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Association between social networks and symptoms of post-traumatic stress during the pandemic: Cohort study in South Korea

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ABSTRACT

Background: This study estimated the association between pre-pandemic social network properties and symptoms of posttraumatic stress during the coronavirus disease 2019 (COVID-19) pandemic in South Korea.
Methods: We conducted four online mental health surveys during COVID-19 (from March 14, 2020, to December 11, 2021) among individuals enrolled in a community-based cohort study (previously recruited from 2013 to 2018). Among 4060 people interviewed at the pre-pandemic baseline, 2652 individuals (men = 951, women = 1701) who responded to at least one of the four surveys conducted were included. At baseline, each individual's social network, including size and average closeness, was measured in an egocentric way. Post Traumatic Stress Disorder Checklist for DSM-5 (PCL-5) was measured at each survey point. A generalized linear model and a generalized linear mixed model were used after stratified by sex.
Results: Among men, network size was negatively associated with total PCL-5 score (b = −0.42, SE = 0.16, p = 0.002). The magnitude of the association increased over time and was maximal by the 4th survey (b = −0.65, SE = 0.31, p = 0.037). Among women, average closeness was negatively associated with the total PCL-5 score (b = −1.16, SE = 0.37, p = 0.002). In analyses disaggregated by symptom clusters, social networks were associated explicitly with symptoms of intrusion and mood but not with avoidance and arousal symptoms.
Conclusion: In this cohort of adults followed for more than a year during the outbreak of COVID-19 in South Korea, social networks established before the onset of the COVID-19 pandemic had a protective association against developing symptoms of PTSD during the first two years of the pandemic.

1. Introduction

While posttraumatic stress disorder (PTSD) is typically manifest in response to severe trauma or exposure to large-scale disaster [1,2], the pandemic of severe coronavirus disease 2019 (COVID-19) has also been investigated as a potentially traumatic event experienced by people worldwide. According to a meta-analysis of 19,428 people from 38 research across populations from diverse regions including Asia, North America, and Europe, the prevalence of PTSD symptoms was estimated to be around 18% during the pandemic [3,4], which is much higher than pre-pandemic estimates [5,6]. Similar studies have shown elevated rates of depression, anxiety, and suicide ideation during the pandemic, both in South Korea [7–12] and elsewhere around the world [13–15].

Social networks, the networks of people surrounding an individual, have been studied for a long time regarding their potential protective effects on mental health [16–18]. Several studies have suggested that PTSD-related symptoms can be better controlled by positive and supportive social interactions [1], while other studies have demonstrated that perceived social support has a protective effect against PTSD symptoms [19,20]. This phenomenon has been investigated in the Korean context, but longitudinal studies are scarce. It has been widely recognized that there is a need for more research on the social and

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structural drivers of mental health during the COVID-19 pandemic [21,22]. Furthermore, while studies have investigated PTSD symptoms in relation to the COVID-19 pandemic in the U.S. [23–25] and other countries [26,27], few studies have assessed the potentially protective effects of social networks on PTSD during the COVID-19 pandemic.

To address these gaps in the literature, we conducted a longitudinal study in South Korea to estimate the association between pre-pandemic social networks and PTSD symptoms during the COVID-19 pandemic. We also sought to assess how the magnitude of these associations changed during the course of the pandemic.

2. Methods

2.1. Study population

The current study used data from one site of the Cardiovascular and Metabolic Diseases Etiology Research Center (CMERC) cohort, an ongoing multicenter population study of cardiovascular and metabolic disease in South Korea [28]. For the CMERC cohort, individuals without a history of myocardial infarction, heart failure, or stroke were recruited from around Seoul (centers 1 and 2) and from a hospital (center 3). This recruitment was done in line with the research objective of identifying risk factors for the development of cardiovascular and metabolic diseases. The subcohorts recruited from center 1 and center 2 represent community-based general population cohorts, while the subcohort recruited from center 3 is characterized as a hospital-based high-risk cohort. From December 2013 to February 2018, participants aged 30 to 64 were recruited as follows: Center 1 enrolled a total of 4060 participants, Center 2 had 4037 participants, and Center 3 had 3270 participants. All of the participants completed questionnaires queried by trained interviewers and underwent physical examinations according to a predefined protocol. Participants answered questions about their age, gender, marital status, socioeconomic status, educational level, medical history, and social network composition. Social network properties include network size, density, content, composition, emotional closeness of alters, volume of contact with alters, bridging potential.

