

Association between social network characteristics and depressive symptoms in South Korean adults: The moderating roles of age diversity and age difference

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Abstract

Background: This study aimed to examine the association between size and intimacy of social networks and substantial depressive symptoms, and further, to assess the moderating roles of age diversity and age difference in these linkages, in the community-dwelling adult population in South Korea.

Methods: A South Korean population of 2,363 in the Cardiovascular and Metabolic Disease Etiology Research Center cohort was utilized. Each participant's social network characteristics were measured using the egocentric social network analysis tool. Substantial depressive symptoms were assessed using the Beck Depression Inventory-II (BDI-II). Multivariable logistic regression was used to compute odds ratios (ORs) for substantial depressive symptoms by different social network characteristics.

Results: Mean perceived intimacy of social networks had an inverse association with substantial depressive symptoms; Overall, the size of social networks had a negative association with depressive symptoms. In women, age diversity and age difference had moderation effects on the association of network size and intimacy with substantial depressive symptoms. The association of network size and intimacy with substantial depressive symptoms was stronger than women's average (OR=3.23; 95% CI=1.91-5.47) when social networks had a higher age diversity (OR=4.95; 2.32-10.51) and higher age differences (OR=5.38; 2.22-13.05).

Limitations: Substantial Depressive symptoms were measured according to self-assessed levels of depressive symptoms during the previous two weeks, which do not necessarily indicate depressive disorder. Categorization of certain variables was made considering the distribution, but not with the actual critical known cut-off.

Conclusions: We found that low social network size and intimacy were linearly associated with substantial depressive symptoms in women. Women whose networks are small-sized, less intimate, and with high age diversity and age difference, especially with older persons are more likely to have depressive symptoms in South Korean settings.

Trial registration: KCT0001038, Clinical Research Information Service (CRIS)

1. Background

Depression is the most prevalent mental illness, with more than 300 million people of all ages affected worldwide [1, 2]. Depression is a serious health condition that can cause impairments in daily functioning and significantly lower the quality of life. Depression can also increase the risk of physical illnesses, including cardiovascular diseases, and suicide at its worst [3, 4]. While the global burden of depression is substantial, its pathogenesis remains not fully understood, although research has found a number of determinants including biological, psychological, and social factors that act independently or interdependently to contribute to depression [1-3].

With regard to the social determinants of depression, extensive literature has explored the relationships between social networks and mental wellbeing. Social networks refer to the systems of social relationships in which individuals are connected to one another through different sets of interactions [4-6]. Abundant research has reported a link between social networks and mental health outcomes in both positive and negative ways [7, 8], in middle-aged [9] or elderly people [10], in Western [11-13] or non-Western background [6, 14, 15], or patients with mental illnesses such as depression [3, 16-18], anxiety [19], psychosis [20], post-traumatic stress disorder [8, 21, 22], or dementia [14]. Some researchers have proposed that an inadequacy of social network quality or quantity may lead to loneliness, which is related to an elevated risk of depression or psychiatric symptoms [16, 23, 24].

According to Santini et al., earlier prospective studies have supported a causal direction from perceived social support to favorable depression outcomes and the protective roles of the large size and diverse types of social networks against depression [4]. Despite the wealth of literature on the relationships between social network characteristics and depression,

however, few have compared the magnitude of their associations with depression or examined the interdependence among the network characteristics [4, 8, 23]. Previous studies have mostly focused on specific social network properties as independent factors or in a specific age or patient group [4]. A cross-sectional study that compared a broad range of social relationship variables revealed a strong correlation of the perceived quality of social networks and frequency of contacts with depression [23]. However, the aforementioned study, which used European cohort, did not address some key social network properties, including network size. Moreover, contrary to much other research, some studies reported that the quantitative aspects of social networks were not related to depression, and which factors contribute to such inconsistency remains poorly understood [2, 25].

Such notable gaps exist, as social network characteristics in practice do not act separately but work interdependently to exert mental health outcomes [26]. In this regard, this study aimed to examine the relative magnitude of the association of social network size (as a quantitative factor) and intimacy (as a qualitative factor) with substantial depressive symptoms using a Korean community-dwelling adult population. We hypothesized that intimacy is more related to substantial depressive symptoms than network size, and that a large-sized but low intimacy network group may show a higher prevalence of substantial depressive symptoms compared to a small-sized but high intimacy network group. Therefore, we conducted a confirmatory analysis to examine the association between size and intimacy of social network and substantial depressive symptoms as our primary objective.

In addition, one of the most influential factors in social relationships specific to Koreans is age. Korean culture has a strong concept of seniority based on the Confucian tradition and a unique calendar-year-based age system that contribute to a hierarchical order in human relationships [27]. In Korean settings, even one year of age difference matters as it determines ranks as well as the conjugation and appellation to use appropriately, which leads to a strong bond among persons of the same age or peers [27]. In this regard, age diversity and age difference may have implications on the relationship between social networks and depressive symptoms in people with Korean cultural backgrounds.

Although previous research supported positive effects of social network diversity on psychiatric outcomes [4, 6, 28], not many studies have addressed diversity in terms of age, especially in the Korean cultural background. A previous study reported a negative correlation between age heterogeneity in social networks and depressive symptoms in elderly Caucasian women [29]. This finding, however, may not be directly replicable to other populations, due to the narrow spectrum of the cohort used. Considering the culture-dependent nature of the link between social network properties and depression [13] as well as the significance of age in Korean culture, examining the potential moderating roles of age diversity and age difference in a Korean cohort may contribute to deepening our understanding of the social determinants of depression in non-Western regions. Therefore, we conducted further analyses to assess the moderating roles of age diversity and age differences between social networks and depressive symptoms.

In summary, this study aimed to assess the association between the qualitative and quantitative aspects of social networks and substantial depressive symptoms, and further examine the potential moderation of age diversity and age difference within social networks using a general adult population cohort of South Korea. Social network size (number of social network members), and mean perceived intimacy (self-rated intimacy with each network member) were investigated as variables pertaining to the quantitative and qualitative aspects of social network respectively. Overall, the objective of this study was to contribute to expanding the knowledge of associations of substantial depressive symptoms focusing on social network size, intimacy, age diversity, and disparity. We expect the findings of this study may provide a theoretical foundation for clinical interventions targeting patients from non-Western cultural background.

