Since January 2020 Elsevier has created a COVID-19 resource centre with free information in English and Mandarin on the novel coronavirus COVID-19. The COVID-19 resource centre is hosted on Elsevier Connect, the company's public news and information website.

Journal of Affective Disorders 318 (2022) 456–464

Contents lists available at ScienceDirect

Journal of Affective Disorders

journal homepage: www.elsevier.com/locate/jad

Research paper

Associations between depressive symptoms and quality of life among residents of Wuhan, China during the later stage of the COVID-19 pandemic: A network analysis

Yan-Jie Zhao [a,b,c,1], Shu-Fang Zhang [d,e,1], Wen Li [f,g,1], Ling Zhang [a,1], Tong Guo [a,1], Teris Cheung [h], Todd Jackson [i], Bing Xiang Yang [j,*], Yu-Tao Xiang [b,c,**]

[a] The National Clinical Research Center for Mental Disorders & Beijing Key Laboratory of Mental Disorders, Beijing Anding Hospital & the Advanced Innovation Center for Human Brain Protection, Capital Medical University, Beijing, China
[b] Unit of Psychiatry, Department of Public Health and Medicinal Administration, & Institute of Translational Medicine, Faculty of Health Sciences, University of Macau, Macao SAR, China
[c] Centre for Cognitive and Brain Sciences, University of Macau, Macao SAR, China
[d] Research Center for Psychological and Health Sciences, China University of Geosciences, Wuhan, Hubei province, China
[e] Department of Psychiatry, Wuhan Mental Health Center, Wuhan, Hubei province, China
[f] Shanghai Key Laboratory of Forensic Medicine, Key Laboratory of Forensic Science, Ministry of Justice, China
[g] Shanghai Forensic Service Platform, Academy of Forensic Science, Shanghai, China
[h] School of Nursing, Hong Kong Polytechnic University, Hong Kong SAR, China
[i] Department of Psychology, University of Macau, Macao SAR, China
[j] School of Nursing, Wuhan University, Wuhan, Hubei province, China

ARTICLE INFO

Keywords:
Depression
Quality of life
Later stage of COVID-19
Network analysis

ABSTRACT

Background: Various populations have experienced significant increases in depression and decreased quality of life (QOL) during the coronavirus disease 2019 (COVID-19) pandemic. This network analysis study was designed to elucidate interconnections between particular depressive symptoms and different aspects of QOL and identify the most clinically important symptoms in this network among adults in Wuhan China, the initial epicenter of the COVID-19 pandemic.

Methods: This cross-sectional, convenience-sampling study ($N = 2459$) was conducted between May 25 to June 18, 2020, after the lockdown policy had been lifted in Wuhan. Depressive symptoms and QOL were measured with the Patient Health Questionnaire-9 (PHQ-9) and first two items of the World Health Organization Quality of Life Questionnaire - brief version (WHOQOL-BREF), respectively. A network structure was constructed from the extended Bayesian Information Criterion (EBIC) model. Network centrality strength and bridge strength were evaluated along with the stability of the derived network model.

Results: Loss of energy (DEP-4) and *Guilt feelings* (DEP-6) were the two central symptoms with the highest strength as well as the two most prominent bridge symptoms connecting the clusters of depression and quality of life (QOL) in tandem with the two nodes from the QOL cluster. Network structure and bridge strengths remained stable after randomly dropping 75 % of the sample.

Conclusion: Interventions targeting "*Loss of energy*" and "*Guilt feelings*" should be evaluated as strategies for reducing depressive symptoms and promoting improved QOL in COVID-19-affected populations.

Abbreviations: COVID-19, coronavirus disease 2019.

* Correspondence to: B.X. Yang, School of Health Sciences, Wuhan University, Wuhan, Hubei, China.
** Correspondence to: Y-T. Xiang, 1/F, Building E12, Faculty of Health Sciences, University of Macau, Avenida da Universidade, Taipa, Macao.
E-mail addresses: yangbingxiang82@163.com (B.X. Yang), xyutly@gmail.com (Y.-T. Xiang).

[1] These authors contributed equally to the work.

https://doi.org/10.1016/j.jad.2022.08.104
Received 21 December 2021; Received in revised form 23 March 2022; Accepted 26 August 2022
Available online 2 September 2022

1. Introduction

Coronavirus disease 2019 (COVID-19) was first reported in Wuhan, Hubei province of China at the end of 2019, and was subsequently found in other parts of the world (World Health Organization, 2020a, 2020b). Due to its fast transmission rate, the World Health Organization (WHO) declared the COVID-19 outbreak to be a pandemic on March 11, 2020 (World Health Organization, 2020c). Notwithstanding its impact on health and mortality rates, the COVID-19 pandemic has also had pronounced effects on mental health status and quality of life (QOL) (Gu et al., 2021; Kılınçel et al., 2021; Pan et al., 2022). For example, various subpopulations including COVID-19 survivors, healthcare professionals and ordinary residents have experienced significant increases in depressive symptoms (Brooks et al., 2020; Canet-Juric et al., 2020; Hu et al., 2020; Li et al., 2021; Zhao et al., 2021) and decreases in QOL (Genta et al., 2021; Lizana et al., 2021; Moser et al., 2020) as a result of the pandemic.