The present study was initiated with the CMERC center 1 data as its baseline. Beginning with the outbreak of COVID-19 in Korea on January 20, 2020, an online mental health survey was conducted among CMERC center 1 cohort participants at 4 time points: March 14–18, 2020; August 13–15, 2020; March 8–14, 2021; and December 3–11, 2021. We contacted 3940 out of the 4060 participants who were surveyed at baseline (excluding 59 who had withdrawn consent or died and 61 who could not be reached by telephone), first using paper-based mail, followed by a text message containing the URL of the online survey, and then a second text message a week later.

2.2. Primary measures

We used a social network survey module modeled after that which was included in the U.S. National Social Life, Health, and Aging Project (NSHAP) [29]. The NSHAP collected social network data through a module that allows respondents to provide information about network members and the relationships between them [30,31]. The Korean version was developed to consistently measure social networks in health research and validated in a nationwide study [32]. All social network properties were elicited based on a recall window in the year before the criteria rating.

In detail, participants were first requested to identify their spouses. Subsequently, they were asked to list up to five people whom they have discussed the most frequently on significant matters over the preceding 12 months. The list may or may not include their spouse. Consequently, the network size varied between 0 and 6. Next, participants specified the nature of the relationship (e.g., spouse, parents, child, sibling, friend, colleagues, religious affiliates) with each listed member. Afterwards, participants assessed the duration of the relationship, the frequency of conversations (through phone calls, text messages, or social network services) and face-to-face interactions, the level of emotional closeness, and the ability to converse about health-related topics with every member mentioned in their network.

The primary exposures of interest, measured at baseline, were 'network size' and 'average closeness.' These two social network properties were selected because network size is a representative 'quantitative' property, and average closeness a typical 'qualitative' property, used in health research. Network size was defined as the number of network members, including a spouse and up to 5 other people with whom the respondent discussed important issues (range, 0–6). Average closeness between respondent and each member of their social network was evaluated on a 4-point Likert-type scale using the question, "How close are you to him or her?" Response options included "not very close" (1), "somewhat close" (2), "very close" (3), and "extremely close" (4). Average closeness was calculated by averaging all responses across each respondent's network members. The social network questionnaires used in the current study are described in Supplementary Figure 2 [33].

In all four online mental health surveys, subjects were asked to respond to the 20-item Post Traumatic Stress Disorder checklist for DSM-5 (PCL-5) [34], which has been validated in the Korean population [35]. The PCL-5 assesses four clusters of posttraumatic stress symptoms, corresponding to the DSM-5 disturbance criteria for PTSD: intrusive symptoms, avoidance symptoms, negative alterations in cognition and mood, and hyperarousal symptoms [34]. Respondents were asked to rate the degree of bother for each symptom in the past month on a 5-point Likert scale ranging from 0 to 4. The sum of items provided a total severity score ranging from 0 to 80. Subscale scores were also calculated for each of the four symptom clusters: intrusive symptoms (range, 0–20), avoidance symptoms (range, 0–8), negative alteration in cognition and mood (range, 0–28), and hyperarousal symptoms (range, 0–24).

2.3. Other covariates measured at baseline

Baseline household income was divided into quartiles (<24.5, 24.5 to <34.5, 34.5 to <48.3, and ≥ 48.3 million Korean Won/year). Participants were classified into three categories of educational attainment: ≤9, 10–12, and ≥ 13 years of education. Marital status categories were: "unmarried," "divorced/married but living apart," "married and living with spouse," and "widowed." Cigarette and alcohol consumption were categorized into "none," "past," and "current." Physical activity was evaluated using the Korean version of the International Physical Activity Questionnaire-Short Form [36]. Participants were divided into tertiles of physical activity in metabolic equivalents of task (MET) minutes (<924 MET min/week, 924–2771 MET min/week, ≥2772 MET min/week) [36,37]. Finally, participants were asked if they had ever been diagnosed by a physician as having any of the following: coronary heart disease; stroke; chronic renal failure; chronic hepatitis B or C viral infection; diabetes mellitus; or cancer of the liver, colon/rectum, stomach, lung, breast, uterus/cervix, or thyroid.

