

Associations of Quality, Quantity, and Structural Characteristics of Individual Social Network on Depressive Symptoms

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Abstract

Background This study explores the association between the size and intimacy of an individual's social network with depressive symptoms, considering age diversity and age difference in the general adult population in South Korea. **Methods** We utilized data from a population of 2,363 in the Cardiovascular and Metabolic Disease Etiology Research Center cohort. Each participant's social network properties and social support status were measured using the egocentric social network analysis tool. Depressive symptoms were assessed using the Beck Depression Inventory-II. Multivariable logistic regression was used to compute odds ratios (ORs) for depression by different social network characteristics. **Results** Overall, network size and mean intimacy were both associated with depressive symptoms; however, the combination of the two showed different association patterns with depressive symptoms by gender. Compared to those with both a larger network size and higher average intimacy in the network, only women showed significantly increased ORs for depression with decreases in either the size or the intimacy of the network. This tendency was prominent in women whose social networks had high age diversity or members mainly older than themselves. **Limitations** Depressive symptoms were measured according to self-assessed levels of depressive symptoms during the previous two weeks, which do not necessarily indicate depressive disorder. **Conclusion** The social network characteristics of size and intimacy associated differently with depressive symptoms by gender. In women whose social networks had high age diversity, smaller-sized and less intimate networks increased the likelihood of depression.

1. Background

Social networks have essential effects on mental well-being in both positive and negative ways [1, 2]. Literature has revealed a link between social networks and mental health outcomes, focusing mainly on middle-aged [3] or elderly people [4], or patients with mental illnesses such as depression [5–8], anxiety [9], psychosis [10], post-traumatic stress disorder [2, 11, 12], or dementia [13]. Social networks here refer individual's connections including with both family and close friends, or broader social ties within a community [14–16]. Other terms are often used interchangeably, such as social relations, social connections, or social ties [1, 14]. Studies have suggested that loneliness, a distressing emotion based on perceived inadequacies of the quality or quantity of one's social networks, may lead to an elevated risk of psychiatric symptoms [5, 17].

Although previous literatures have discussed the relationship between social networks and mental health, few studies have considered multiple aspects of social networks [2]. This is a notable gap because social network variables such as quantity, quality, and structural characteristics do not operate separately; they actively interact to exert a comprehensive impact on mental health [18]. Some factors of social networks may be more influential due to a synergistic effect, and others less important, as they can be complemented [19]. Thus, assessing social network variables separately makes it difficult to distinguish which of those variables are crucial.

This study aims to fill the knowledge gaps in the literature by utilizing a large-scale general population cohort in South Korea to examine the predictive values of quantitative, qualitative, and structural aspects of social networks on depressive symptoms. Quantitative aspects refer to social network size (indicating the number of network members) and qualitative aspects refer to average perceived intimacy with network members, and structural aspects refer to network diversity, specifically age diversity and age differences in the present study. The primary goal of this study was to assess the associations of quantity, quality, and structure characteristics on depressive symptoms in general adult population of Korea.

2. Methods

2.1. Study population

The present study used data from the Cardiovascular and Metabolic Disease Etiology Research Center (CMERC) cohort study, which was designed to recruit members of the general population residing in four South Korean districts (Seoul, Goyang, Gimpo, and Incheon). An initial total of 3,332 participants aged 30–64 years were enrolled between 2013 and 2016. All participants completed health questionnaires and examinations according to a predefined protocol. The sampling and measurement procedures have been described in detail previously [20]. Of these, 969 participants were excluded owing to missing key variables, such as social network variables ($n = 968$) and Beck Depression Inventory-II (BDI, Korean version) scores ($n = 1$). A cross-sectional analysis was conducted of

the remaining 870 men and 1,493 women (Fig. 1). All participants provided written informed consent, and the study protocol was approved by the Institutional Review Board of Severance Hospital at Yonsei University College of Medicine (4-2013-0661).

2.2. Measurements

Standardized questionnaires were used to gather information about the study participants' demographics, medical history, and health behaviors. Sociodemographic variables included age, education (< 12 or ≥ 12 years), marital status, and household income. Participants were classified into two groups according to marital status: married, unmarried (never married, divorced, separated, widowed, or unknown). The study population was also classified into three groups according to household income level: lower, middle, or upper (< 30, 30–50, or ≥ 50 million Korean won/year, respectively). Number of comorbidities was calculated as the total number of the following physician-diagnosed diseases, according to a self-report: stroke, transient ischemic attacks, myocardial infarction, angina pectoris, heart failure, chronic kidney disease, hypertension, dyslipidemia, diabetes, thyroid disease, fatty liver disease, chronic hepatitis, liver cirrhosis, asthma or chronic obstructive pulmonary disease, osteoporosis, arthritis, autoimmune disease, or malignant tumor. Health behaviors included smoking status (current smoker, former smoker, or non-smoker), alcohol intake (current drinker, former drinker, or non-drinker), and physical activity. Physical activity was assessed using the International Physical Activity Questionnaire-Short Form. Regular exercise was defined as moderate- to high-intensity physical activity performed at least three times per week.