Previous studies have suggested that the relationship between depression and poor QOL is reciprocal and bi-directional, across pandemic (Ferreira et al., 2021; Ma et al., 2020) and non-pandemic eras (Abbey and Andrews, 1985; Chan et al., 2006). Furthermore, individuals who do not meet all diagnostic criteria for major depressive disorder (MDD) but who endorse select severe depressive symptoms also report lowered QOL (Bertha and Balázs, 2013) as well as other adverse consequences, including increased impairment with daily activities (Geiselmann and Bauer, 2000) and risk for suicidal behaviors (Balázs et al., 2013; Hegerl, 2016). The severity and impact of depressive symptoms may be magnified as a result of pandemics. For example, previous research indicated negative effects of severe acute respiratory syndrome (SARS) on mental health status persisted for over one year (Lee et al., 2007; Mak et al., 2009; Maunder et al., 2006). These data underscore how associations between mental health concerns and QOL may become more deeply entrenched in the context of pandemics. Consequently, understanding interactions between depressive symptoms ("depression" hereafter) and QOL during the COVID-19 pandemic may provide foundations for targeted interventions that alleviate depression and its negative impact on functioning.

To date, traditional models of psychopathology have conceptualized depression and other psychiatric syndromes on the basis of latent models wherein individual clinical symptoms (i.e., observable indicators) are equally-weighted manifestations of latent variables (i.e., unobservable factors) (Epskamp and Fried, 2018; Schmittmann et al., 2013). Relatedly, a key premise of traditional approaches is that the severity of syndromes such as depression is best measured as the sum of individual symptoms endorsed on interview or questionnaire measures (Eaton, 2015; Epskamp and Fried, 2018). Unfortunately, such approaches may obscure meaningful associations between individual symptoms of a syndrome that may vary in strength with one another and with other indicators of functioning such as QOL (Fried and Nesse, 2014).

Network analysis is an alternative approach designed to elucidate syndromes, comorbidity, and associations with correlates at the level of individual symptoms or attributes (Borsboom and Cramer, 2013). For example, network analysis can provide a visual depiction of how depressive symptoms and different aspects of QOL are interconnected as well as specific symptoms that are more central or clinically important within the overall symptom network (Borsboom, 2017; Borsboom and Cramer, 2013; Cramer et al., 2016; Cramer et al., 2010). The network approach has been applied recently to explore patterns of psychiatric symptom interactions during the COVID-19 pandemic. For example, two previous network analysis studies investigated core post-traumatic stress symptoms (PTSS) in a region most widely affected by COVID-19 (Jiang et al., 2020; Sun et al., 2021). In other research, Wang et al. (Wang et al., 2020) explored changes in relations between depressive and anxiety symptoms during different phases of the COVID-19 pandemic.

This study was designed to extend recent network analysis research by attempting to identify depressive symptoms having the strongest influence in relation to QOL in a sample living at the initial epicenter of Wuhan China shortly after the initial lockdown policy had been lifted on April 8, 2020 (i.e., the later stage of the COVID-19 pandemic) (China Daily Global, 2020). In addition, we examined the impact of select subgroup influences (i.e., gender, age group, residence, status as a close contact of someone infected by COVID-19) on the structure and strength of relations between depressive symptoms and QOL facets in observed network models.

2. Methods

2.1. Study setting and participants

This cross-sectional study was conducted in Wuhan, China between May 25, 2020 and June 18, 2020, after the lockdown policy has been lifted (Xinhua Net, 2020b), based on convenience sampling. The questionnaire was designed using the Questionnaire Star application, and a Quick Response (QR) code linked to the invitation and assessment form was generated and distributed via WeChat, which is the most popular social network application in China with around 1.2 billion active users monthly (China Academy of Information and Communications Technology (CAICT), 2020). To be eligible, participants were required to meet the following selection criteria: 1) aged 18 years or older; 2) able to read Chinese and understand the purpose and contents of the assessments; 3) not infected with COVID-19 during the pandemic; 4) provided online electronic informed consent. Otherwise, there were no exclusion criteria in this study. The study protocol was approved by the ethics committee of Beijing Anding Hospital, Capital Medical University.

2.2. Assessment tools

Severity of depressive symptoms in the past two weeks was assessed using the Chinese version of the Patient Health Questionnaire – 9 (PHQ-9), which consists of 9 depressive symptom items, each scored from 0 (not at all) to 3 (almost every day) (Spitzer et al., 1999). Higher PHQ-9 scores represent more severe depression (Chen et al., 2015). Participants reporting a PHQ-9 total score of 5 or above were considered as having clinically relevant depressive symptoms (depression hereinafter) (Chen et al., 2015). Psychometric properties of PHQ-9 Chinese version have been validated in Chinese populations (Wang et al., 2014; Xu et al., 2007). QOL in the past two weeks was assessed with the first two items of the World Health Organization Quality of Life Questionnaire - brief version (WHOQOL-BREF). For these items, participants rated their global life quality and general health status from 1 (very dissatisfied) to 5 (very satisfied) with higher scores representing better QOL (Fang et al., 1999; The WHOQOL GROUP, 1998). The Chinese version of the WHOQOL has been validated in Chinese samples, with good psychometric properties (Fang et al., 1999). Finally, demographic information was sought about participants' age, gender, residence (Wuhan versus other area), and status as a close contact, i.e., having family members, colleagues, close friends or neighbors who had been infected with COVID-19 (National Health Commission of the People's Republic of China, 2020a).