2.4. Statistical analysis

We first tabulated baseline summary characteristics for the sample, stratifying by probable PTSD status defined as a PCL-5 score of 33 or higher on at least one of the four post-baseline surveys. Baseline characteristics were compared to according to PTSD status using Pearson's χ^2-test for categorical variables and Student's *t*-test for continuous variables.

A generalized linear model was fitted to the data to estimate the association between social network properties at baseline and PCL-5 scores at each surveys during follow-up. A generalized linear mixed model was used to estimate the association between social network properties at baseline and the PCL-5 score across the four surveys. The final model was adjusted for age, education level, marital status, income,

smoking, drinking, physical activity, and comorbidities.

Finally, to further explore the nature of the association between social networks and posttraumatic stress symptoms, similar generalized linear models were fitted with the same covariates, specifying each subscale score corresponding to the four symptom clusters as the dependent variable. Since each symptom cluster was scored on a different scale (with maximum values ranging from 8 to 28, as noted above), each subscale score was standardized to a mean of 0 and standard deviation of 1, and standardized estimates were presented.

Because population surveys generally find that women are more likely to develop PTSD, even though men report greater exposure to traumatic events [38–40], and given that sex likely modifies the association between social networks and PTSD, we stratified all analyses by sex. Bonferroni correction was applied for multiple comparisons of the four online surveys (such that an alpha level of $p < 0.0125$ was required for statistical significance). All data analyses were performed using SAS version 9.4 (SAS Institute, NC, USA).

2.5. Ethics

The study protocol was approved by the institutional review board of the hospital at Yonsei University College of Medicine (4–2013-0661, Y-2020-0006), and written informed consent was obtained from all participants. All procedures in this work complied with the ethical standards of the relevant national and institutional committees on human experimentation, and were carried out in accordance with the Ethical Principles for Medical Research from the Helsinki Declaration of 1975 revised in 2008.

3. Results

Response rates for the 4 time points were as follows: March 14–18, 2020, $N = 1970$ (693 men, 1277 women) (50%); August 13–15, 2020, $N = 1905$ (655 men, 1250 women) (48%); March 8–14, 2021, $N = 1791$ (626 men, 1165 women) (45%); and December 3–11, 2021, $N = 1605$ (572 men, 1033 women) (41%). Those with missing social network values were excluded from this analysis, as were those with missing PCL-5 scores. The final analytic sample included 1946 people (685 men, 1261 women) who responded to the 1st survey, 1876 people (647 men, 1229 women) who responded to the 2nd survey, 1750 people (607 men, 1143 women) who responded to the 3rd survey, and 1568 people (565 men, 1003 women) who responded to the 4th survey. Altogether 2652 people (951 men, 1701 women) who completed at least one survey were included in the current analysis (Supplementary Fig. 1). Altogether we had data on 14,438.35 person-years of follow-up.

As a result of comparing baseline characteristics, it was found that the ever-PTSD group was younger than the non-PTSD group, had a higher education level, and had a higher ratio of unmarried/divorced/living apart. There were no statistically significant differences in gender, income, lifestyle, morbidity, or social network properties (Table 1).

In all 3 surveys except the 1st survey, the mean PCL-5 score was significantly higher in women than in men ([1st survey] men: mean = 10.25, standard deviation (SD) = 9.97; women: mean = 10.31, SD = 10.41; p-value = 0.910; [2nd survey] men: mean = 6.83, SD = 9.05; women: mean = 8.51, SD = 9.32; p-value<0.001; [3rd survey] men: mean = 8.47, SD = 11.43; women: mean = 10.67, SD = 12.19; p-value<0.001; [4th survey] men: mean = 9.01, SD = 11.83; women: mean = 11.24, SD = 13.06; p-value = 0.001). For both men and women, the mean value of the PCL-5 score showed a tendency to decrease on the 2nd survey and then increase again on the 3rd and 4th surveys (Fig. 1, Supplementary Table 1).