Standing height was measured to the nearest 0.1 cm using a stadiometer (DS-102, JENIX, Seoul, South Korea), and body weight was measured to the nearest 0.1 kg on a digital scale (DB-150, CAS, Seongnam, South Korea) according to a predetermined protocol. Body mass index (BMI, kg/m²) was calculated as body weight divided by standing height squared.

We measured participants' egocentric social networks and collected data on each participant's social network properties. Through face-to-face interviews by trained interviewers, each participant was asked to provide the names or nicknames of up to seven close individuals, including their spouse and up to five others to whom they talked most frequently, and one more person considered to be their closest and most important relationship. Respondents were also asked to provide information on the quality of their relationship with alters by scoring intimacy on a scale from 1 (not intimate) to 4 (most intimate). The total number of names provided was used as an index of each respondent's social network size (quantity), and mean intimacy score was used as an index of the social network's quality. Alters' ages were used to analyze the age diversity and age difference within a social network. Age diversity was represented by the standard deviation of the ages of members of the social network, whereas age difference referred to the difference between the age of the respondent and the average age of those in their social network.

Depressive symptoms was assessed using the BDI [21]. The BDI includes 21 questions evaluating emotional, cognitive, motivational, physiological, and other symptoms. Each item contains four statements describing the intensity of the symptoms; each item is rated on a scale from 0 to 3, reflecting how participants have felt over the past two weeks. Thus, total BDI scores range from 0 to 63, with higher scores representing greater depression. This instrument has demonstrated acceptable sensitivity and specificity in distinguishing between participants with and without depressive symptoms, and is considered a valid and reliable measure of depressive symptoms [22, 23]. For the purpose of this study, depressive symptoms were considered present for individuals who scored ≥ 20 on the BDI or who took antidepressants.

Statistical analysis

Descriptive analysis was conducted using t-tests for normally distributed continuous variables and chi-square for categorical variables. Multivariable logistic regression analyses were used to assess independent associations between social network factors and depressive symptoms in four adjusted models: [1] adjusted for age and menopause status; [2] additionally adjusted for marital status, education, and income status; [3] additionally adjusted for number of comorbidities, smoking, alcohol intake, and physical activity; and [4] additionally adjusted for social network quantity or quality.

Stratified analyses were conducted accordingly: social network quantity was stratified as small (social network size < median) and large (size ≥ median) and social network quality was stratified as low (average intimacy with alters < median) and high (average intimacy ≥ median). We divided by four groups based on social network quantity and quality (large & high, large & low, small & high, small & low). All statistical tests were performed using SAS version 9.4 (SAS Institute, Cary, NC, USA). Statistical significance was defined as a two-sided P value < 0.05.

3. Results

Table 1 presents the aspects of depressive symptoms of the study sample according to sociodemographic, lifestyle, and health-related variables. The total sample included 2,363 participants aged from 30 to 65 years. The sample was slightly female-dominant (63.2% women). The majority of participants were aged 50–59 (42.2%), and the breakdown across the other three age groups was comparatively even (22.5% for 30–39, 17.7% for 40–49, and 17.6% for 60–65). The prevalence of depressive symptoms was 10.6% in the overall sample. Most participants were married (86.4%) and had graduated from high school or higher (85.1%). Slightly less than half (46.6%) had a yearly family income of 50 million won or higher.