2.3. Data analysis

All analyses were conducted using R version 4.0.3 (R Core Team, 2020). Because all scores for each parameter had skewed distributions, the network model in this study was constructed using the extended Bayesian Information Criterion (EBIC) model graphical least absolute shrinkage and selection operator (gLASSO) with the non-paranormal transformation (Epskamp and Fried, 2018; Garabiles et al., 2019); thicker edges in the EBIC model indicated stronger relationships between nodes. Estimation and visualization of the network were conducted using the R package *bootnet version 1.4.3* (Epskamp et al., 2018).

Network centrality indices of strength and bridge strength were evaluated using the R packages *qgraph version 1.6.5* (Epskamp et al., 2012), *bootnet version 1.4.3* (Epskamp et al., 2018) and *networktools version 1.2.3* (Jones, 2020). Strength was defined as the sum of absolute weights of the edge connecting a certain node to all other nodes (Valente, 2012). Bridge strength was defined as the sum of absolute value of all edges between a node A and all nodes that were not in the same cluster as node A (Jones, 2020).

To assess the robustness of the network, network stability was examined via correlation stability coefficients (*CS-C*) using a case-dropping 1000-time bootstrap method (Chernick, 2011; Costenbader and Valente, 2003). A *CS-C* quantifies the maximum proportion of cases that can be dropped at random to retain, with 95 % certainty, a correlation coefficient (*r*) of at least 0.7 between centralities of the original network and the subsample network (Epskamp et al., 2018). The *CS-C* is preferentially above 0.5, with a minimum requirement of 0.25 (Epskamp et al., 2018). This procedure was performed using R package *bootnet version 1.4.3* (Epskamp et al., 2018). Network comparison tests (NCT) with Holm's correction for multiple comparisons examined whether network characteristics differed within subgroups based on gender, age (two subgroups split by median age), residence, and status as a close contact, using R package *NetworkComparisonTest version 2.2.1* (van Borkulo et al., 2022).

3. Results

3.1. Basic demographic characteristics

In total, 2614 adults were invited to participate in this study. Of these, 16 people did not provide informed consent and 139 others had been infected previously with COVID-19 and were, therefore, ineligible for inclusion in data analyses. The remaining participants ($N = 2459$) fulfilled all eligibility criteria. Of the included respondents, 1169 were close contacts (male ratio: 25.5 %; 37.2 ± 10.1 years old) and 1290 were not close contacts (male ratio: 25.75 %; 33.7 ± 11.4 years old). A majority of participants (1458/2459) resided in Wuhan, while others ($n = 1001$) resided in other cities of Hubei province or other provinces. Using a PHQ-9 score of 5 or above as cutoff value (Chen et al., 2015), 46.9 % of the sample experienced depression (1153/2459; 95 % CI: 44.9 %–48.9 %).

3.2. Network estimation and centrality measures

Means, standard deviations (*SDs*), node strengths, bridge strengths, predictability, skewness and kurtosis of all PHQ-9 and QOL items are presented in Table 1. *Loss of energy* (DEP-4) and *Guilt feelings* (DEP-6) were the two most prominent central symptoms with the highest strength values. The network of PHQ-9 symptoms and QOL items is displayed in Fig. 1. Together with the two nodes from the QOL cluster, *Loss of energy* (DEP-4) and *Guilt feelings* (DEP-6) were the strongest bridge symptoms connecting the cluster of depression and the cluster of QOL. The strengths and bridge strengths of all nodes are shown in Fig. 2. Between the two clusters, *global QOL* (QOL-1) was strongly associated with *Guilt feelings* (DEP-6) while *General health status* (QOL-2) was strongly interconnected with *Loss of energy* (DEP-4). The mean predictability of all symptoms indicated that an average of 39.29 % of the variance in each node could be explained by the neighboring nodes. On average, 25.30 % of the QOL variance could be explained by depressive symptoms. The weighted adjacency matrix of all items in this network is shown in Supplementary Table 1.

3.3. Network stability and accuracy

The case-dropping bootstrap procedure showed that values of centrality strength and bridge strength remained stable after dropping large proportions of the sample (Fig. 3). *CS-Coefficients* for strength and bridge strength were both 0.75, indicating that 75 % of the sample could be dropped and the network would remain stable.

Bootstrapped 95 % *CIs* for estimated edge weights were narrow, suggesting that the estimates were reliable (Supplementary Fig. 1). Pairwise edge weight and node strength differences are shown in Supplementary Figs. 2–3.

3.4. Comparison of networks based on subgroups

Comparisons of networks based on gender, younger versus older age groups (split by the median age), living area and status as a close contact are shown in Fig. 4. Network invariance tests, global strength invariance tests, and edge invariance tests revealed that the edge weights and global strength between subgroups based on gender, age group, living area and status as a close contact were similar. Node strengths based on these subgroups are shown in Supplementary Fig. 4 while results of network invariance tests and global strength invariance tests are shown in Supplementary Figs. 5–8. The exact *p* values in edge invariance tests for subgroups by gender, age, living area, and being a close contact are shown in Supplementary Table 2.

