Research Square

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COVID-19 lockdown has altered the dynamics among affective symptoms and social isolation among older adults: results from a longitudinal network analysis

Junhong Yu (pcmyj@nus.edu.sg)
National University of Singapore
Rathi Mahendran
National University of Singapore

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Abstract

The COVID-19 lockdown has drastically limited social interactions and brought about a climate of fear and uncertainty. These circumstances not only increase affective symptoms and social isolation among community dwelling older adults but also alter the dynamics among them. Using network analyses, we study the changes in these dynamics before and during the lockdown. Community-dwelling older adults (N = 419) completed questionnaires assessing depression, anxiety, and social isolation, before the COVID-19 pandemic, as part of a cohort study, and during the lockdown period. The total scores of these questionnaires were compared across time. For the network analyses, partial correlation networks were constructed using items in the questionnaires as nodes, separately at both timepoints. Changes in edges, as well as nodal and bridge centrality were examined across time. Depression and anxiety symptoms, and social isolation had significantly increased during the lockdown. Significant changes were observed across time on several edges. Greater connectivity between the affective and social isolation nodes at lockdown was observed. Depression symptoms have become more tightly coupled across individuals, and so were the anxiety symptoms. Depression symptoms have also become slightly decoupled from those of anxiety. These changing network dynamics reflect the greater influence of social isolation on affective symptoms across individuals and an increased vulnerability to affective disorders. These findings provide novel perspectives and translational implications on the changing mental health context amidst a COVID-19 pandemic situation.

Introduction

The COVID-19 outbreak has brought about a global healthcare crisis on an unprecedented scale. Healthcare systems are on the brink of exhaustion as they cope with the ever-increasing number of infections. In an attempt to slow down the spread of the virus to relieve the pressure on healthcare resources, lockdown measures have been widely implemented.

Within the context in Singapore, the COVID-19 ‘lockdown’ consisted of two phases which were known locally as the ‘circuit-breaker’ and ‘phase 1’. The circuit-breaker measures were implemented on 8th April 2020. These measures included the closure of non-essential workplaces, schools, and places of worship. Eating out was no longer allowed. Food had to be taken away from food establishments and consumed at home. Residents were strongly encouraged to stay at home, unless they had to travel for essential work or needed to purchase essentials. Home-based gatherings consisting of people not within the same household were forbidden. Subsequently, some of these measures were relaxed in the phase 1 period, which spanned from 2nd to 19th June 2020. During this period, some non-essential businesses and schools could reopen, and each household could receive up to two visitors a day.

Most of these lockdown measures were not unique to Singapore. Around the world, people are strongly advised, or in some cases legally obligated to stay at home. Inevitably, these measures increased social isolation within the community. While many can, to some extent, mitigate such isolation by shifting their day to day social interactions and activities online, a sizable proportion of older adults may not be able to

make this shift due to their relatively low levels of 'digital literacy' [1]. Thus, the older adult population was arguably more vulnerable to the effects of social isolation during the lockdown. Such isolation will result in major mental health consequences. As longitudinal research has shown, perceived and objective social isolation among older adults are significant risk factors for developing depression and anxiety symptoms [2].

Along with social isolation, the pandemic has also brought about a climate of fear [3]. These fears generally relate to becoming infected with the virus [4], unknowingly infecting others [5], losing livelihoods or stigmatization [6]. Taken together with the general uncertainty of the pandemic situation [7], these circumstances further provoked affective symptoms. Due to these aggravating factors, we would not just expect a general increase in the levels of affective symptoms and perceived isolation, but also a change in the dynamics between them— reflecting the greater influence of social isolation and increased vulnerability to affective disorders during this period.

In the current study, we used network analyses to study how these dynamics have altered during the lockdown. A network is characterized by 'nodes' that are linked to each other via 'edges'. According to the network model of psychopathology, psychiatric symptoms do not arise from psychopathology, but rather it is the dynamic interaction (edges) between psychiatric symptoms (nodes) that constitutes psychopathology [8]. Our network approach was based loosely on this model, with the nodes representing the affective and social isolation-related features and edges representing the correlations between these features. We constructed network maps before and during the lockdown, to study the changes in the network structure across time. In particular, we tested the hypothesis that social isolation had a greater influence on affective symptoms at lockdown by examining the connectivity between the social isolation and affective nodes before and during the lockdown. We also tested the hypothesis that the lockdown had resulted in a general increase in connectivity among affective nodes, reflecting the increased coupling among affective symptoms and vulnerability to affective disorders.