Table 1
Characteristics of study participants

Variables	Total (n = 2,363)		No depressive symptoms (n = 2,112)		Depressive symptoms (n = 251)		p Value
Age, years							
30–39	532	(22.5)	479	(90.0)	53	(10.0)	0.882
40–49	417	(17.7)	374	(89.7)	43	(10.3)	
50–59	998	(42.2)	891	(89.3)	107	(10.7)	
60–65	416	(17.6)	368	(88.5)	48	(11.5)	
Sex							
Men	870	(36.8)	810	(93.1)	60	(6.9)	< 0.001
Women	1,493	(63.2)	1,302	(87.2)	191	(12.8)	
Marital status							
Married	2,041	(86.4)	1,843	(90.3)	198	(9.7)	< 0.001
Divorced/separated/ widowed	322	(13.6)	269	(83.5)	53	(16.5)	
Education							
High school or higher	2,010	(85.1)	1,823	(90.7)	187	(9.3)	< 0.001
Under-high school	353	(14.9)	289	(81.9)	64	(18.1)	
Familial yearly income (million Korean Won)							
<30	396	(16.8)	383	(96.7)	13	(3.3)	< 0.001
30–50	866	(36.7)	772	(89.2)	94	(10.8)	
≥50	1,101	(46.6)	957	(86.9)	144	(13.1)	
Body mass index, kg/m ²	23.8	± 3.1	23.8	± 3.0	23.9	± 3.4	0.797
Smoking status							
Non-smokers	1,594	(67.5)	1,429	(89.7)	165	(10.3)	0.013
Former smokers	405	(17.1)	372	(91.9)	33	(8.1)	
Current smokers	364	(15.4)	311	(85.4)	53	(14.6)	
Alcohol intake							
Never drinkers	628	(26.6)	562	(89.5)	66	(10.5)	0.404

Note. Data are expressed as means ± standard deviation or numbers (percentages). p-values were derived from an independent t-test or chi-square test.

^a Social network quantity: small (social network size < median) and large (size ≥ median).

^b Social network quality: low (subjective intimacy < median) and high (subjective intimacy ≥ median).

^c Age diversity: low (standard deviation of alters' age < median) and high (standard deviation ≥ median).

^d Age difference: difference between age of respondent and average age of social network alters.

Variables	Total (n = 2,363)		No depressive symptoms (n = 2,112)		Depressive symptoms (n = 251)		p Value
Former drinkers	104	(4.4)	97	(93.3)	7	(6.7)	
Current regular drinkers	1,631	(69.0)	1,453	(89.2)	178	(10.9)	
Regular exercise							
Yes	1,458	(61.7)	1,313	(90.1)	145	(9.9)	0.175
No	905	(38.3)	799	(88.3)	106	(11.7)	
Number of comorbidity	0.6	± 0.9	0.6	± 0.9	0.8	± 1.0	0.007
Social network							
Quantity ^a & quality ^b							
Small & low	730	(30.9)	614	(84.1)	116	(15.9)	< 0.001
Small & high	645	(27.3)	585	(90.7)	60	(9.3)	
Large & low	506	(21.4)	464	(91.7)	42	(8.3)	
Large & high	482	(20.4)	449	(93.2)	33	(6.8)	
Age-diversity ^c							
Low	1,210	(51.2)	1,070	(88.4)	140	(11.6)	0.125
High	1,153	(48.8)	1,042	(90.4)	111	(9.6)	
Age-difference(in Tertiles) ^d							
T1 (with the younger surroundings)	797	(33.7)	708	(88.8)	89	(11.2)	0.575
T2 (with ones of similar age)	781	(33.1)	695	(88.9)	86	(11.1)	
T3 (with the older surroundings)	785	(33.2)	709	(90.3)	76	(9.7)	
Note. Data are expressed as means ± standard deviation or numbers (percentages). p-values were derived from an independent t-test or chi-square test.							
^a Social network quantity: small (social network size < median) and large (size ≥ median).							
^b Social network quality: low (subjective intimacy < median) and high (subjective intimacy ≥ median).							
^c Age diversity: low (standard deviation of alters' age < median) and high (standard deviation ≥ median).							
^d Age difference: difference between age of respondent and average age of social network alters.							

Factors associated with higher odds for depressive symptoms were gender, marital status, level of education, income, smoking status, and number of comorbidities. The sociodemographic groups with a higher prevalence of depressive symptoms were women, unmarried individuals, and individuals with low education, as illustrated in Table 1. In terms of lifestyle, smoking was correlated with depression. Current smokers had higher odds for depressive symptoms, followed by non-smokers and then former smokers. Number of comorbidities also showed a correlation with depressive symptoms; depressive groups tended to have higher numbers of comorbidities. Age, BMI, regular exercise, and alcohol intake did not show clear correlation with depressive symptoms. In terms of social network, those with smaller, less intimate social networks had the highest odds for depressive symptoms, and those with larger, more intimate social networks had the lowest. However, the association of age diversity and age difference with depressive symptoms was unclear.

To assess the association between social network quantity and quality and depressive symptoms, participants were split into quantiles based on the size and intimacy of their social network. Table 2 illustrates that social network size had a reversed J-shaped relationship with depressive symptoms. Among the four social network size quantiles, the group with the second-smallest network size showed the highest prevalence of depressive symptoms, followed by the group with the smallest size. Intimacy, on the other hand, showed a negative linear correlation with depressive symptoms (Table 3). Among the four social network intimacy quantiles, the group with the lowest intimacy showed the highest odds for depressive symptoms, followed by the second quantile and third quantile, respectively. The J-shaped correlation of size and the negative linear correlation of intimacy with depressive symptoms were dominant in both men and women.