4. Discussion

To the best of our knowledge, this study was the first to explore interactions of depressive symptoms with QOL in a COVID-19 affected population. One somatic symptom *Loss of energy* (DEP-4) and one affective symptom *Guilt feelings* (DEP-6) emerged as the most central Depressive symptoms in tandem with the two QOL nodes. *Loss of energy* and *Guilt* were also the top two bridge symptoms connecting the depressive symptom cluster and the QOL cluster.

Because previous studies have not explored bridge symptoms between depression and QOL, direct comparisons with other studies could not be made. However, our results for depression are in line with Hartung et al. (2019) who recently observed *Guilt feelings* (DEP-6) and *Loss*

Table 1
Mean, standard deviation, strength, bridge strength, predictability, skewness, and kurtosis of all items ($n = 2459$).

Items	Mean	*SD*	Strength	Bridge strength	Predictability	Skewness	Kurtosis
DEP-1: anhedonia	0.79	0.80	0.41	−0.63	50.7%	0.93	0.56
DEP-2: sad mood	0.62	0.70	0.93	−0.42	49.4%	1.06	1.20
DEP-3: sleep problems	0.77	0.85	−0.65	−0.50	36.0%	0.98	0.37
DEP-4: loss of energy	0.90	0.81	1.47	0.68	52.3%	0.81	0.40
DEP-5: appetite change	0.57	0.79	0.03	−0.69	41.6%	1.35	1.26
DEP-6: guilt feelings	0.54	0.77	1.08	0.21	39.2%	1.44	1.59
DEP-7: difficulty in concentration	0.53	0.77	0.20	−0.92	39.1%	1.47	1.64
DEP-8: psychomotor signs	0.34	0.64	0.37	−0.44	37.2%	2.11	4.44
DEP-9: suicidal ideation	0.13	0.42	−1.56	−0.80	36.1%	4.08	19.40
QOL-1: global QOL	3.20	0.73	−0.94	2.17	26.5%	−0.43	0.08
QOL-2: general health status	3.30	0.83	−1.32	1.34	24.1%	−0.33	−0.42

SD: standard deviation. The values of strength and bridge strength were transformed into z-scores.

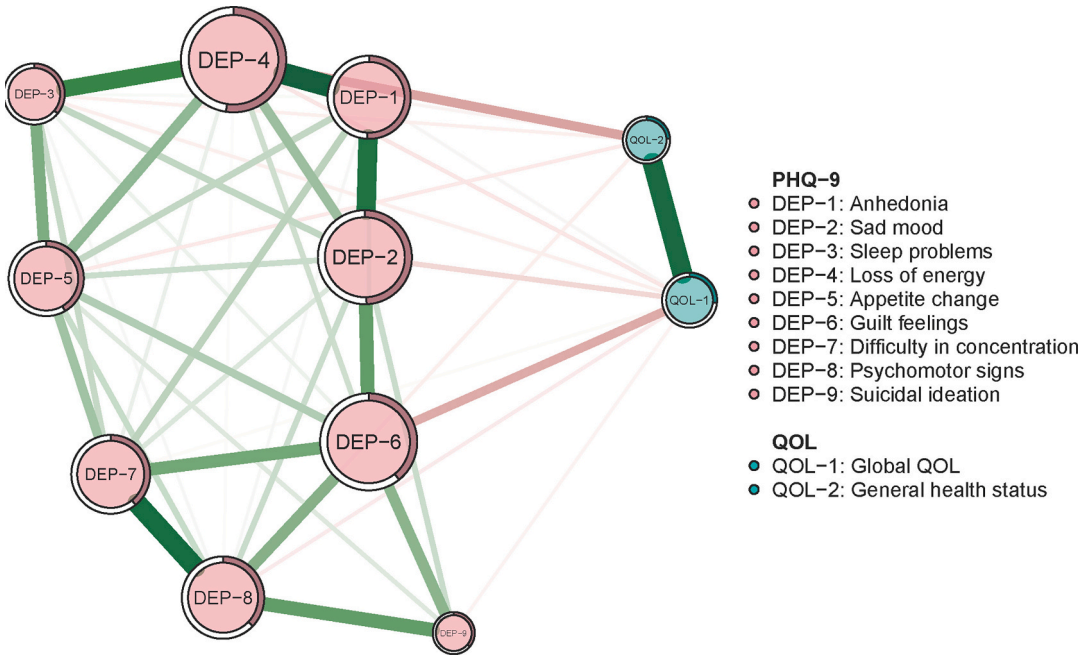

Fig. 1. Network model for depressive symptoms and QOL in the total sample ($N = 2459$).
Figure legend: the size of each node indicates the relative level of strength. Green edges indicate positive associations; red edges indicate negative associations. (For interpretation of the references to colour in this figure legend, the reader is referred to the web version of this article.)