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 [30]. 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 of the remaining 870 men and 1,493 women was conducted. 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 stadiometers (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/m^2) was calculated as body weight divided by standing height squared.

For social network characteristics, participants' egocentric social network properties were measured using the questionnaires developed for the Korean Social Life, Health and Aging Project, which adopted the earlier egocentric social network data collection methodology of the National Social Life, Health, and Aging Project (NSHAP) of the United States [31]. 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 emotional closeness to network members by scoring intimacy ("How close do you think you are to him?") on a 4-point Likert scale from 1 (not intimate, "not so close") to 4 (most intimate, "very close to"). The scores from all network members were averaged to obtain each individual's mean perceived intimacy to the network members. The ages of social network members were used to analyze the age diversity and age difference. Age diversity was represented by the standard deviation of the ages of members of the social network, whereas age difference referred to the disparity between the age of the participant and the mean age of network members.

Depressive symptoms were assessed using the BDI-II. The BDI-II includes 21 questions evaluating emotional, cognitive, motivational, physiological, and other symptoms [32]. 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-II 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 substantial depressive symptoms, and is considered a valid and reliable measure of depressive symptoms [33-35]. Beck et al. suggested 13 as the cut-off score to indicate depression, and interpreted scores ranging from 14 to 19 as 'mild depression', 20 to 28 as 'moderate depression', and 29 to 63 as 'severe depression' [32, 36]. On the other hand, previous validation research on the Korean version of BDI-II indicated that Koreans tend to show higher BDI-II scores compared to Western subjects, suggesting 21 as a

tentative cut-off score opposite to Korean settings [37]. A systematic review of BDI-II cutoff scores in medical patients suggested that the threshold ranged from 7 to 22, and raising the BDI-II cut-off score to 22 could reduce false-positives, thereby concluding that the cut-off scores can be adapted with flexibility by comparing different thresholds for a population sample or study purpose [38]. After taking all of these into consideration, for the purpose of this study, substantial depressive symptoms were considered to be present for individuals who scored ≥ 20 on the BDI-II, which correspond to 'moderate depression' and 'severe depression' in the Beck's guidelines.

2.3. 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 the association of social network size and intimacy with depressive symptoms in four adjusted models. Both social network size and intimacy were classified into quartiles based on a previous study [39]. Statistical modeling and adjusted variables were selected based on prior work, which related to social network status or depression: Statistical modeling and adjusted variables were selected based on prior work, which related to social network status or depression: (1) adjusted for age, gender, and menopause status [40]; (2) additionally adjusted for marital status, education, and income status [41]; (3) additionally adjusted for number of comorbidities, smoking, alcohol intake, and physical activity [42]; and (4) adjusted for social network size or intimacy [4]. We reported results as odds ratios (ORs) and 95% confidence intervals (CIs), and indicate a *p*-for trend to confirm dose-response. In addition, 2-way interactions between size and intimacy (Table 1-2, Supplementary Table 1) and the correlations between each social network index were also examined (Supplementary Table 2).

Stratified analyses were conducted accordingly: We divided into four groups based on social network size and intimacy (large & high, large & low, small & high, small & low). Both age diversity and age differences were stratified into quartiles. The interaction term between social network size and intimacy was tested in terms of age diversity and age differences, respectively.

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 substantial 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 64 years. The sample was slightly female-dominant (63.2% women), and 42.2% of participants were aged 50-59. The age distribution between non-depressed group versus depressed group was not significantly different (*p*-value=0.882). 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)	BDI-II <20 (n=2,112)	BDI-II ≥20 (with substantial 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)	
60-64	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
Unmarried (divorced/ 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
Former drinkers	104 (4.4)	97 (93.3)	7 (6.7)	
Current 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				
Size ^a (continuous)	4.8 ± 1.7	4.9 ± 1.7	4.5 ± 1.6	<0.001
Intimacy ^b (continuous)	3.2 ± 0.6	3.2 ± 0.6	3.0 ± 0.6	<0.001
Size^a & intimacy^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 (continuous)	8.2 ± 6.0	8.2 ± 6.1	7.6 ± 5.5	0.151
Age diversity^c				
Q1	573 (25.0)	498 (24.3)	75 (31.0)	0.103
Q2	574 (25.0)	517 (25.2)	57 (23.6)	
Q3	574 (25.0)	514 (25.1)	60 (24.8)	
Q4	573 (25.0)	523 (25.5)	50 (20.7)	
Age difference ^d (continuous)	-0.01 ± 6.2	-0.03 ± 6.2	0.1 ± 6.3	0.798
Age difference^d				
Q1	590 (25.0)	533 (25.2)	57 (22.7)	0.119
Q2	573 (24.3)	497 (23.5)	76 (30.3)	
Q3	608 (25.7)	551 (26.1)	57 (22.7)	
Q4	592 (25.1)	531 (25.1)	61 (24.3)	

Note. Data are expressed as means ± standard deviation or numbers (percentages). Differences between 'BDI-II scores ≥20' group and 'BDI-II scores <20' group were compared using independent t-test or chi-square test (p-value < 0.05 was considered statistically significant).

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

^b Social network intimacy: low (mean perceived intimacy < median) and high (\geq median).

^c Age diversity: standard deviation of network members' ages.

^d Age difference: difference between age of the participant and the average age of social network members.

Compared to non-depressed group, depressed group showed differences in gender (p-value <0.001), marital status (p-value <0.001), level of education (p-value <0.001), family income (p-value <0.001), smoking status (p-value=0.013), and number of comorbidities (p-value=0.007). The sociodemographic groups with higher prevalence of substantial depressive symptoms were women, singles, ones with relatively low education, and ones with relatively high income, as shown in Table 1. Among lifestyle factors, smoking status differs with depressive symptoms. Current smokers had a higher proportion of depressive symptoms compared to nonsmokers and former smokers. Number of comorbidities also showed a different distribution with substantial depressive symptoms; depressive groups tended to have higher numbers of comorbidities. Age, BMI, regular exercise, and drinking status did not show a clear difference with substantial depressive symptoms.

3.1. Social network size, intimacy and depressive symptoms

In terms of social networks, the small sized and low intimacy group had the highest odds for substantial depressive symptoms, and the large sized and high intimacy group had the lowest odds. Age diversity and age difference were not differed by the prevalence of substantial depressive symptoms (Table 1).