Table 2

Association between social network quantity (social network size) and depressive symptoms (Beck Depression Inventory-II score \geq 20)

	Social network size	No. of participants	No (%) of cases	Model 1		Model 2		Model 3		Model 4	
				OR	[95% CI]						
Total (n = 2,363)	Q4	495	28 (5.7)	1.00		1.00		1.00		1.00	
	Q3	847	90 (10.6)	2.00	[1.29–3.10]	1.74	[1.11–2.72]	1.74	[1.11–2.73]	1.72	[1.09–2.70]
	Q2	469	66 (14.1)	2.73	[1.72–4.34]	2.49	[1.56–3.97]	2.46	[1.54–3.93]	2.45	[1.53–3.93]
	Q1	552	67 (12.1)	2.30	[1.45–3.63]	1.88	[1.17–3.01]	1.86	[1.15–2.98]	1.85	[1.15–2.98]
Men (n = 870)	Q4	166	8 (4.8)	1.00		1.00		1.00		1.00	
	Q3	326	24 (7.4)	2.24	[1.33–3.76]	1.91	[1.12–3.26]	1.83	[1.07–3.14]	1.83	[1.06–3.14]
	Q2	163	13 (8.0)	3.23	[1.88–5.55]	2.94	[1.70–5.10]	2.90	[1.67–5.05]	2.88	[1.65–5.05]
	Q1	215	15 (7.0)	2.82	[1.65–4.85]	2.30	[1.31–4.02]	2.09	[1.19–3.68]	2.01	[1.13–3.57]
Women (n = 1,493)	Q4	329	20 (6.1)	1.00		1.00		1.00		1.00	
	Q3	521	66 (12.7)	2.24	[1.33–3.78]	1.93	[1.13–3.28]	1.84	[1.07–3.15]	1.84	[1.07–3.16]
	Q2	306	53 (17.3)	3.23	[1.88–5.55]	2.95	[1.70–5.11]	2.90	[1.67–5.06]	2.89	[1.65–5.06]
	Q1	337	52 (15.4)	2.85	[1.66–4.89]	2.32	[1.33–4.06]	2.11	[1.20–3.72]	2.03	[1.14–3.60]

Note. Model 1: Adjustment for age and menopause status (women). Model 2: Model 1 + adjustment for marital status, education, and income status. Model 3: Model 2 + adjustment for number of comorbidities, smoking, alcohol intake, and physical activity. Model 4: Model 3 + adjustment for social network quality.

Table 3

Association between social network quality (mean social network intimacy) and depressive symptoms (Beck Depression Inventory-II score ≥ 20)

	Mean intimacy	No. of participants	No (%) of cases	Model 1		Model 2		Model 3		Model 4	
				OR	[95% CI]						
Total (n = 2,363)	Q4	645	46 (7.1)	1.00		1.00		1.00		1.00	
	Q3	537	51 (9.5)	1.37	[0.90–2.07]	1.41	[0.93–2.15]	1.42	[0.93–2.16]	1.45	[0.95–2.22]
	Q2	611	65 (10.6)	1.55	[1.04–2.30]	1.58	[1.06–2.37]	1.55	[1.03–2.31]	1.63	[1.09–2.44]
	Q1	570	89 (15.6)	2.40	[1.64–3.50]	2.34	[1.59–3.43]	2.27	[1.54–3.33]	2.26	[1.53–3.33]
Men (n = 870)	Q4	203	12 (5.9)	1.00		1.00		1.00		1.00	
	Q3	236	15 (6.4)	1.22	[0.74–2.00]	1.29	[0.78–2.13]	1.34	[0.80–2.23]	1.47	[0.87–2.48]
	Q2	211	13 (6.2)	1.93	[1.21–3.07]	1.96	[1.22–3.15]	1.93	[1.19–3.13]	1.98	[1.22–3.22]
	Q1	220	20 (9.1)	2.54	[1.63–3.95]	2.61	[1.65–4.11]	2.55	[1.60–4.05]	2.59	[1.62–4.13]
Women (n = 1,493)	Q4	396	33 (8.3)	1.00		1.00		1.00		1.00	
	Q3	362	36 (9.9)	1.22	[0.74–2.00]	1.29	[0.78–2.13]	1.34	[0.80–2.23]	1.47	[0.88–2.48]
	Q2	348	51 (14.7)	1.93	[1.21–3.08]	1.96	[1.22–3.14]	1.93	[1.19–3.13]	1.98	[1.21–3.21]
	Q1	387	71 (18.4)	2.55	[1.64–3.97]	2.61	[1.66–4.12]	2.56	[1.61–4.06]	2.59	[1.62–4.14]

Note. Model 1: Adjustment for age and menopause status (women). Model 2: Model 1 + adjustment for marital status, education, and income status. Model 3: Model 2 + adjustment for number of comorbidities, smoking, alcohol intake, and physical activity. Model 4: Model 3 + adjustment for social network quality.

