, 1.63) ***	1.37 (1.21, 1.55) ***	1.35 (1.20, 1.51) ***
Education		1.00 (0.99, 1.01)	1.00 (0.99, 1.01)	1.00 (0.99, 1.01)	1.01 (1.00, 1.02)
Income		0.87 (0.82, 0.92) ***	0.86 (0.81, 0.91) ***	0.87 (0.82, 0.92) ***	0.93 (0.88, 0.98) *
Years in the U.S.			1.01 (1.00, 1.01) *	1.01 (1.00, 1.01)	1.00 (1.00, 1.01)
Years in the Community			0.99 (0.98, 1.00) **	0.99 (0.98, 1.00) **	0.99 (0.99, 1.00)
Medical Comorbidities				1.17 (1.12, 1.22) ***	1.04 (1.00, 1.08)
Overall Health Status					1.82 (1.70, 1.95) ***
Health Change in the Past Year					1.33 (1.24, 1.42) ***
Network Size	**0.91 (0.87, 0.95)** ***	**0.91 (0.87,0.94)** ***	**0.91 (0.87, 0.94)** ***	**0.91 (0.87, 0.95)** ***	**0.92 (0.89, 0.95)** ***
			Volume of Contact		
Age	1.02 (1.01, 1.03) ***	1.02 (1.01, 1.03) ***	1.02 (1.01, 1.03) ***	1.02 (1.01, 1.02) ***	1.01 (1.01, 1.02) ***
Female	1.40 (1.24, 1.58) ***	1.41 (1.25, 1.60) ***	1.42 (1.25, 1.60) ***	1.34 (1.18, 1.52) ***	1.33 (1.19, 1.49) ***
Education		1.00 (0.99, 1.01)	1.00 (0.99, 1.01)	1.00 (0.98, 1.01)	1.01 (0.99, 1.02)
Income		0.88 (0.83, 0.93) ***	0.87 (0.82, 0.93) ***	0.87 (0.82, 0.93) ***	0.94 (0.89, 0.99) *
Years in the U.S.			1.01 (1.00, 1.01)	1.01 (1.00, 1.01)	1.00 (0.99, 1.01)
Years in the Community			0.99 (0.98, 1.00) **	0.99 (0.98, 1.00) **	1.00 (0.99, 1.00)
Medical Comorbidities				1.17 (1.12, 1.22) ***	1.04 (1.00, 1.08)
Overall Health Status					1.83 (1.70, 1.96) ***
Health Change in the Past Year					1.33 (1.24, 1.43) ***
Volume of Contact	**0.88 (0.83, 0.94)** ***	**0.88 (0.83, 0.94)** ***	**0.88 (0.83, 0.94)** ***	**0.88 (0.83, 0.93)** ***	**0.88 (0.83, 0.94)** ***
			Emotional Closeness		
Age	1.02 (1.01, 1.02) ***	1.02 (1.01, 1.02) ***	1.02 (1.01, 1.03) ***	1.01 (1.01, 1.02) ***	1.01 (1.00, 1.02) ***

	Outcome: Depressive Symptoms RR (95% CI)				
	Model A	**Model B**	**Model C**	**Model D**	**Model E**
Female	1.48 (1.31, 1.67) ***	1.51 (1.34, 1.71) ***	1.51 (1.34, 1.71) ***	1.43 (1.27, 1.62) ***	1.40 (1.25, 1.57) ***
Education		1.01 (1.00, 1.02)	1.01 (1.00, 1.02)	1.00 (0.99, 1.02)	1.01 (1.00, 1.02) *
Income		0.87 (0.82, 0.92) ***	0.87 (0.82, 0.92) ***	0.87 (0.82, 0.92) ***	0.93 (0.88, 0.99) *
Years in the U.S.			1.00 (1.00, 1.01)	1.00 (1.00, 1.01)	1.00 (0.99, 1.00)
Years in the Community			0.99 (0.98, 1.00) **	0.99 (0.98, 1.00) **	0.99 (0.99, 1.00)
Medical Comorbidities				1.16 (1.11, 1.20) ***	1.03 (1.00, 1.08)
Overall Health Status					1.76 (1.64, 1.89) ***
Health Change in the Past Year					1.36 (1.28, 1.46) ***
Emotional Closeness	**0.60 (0.55, 0.66) *** **	**0.60 (0.55, 0.66) *** **	**0.60 (0.54, 0.65) *** **	**0.60 (0.55, 0.66) *** **	**0.64 (0.59, 0.70) *** **

RR = rate ratio; CI = confidence interval. Depressive symptoms was a continuous variable.