To assess the association of network size and intimacy with substantial depressive symptoms, participants were classified into four quantiles based on the social network variables (Table 2). Overall, social network size showed a negative linear association with substantial depressive symptoms (p-for trend=0.010). Among the four network size quantiles, the 2nd quartile group showed the highest prevalence (OR=2.52; 95% CI 1.57–4.05) compared to the reference group. In addition, social network intimacy showed a negative linear association with substantial depressive symptoms in total (Table 3, p-for trend <.001). Among the four social network intimacy quantiles, the 1st quartile group showed the highest odds (OR=2.24; 1.51–3.32). However, only women showed a statistically significant linear trend in both social network size and intimacy (social network size, p-for trend=0.012; intimacy, p-for trend <.001).

Table 2 Association between social network size and substantial depressive symptoms (BDI-II \geq 20)

Network size	No. of participants	No (%) of cases	Crude model		Model 1		Model 2		Model 3		Model 4		<i>p</i> for interaction (size × intimacy)	
			OR	[95% CI]	OR	[95% CI]	OR	[95% CI]	OR	[95% CI]	OR	[95% CI]		
Total (n=2,363)	Q4	495	28 (5.7)	1.00		1.00		1.00		1.00		1.00		0.900
	Q3	847	90 (10.6)	1.98	[1.28-3.08]	2.06	[1.33-3.20]	1.81	[1.16-2.85]	1.77	[1.12-2.79]	1.76	[1.12-2.78]	
	Q2	469	66 (14.1)	2.73	[1.72-4.33]	2.77	[1.75-4.41]	2.56	[1.60-4.09]	2.51	[1.57-4.03]	2.52	[1.57-4.05]	
	Q1	552	67 (12.1)	2.30	[1.46-3.65]	2.40	[1.51-3.80]	2.00	[1.24-3.21]	1.89	[1.17-3.05]	1.88	[1.16-3.05]	
													<i>p</i> for trend	0.010
Men (n=870)	Q4	166	8 (4.8)	1.00		1.00		1.00		1.00		1.00		0.708
	Q3	326	24 (7.4)	1.57	[0.69-3.57]	1.46	[0.60-3.53]	1.27	[0.52-3.11]	1.31	[0.53-3.25]	1.36	[0.54-3.41]	
	Q2	163	13 (8.0)	1.71	[0.69-4.25]	1.70	[0.69-4.22]	1.54	[0.62-3.86]	1.47	[0.58-3.74]	1.47	[0.58-3.75]	
	Q1	215	15 (7.0)	1.48	[0.61-3.58]	1.60	[0.70-3.65]	1.44	[0.62-3.35]	1.44	[0.61-3.39]	1.42	[0.60-3.35]	
													<i>p</i> for trend	0.617
Women (n=1,493)	Q4	329	20 (6.1)	1.00		1.00		1.00		1.00		1.00		0.546
	Q3	521	66 (12.7)	2.24	[1.33-3.77]	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)	3.24	[1.89-5.56]	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)	2.82	[1.64-4.84]	2.85	[1.66-4.89]	2.32	[1.33-4.06]	2.11	[1.20-3.72]	2.03	[1.14-3.60]	
													<i>p</i> for trend	0.012

Note. Model 1: Adjustment for age, gender, 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 intimacy and multiple term of social network size and mean intimacy.

Table 3 Association between mean perceived intimacy of social networks and substantial depressive symptoms (BDI-II ≥20)

Mean intimacy		No. of participants	No (%) of cases	Crude model		Model 1		Model 2		Model 3		Model 4		<i>p</i> for interaction (size × intimacy)
				OR	[95% CI]	OR	[95% CI]	OR	[95% CI]	OR	[95% CI]	OR	[95% CI]	
Total	Q4	645	46 (7.1)	1.00		1.00		1.00		1.00		1.00		0.900
(n=2,363)	Q3	537	51 (9.5)	1.37	[0.90-2.07]	1.43	[0.94-2.18]	1.45	[0.95-2.23]	1.45	[0.95-2.23]	1.50	[0.97-2.31]	
	Q2	611	65 (10.6)	1.55	[1.04-2.30]	1.57	[1.05-2.36]	1.52	[1.01-2.28]	1.52	[1.01-2.28]	1.60	[1.06-2.41]	
	Q1	570	89 (15.6)	2.41	[1.66-3.51]	2.31	[1.57-3.41]	2.24	[1.51-3.31]	2.24	[1.51-3.31]	2.24	[1.51-3.32]	
														<i>p</i> for trend <.001
Men	Q4	203	12 (5.9)	1.00		1.00		1.00		1.00		1.00		0.708
(n=870)	Q3	236	15 (6.4)	1.08	[0.49-2.37]	1.54	[0.73-3.25]	1.47	[0.69-3.11]	1.44	[0.67-3.08]	1.43	[0.66-3.11]	
	Q2	211	13 (6.2)	1.05	[0.47-2.35]	1.03	[0.46-2.31]	1.09	[0.48-2.46]	1.00	[0.44-2.29]	1.00	[0.43-2.30]	
	Q1	220	20 (9.1)	1.59	[0.76-3.35]	1.09	[0.50-2.38]	1.10	[0.50-2.42]	1.11	[0.50-2.48]	1.11	[0.49-2.52]	
														<i>p</i> for trend 0.396
Women	Q4	396	33 (8.3)	1.00		1.00		1.00		1.00		1.00		0.546
(n=1,493)	Q3	362	36 (9.9)	1.22	[0.74-1.99]	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)	1.89	[1.19-3.00]	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)	2.47	[1.59-3.84]	2.55	[1.64-3.97]	2.61	[1.66-4.12]	2.56	[1.61-4.06]	2.59	[1.62-4.14]	
														<i>p</i> for trend <.001

Note. Model 1: Adjustment for age, gender, 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 size and multiple term of social network size and mean intimacy.

In women (Fig. 1), compared to the reference group with large sized and high intimacy networks, the small sized but high intimacy group (OR=1.84; 1.05-3.23) or the large size but low intimacy group (OR=1.86; 1.03-3.37) had slightly higher odds for substantial depressive symptoms. The small size and low intimacy group had the highest odds for substantial depressive symptoms (OR=3.23; 1.91-5.47).