Methods

Participants and procedures

Data collection was carried out across two time points — pre-COVID-19 and lockdown. In the former, participants (N = 762) were recruited from the community for an observational cohort study. The inclusion criteria and recruitment procedures for this timepoint have been described in detail elsewhere [9] . Data collection for this study took place from 1st February 2018 to 15th January 2020; all responses for the relevant variables were collected via pen-and-paper questionnaires. Subsequently, a follow-up study was initiated for the lockdown timepoint. All participants from the previous time point, except those diagnosed with dementia, were contacted (N = 614). Data collection for this follow-up study spanned from 11th May 2020 to 19th June 2020. Depending on participants' preference, the English or back-translated Chinese questionnaires were administered via an online platform (i.e., Qualtrics) or pen-and-paper questionnaires mailed to them. They were given S$10 upon completion of the questionnaires. Ethical approval for both

studies was granted by the National University of Singapore Institutional Review Board. Informed consent was obtained from participants prior to their participation in both studies. The study procedures have been performed in accordance with the Declaration of Helsinki.

A total of 419 participants (275 females) completed both waves of data collection and were included in the current analyses. They had a mean age of 69.0 years (SD = 5.5), an average of 13.6 years of education (SD = 3.8), and a mean Mini-Mental State Examination score of 28.4 (SD = 1.5). The average follow-up period was 1.3 years (SD = 0.52). Most participants chose to complete the English questionnaires (N = 315); 231 and 190 participants completed the questionnaires via the online and offline options, respectively.

Measures

The 15-item version [10] of the Geriatric Depression Scale (GDS) was used to index the level of depressive symptoms. This scale consists of 15 yes/no questions, each worth a point, giving a maximum total score of 15. It has a cutoff score of 4/5. This version of the GDS has demonstrated good psychometric validity in the local context (Nyunt et al. 2009).

The Geriatric Anxiety Inventory (GAI)[11] was used to measure the level of anxiety symptoms. There are 20 agree/disagree items in the questionnaire, each worth a point, giving a maximum possible total score of 20. The GAI was validated and had shown good psychometric properties in a similar Asian population [12]. It has a cutoff score of 10/11.

We used the friendship scale (TFS) to measure social isolation. This scale was designed specifically for use among older adults and consisted of six 5-point scale items. The scale had excellent internal consistency and concurrent validity according to its original validation study [13]. TFS was previously used in an Asian sample similar to the present and had demonstrated good concurrent validity [14].

For the GDS and GAI, higher scores corresponded to worse outcomes, whereas lower scores in TFS corresponded to worse outcomes. The individual items from these questionnaires were used as nodes in the network analyses.

Statistical analyses

To provide an overview of the three outcome measures, we assessed the relationships between their total scores using Pearson's correlations and assessed the changes in total scores across time using paired-samples t-tests. Then, we constructed partial correlation networks separately at both time points, using the graphical Lasso based on an extended Bayesian information criterion (EBICglasso) option within the R package qgraph [15]. This approach reduces small partial correlations to zero such that they do not appear in the final network; false-positive edges are eliminated in the process, thus leaving only robust edges in the final network. The spearman's correlation method was used in view of the ordinal data from the TFS items. Although several graph theory metrics can be derived from these networks, not all are meaningful and interpretable in the current context. Hence, we restricted our analyses and interpretations

to metrics such as global strength, edge values, nodal strength centrality and bridge centrality, which were more relevant in the current context. Global strength refers to the sum of the absolute values of all edges in the network. The edge value represents the partial correlation between a pair of nodes after controlling for the influence of other nodes. The nodal strength centrality is the sum of these absolute values from all edges that connect to the node. Bridge strength centrality indicates the sum of all absolute edge values from a node that connects to other communities [16]. In the current study, the affective (GDS and GAI items) and social isolation nodes (TFS items) are assigned to two different communities, to test the connectivity between affective symptoms and social isolation.