* $p < .05$,

** $p < .01$,

*** $p < .001$.

Table 3.

Association between levels of social networks and depressive symptoms.

	Outcome: Depressive Symptoms RR (95% CI)				
	Model A	**Model B**	**Model C**	**Model D**	**Model E**
	Levels of Social Network Size (Reference: network size 0)				
Age	1.02 (1.01, 1.02) ***	1.02 (1.01, 1.03) ***	1.02 (1.01, 1.03) ***	1.01 (1.01, 1.02) ***	1.01 (1.00, 1.02) **
Female	1.42 (1.26, 1.60) ***	1.44 (1.27, 1.63) ***	1.44 (1.27, 1.63) ***	1.36 (1.21, 1.54) ***	1.34 (1.20, 1.51) ***
Education		1.00 (0.99, 1.02)	1.00 (0.99, 1.01)	1.00 (0.99, 1.01)	1.01 (1.00, 1.02)
Income		0.87 (0.82, 0.92) ***	0.86 (0.81, 0.91) ***	0.87 (0.82, 0.92) ***	0.93 (0.88, 0.98) *
Years in the U.S.			1.01 (1.00, 1.01)	1.01 (1.00, 1.01)	1.00 (0.99, 1.01)
Years in the Community			0.99 (0.98, 1.00) **	0.99 (0.98, 1.00) **	0.99 (0.99, 1.00)
Medical Comorbidities				1.16 (1.12, 1.21) ***	1.03 (0.99, 1.07)
Overall Health Status					1.82 (1.70, 1.95) ***
Health Change in the Past Year					1.33 (1.25, 1.43) ***
Network Size 1–2	**0.79 (0.53, 1.18)**	**0.78 (0.51, 1.18)**	**0.78 (0.51, 1.18)**	**0.78 (0.52, 1.17)**	**0.72 (0.49, 1.05)**
Network Size 3–5	**0.61 (0.41, 0.91)** *	**0.60 (0.40, 0.90)** *	**0.59 (0.39, 0.89)** *	**0.61 (0.41, 0.91)** *	**0.59 (0.41, 0.85)** **
	Levels of Volume of Contact (Reference: low level of contact)				
Age	1.02 (1.01, 1.03) ***	1.02 (1.01, 1.03) ***	1.02 (1.01, 1.03) ***	1.02 (1.01, 1.02) ***	1.01 (1.00, 1.02) ***
Female	1.42 (1.25, 1.60) ***	1.42 (1.26, 1.61) ***	1.43 (1.26, 1.61) ***	1.35 (1.19, 1.52) ***	1.34 (1.19, 1.50) ***
Education		1.00 (0.99, 1.01)	1.00 (0.99, 1.01)	1.00 (0.98, 1.01)	1.01 (0.99, 1.02)
Income		0.87 (0.83, 0.92) ***	0.87 (0.82, 0.92) ***	0.87 (0.82, 0.93) ***	0.93 (0.88, 0.99) *
Years in the U.S.			1.01 (1.00, 1.01)	1.01 (1.00, 1.01)	1.00 (0.99, 1.01)
Years in the Community			0.99 (0.98, 1.00) **	0.99 (0.98, 1.00) **	1.00 (0.99, 1.00)
Medical Comorbidities				1.17 (1.12, 1.22) ***	1.04 (1.00, 1.08)
Overall Health Status					1.83 (1.70, 1.96) ***
Health Change in the Past Year					1.33 (1.24, 1.42) ***
Medium Level of Contact	**0.74 (0.64, 0.86)** ***	**0.75 (0.65, 0.87)** ***	**0.75 (0.65, 0.87)** ***	**0.74 (0.64, 0.86)** ***	**0.80 (0.70, 0.92)** **
High Level of Contact	**0.81 (0.70, 0.93)** **	**0.81 (0.70, 0.94)** **	**0.81 (0.70, 0.94)** **	**0.80 (0.69, 0.92)** **	**0.81 (0.71, 0.93)** **