Figure 1 Selection of participants in the CMERC cohort study

Figure 2 Association between social network status and depressive symptoms in women (n = 1,493)

1) Social network quantity (size): large (size \geq median) and small (size $<$ median).

2) Social network quality (intimacy): high (average intimacy with alters \geq median) and low (average intimacy $<$ median).

3) Age diversity (standard deviation of alters' age): high (standard deviation \geq median) and low (standard deviation $<$ median).

4) Age difference: Difference in age between participants and average age of alters.

Figure 3 Association between social network status and depressive symptoms in men (n = 870)

1) Social network quantity (size): large (size \geq median) and small (size $<$ median).

2) Social network quality (intimacy): high (average intimacy with alters \geq median) and low (average intimacy $<$ median).

3) Age diversity (standard deviation of alters' age): high (standard deviation \geq median) and low (standard deviation $<$ median)

Mean intimacy	No. of participants	No (%). of cases	Model 1		Model 2		Model 3		Model 4	
			OR	[95% CI]	OR	[95% CI]	OR	[95% CI]	OR	[95% CI]
4) Age difference: Difference in age between participants and average age of alters.										

In women (Fig. 2), compared to a reference group with large and highly intimate networks, groups with either small network size (OR = 1.84; 1.05–3.23) or low intimacy (OR = 1.86; 1.03–3.37) had increased odds for depressive symptoms. The small network size and low intimacy group had the highest odds for depressive symptoms (OR = 3.23; 1.91–5.47). In men, however, no significant association was found between these variables and depressive symptoms (Fig. 3).

Building on these results, the impact of social network age diversity and age difference on the association between quantitative and qualitative variables and depressive symptoms was analyzed. Statistically significant relations were found only in women.

In women (Fig. 2), a significant positive association was found between age diversity and increased odds for depressive symptoms as either the size or the intimacy of the social network decreased. Among the small size and low intimacy group, those with high age diversity in their social network showed significantly higher odds for depressive symptoms (OR = 4.95; 2.32–10.51) compared to the average (OR = 3.23; 1.91–5.47). In contrast, those with low age diversity showed lower odds than the average (OR = 1.87; 0.87–4.01), although this result was not statistically significant. These results may imply that the association between the quantitative and qualitative variables of social networks and depressive symptoms grows stronger as age diversity in social networks increases.

A similar tendency was found with respect to age difference. In women, in the small size and low intimacy group, the third tertile (alters mainly older than the participant) showed remarkably higher odds for depressive symptoms (OR = 10.09; 3.22–31.60) compared to the average (OR = 3.23; 1.91–5.47). In contrast, the first tertile (alters mainly younger) showed slightly lower odds for depressive symptoms (OR = 3.19; 1.30–7.83) compared to the average. The second tertile (alters of a similar age) presented considerably lower odds for depressive symptoms (OR = 1.47; 0.61–3.59) compared to the average, although this result was not statistically significant. These results imply that the association between the quantitative and qualitative variables of social networks and depressive symptoms is stronger when women socialize with people older than themselves. In contrast, changes in social network status have a lower impact on depressive symptoms when women socialize with peers of a similar age.

4. Discussion

Based on a sample from a large community-dwelling adult cohort in South Korea, this study investigated the association between depressive symptoms and the quantity (number of network members) and quality (average intimacy) of social networks. The results for qualitative aspects replicated previous findings that a low level of perceived emotional support is a risk factor for depression [19]. However, with respect to quantitative aspects, the study found that smaller social network size did not necessarily mean increased prevalence of depressive symptoms. Unsurprisingly, findings in the literature are contradictory regarding the impact of social network size on mental health: some studies suggest that having a small social network is associated with an elevated risk of depression [4], whereas others suggest that objective social isolation is unrelated to psychological distress or depressive symptoms [24].

Previous research can provide a theoretical explanation for such discrepancies in research findings and the reversed U-shaped association between the quantitative aspects of social networks and depressive symptoms. Corresponding to the results of this study, another study showed that a group with lower perceived support and more problematic social interactions showed the highest level of depression [25]. Social networks, as a “double-edged sword,” can play both a protective and a destructive role in mental health [25, 26]. Unmet expectations of social connections or negative input from intimate relationships may lead to “upset with the social network,” the extent of which is a strong predictor of depression [26]. In contrast, perceived quality of social networks has repeatedly been shown to correlate positively with mental health [9, 26]. Studies have suggested that what matters is not the number of social interactions but the characteristics of overall social networks, which may mediate risk factors of depression, including loneliness or unhealthy behavioral traits [6, 27].