In order to examine the stability of the network metrics, we carried out a case-dropping bootstrapping procedure with 1000 bootstraps and computed the correlation stability (CS) coefficients for the edge values. The CS coefficient is defined as the maximum proportion of cases that can be dropped while maintaining a 95% probability that the correlation of the network metrics between the sample with and without dropouts is at least .70. It was previously suggested that the CS coefficients should be at least .25 [17]. These procedures were executed using the R package bootnet [17].

Finally, we carried out paired network comparison tests using the R package NetworkComparisonTest [18] to compare the edge values, nodal and bridge strength centrality, and global strength between both time points. The statistical significance of these differences across time was determined using a null distribution generated from 5000 iterations of a permutation test. Statistical significance was set at $p < .05$. All analyses were carried out in R 4.0.0. The R code for executing these analyses and generating the figures are available at https://osf.io/gu4wd/files/.

Results

Changes in total scores across time

Table 1 shows the descriptive statistics of the three questionnaires' total scores at both timepoints. Figure 1 illustrates the changes across time in these total scores. Paired-samples t-tests revealed GDS ($t = 10.61$, $p = < .001$, $d = .52$) and GAI ($t = 2.30$, $p = .022$, $d = .11$) scores had increased significantly, whereas TFS scores had decreased significantly ($t = 5.14$, $p = < .001$, $d = .25$) during the lockdown period.

Table 1
Descriptive statistics

Variable	M	SD
1. $GDS_{pre-COVID-19}$	1.02	1.76
2. $GAI_{pre-COVID-19}$	1.12	2.58
3. $TFS_{pre-COVID-19}$	25.51	3.22
4. $GDS_{lockdown}$	2.11	2.30
5. $GAI_{lockdown}$	1.38	3.14
6. $TFS_{lockdown}$	24.70	3.57

Note. GDS = geriatric depression scale; GAI = geriatric anxiety inventory; TFS = the friendship scale

Network analyses

The CS coefficients for the edges at pre-COVID-19 and lockdown were .39 and .44, respectively, suggesting that the edge values had satisfactory levels of stability. Figures 2a and b illustrate the pre-COVID-19 and lockdown networks. Figures 3a and b provide a summary of the within- and between-questionnaire nodal connectivity at both timepoints. In general, the average absolute edge values between-questionnaires were low compared to those of within-questionnaires—suggesting that within-questionnaire nodal connections dominated the network and relatively fewer and weaker connections exist between any two questionnaires.

Moving on to comparisons across time, global strength was not significantly different ($p = .72$) at pre-COVID-19 and lockdown. Overall, the average absolute edge values have increased within and between questionnaires, except between GDS and GAI (see Fig. 3c). A closer examination in the differences across time in individual nodes (see Fig. 4) would suggest that various nodes had increased and decreased in nodal and bridge strength centrality across time, though none of these changes emerge statistically significant from the permutation tests. Narrowing down to the individual edges, our permutation analyses identified 34 edges that had changed significantly across time (see Fig. 2c).

Interpretations

While many possible interpretations can be made from the results at the level of the individual nodes and edges, it would be more meaningful to interpret the results at the questionnaire level. The TFS nodes appeared to be weakly associated with the GDS and GAI nodes at pre-COVID-19, as indicated visually by the smaller number and magnitude of edges (see Fig. 2a), and also objectively via the relatively low average absolute edge values (see Fig. 3a). However, these TFS nodes became more visibly connected to the GDS and GAI nodes at lockdown (see Fig. 2b); these connections were also associated with higher

average absolute edge values (see Fig. 3b) and bridge strength centrality (see Fig. 4b). Taken together, this suggests that social isolation had a greater influence on affective symptoms at lockdown than at pre-COVID-19. While connectivity has increased within all three questionnaires at lockdown, as indicated by the increased average edge values, some decoupling between GDS and GAI has also occurred. For instance, multiple edge connections between GDS and GAI nodes have weakened significantly (see Fig. 2c) and the average edge values between GDS and GAI have also decreased across time (see Fig. 4c).