As a result of the generalized linear mixed model analysis, there was a significant negative association between average closeness and the PCL-5 scores for both men and women across the four surveys. However, the size of the association was larger in women than in men ([men] b = −0.95, standard error(SE) = 0.46, p- = 0.040; [women] b = −1.16, SE = 0.37, $p = 0.002$). In the case of network size, only men showed a statistically significant negative association ([men] b = −0.42, SE = 0.16, $p = 0.007$; [women] b = −0.14, SE = 0.14, $p = 0.320$).

For average closeness, among women, the PCL-5 scores in all survey results except for the primary survey presented negative and statistically significant associations with the average closeness at baseline in the fully adjusted model ([1st survey] b = 0.17, SE = 0.51, $p = 0.739$; [2nd survey] b = −1.31, SE = 0.46, $p = 0.005$; [3rd survey] b = −2.22, SE = 0.63, $p < 0.0001$; [4th survey] b = −1.64, SE = 0.74, $p = 0.027$). The 2nd and 3rd surveys showed statistically significant results even under Bonferroni's correction. We adjusted for age, education level, marital status, income, smoking, drinking, physical activity, and comorbidity. Although men also showed negative associations, the magnitude of the associations was smaller than that of women, and it was not statistically significant in all four surveys ([1st survey] b = −0.55, SE = 0.69, $p =$

Table 1
Baseline characteristics of participants classified by PTSD ($N = 2652$).

Variables	Non-PTSD group $N = 2356$ 88.8%	Ever PTSD group $N = 296$ 1.2%	*p value*
Age, years	51.1 ± 9.3	49.2 ± 9.9	0.006
Age (groups)			
<44	557 (23.6)	94 (31.8)	0.012
44–53	584 (24.8)	72 (24.3)	
54–58	620 (26.3)	72 (24.3)	
≥59	595 (25.3)	58 (19.6)	
Sex			
Men	853 (36.2)	98 (33.1)	0.295
Women	1503 (63.8)	198 (66.9)	
Education, years			
≤9	231 (9.8)	23 (7.8)	0.025
10–12	881 (37.4)	92 (31.1)	
≥13	1244 (52.8)	181 (61.2)	
Marital status			
Unmarried	125 (5.3)	28 (9.5)	0.022
Divorced or living apart	95 (4.0)	15 (5.1)	
Living together	2052 (87.1)	245 (82.8)	
Widowed	84 (3.6)	8 (2.7)	
Income			
<2450 won/year	592 (25.1)	84 (28.4)	0.435
2450–3450 won/year	505 (21.4)	67 (22.6)	
3450–4830 won/year	629 (26.7)	77 (26.0)	
≥4830 won/year	630 (26.7)	68 (23.0)	
Smoking			
Nonsmoker	1625 (69.0)	214 (72.3)	0.139
Past smoker	453 (19.2)	43 (14.5)	
Current smoker	278 (11.8)	39 (13.2)	
Alcohol			
Nondrinker	496 (21.1)	61 (20.6)	0.752
Past drinker	109 (4.6)	11 (3.7)	
Current drinker	1751 (74.3)	224 (75.7)	
Physical activity			
<924 MET min/week	754 (32.0)	101 (34.1)	0.752
924–2771 MET min/week	857 (36.4)	103 (34.8)	
≥2772 MET min/week	745 (31.6)	92 (31.1)	
Comorbidity			
0	1347 (57.2)	161 (54.4)	0.655
1	626 (26.6)	83 (28.0)	
≥2	383 (16.3)	52 (17.6)	
Average closeness			
<2.5	410 (17.4)	56 (18.9)	0.403
2.5–3.5	898 (38.1)	101 (34.1)	
≥3.5	1048 (44.5)	139 (47.0)	
Network size			
1–2	239 (10.1)	31 (10.5)	0.700
3–4	1238 (52.6)	162 (54.7)	
5–6	879 (37.3)	103 (34.8)	

Values are presented as the mean ± SD or N (%).
Average closeness: the mean of the degree of closeness (4-point scale) felt with people in the network.
Network size: spouse +5 people with whom the participants talked about important things (up to 6).