	Outcome: Depressive Symptoms RR (95% CI)				
	Model A	**Model B**	**Model C**	**Model D**	**Model E**
	Levels of Emotional Closeness (Reference: low level of closeness)				
Age	1.02 (1.01, 1.02) ***	1.02 (1.01, 1.03) ***	1.02 (1.01, 1.03) ***	1.01 (1.01, 1.02) ***	1.01 (1.00, 1.02) ***
Female	1.47 (1.30, 1.66) ***	1.50 (1.33, 1.70) ***	1.50 (1.33, 1.70) ***	1.42 (1.25, 1.60) ***	1.39 (1.24, 1.55) ***
Education		1.01 (1.00, 1.02)	1.01 (1.00, 1.02)	1.00 (0.99, 1.02)	1.01 (1.00, 1.02) *
Income		0.87 (0.82, 0.92) ***	0.87 (0.82, 0.92) ***	0.87 (0.82, 0.92) ***	0.93 (0.88, 0.99) *
Years in the U.S.			1.01 (1.00, 1.01)	1.01 (1.00, 1.01)	1.00 (0.99, 1.01)
Years in the Community			0.99 (0.98, 1.00) **	0.99 (0.98, 1.00) **	0.99 (0.99, 1.00)
Medical Comorbidities				1.16 (1.11, 1.21) ***	1.04 (1.00, 1.08)
Overall Health Status					1.77 (1.65, 1.90) ***
Health Change in the Past Year					1.35 (1.26, 1.44) ***
High Level of Closeness	**0.59 (0.52, 0.66) *** **	**0.59 (0.52, 0.66) *** **	**0.59 (0.52, 0.66) *** **	**0.59 (0.53, 0.67) *** **	**0.66 (0.59, 0.73) *** **

RR = rate ratio; CI = confidence interval. Depressive symptoms were measured by PHQ-9, ranging from 0 to 27.

* $p < .05$,

** $p < .01$,

*** $p < .001$.

Table 4.

Association between social networks and depression.

	Outcome: Depression OR (95% CI)				
	Model A	**Model B**	**Model C**	**Model D**	**Model E**
			Social Network Size		
Age	1.02(1.01, 1.03) ***	1.02(1.01, 1.03) ***	1.02(1.01, 1.04) ***	1.02(1.00, 1.03) **	1.01(1.00, 1.02)
Female	1.62(1.35, 1.95) ***	1.65(1.36, 1.99) ***	1.64(1.35, 1.98) ***	1.51(1.24, 1.83) ***	1.61(1.31, 1.98) ***
Education		1.01(0.99, 1.02)	1.00(0.99, 1.02)	1.00(0.98, 1.02)	1.01(0.99, 1.03)
Income		0.84(0.76, 0.93) ***	0.84(0.76, 0.94) **	0.85(0.76, 0.95) **	0.91(0.81, 1.02)
Years in the U.S.			1.01(1.00, 1.02)	1.01(1.00, 1.02)	1.00(0.99, 1.01)
Years in the Community			0.98(0.97, 1.00) **	0.99(0.98, 1.00) **	1.00(0.98, 1.01)
Medical Comorbidities				1.23(1.16, 1.31) ***	1.03(0.96, 1.10)
Overall Health Status					2.67(2.31, 3.08) ***
Health Change in the Past Year					1.60(1.41, 1.83) ***
Network Size	**0.86(0.81, 0.91) *** **	**0.85(0.80, 0.90) *** **	**0.85(0.80, 0.90) *** **	**0.85(0.80, 0.90) *** **	**0.83(0.77, 0.88) *** **
			Volume of Contact		
Age	1.02(1.01, 1.03) ***	1.02(1.01, 1.03) ***	1.02(1.01, 1.04) ***	1.02(1.00, 1.03) *	1.01(1.00, 1.02)
Female	1.64(1.36, 1.98) ***	1.67(1.38, 2.03) ***	1.67(1.38, 2.03) ***	1.53(1.26, 1.87) ***	1.57(1.27, 1.94) ***
Education		1.00(0.99, 1.02)	1.00(0.98, 1.02)	1.00(0.98, 1.01)	1.01(0.99, 1.03)
Income		0.86(0.78, 0.95) **	0.87(0.78, 0.96) **	0.87(0.78, 0.97) *	0.93(0.83, 1.04)
Years in the U.S.			1.01(1.00, 1.02)	1.00(1.00, 1.02)	1.00(0.99, 1.01)
Years in the Community			0.99(0.98, 1.00) *	0.99(0.98, 1.00) *	1.00(0.98, 1.01)
Medical Comorbidities				1.24(1.16, 1.32) ***	1.05(0.98, 1.12)
Overall Health Status					2.61(2.26, 3.02) ***
Health Change in the Past Year					1.59(1.39, 1.81) ***
Volume of Contact	**0.84(0.77, 0.93) *** **	**0.84(0.76, 0.92) *** **	**0.84(0.77, 0.93) *** **	**0.84(0.76, 0.92) *** **	**0.87(0.79, 0.97) * **
			Emotional Closeness		
Age	1.02(1.01, 1.03) ***	1.02(1.01, 1.03) ***	1.02(1.01, 1.03) ***	1.01(1.00, 1.03) *	1.01(1.00, 1.02)