Previous research has reported that diversity in social networks may play a protective role against psychiatric conditions and lead to physical and mental health benefits [2, 28, 29]. However, this does not apply to age diversity. This study’s secondary analysis, which

considered age diversity and age difference in social networks, revealed that high age heterogeneity in women's social networks may mediate a decrease in the quantity or quality of social networks and depressive symptoms. Higher age deviations in women's social networks were associated with higher likelihood of depressive symptoms as either size or intimacy decreased. In women, older-dominant networks increased the impact of variations in social network size or intimacy on depressive symptoms. This impact was not prominent in younger-dominant networks. Peer-dominant networks seemed to have an opposite effect, although the finding was not statistically significant. Considering these results, the ideal structure of women's social networks may be close relationships with peers around their own age.

A possible underlying mechanism is that higher age diversity and greater age difference may mean weaker friend networks and stronger non-friend networks—perhaps family networks—in most cases. Empirical evidence suggests that friends are a key correlate with mental health at all stages of life [14, 24, 30]. Although not having any family members to provide support is also a risk factor for depression, the absence of friends was found to be more detrimental to mental well-being [14, 24, 31, 32]. This importance is based on the voluntary and optional properties of friend networks in contrast to family networks, which are more obligatory and may thus involve more emotional ambivalence or problematic interactions [24, 32]. Friends, because they are selected by mutual affinity, not only provide companionship and social integration but also boost morale and help re-affirm one's sense of identity, competence, and self-worth through a form of reciprocity [10, 31, 32]. This is supported by a study on patients with psychosis, which revealed that patients with psychosis had more family-dominated and less friend-inclusive social networks than the general population, and that patients with friend-dominated social networks had less difficulty in self-care [10]. The importance of a sense of competence and self-worth to mental well-being may provide a clue to why the younger-dominant networks did not show a higher than average prevalence of depressive symptoms as either size or intimacy of the social network decreased.

These explanations may also provide insight into why these tendencies were prominent only in women. Research has established that women have a higher prevalence of depression than men [33]. One reason may be that women tend to be more affected by social networks than men in terms of mental well-being. Previous studies suggest that compared to men, women are more vulnerable to feelings of loneliness and more likely to suffer from other people's problems, both of which can lead to depression [4, 34]. However, women are also more likely than men to benefit from emotionally supportive social networks and their protective role against depression [35, 36]. Considering this, it may be inferred that women with high age diversity in their social networks or with older-dominant networks are less likely to benefit from the effects of friend networks, and they may tend to experience low social integration, morale, and self-worth, which can lead to depressive symptoms.

Altogether, this study's findings consistently confirm that the subjective quality of social support and intimacy are more strongly associated with mental well-being than the objective and quantitative aspects of social networks, especially in women.

The main strength of this study is its large-scale social network analysis of the general South Korean population. Because this study used a community-dwelling sample of adults from 30 to 64, the findings may be more reliably projected to the characteristics of the general population. Additionally, the study used gender-disaggregated data, which allowed a clear examination of the influence of gender. The study considered the association of quantitative and qualitative aspects of social networks with depressive symptoms both separately and comprehensively. Finally, the study's findings may provide specific insight into a specific society where age plays a key role in interpersonal relationships and networking. Given that previous research on social networks and mental health is concentrated mainly in Western countries [37], this study extends our understanding of the association between depressive symptoms and quantitative, qualitative, and structural aspects of social networks to the South Korean context, which has a more vertical culture than Western countries.

Despite these strengths, some limitations should be considered when interpreting the results. The clinical correlation between depressive symptoms and depression in this study is not ensured. Depressive symptoms in this study were measured according to self-assessed levels of depressive symptoms during the previous two weeks, which do not necessarily indicate depressive disorder. Additionally, the cross-sectional and correlational nature of this study prevents inference of the direction of the relationship between social network variables and depressive symptoms.

List Of Abbreviations

CMERC, Cardiovascular and Metabolic Disease Etiology Research Center; BDI, Beck Depressive Inventory-II; BMI, body mass index; OR, odds ratio; CI, confidence interval

Declarations

Ethics approval and consent to participate

All participants provided written informed consent, and the study protocol was approved by the Institutional Review Board Hospital at Yonsei University College of Medicine (4-2013-0661).

Availability of data and materials

The datasets used and/or analyzed during the current study are available from the corresponding author on reasonable request.