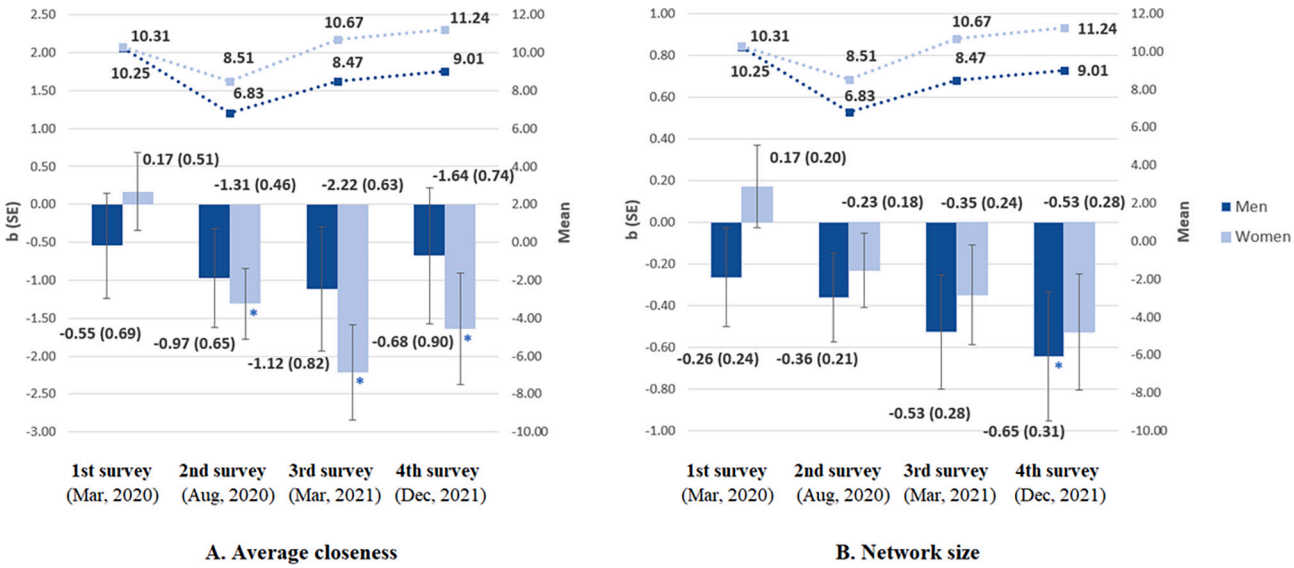

Fig. 1. Association between social network properties and PCL5 at each follow-up survey.
Average closeness: the mean of the degree of closeness (4-point scale) felt with people in the network.
Network size: spouse +5 people with whom the participants talked about important things (up to 6).
b(SE): the estimates from the generalized linear model after adjusting for age, education, marital status, income, smoking, drinking, physical activity, and comorbidity.
Mean: the mean of PCL-5 scores. The error bar represents the (b-SE, b-SE) interval. The * mark indicates statistical significance ($p < 0.05$).

0.429; [2nd survey] b = −0.97, SE = 0.65, $p = 0.139$; [3rd survey] b = −1.12, SE = 0.82, $p = 0.173$; [4th survey] b = −0.68, SE = 0.90, $p = 0.451$). For both men and women, as the survey progressed (1st to 2nd, 2nd to 3rd), which means the passage of time, the magnitude of the association increased, showing the largest negative association in the 3rd survey, and then decreasing again in the 4th survey.

For network size, there was a statistically significant negative association with PCL-5 scores only for men in the 4th survey in the fully adjusted model ([4th survey] b = −0.65, SE = 0.31, $p = 0.037$). In all surveys, the magnitudes of the negative association between network size and PCL-5 scores were greater for men than women. Additionally, for both men and women, the magnitude of the negative association between network size and PCL-5 scores increased over time, exhibiting the largest negative association in the 4th survey (Fig. 1, Supplementary Table 1).

Associations between social network properties and subcategories of PTSD symptoms defined by the DSM-5 were analyzed based on the 4th survey. For average closeness, among women, 'intrusive symptoms' and 'negative alterations in cognition and mood' were significantly and negatively associated with average closeness ('intrusive symptoms': standardized b = −0.064, standardized SE = 0.033; 'negative alterations in cognition and mood': standardized b = −0.085, standardized SE = 0.033). In other words, as the intensity at baseline increased, the 'intrusive symptoms' and 'negative substitution and mood' decreased. The other two symptoms, including avoidance symptoms' and 'hyperarousal symptoms', did not present a statistically significant association with PCL-5. In men, none of the four symptoms showed a statistically significant association with average closeness, and the magnitude of the association was smaller than that for women.