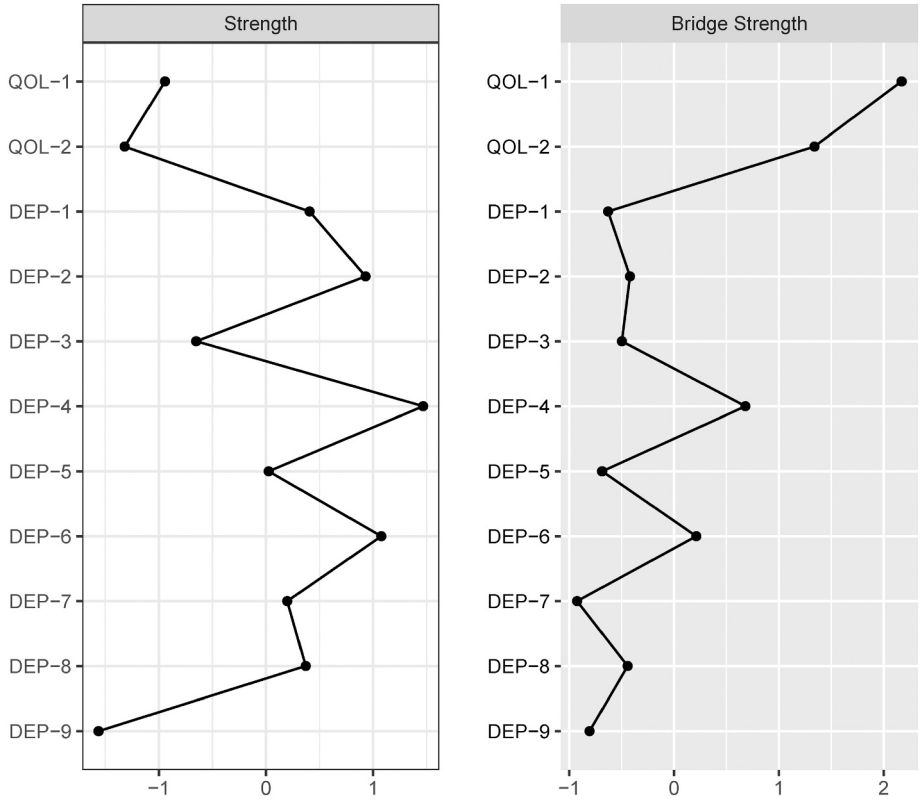

Fig. 2. Strength and bridge strength of all the nodes (z-scores).
Figure legend: DEP-1: anhedonia; DEP-2: sad mood; DEP-3: sleep problems; DEP-4: loss of energy; DEP-5: appetite change; DEP-6: guilt feelings; DEP-7: difficulty in concentration; DEP-8: psychomotor signs; DEP-9: suicidal ideation; QOL-1: global QOL; QOL-2: general health status.

of energy (DEP-4) had the highest centrality completion strength in the depressive symptom community within the general population (Hartung et al., 2019). The mean predictability of QOL (25.3 %) was lower than the average predictability of all nodes (39.3 %). Hence, although the nine depressive symptoms combined to explain some variance in QOL, substantial variance was unexplained. This finding might be attributable