	Outcome: Depression OR (95% CI)				
	Model A	**Model B**	**Model C**	**Model D**	**Model E**
Female	1.76(1.45, 2.13) ***	1.83(1.50, 2.23) ***	1.81(1.49, 2.21) ***	1.67(1.37, 2.04) ***	1.70(1.37, 2.10) ***
Education		1.01(0.99, 1.03)	1.01(0.99, 1.03)	1.00(0.98, 1.02)	1.01(0.99, 1.03)
Income		0.85(0.77, 0.94) **	0.86(0.77, 0.96) **	0.86(0.77, 0.96) **	0.92(0.82, 1.03)
Years in the U.S.			1.01(1.00, 1.02)	1.00(0.99, 1.01)	1.00(0.99, 1.01)
Years in the Community			0.99(0.98, 1.00) *	0.99(0.98, 1.00)	1.00(0.99, 1.01)
Medical Comorbidities				1.24(1.16, 1.32) ***	1.05(0.98, 1.13)
Overall Health Status					2.47(2.13, 2.86) ***
Health Change in the Past Year					1.65(1.44, 1.88) ***
Emotional Closeness	**0.47(0.41, 0.54) *** **	**0.47(0.40, 0.54) *** **	**0.46(0.40, 0.54) *** **	**0.46(0.40, 0.54) *** **	**0.51(0.43, 0.59) *** **
	Levels of Social Network Size (Reference: network size 0)				
Age	1.02(1.01, 1.03) ***	1.02(1.01, 1.03) ***	1.02(1.01, 1.03) ***	1.02(1.00, 1.03) *	1.01(1.00, 1.02)
Female	1.61(1.34, 1.94) ***	1.64(1.36, 1.98) ***	1.63(1.35, 1.97) ***	1.50(1.24, 1.82) ***	1.60(1.30, 1.97) ***
Education		1.01(0.99, 1.03)	1.01(0.99, 1.02)	1.00(0.98, 1.02)	1.01(0.99, 1.03)
Income		0.84(0.76, 0.93) ***	0.85(0.76, 0.94) **	0.85(0.77, 0.95) **	0.91(0.82, 1.02)
Years in the U.S.			1.01(1.00, 1.02)	1.01(1.00, 1.02)	1.00(0.99, 1.01)
Years in the Community			0.99(0.97, 1.00) **	0.99(0.98, 1.00) **	1.00(0.98, 1.01)
Medical Comorbidities				1.23(1.16, 1.31) ***	1.03(0.96, 1.11)
Overall Health Status					2.65(2.29, 3.06) ***
Health Change in the Past Year					1.61(1.41, 1.84) ***
Network Size 1–2	**0.64(0.38, 1.08)**	**0.63(0.37, 1.10)**	**0.66(0.38, 1.14)**	**0.63(0.36, 1.09)**	**0.62(0.34, 1.14)**
Network Size 3–5	**0.42(0.25, 0.70) *** **	**0.40(0.23, 0.69) *** **	**0.41(0.24, 0.71) ** **	**0.40(0.23, 0.68) *** **	**0.36(0.20, 0.66) *** **
	Levels of Volume of Contact (Reference: low level of contact)				
Age	1.02(1.01, 1.03) ***	1.02(1.01, 1.04) ***	1.02(1.01, 1.04) ***	1.02(1.00, 1.03) **	1.01(1.00, 1.03)
Female	1.65(1.37, 1.99) ***	1.69(1.39, 2.05) ***	1.68(1.39, 2.04) ***	1.55(1.27, 1.89) ***	1.60(1.29, 1.97) ***
Education		1.00(0.99, 1.02)	1.00(0.98, 1.02)	1.00(0.98, 1.01)	1.01(0.99, 1.03)
Income		0.86(0.78, 0.95) **	0.86(0.78, 0.96) **	0.87(0.78, 0.97) **	0.93(0.83, 1.04)
Years in the U.S.			1.01(1.00, 1.02)	1.01(1.00, 1.02)	1.00(0.99, 1.01)