In men, no significant association was observed between these variables and substantial depressive symptoms (Fig. 2). However, when converted into continuous variables, both network size (β (SE), -1.52 (0.64); *p*-value=0.018) and intimacy (β (SE), -2.64 (0.91); *p*-value=0.004) had a negative association with depressive symptoms in men. 2-way interactions between size and intimacy were not statistically significant in both men (*p* for interaction=0.065) and women (*p* for interaction=0.226) and in total (*p* for interaction=0.924).

3.2. The moderating roles of age diversity and age difference

The effects of age diversity and age difference on the association between the network size and intimacy and substantial depressive symptoms were analyzed.

In women (Fig. 1), in the small sized and low intimacy group, those with high age diversity in their social network showed significantly higher odds for substantial depressive symptoms (OR=7.64; 2.07-28.13) compared to the average (OR=3.23; 1.91-5.47). In contrast, those with low age diversity showed lower odds for substantial depressive symptoms (OR=0.94; 0.37-2.41) than the average, although this result was not statistically significant. These results may imply that the association between social network size and intimacy with substantial depressive symptoms is stronger when the age diversity in social networks is higher in women, but the interaction term between social network characteristics and age diversity was not significant ($p=0.428$).

A similar tendency was found with respect to age difference. In women (Fig. 1), a positive association was found between age difference and substantial depressive symptoms as either the size or the intimacy of the social network decreased. In the small sized and low intimacy group, those with high age differences (4th quartile; social networks primarily with older persons) in their social network showed higher odds for depressive symptoms (OR=13.27; 3.61-48.83) compared to the average (OR=3.23; 1.91-5.47), but the interaction term between social network characteristics and age differences was not significant ($p=0.401$).

These results may imply that the association between the size and intimacy of social networks and substantial depressive symptoms is much stronger when women socialize with people older than themselves.

As shown in Fig. 2, in the case of men, no specific association according to high age diversity or age differences was found, or was statistically significant. In addition, the interaction term with social network characteristics was not statistically significant for both age diversity ($p=0.332$) and age differences ($p=0.277$).

4. Discussion

4.1. Associations of social network size and intimacy with depressive symptoms

The results partially supported the hypothesis of this study on the association between social network characteristics and depressive symptoms. Mean perceived intimacy of social networks had a strong inverse association with depressive symptoms, which is a confirmation of the findings from previous research [19, 43]. On the other hand, we found that social network size had a linear association with substantial depressive symptoms, especially in women, but not in men. Overall, our study found a significant linear trend for social network size, but the OR for the substantial depressive symptoms in the 2nd quartile was the highest. Although this study is not informative on the mechanism under this linear association between network size and depressive symptoms, previous findings might help find a clue to understand this phenomenon. Santini et al. suggested that negative human interactions may be a significant risk factor for depression [4]. Social networks, as a "double-edged sword," can play both a protective and a destructive role in mental health [43, 44]. Hence, social networks that act as a source of stress or negative emotions may contribute to increased depression [43]. If a person's network is small, this might be related to low probability of having such problematic relationships, and consequently, related to the reduced prevalence of depressive symptoms. Overall, findings from this study confirm the previous research that showed what matters more fundamentally is the qualitative aspect of social networks [3, 45].

4.2. The moderating roles of age diversity and age difference

Previous studies have reported that social network diversity may play a protective role against psychiatric conditions and lead to physical and mental health benefits [8, 28, 46]. This tendency, however, did not apply to age diversity in South Korean population. There was no significant association between age diversity or age difference and depressive symptoms. Rather, the age diversity and age difference played moderating roles in the associations of size and intimacy of social networks with depressive symptoms. In women, the associations were stronger when the age deviations among network members or the age disparities between the participant and network members were bigger. The associations were especially strong when the social networks were primarily with older persons, as shown in Figure 1. This effect was not prominent when the social

networks were primarily with younger persons. In women with peer-dominant networks, and in women with age-homogenous networks, deficits in social network size or intimacy were not associated with depressive symptoms.

To synthesize, the association between social network characteristics (size and intimacy) and depressive symptoms was specific to age diversity and age difference status in Korean women. In women whose network size and intimacy were both low, the prevalence of depressive symptoms were 3.23 times higher compared to when both variables were high. When a woman socialized primarily with people of more diverse age groups (4th quartiles) than average, this prevalence increased 7.64 times; and when a woman socialized primarily with older people (4th quartiles), this prevalence increased 13.27 times; but the interaction terms with social network characteristics were not statistically significant for both age diversity and age difference. Overall, women who are less intimate, with small-sized networks, and with high age diversity or primarily with older people appear to be at high risk of substantial depressive symptoms. A possible underlying mechanism on this is that higher age diversity may mean that social networks primarily consist of kinship (mainly family) than friends in most cases. As Supplementary Table 2 shows, there is a strong correlation between the age diversity and proportion of kinship (number of kin / network size) in both men ($r = 0.445$; p -value < 0.001) and women ($r = 0.475$; p -value < 0.001). In other words, higher age diversity may mean the social network primarily consist of family than friends. Empirical evidence suggests that friends are a key correlate with mental health at all stages of life [11, 47, 48]. 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 wellbeing [11, 47, 49, 50]. This importance is based on the voluntary and optional properties of friend networks in contrast to family networks, which are obligatory and thus may involve more emotional ambivalence or problematic interactions [47, 50]. 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 [20, 49, 50]. The importance of a sense of competence and self-worth to mental wellbeing may provide a clue to why women with high age diversity networks are more likely to have depressive symptoms when network size is small or intimacy is low.

These theoretical explanations may also provide insight into why these tendencies were prominent only in women. It is widely accepted that women have a higher prevalence of depression than men [35, 51]. One reason may be that women tend to be more affected by social networks than men in terms of mental wellbeing. Previous studies suggest that compared to men, women are more vulnerable to feelings of loneliness or distress from lack of social involvement, and more likely to suffer from other people's problems, all of which can lead to depression [10, 52, 53]. However, women also tend to benefit more from emotionally supportive social networks and their protective roles against depression compared to men [54, 55]. Hence, women with high age diversity networks, which is related to higher proportion of family or kinship in the networks, might benefit less from the aforementioned supportive properties of friend networks. This may lead to experiencing low social integration, morale, and self-worth, which can result in substantial depressive symptoms.