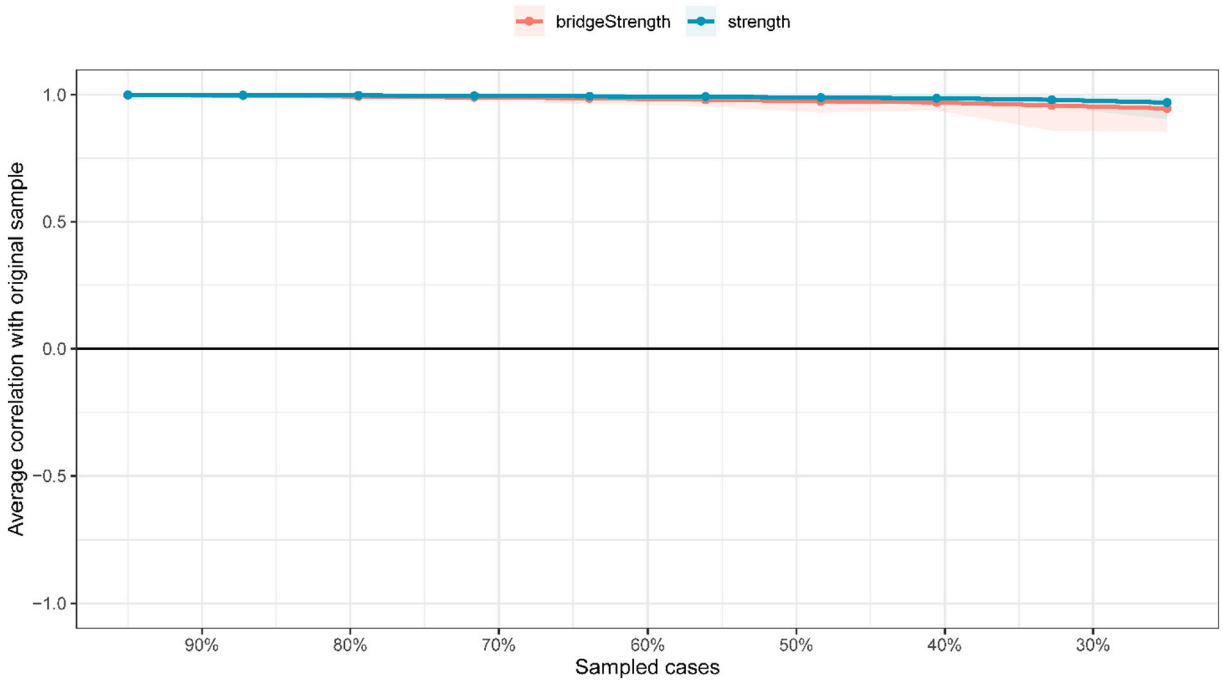

Fig. 3. Network stability by case-dropping bootstrap method.
Figure legend: the x-axis represents the percentage of cases of the original sample remained at each case-dropping subset. The y-axis represents the average of correlations between the centrality indexes from the original network and the re-estimated network after case-dropping procedure.

to evidence that QOL can be influenced by many factors aside from depression including anxiety levels, socio-environmental support, and stressors (Chen et al., 2020; Liu et al., 2021; Lizana et al., 2021).

The central somatic symptom, *Loss of energy* (DEP-4), has the highest interconnection with *General health status* (QOL-2) in depression-QOL network model generated for Wuhan residents. Loss of energy, which refers to feelings of tiredness, fatigue and reduced energy (Billones et al., 2020), is a common symptom of depression (Angst and Dobler-Mikola, 1984; Buchwald and Rudick-Davis, 1993; Corfield et al., 2016; Pae et al., 2007; Reyes-Gibby et al., 2006), especially among people who tend to somatize their depressive symptoms (Stahl, 2002). The relationship between loss of energy and poor general health status has been supported in several respects. First, fatigue or loss of energy is very common in people experiencing chronic physical illnesses (Swain, 2000; Winters et al., 2010) because chronic medical conditions may cause oxidative stress and excessive inflammatory responses that contribute to fatigue or loss of energy (Menting et al., 2018; Morris and Maes, 2014). Second, in relation to the COVID-19 pandemic, the manifestation of "*Loss of energy*" might be attributed, in part, to a less physically active lifestyle imposed by the lockdown experience (McIlvenny et al., 2000; Stewart et al., 1998) and lack of physical exercise might contribute to declines in general health status (Biddle et al., 2004; Booth et al., 2012; Buchner et al., 1992). It has been broadly verified that participating in exercise can elevate physical energy (Gebhart et al., 2011; Jakobsen et al., 2017; Witard et al., 2016) and improve QOL (Courneya and Friedenreich, 1999; Dauwan et al., 2021; Mehnert et al., 2011; Pacheco et al., 2012).

A key implication of this finding is that interventions designed to address *Loss of energy* (DEP-4), whether via lifestyle changes or physical exercise, may be useful in improving QOL facets related to perceptions of one's general health status. Policymakers who wish to promote infection control measures and quarantine policies should also attend to developing creative strategies to promoting physical activity and dynamic lifestyles as means of protecting the mental health status and QOL of general populations living in pandemic conditions.

The central affective symptom, *Guilt feelings* (DEP-6), was strongly associated with *Global QOL* (QOL-1) and had the second highest strength in the network model. Guilt is defined as an aversive conscious emotion that involves self-criticism, remorse for one's thoughts, feelings or actions and a sense of wrongdoing, as if one has violated a moral principle or caused harm to others (Berrios et al., 1992; Tangney and Dearing, 2003). In some cases, guilt can be adaptive because it prompts proactive actions such as confessing, apologizing, or improving interpersonal relationships to remedy distress (Cavalera, 2020; Tangney, 1995). However, guilt can also be maladaptive when it becomes excessive and overwhelming (Cândea and Szentagotai-Tătar, 2018). During the COVID-19 pandemic, sources of guilt feelings may vary between populations. Confirmed cases might experience guilt for being infected or transmitting the virus to family or friends (Aliakbari Dehkordi et al., 2020; Yuan et al., 2021b). Healthcare workers can experience guilt because of medical resource shortages or rationing that interferes with optimal care and increases the likelihood that there will be more victims (Chan and Huak, 2004; Chong et al., 2004; Yuan et al., 2021a). Excessive guilt could result in problematic outcomes such as impaired motivation and maladaptive behaviors that perpetuate depression and reduced QOL (Luck and Luck-Sikorski, 2020; Tilghman-Osborne et al., 2010, 2012). The emergence of guilt as a bridge symptom to QOL in this research aligns with previous studies of other stressors linking lower levels of guilt with higher QOL in various populations including women in menopause (Zivdir and Sohbet, 2017) and male spouses of women with breast cancer (Duggleby et al., 2014; Duggleby et al., 2015).

The centrality of guilt in this research suggests that interventions targeting these feelings may have utility in reducing depression and facilitating mental health during the COVID-19-pandemic. Several post-pandemic psychological recovery interventions emphasize efforts to reduce feelings of guilt in the prevention of adverse psychological functioning in the COVID-19 pandemic (Dodgen-Magee, 2021; Foster, 2021; Minihan et al., 2020). For example, cognitive-behavioral interventions targeting maladaptive thoughts that contribute to feelings of guilt may be useful in reducing depression and associated impairments in functioning, facilitating recovery and improving QOL among people living through the COVID-19 pandemic.