Discussion

The current study investigated how a COVID-19 lockdown has altered the dynamics between depression, anxiety, and social isolation. Overall, participants' well-being had worsened significantly in these socio-affective domains during the lockdown. The lockdown has strengthened the association between social isolation and affective symptoms. Importantly, our results also indicated that depression, anxiety, and social isolation features were more tightly coupled within their respective domains during the lockdown, despite the slight decoupling between depression and anxiety. Hence, it has become more likely that related affective symptoms would appear together across individuals. Our network-based findings provide novel and useful perspectives on the increased vulnerability to psychopathology during this period.

While it is expected that perceived social isolation would have increased during this period of time, it is somewhat alarming that such perceptions had become more strongly associated with affective symptoms. There are two likely explanations for this. First, the same level of perceived isolation may have become more distressful or appraised more negatively during the lockdown. For instance, our results showed that the thought of being ‘alone’ has become more likely to co-occur with several depression nodes, including feelings of ‘emptiness’. Speculatively, participants were more likely during the lockdown to overinterpret or overgeneralize their feelings of loneliness as emptiness in their life. Second, the lockdown might have weakened protective factors that could have mitigated affective symptoms. Hence, the same level of perceived social isolation has become more damaging in the absence of these protective factors. For instance, physical activity, which has been drastically limited during the lockdown, was known to protect older adults from depression [19]. In particular, previous research has shown that even a single session of physical exercise, can significantly enhance the emotional regulation [20] that is needed to buffer against affective dysfunction. Social support is another such protective factor that has weakened; in fact, it might have a double role in the current context. While the difficulty of accessing social support during the lockdown has increased the perceptions of social isolation, the lack of social support also made it difficult for one to cope with stress [21] and regulate emotions [22]. In general, these weakened protective factors could amplify the effects of most if not all etiological factors associated with affective disorders, beyond that of social isolation.

Across individuals, the lockdown has increased coupling of symptoms within the depression or anxiety syndrome. This suggests that affective symptoms are more likely to appear concurrently with other

symptoms as part of a larger cluster of depression or anxiety symptoms, alluding to a steeper developmental trajectory of affective dysfunction. The weakened protective factors, as discussed above, especially in relation to compromised emotional regulation, could have allowed internalizing symptoms, such as those associated with depression and anxiety to escalate more rapidly [23,24]. This increased coupling of within-syndrome symptoms could also be attributed to a 'third variable problem'; that is, the tight coupling between these symptoms was merely the consequence of them being triggered by the same extraneous variable. In the current context, this 'third variable' could manifest as the fear, uncertainty, and daily stressors associated with the COVID-19 pandemic. Regardless of the cause, the increased within-syndrome coupling among affective symptoms reflects an increased vulnerability to affective dysfunction. Interestingly, despite the increased within-syndrome coupling, the syndromes appeared to have decouple from each other. Speculatively, this could mean that depression and anxiety are triggered by different lockdown-related dispositional factors. For instance, the fear of getting infected with COVID-19 may be more specific in triggering anxiety symptoms (Lee et al., 2020), whereas the lockdown-related isolation may aggravate depression symptoms [26] more so than those of anxiety.

Our findings present important implications in the wider public health context. First, we provided valuable longitudinal evidence to raise the alarm for the deteriorating mental health situation among community-dwelling older adults. Second, in view of the fact that the COVID-19 pandemic has overstretched healthcare resources, it has become even more important to identify efficient intervention targets, to maximize treatment gains with minimal resources. To this end, we have identified several symptoms that were highly central in the network such as nervousness, anhedonia, perceptions of loneliness and emptiness. Given their centrality in the network, the successful treatment of these symptoms would likely 'switch off' other connected symptoms [27], thus accelerating the recovery process. Such targeted approach can be implemented on mental health hotlines, especially given their increasing importance in providing mental health support during a lockdown [28]. Staff manning such hotlines should screen for these symptoms proactively and be adequately trained to deal with these symptoms using a variety of approaches.

The current findings are subjected to some limitations. One should exercise caution in interpreting these edge- and node-level results. Second, given that the COVID-19 situation and its associated lockdown can vary very differently across countries and cities, it would be difficult to generalize our results to other older adult populations in other countries and cities. Finally, while it is tempting to interpret these results from a within-person perspective (i.e., symptom becomes more tightly coupled within a person), this would not be justified because our results are derived from between-subject networks. Nevertheless, these between-subject findings do reveal on a macroscopic level, the general structural changes of affective symptomology in relation to perceived social isolation during a lockdown. These networks also generate testable hypotheses on the psychiatric developmental trajectories shared by individuals [8].