	Outcome: Depression OR (95% CI)				
	Model A	**Model B**	**Model C**	**Model D**	**Model E**
Years in the Community			0.99(0.97, 1.00) **	0.99(0.98, 1.00) *	1.00(0.98, 1.01)
Medical Comorbidities				1.24(1.17, 1.32) ***	1.05(0.97, 1.12)
Overall Health Status					2.63(2.27, 3.04) ***
Health Change in the Past Year					1.58(1.38, 1.81) ***
Medium Level of Contact	**0.67(0.54, 0.84) *** **	**0.67(0.54, 0.84) *** **	**0.67(0.54, 0.84) *** **	**0.65(0.52, 0.82) *** **	**0.71(0.56, 0.90) ** **
High Level of Contact	**0.85(0.69, 1.05)**	**0.85(0.68, 1.05)**	**0.86(0.69, 1.07)**	**0.85(0.68, 1.06)**	**0.96(0.76, 1.21)**
		Levels of Emotional Closeness (Reference: low level of closeness)			
Age	1.02(1.01, 1.03) ***	1.02(1.01, 1.03) ***	1.02(1.01, 1.04) ***	1.02(1.00, 1.03) *	1.01(1.00, 1.02)
Female	1.69(1.40, 2.04) ***	1.75(1.44, 2.13) ***	1.74(1.43, 2.12) ***	1.60(1.31, 1.95) ***	1.63(1.32, 2.01) ***
Education		1.01(0.99, 1.03)	1.01(0.99, 1.03)	1.00(0.98, 1.02)	1.01(0.99, 1.03)
Income		0.86(0.78, 0.95) **	0.86(0.77, 0.96) **	0.86(0.78, 0.96) **	0.92(0.82, 1.03)
Years in the U.S.			1.01(1.00, 1.02)	1.00(0.99, 1.02)	1.00(0.99, 1.01)
Years in the Community			0.99(0.98, 1.00) *	0.99(0.98, 1.00) *	1.00(0.99, 1.01)
Medical Comorbidities				1.24(1.16, 1.32) ***	1.05(0.98, 1.12)
Overall Health Status					2.52(2.17, 2.92) ***
Health Change in the Past Year					1.62(1.42, 1.85) ***
High Level of Closeness	**0.50(0.42, 0.61) *** **	**0.50(0.42, 0.60) *** **	**0.50(0.41, 0.60) *** **	**0.50(0.41, 0.60) *** **	**0.57(0.47, 0.70) *** **

Depression was a categorical variable (0 = no depression; 1 = depression). OR = odds ratio; CI = confidence interval.

* $p < .05$,

** $p < .01$,

*** $p < .001$.