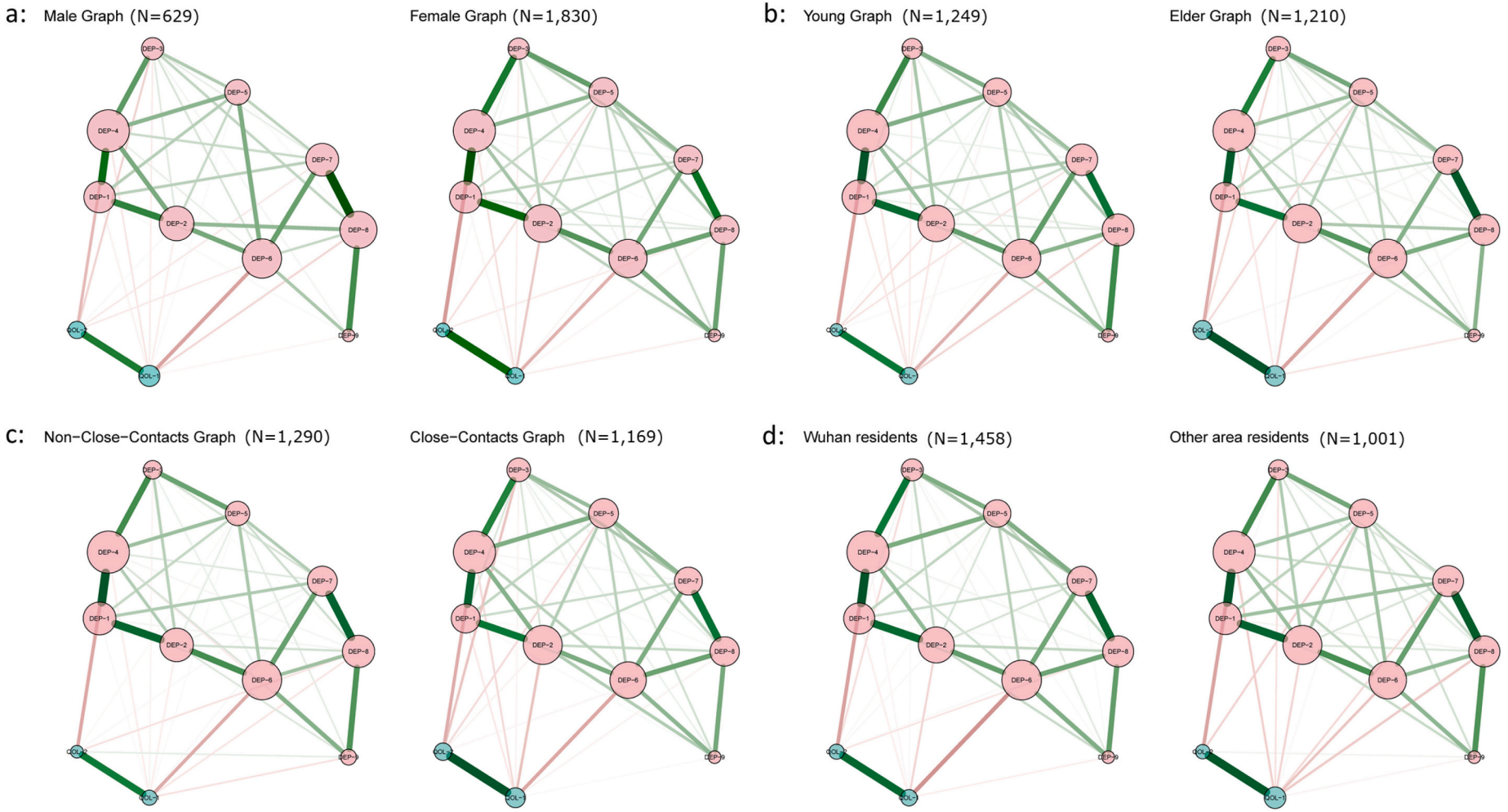

Fig. 4. Network model for depressive symptoms and QOL based on subgroups by gender, age, living area, and whether being a close contact.
Figure legend: DEP-1: anhedonia; DEP-2: sad mood; DEP-3: sleep problems; DEP-4: loss of energy; DEP-5: appetite change; DEP-6: guilt feelings; DEP-7: difficulty in concentration; DEP-8: psychomotor signs; DEP-9: suicidal ideation; QOL-1: global QOL; QOL-2: general health status.
Young participants were defined as aged 34 years old or below, and elder participants were defined as aged 35 years old or above by age-median-split method.