Declarations

Competing interests

The authors declare no conflicts of interest.

Author contributions

JY designed the study, analyzed the data and wrote the manuscript. RM obtained funding for the study and assisted in the writing of the manuscript

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Figures

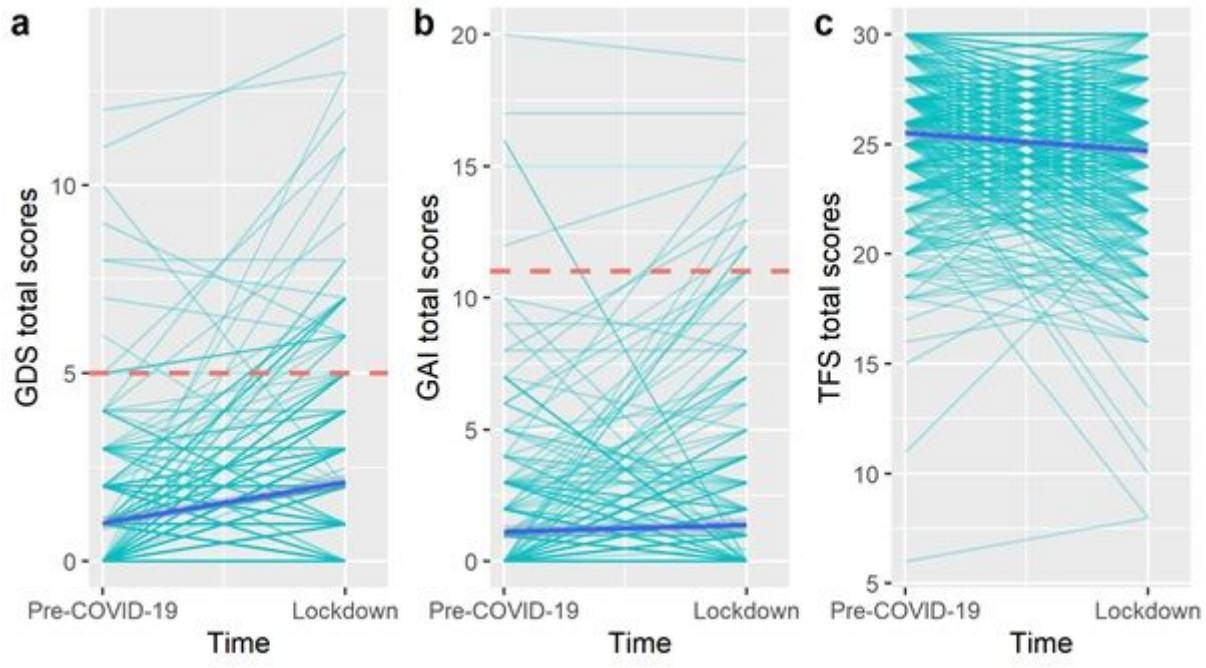

Figure 1

Changes in the total scores of a) geriatric depression scale, b) geriatric anxiety inventory and c) the friendship scale across time. Each light blue line represents the trajectory of a single participant. The dark blue line represents the mean trajectory. The red dotted lines represent the clinical cutoffs for the geriatric depression scale and geriatric anxiety inventory. *p<.05, ***p<.001.