With regard to age differences, one of the possible mechanisms might be on the unique cultural background of South Korea. Koreans, strongly influenced by Confucian values that emphasize the mutual obligations between seniors (responsibility for juniors) and juniors (veneration for seniors) [56], tend to identify the social rank for each member of the group to determine the appropriate languages and manners for interactions, and the main criterion for identifying the social ranks is age [27, 57]. Deviated behaviors from social norms or failure to meet expected roles, especially of a person in a subordinate position, may act as the source of interpersonal stress [56]. Consequently, it is possible that age difference function as a barrier between younger and older persons in Koreans. Hahn et al. suggested that Koreans, unlike Americans, showed a remarkable disparity between different age groups in terms of psychological needs in emotional wellbeing [27]. Korean older adults put the highest importance on self-actualization and popularity-influence, whereas Korean young adults on autonomy [27]. Considering all these points, we can infer that persons socializing with peers may be relatively free from such age barriers. On the other hand, persons socializing primarily with older persons may be more exposed to interpersonal stress in social interactions and their autonomy may be more limited, which might lead to a higher risk of substantial depressive symptoms. In short, the hierarchical age culture of Korean society might be contributing to the higher association between the deficits of

social network properties and the prevalence of substantial depressive symptoms in women socializing primarily with older people in South Korea.

4.3. Strengths and limitations of this study

The main strength of this study is the large-scale social network analysis of the general South Korean population cohort. Because this study used a community-dwelling sample of adults from 30 to 64, the findings may be replicable to the general population of South Korea. In addition, this study provides novel insight into the importance of cultural background in examining social correlates of depression. Depression is considered as an emergent property of the culture-mind-brain system [58]. Although researchers have recognized the importance of culture in depression, not many studies have specified in which ways culture matters [58]. This study provided an example in that aspect by focusing on age diversity and age difference as cultural correlates of substantial depressive symptoms in one of the most age-conscious societies in the world. Given that previous studies on social networks and depression were concentrated mainly in Western countries [59], this study extends our understanding of social determinants of depressive symptoms in non-Western countries.

Some limitations need to be considered when interpreting the results. First, the clinical correlation between substantial depressive symptoms and depression in this study is not ensured. Substantial depressive symptoms in this study were measured by self-assessed levels of depressive symptoms during the previous two weeks, which do not necessarily indicate depressive disorder. Second, there could be some measurement bias in social network survey data, especially for intimacy, because the criteria for determining intimacy may vary from person to person. Further investigation is needed to verify the validity of the social network questionnaire. Third, the cross-sectional nature of this study prevents inference of the direction of the relationship between social network variables and substantial depressive symptoms. Moreover, we could not assess the adverse social interaction and perceived subjective social support influence based on the results of the current study. Finally, the findings on age diversity and age difference may not be replicable to non-Korean settings due to the uniqueness of Korean culture with regard to age.

List Of Abbreviations

CMERC, Cardiovascular and Metabolic Disease Etiology Research Center; BDI-II, Beck Depressive Inventory-II; BMI, Body Mass Index; NSHAP, National Social Life, Health, and Aging Project; OR, Odds Ratio; CI, Confidence Interval; SE, Standard Error

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).

Consent for publication

Not applicable.

Availability of data and material

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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Authors' contributions

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

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References

1. Liu Q, He H, Yang J, Feng X, Zhao F, Lyu J: **Changes in the global burden of depression from 1990 to 2017: Findings from the Global Burden of Disease study.** *J Psychiatr Res* 2019.
2. Bassett E, Moore S: **Social capital and depressive symptoms: the association of psychosocial and network dimensions of social capital with depressive symptoms in Montreal, Canada.** *Soc Sci Med* 2013, **86**:96-102.
3. Rosenquist JN, Fowler JH, Christakis NA: **Social network determinants of depression.** *Mol Psychiatry* 2011, **16**(3):273-281.
4. Santini ZI, Koyanagi A, Tyrovolas S, Mason C, Haro JM: **The association between social relationships and depression: a systematic review.** *J Affect Disord* 2015, **175**:53-65.
5. Visentini C, Cassidy M, Bird VJ, Priebe S: **Social networks of patients with chronic depression: A systematic review.** *J Affect Disord* 2018, **241**:571-578.
6. Ojagbemi A, Gureje O: **Typology of Social Network Structures and Late-Life Depression in Low- and Middle-Income Countries.** *Clin Pract Epidemiol Ment Health* 2019, **15**:134-142.
7. Berkman LF, Glass T, Brissette I, Seeman TE: **From social integration to health: Durkheim in the new millennium.** *Soc Sci Med* 2000, **51**(6):843-857.
8. Platt J, Keyes KM, Koenen KC: **Size of the social network versus quality of social support: which is more protective against PTSD?** *Soc Psychiatry Psychiatr Epidemiol* 2014, **49**(8):1279-1286.
9. Fiori KL, Denckla CA: **Social support and mental health in middle-aged men and women: a multidimensional approach.** *J Aging Health* 2012, **24**(3):407-438.
10. Domenech-Abella J, Lara E, Rubio-Valera M, Olaya B, Moneta MV, Rico-Urbe LA, Ayuso-Mateos JL, Mundo J, Haro JM: **Loneliness and depression in the elderly: the role of social network.** *Soc Psychiatry Psychiatr Epidemiol* 2017, **52**(4):381-390.
11. Werner-Seidler A, Afzali MH, Chapman C, Sunderland M, Slade T: **The relationship between social support networks and depression in the 2007 National Survey of Mental Health and Well-being.** *Soc Psychiatry Psychiatr Epidemiol* 2017, **52**(12):1463-1473.