Regarding network size, for men, 'intrusive symptoms' and negative alterations in cognition and mood' were significantly and negatively associated with network size ('intrusive symptoms': standardized b = −0.088, standardized SE = 0.043; 'negative alterations in cognition and mood': standardized b = −0.104, standardized SE = 0.043). The other two symptoms, 'avoidance symptoms' and 'hyperarousal symptoms', did not exhibit a statistically significant association with PCL-5. For women, only 'intrusive symptoms' showed a significant and negative association with network size (standardized b = −0.063, standardized SE = 0.032). The other symptoms did not have a statistically significant association with network size (Fig. 2, Supplementary Table 2).

4. Discussion

The results of our study indicated that PTSD symptoms in the COVID-19 pandemic were decreased among those with a larger social network size or a higher average closeness of previously existing social networks. In addition, as the COVID-19 pandemic has continued, the impact of social networks has become more important in lowering the risk of PTSD. Among the previous social network properties, for men, a larger network size was associated with a lower risk of PTSD, whereas for women, higher average closeness was associated with a lower risk of PTSD. Among the 4 PTSD symptoms defined by DSM-5, 'intrusive symptoms' and 'negative alterations in mood and cognition' were affected by social networks.

As the four surveys progressed, overall, the mean PCL-5 score of the participants increased, which means that as the COVID-19 pandemic lengthened, more PTSD symptoms occurred. In the second survey, the mean PCL-5 score was lower than in the other surveys. At that time, Korea was evaluated as having a good response to infectious diseases, and the number of confirmed cases had decreased. At the end of February and early March 2020, the daily number of confirmed cases was approximately 500, while from April to early August, the daily number of confirmed cases was approximately 50 [41]. Therefore, it could be inferred that people's anxiety about COVID-19 was reduced, and there were fewer PTSD symptoms as a result. However, then the PCL-5 score tended to increase again until the 4th survey. Similar to our findings, there are a number of other studies showing the deterioration of people's mental health as the COVID-19 situation continued into 2021 [9,10,42].

Previous studies have shown that social network with other individuals, groups, and their communities can create resilience to trauma-related stress because they are important for helping them adapt to adversity and maintaining physical and mental health [43–45]. Therefore, given the current study, it can be tentatively suggested that certain properties of social networks, including a large network size or high closeness, may have potentially helped people adapt to the COVID-