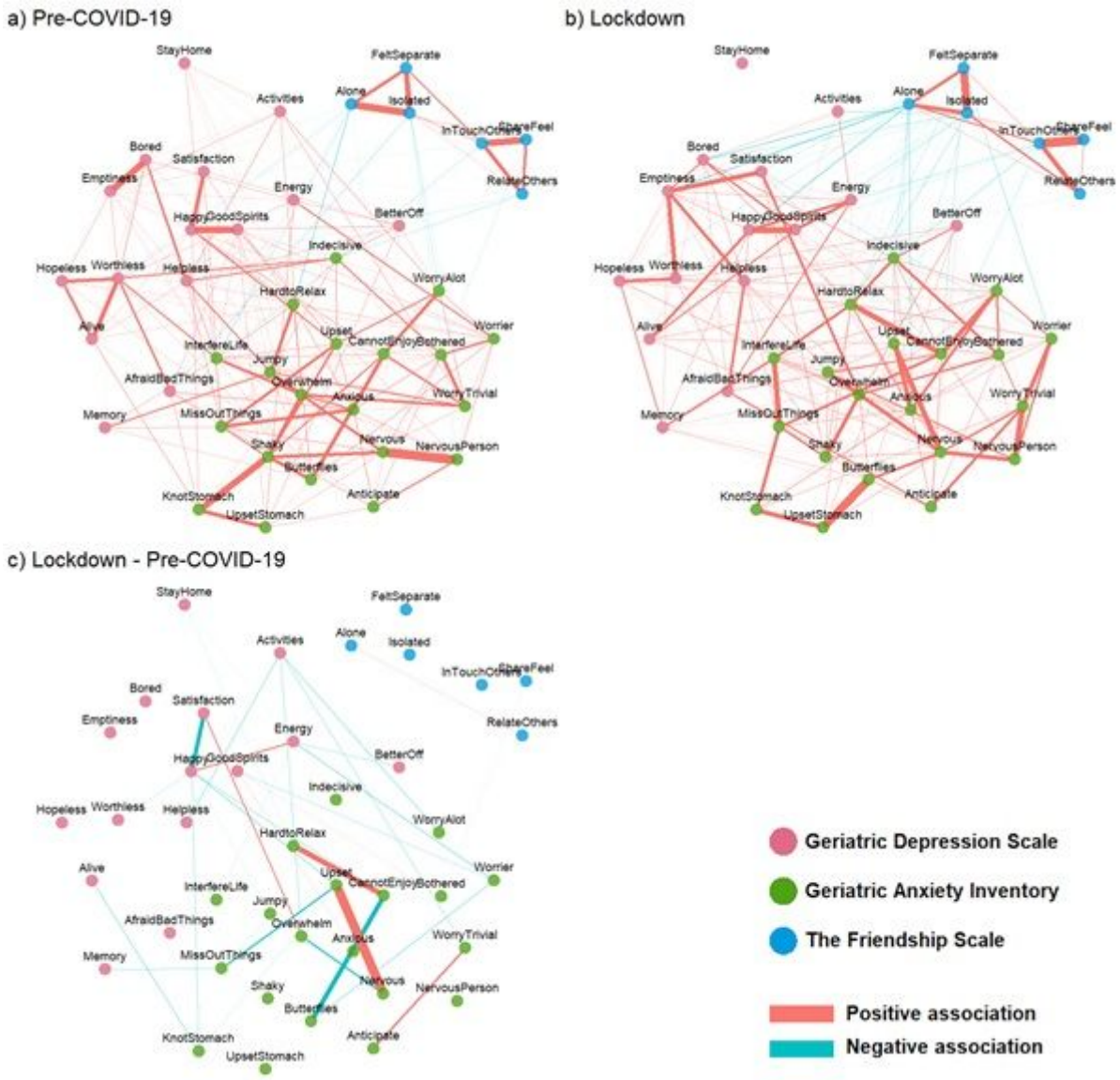

Figure 2

Partial correlation networks depicting items from the geriatric depression scale, geriatric anxiety inventory and the friendship scale at a) Pre-COVID-19 and b) lockdown. Differences across time in edges values are presented in the c) Lockdown - Pre-COVID-19 network. Only the edges with significant changes (uncorrected p>.05) across time, as determined by the paired network comparison test, are shown. “Positive association” and “Negative association” in the context of c) meant that the edges became more positive and negative, respectively, across time. Thick lines corresponded to stronger associations. To facilitate visual comparison, the nodal positions in all three networks are fixed to a common layout, as determined by averaging layouts of the Pre-COVID-19 and lockdown networks. In general, strongly connected nodes would cluster in the middle, whereas less connected nodes are located more in the periphery of the network.

Figure 3

Average (absolute) edge values between and within questionnaires at a) pre-COVID-19, b) Lockdown and c) of the difference between both timepoints. The diagonal represents the average (absolute) edges values within questionnaires.