12. Peirce RS, Frone MR, Russell M, Cooper ML, Mudar P: **A longitudinal model of social contact, social support, depression, and alcohol use.** *Health Psychol* 2000, **19**(1):28-38.
13. Gariépy G, Honkaniemi H, Quesnel-Vallée A: **Social support and protection from depression: systematic review of current findings in Western countries.** *Br J Psychiatry* 2016, **209**(4):284-293.
14. Lau YW, Vaingankar JA, Abidin E, Shafie S, Jeyagurunathan A, Zhang Y, Magadi H, Ng LL, Chong SA, Subramaniam M: **Social support network typologies and their association with dementia and depression among older adults in Singapore: a cross-sectional analysis.** *BMJ Open* 2019, **9**(5):e025303.
15. Park NS, Chiriboga DA, Chung S: **A Typology of Social Networks and Its Relationship to Psychological Well-Being in Korean Adults.** *Int J Aging Hum Dev* 2020, **90**(3):211-233.
16. Cacioppo JT, Hughes ME, Waite LJ, Hawkley LC, Thisted RA: **Loneliness as a specific risk factor for depressive symptoms: cross-sectional and longitudinal analyses.** *Psychol Aging* 2006, **21**(1):140-151.
17. Schwarzbach M, Luppa M, Forstmeier S, König HH, Riedel-Heller SG: **Social relations and depression in late life-a systematic review.** *Int J Geriatr Psychiatry* 2014, **29**(1):1-21.
18. Teo AR, Choi H, Valenstein M: **Social relationships and depression: ten-year follow-up from a nationally representative study.** *PLoS One* 2013, **8**(4):e62396.
19. Levine DS, Taylor RJ, Nguyen AW, Chatters LM, Himle JA: **Family and friendship informal support networks and social anxiety disorder among African Americans and Black Caribbeans.** *Soc Psychiatry Psychiatr Epidemiol* 2015, **50**(7):1121-1133.
20. Palumbo C, Volpe U, Matanov A, Priebe S, Giacco D: **Social networks of patients with psychosis: a systematic review.** *BMC Res Notes* 2015, **8**:560.
21. Schneider FD, Loveland Cook CA, Salas J, Scherrer J, Cleveland IN, Burge SK, Residency Research Network of Texas I: **Childhood Trauma, Social Networks, and the Mental Health of Adult Survivors.** *J Interpers Violence* 2020, **35**(5-6):1492-1514.
22. Bryant RA, Gallagher HC, Gibbs L, Pattison P, MacDougall C, Harms L, Block K, Baker E, Sinnott V, Ireton G *et al*: **Mental Health and Social Networks After Disaster.** *Am J Psychiatry* 2017, **174**(3):277-285.
23. Barger SD, Messerli-Bürgy N, Barth J: **Social relationship correlates of major depressive disorder and depressive symptoms in Switzerland: nationally representative cross sectional study.** *BMC Public Health* 2014, **14**:273.
24. Hawkley LC, Cacioppo JT: **Loneliness matters: a theoretical and empirical review of consequences and mechanisms.** *Ann Behav Med* 2010, **40**(2):218-227.
25. Nezlek JB, Imbrie M, Shean GD: **Depression and everyday social interaction.** *J Pers Soc Psychol* 1994, **67**(6):1101-1111.
26. Windsor TD, Rioseco P, Fiori KL, Curtis RG, Booth H: **Structural and functional social network attributes moderate the association of self-rated health with mental health in midlife and older adults.** *Int Psychogeriatr* 2016, **28**(1):49-61.
27. Hahn J, Oishi S: **Psychological needs and emotional well-being in older and younger Koreans and Americans.** *Personality and Individual Differences* 2006, **40**(4):689-698.
28. Ali T, Nilsson CJ, Weuve J, Rajan KB, Mendes de Leon CF: **Effects of social network diversity on mortality, cognition and physical function in the elderly: a longitudinal analysis of the Chicago Health and Aging Project (CHAP).** *J Epidemiol Community Health* 2018, **72**(11):990-996.
29. Goldberg EL, Van Natta P, Comstock GW: **Depressive symptoms, social networks and social support of elderly women.** *Am J Epidemiol* 1985, **121**(3):448-456.
30. Shim JS, Song BM, Lee JH, Lee SW, Park JH, Choi DP, Lee MH, Ha KH, Kim DJ, Park S *et al*: **Cardiovascular and Metabolic Diseases Etiology Research Center (CMERC) cohort: study protocol and results of the first 3 years of enrollment.** *Epidemiol Health* 2017, **39**:e2017016.
31. Youm Y, Laumann EO, Ferraro KF, Waite LJ, Kim HC, Park YR, Chu SH, Joo WT, Lee JA: **Social network properties and self-rated health in later life: comparisons from the Korean social life, health, and aging project and the national social**

life, health and aging project. *BMC Geriatr* 2014, **14**:102.

32. Beck A, Steer R, Brown GJSA, TX: Psychological Corporation: **Beck Depression Inventory manual 2nd ed.** 1996.
33. Dere J, Watters CA, Yu SC, Bagby RM, Ryder AG, Harkness KL: **Cross-cultural examination of measurement invariance of the Beck Depression Inventory-II.** *Psychol Assess* 2015, **27**(1):68-81.
34. Whisman MA, Judd CM, Whiteford NT, Gelhorn HL: **Measurement invariance of the Beck Depression Inventory-Second Edition (BDI-II) across gender, race, and ethnicity in college students.** *Assessment* 2013, **20**(4):419-428.
35. Dalgard OS, Dowrick C, Lehtinen V, Vazquez-Barquero JL, Casey P, Wilkinson G, Ayuso-Mateos JL, Page H, Dunn G: **Negative life events, social support and gender difference in depression: a multinational community survey with data from the ODIN study.** *Soc Psychiatry Psychiatr Epidemiol* 2006, **41**(6):444-451.
36. Smarr KL, Keefer AL: **Measures of depression and depressive symptoms: Beck Depression Inventory-II (BDI-II), Center for Epidemiologic Studies Depression Scale (CES-D), Geriatric Depression Scale (GDS), Hospital Anxiety and Depression Scale (HADS), and Patient Health Questionnaire-9 (PHQ-9).** *Arthritis Care Res (Hoboken)* 2011, **63 Suppl 11**:S454-466.
37. Hahn HM, Yum TH, Shin YW, Kim KH, Yoon DJ, Chung KJ: **A Standardization Study of Beck Depression Inventory in Korea.** *Neuropsychiatry* 1986, **25**(3):487-502.
38. Wang YP, Gorenstein C: **Assessment of depression in medical patients: a systematic review of the utility of the Beck Depression Inventory-II.** *Clinics (Sao Paulo)* 2013, **68**(9):1274-1287.
39. Sakurai R, Kawai H, Suzuki H, Kim H, Watanabe Y, Hirano H, Ihara K, Obuchi S, Fujiwara Y: **Poor Social Network, Not Living Alone, Is Associated With Incidence of Adverse Health Outcomes in Older Adults.** *J Am Med Dir Assoc* 2019, **20**(11):1438-1443.
40. Stute P, Spyropoulou A, Karageorgiou V, Cano A, Bitzer J, Ceausu I, Chedraui P, Durmusoglu F, Erkkola R, Goulis DG *et al*: **Management of depressive symptoms in peri- and postmenopausal women: EMAS position statement.** *Maturitas* 2020, **131**:91-101.
41. Litwin H: **The association between social network relationships and depressive symptoms among older Americans: what matters most?** *Int Psychogeriatr* 2011, **23**(6):930-940.
42. Bruin MC, Comijs HC, Kok RM, Van der Mast RC, Van den Berg JF: **Lifestyle factors and the course of depression in older adults: A NESDO study.** *Int J Geriatr Psychiatry* 2018, **33**(7):1000-1008.
43. Fiore J, Becker J, Coppel DB: **Social network interactions: a buffer or a stress.** *Am J Community Psychol* 1983, **11**(4):423-439.
44. Revenson TA, Schiaffino KM, Majerovitz SD, Gibofsky A: **Social support as a double-edged sword: the relation of positive and problematic support to depression among rheumatoid arthritis patients.** *Soc Sci Med* 1991, **33**(7):807-813.
45. Christakis NA, Fowler JH: **The spread of obesity in a large social network over 32 years.** *N Engl J Med* 2007, **357**(4):370-379.
46. Barefoot JC, Gronbaek M, Jensen G, Schnohr P, Prescott E: **Social network diversity and risks of ischemic heart disease and total mortality: findings from the Copenhagen City Heart Study.** *Am J Epidemiol* 2005, **161**(10):960-967.
47. Taylor HO, Taylor RJ, Nguyen AW, Chatters L: **Social Isolation, Depression, and Psychological Distress Among Older Adults.** *J Aging Health* 2018, **30**(2):229-246.
48. Jensen MP, Smith AE, Bombardier CH, Yorkston KM, Miro J, Molton IR: **Social support, depression, and physical disability: age and diagnostic group effects.** *Disabil Health J* 2014, **7**(2):164-172.
49. DuPertuis LL, Aldwin CM, Bosse R: **Does the source of support matter for different health outcomes? Findings from the Normative Aging Study.** *J Aging Health* 2001, **13**(4):494-510.
50. Fiori KL, Antonucci TC, Cortina KS: **Social network typologies and mental health among older adults.** *J Gerontol B Psychol Sci Soc Sci* 2006, **61**(1):P25-32.
51. Kim JH, Cho MJ, Hong JP, Bae JN, Cho SJ, Hahm BJ, Lee DW, Park JI, Lee JY, Jeon HJ *et al*: **Gender Differences in Depressive Symptom Profile: Results from Nationwide General Population Surveys in Korea.** *J Korean Med Sci* 2015,