Competing interests

The authors declare no conflicts of interest.

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Contributors

SJJ and SWJ designed research. JEH, YY and HCK contributed to data collection and analyzed the data. JEH and SWJ wrote the first draft of the manuscript. SJJ provided critical revision of the manuscript for important intellectual content. All authors read and approved the final manuscript.

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Figures

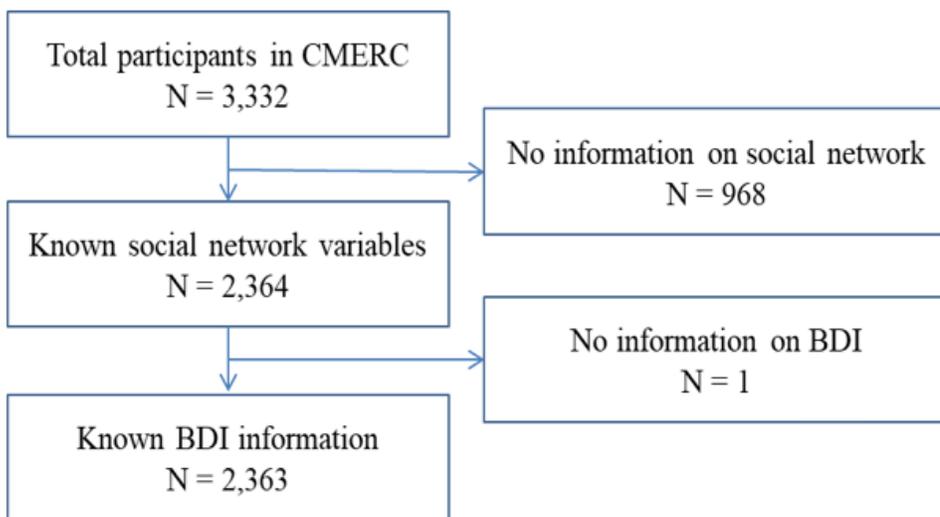


Figure 1

Selection of participants in the CMERC cohort study

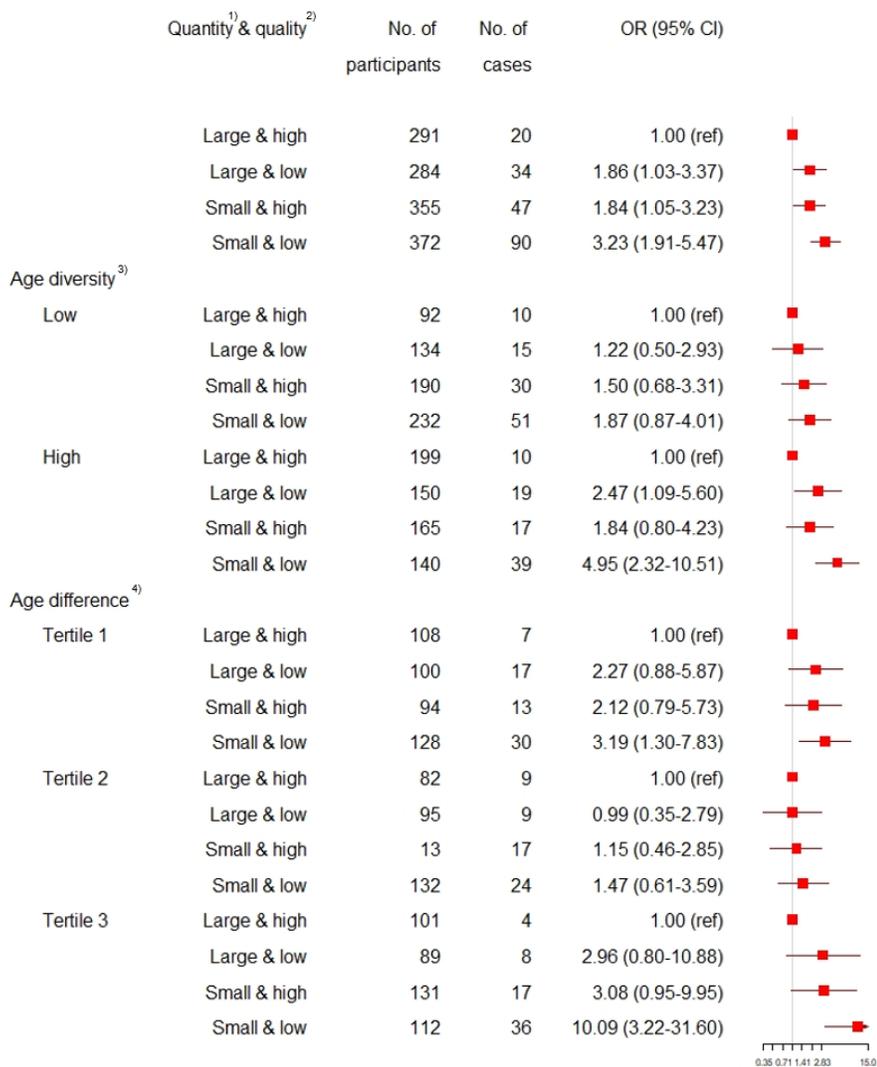


Figure 2

Association between social network status and depressive symptoms in women (n = 1,493) 1) Social network quantity (size): large (size \geq median) and small (size $<$ median). 