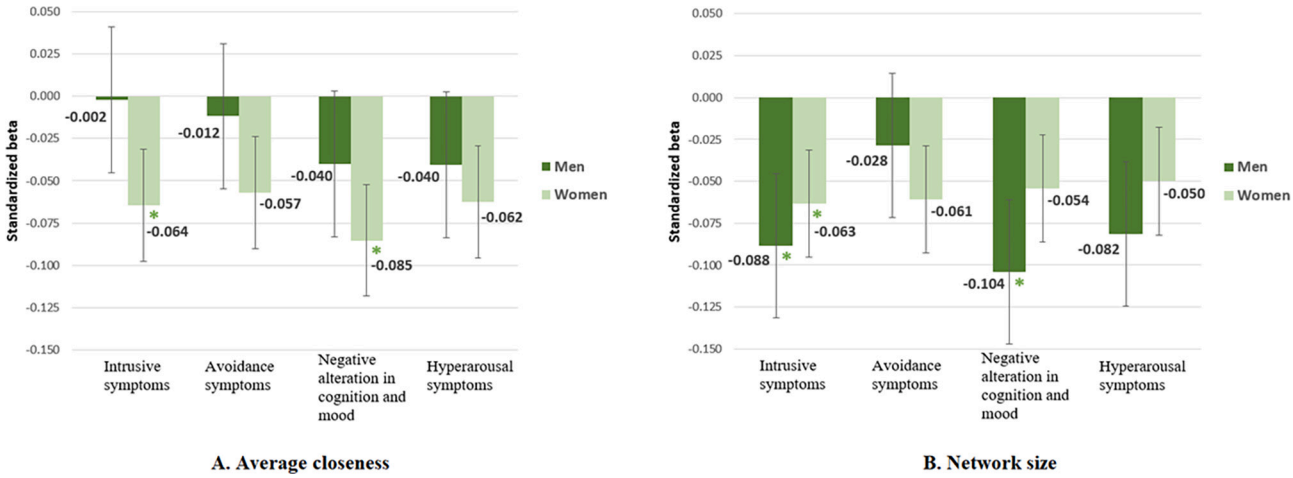

Fig. 2. Association between social network properties and PTSD symptoms at the 4th survey.
Average closeness: the mean of the degree of closeness (4-point scale) felt with people in the network.
Network size: spouse +5 people with whom the participants talked about important things (up to 6).
Standardized beta: the standardized estimate from the generalized linear model after adjusting for age, education, marital status, income, smoking, drinking, physical activity, and comorbidity.
Intrusive symptoms (PCL-5 question 1–5), Avoidance symptoms (PCL-5 question 6–7), Negative alteration in cognition and mood (PCL-5 question 8–14), Hyperarousal symptoms (PCL-5 question 15–20).
The error bar represents the (b-SE, b-SE) interval. The * mark indicates statistical significance ($p < 0.05$).

19 situation and caused less trauma-related stress. In the current study, the negative association between social network size and PTSD symptoms in men became stronger over time, except for a slight weakening in the 4th survey. The negative association between average closeness and PTSD symptoms among women has consistently become more pronounced over time. Therefore, it can be interpreted that the role of social networks in reducing PTSD symptoms has grown larger as the COVID-19 situation has been prolonged.

Each social network property of the NSHAP study, as applied in the present study, has the following potential implications. For network size, interviewers asked respondents to name those with whom they discuss "important matters." Thus, a scale of network size derived from the data can determine the extent to which a person has the strongest types of social ties. Additionally, social ties are most likely source of social support [30]. Individuals with larger social networks, assuming all other factors are equal, have greater access to social resources such as instrumental and socioemotional support. In regard to closeness, the NSHAP and this study asked respondents to rate the quality of the relationship and how close they are to him or her [30]. The subjective, emotional quality of relationships has been linked to well-being and may regulate the impact of other network features on well-being [46,47]. High-quality relationships, that is, those with a high degree of closeness, are most likely to provide individuals a sense of belonging and self-esteem [30]. Combining the results of our study with the potential implication of social network properties, it can be inferred that men exhibited fewer PTSD symptoms as access to social resources such as institutional and socioemotional support increased through a large network size. In the case of women, it can be seen that they showed fewer PTSD symptoms by receiving a sense of belonging and self-esteem through high closeness.

Our findings suggest that men with smaller social networks and women with lower intranetwork closeness may be at higher risk of developing PTSD symptoms during the pandemic. Likewise, several studies have proposed gender differences in the association between social networks and PTSD. In a study of military veterans in the United States, it was found that both social support and attachments were more protective factors against PTSD in women than men [48]. In a British study that included victims of violent crime, the effect of social support on PTSD was much greater for women than for men [49]. It has also been known that gender differences mainly arise from coping mechanisms for stress: women have evolved to take advantage of the 'tend-and-befriend mechanism' that reflects their reliance on social groups to avoid stressors and threats and thus they generally benefit more from social networks and social support than men [33,50]. According to these previous studies, it is somewhat convincing that the association between average closeness and PTSD symptoms was greater in women than in men. On the other hand, as another result in the current study, the effect of network size on PTSD symptoms was greater in men than in women, and this association was not statistically significant in women. However, there have also been opposite results reported. As an example, in a study investigating the effect of social networks on PTSD in female North Korean immigrants, there was a strong association between network size and PTSD compared to its density or composition [51].