30(11):1659-1666.

52. Kawachi I, Berkman LF: **Social ties and mental health.** *J Urban Health* 2001, **78**(3):458-467.
53. Umberson D, Chen MD, House JS, Hopkins K, Slaten E: **The Effect of Social Relationships on Psychological Well-Being: Are Men and Women Really So Different?** *American Sociological Review* 1996, **61**(5):837-857.
54. Grav S, Hellzen O, Romild U, Stordal E: **Association between social support and depression in the general population: the HUNT study, a cross-sectional survey.** *J Clin Nurs* 2012, **21**(1-2):111-120.
55. Kendler KS, Myers J, Prescott CA: **Sex differences in the relationship between social support and risk for major depression: a longitudinal study of opposite-sex twin pairs.** *Am J Psychiatry* 2005, **162**(2):250-256.
56. Jia CX, Zhang J: **Confucian Values, Negative Life Events, and Rural Young Suicide with Major Depression in China.** *Omega (Westport)* 2017, **76**(1):3-14.
57. Horak S: **Culture or anonymity? Differences in proposer behaviour in Korea and Germany.** *Int J Psychol* 2015, **50**(5):397-401.
58. Ryder AG, Chentsova-Dutton YE: **Depression in cultural context: "Chinese somatization," revisited.** *Psychiatr Clin North Am* 2012, **35**(1):15-36.
59. Ye L, Zhang X: **Social Network Types and Health among Older Adults in Rural China: The Mediating Role of Social Support.** *Int J Environ Res Public Health* 2019, **16**(3).