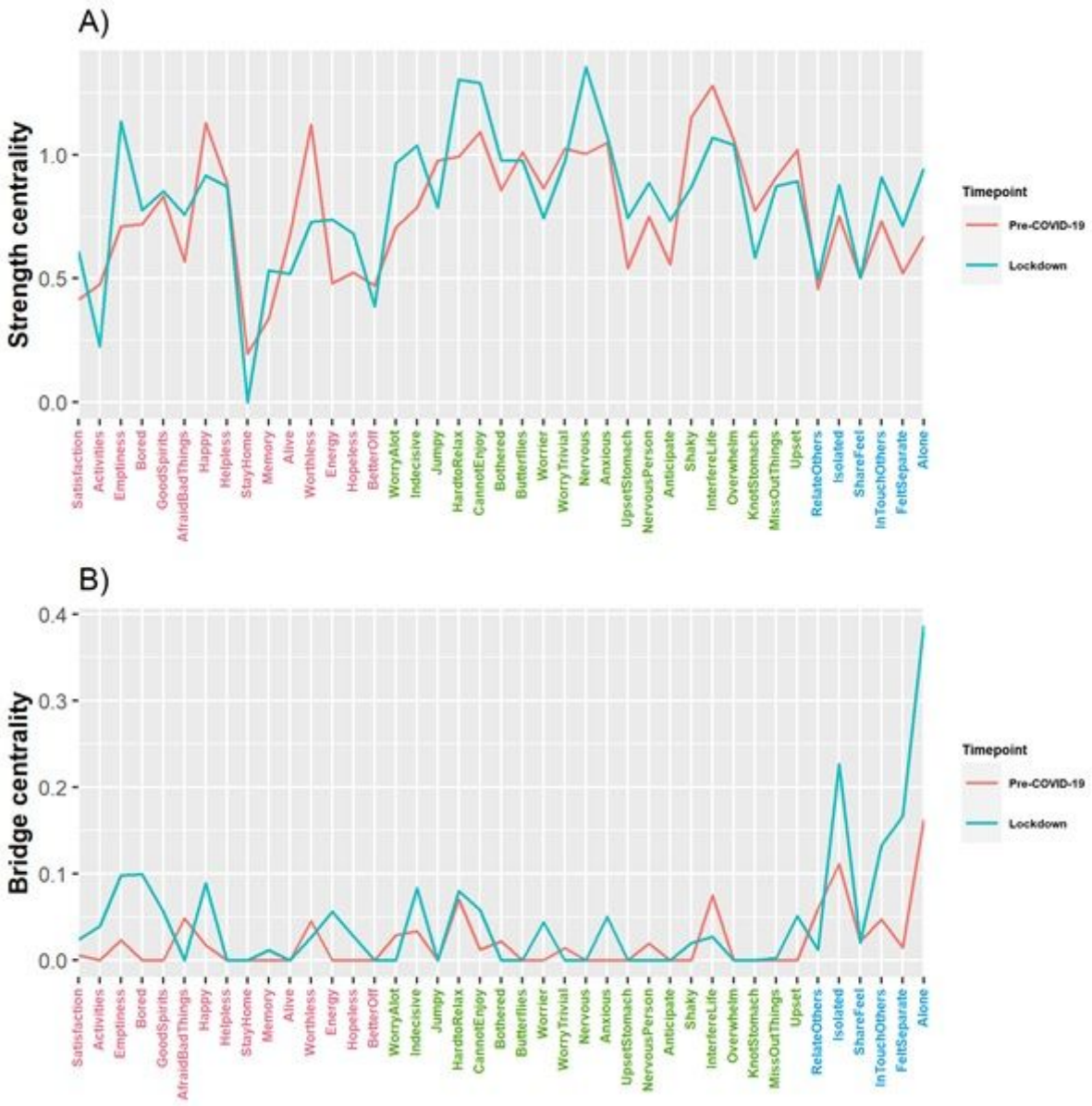

Figure 4

A) Strength centrality and B) bridge centrality of all nodes across both timepoints. The red, green and blue axis labels correspond to the items from the geriatric depression scale, geriatric anxiety inventory and the friendship scale, respectively.