2) Social network quality (intimacy): high (average intimacy with alters \geq median) and low (average intimacy $<$ median). 3) Age diversity (standard deviation of alters' age): high (standard deviation \geq median) and low (standard deviation $<$ median). 4) Age difference: Difference in age between participants and average age of alters.

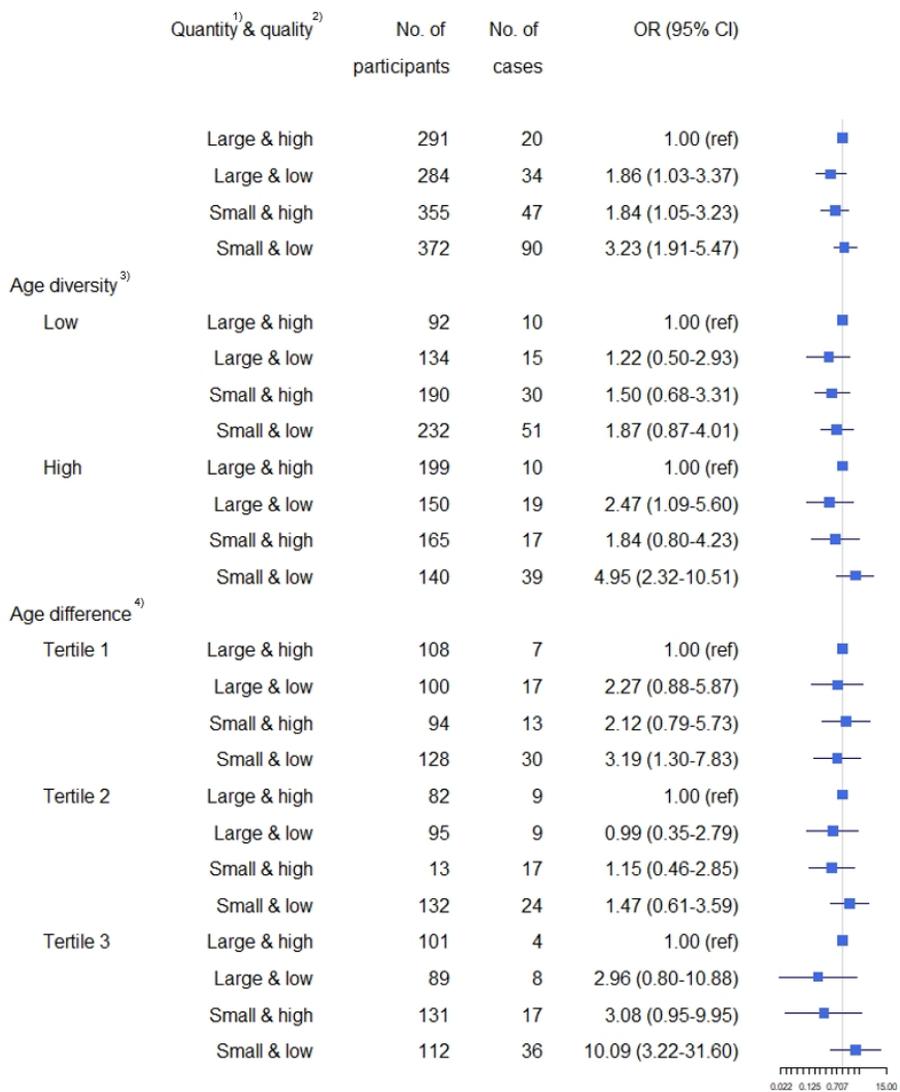


Figure 3

Association between social network status and depressive symptoms in men (n = 870) 1) Social network quantity (size): large (size \geq median) and small (size $<$ median). 2) Social network quality (intimacy): high (average intimacy with alters \geq median) and low (average intimacy $<$ median). 3) Age diversity (standard deviation of alters' age): high (standard deviation \geq median) and low (standard deviation $<$ median) 4) Age difference: Difference in age between participants and average age of alters.