Figures

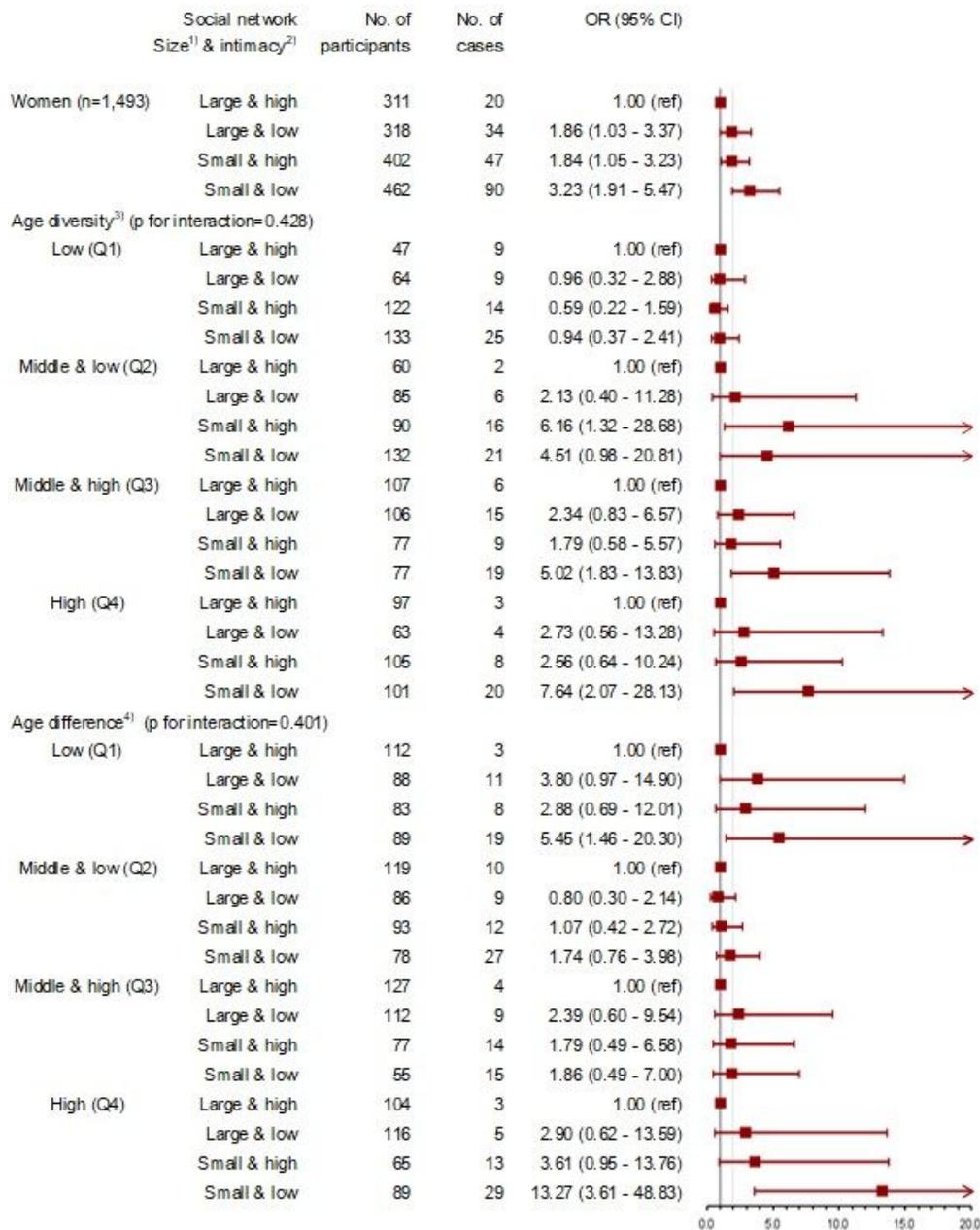


Figure 1

Association between social network status and substantial depressive symptoms ($BDI-II \geq 20$), and the moderation of age diversity and differences in women ($n = 1,493$) 1) Social network size: large (\geq median, 5.00) and small ($<$ median, 5.00). 2) Social network intimacy: high (mean perceived intimacy with each network member \geq median, 3.17) and low ($<$ median, 3.17). 3) Age diversity (standard deviation of network members' age): classified into quartiles. 4) Age difference (difference in age between participant and average age of network members): classified into quartiles.

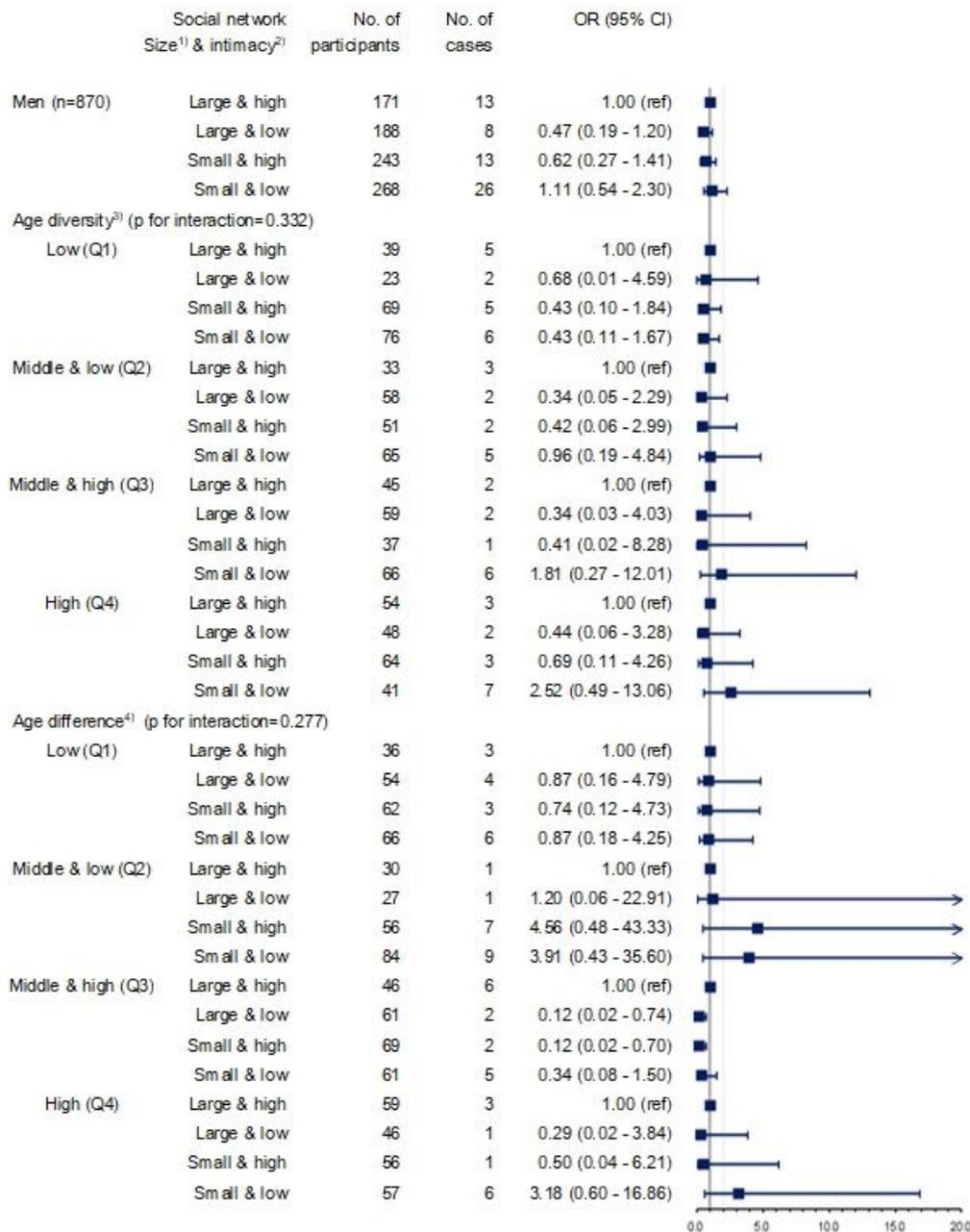


Figure 2

Association between social network status and substantial depressive symptoms (BDI-II ≥ 20), and the moderation of age diversity and differences in men (n = 870) 1) Social network size: large (\geq median, 5.00) and small ($<$ median, 5.00). 2) Social network intimacy: high (mean perceived intimacy with each network member \geq median, 3.25) and low ($<$ median, 3.25). 3) Age diversity (standard deviation of network members' age): classified into quartiles. 4) Age difference (difference in age between participant and average age of network members): classified into quartiles.

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