After dividing PTSD symptoms into 4 categories according to the DSM-5 diagnostic criteria, 'intrusive symptoms' and 'negative alterations in cognition and mood' were significantly and negatively associated with PTSD symptoms. The other two symptoms, including avoidance symptoms' and 'hyperarousal symptoms', did not present a statistically significant association with PTSD symptoms in both men and women. To the best of our knowledge, few studies have analyzed the association between social network properties and each distinct PTSD symptom. However, similar to our findings, a study reported that 'intrusive symptoms' and 'negative alterations in cognition and mood' had greater associations with the social network than the other two symptoms [52]. In that study, 259 Croatian Homeland War veterans with a diagnosis of PTSD and a minimum of 6 months of combat experience were included. Similar to our study, the PCL-5 questionnaire was administered, with 20 items categorized into 4 clusters based on the DSM-5. The study utilized specific modules to assess social networks and measured perceived social support. From the results of this study, it can be inferred that social networks have a preventive effect on 'intrusive symptoms (re-experience)' and 'negative alterations in cognition and mood' rather than 'avoidance symptoms' and 'hyperarousal symptoms' among PTSD symptoms. In clinical practice, when evaluating high-risk groups for PTSD, this will be a meaningful source of evidence for detailed evaluation of existing social networks according to gender, predicting the course of PTSD and establishing treatment strategies.

There are several limitations of the current study. First, information

on social network properties was measured only at baseline, not during the COVID-19 period. The perceived social network may have been affected, and the network size and average closeness may have changed during the time of COVID-19. By measuring social network properties during the COVID-19 period, changes in social networks caused by the pandemic should be investigated, and the effects of those changes on PTSD symptoms should also be studied. However, our study itself holds significance in evaluating the long-term impact of social network properties on PTSD. Second, there were few clinical PTSD cases in this study due to the insufficient number of participants. Although the PCL-5 score was used as a continuous variable to analyze the risk of PTSD, the association between social network properties and actual clinical PTSD occurrence could not be analyzed. Third, the current study could not obtain specific information about the traumatic events experienced by the subjects. Depending on the type of trauma, the protective effect of the social network against PTSD may be different [53]. Analyzing the association between PTSD and social network properties among each type of traumatic event could provide greater insight into specifically which social network properties buffer the effect of which types of trauma. Nevertheless, in this study, it is expected that social changes due to the pandemic and difficulty in adaptation played a common role as trauma, and analyzing it based on the trauma of adaptation and social change due to the pandemic has meaning.

However, the current study also exhibits several strengths. First, as this study employed a longitudinal study design, it was able to reduce the reverse causation. There are two primary theoretical frameworks to illustrate the association between social networks and PTSD. One theory postulates that social networks may act as a buffer to protect individuals from increased PTSD symptoms, while other studies suggest that increased PTSD symptoms can lead to the erosion of social networks [20,54,55]. In this study, as the temporal order of social network properties and PTSD was clearly established, the causal interpretation based on the former theory could be given more strength. Second, this study was conducted at various points during the COVID-19 pandemic, and it was possible to confirm how mental health problems have changed as the COVID-19 situation has been prolonged. Third, in this study, many covariates were used, and the analysis was performed by sex. Since social networks are closely related to socioeconomic status or lifestyle [56,57], it was important to adjust them as confounders. Through analysis stratified by gender, it was possible to determine which social network properties were associated with PTSD symptoms.

5. Conclusion

We investigated the association between the previous social network properties and the risk of PTSD occurrence during the COVID-19 pandemic. In our study, we observed that men with larger social networks and women with closer-knit connections had a lower risk of developing PTSD symptoms. In addition, a stronger association was shown as the COVID-19 situation continued. Therefore, it is important to recognize the importance of social networks as a factor to prevent the risk of PTSD in the current disaster situation and to propose different types of social support according to gender as a preventive measure. In particular, it is necessary to make national efforts to organize and recommend various social activities so that social networks can be formed for the socially marginalized.

Author statements

Study design and concept: Yang, Jung.
Acquisition, analysis, or interpretation of data: Yang, Jung.
Drafting of the manuscript: Yang.
Critical revision of the manuscript for important intellectual content: Yang, Lee, Jung, Cho, Kim, Tsai.
Statistical analysis: Yang.
Obtained funding: Jung.
Administrative, technical, or material support: Lee.
Study supervision: Jung.

Funding

The funders of the study had no role in the study design, data collection, data analysis, data interpretation, or writing of the report.

Declaration of Competing Interest

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Appendix A. Supplementary data

Supplementary data to this article can be found online at https://doi.org/10.1016/j.comppsych.2023.152432.

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