Other analyses indicated that depressive symptom-QOL network structures were similar between close-contacts and non-close-contacts, as well as between participants living in the initial epicenter (Wuhan) versus other areas. Similarities in network structures between these subgroups may be due, in part, to enhanced control of the virus during data collection. That is, this study was conducted after the lockdown policy in Wuhan was lifted on April 8, 2020, and there had been no new cases reported for 19 days (China Daily Global, 2020; DX Doctor, 2021). As such, the data collection period occurred after the most urgent and intensive phase of COVID-19 had passed and life in Wuhan was returning to normal for various subgroups (Xinhua Net, 2020a, 2020b). Second, health administrative agencies in China had released considerable health education information and resources for mental health and counseling support to the general public in early stages of the pandemic (Li et al., 2020; National Health Commission of the People's Republic of China, 2020b). Such efforts may have ensured that more widespread segments of the population had accurate knowledge about COVID-19 and strategies to reduce personal risk. A possible consequence of far-reaching public health education may have been increased similarity in the nature of links between depressive symptoms and QOL among groups at risk for COVID-19-related distress such as close contacts and those living near the epicenter compared to groups with lower overall risk.

Strengths of this study included its relatively large sample size, use of network analysis to elucidate depression-QOL relations at a symptom level, and the assessment of a group living at the initial epicenter of the COVID-19 outbreak. Regarding limitations, due to the cross-sectional study design, causal relationships and dynamic changes between depression symptoms and QOL experiences could not be examined. Second, because the assessment was limited to a sample in the Wuhan region, it is not clear whether the depressive symptom-QOL network documented in this research is applicable to different subpopulations in other regions (Marchetti, 2018; Mullarkey et al., 2019). Third, the network structure in this study was limited to the 9 canonical symptoms of depression and 2 brief items about QOL. Hence, including other depressive symptoms and facets of QOL or other forms of distress (e.g., anxiety and insomnia) in the assessment might produce different patterns of relation between depressive symptoms and QOL. Finally, because a random sampling method was not used in this study, the representativeness of the study sample for the population of Wuhan is not known.

In conclusion, *Loss of energy* and *Guilt* emerged as critical central symptoms and bridge symptoms in a network model of depression and QOL examined among residents of Wuhan during the COVID-19 pandemic. Public health education, physical activity and psychological interventions targeting these central symptoms, including cognitive behavioral therapy (CBT) and regular physical exercise, have promise as approaches to improving the mental health status and QOL of COVID-19-affected populations including those living in Wuhan.

Sources of funding

The study was supported by the National Science and Technology Major Project for investigational new drug (2018ZX09201-014), the Beijing Municipal Science & Technology Commission (No. Z181100001518005), the University of Macau (MYRG2019-00066-FHS), and the Fundamental Research Funds for the Central Universities (2020YJ065).

CRediT authorship contribution statement

Study design: Shu-Fang Zhang, Bing Xiang Yang, Yu-Tao Xiang.

Data collection, analysis and interpretation: Yan-Jie Zhao, Wen Li, Ling Zhang, Shu-Fang Zhang, Tong Guo, Bing Xiang Yang.

Drafting of the manuscript: Yan-Jie Zhao, Teris Cheung, Yu-Tao Xiang.

Critical revision of the manuscript: Todd Jackson.

Approval of the final version for publication: all co-authors.

Conflict of interest

The authors have no conflicts of interest to declare.

Acknowledgements

None.

Appendix A. Supplementary data

Supplementary data to this article can be found online at https://doi.org/10.1016/j.jad.2022.08.104.

References

Abbey, A., Andrews, F.M., 1985. Modeling the psychological determinants of life quality. Soc. Indic. Res. 16 (1), 1–34.

Aliakbari Dehkordi, M., Eisazadeh, F., Aghajanbigloo, S., 2020. Psychological consequences of patients with coronavirus (COVID-19): a qualitative study. Iran.J. Health Psychol. 2 (2), 9–20.

Angst, J., Dobler-Mikola, A., 1984. The definition of depression. J. Psychiatr. Res. 18 (4), 401–406.

Balázs, J., Miklósi, M., Keresztény, A., Hoven, C.W., Carli, V., Wasserman, C., Apter, A., Bobes, J., Brunner, R., Cosman, D., Cotter, P., Haring, C., Iosue, M., Kaess, M., Kahn, J.P., Keeley, H., Marusic, D., Postuvan, V., Resch, F., Saiz, P.A., Sisask, M., Snir, A., Tubiana, A., Varnik, A., Sarchiapone, M., Wasserman, D., 2013. Adolescent subthreshold-depression and anxiety: psychopathology, functional impairment and increased suicide risk. J. Child Psychol. Psychiatry 54 (6), 670–677.

Berrios, G., Bulbena, A., Bakshi, N., Dening, T., Jenaway, A., Markar, H., Martin-Santos, R., Mitchell, S., 1992. Feelings of guilt in major depression. Br. J. Psychiatry 160 (6), 781–787.

Bertha, E.A., Balázs, J., 2013. Subthreshold depression in adolescence: a systematic review. Eur. Child Adolesc. Psychiatry 22 (10), 589–603.

Biddle, S.J., Gorely, T., Stensel, D.J., 2004. Health-enhancing physical activity and sedentary behaviour in children and adolescents. J. Sports Sci. 22 (8), 679–701.

Billones, R.R., Kumar, S., Saligan, L.N., 2020. Disentangling fatigue from anhedonia: a scoping review. Transl. Psychiatry 10 (1), 1–11.

Booth, F.W., Roberts, C.K., Laye, M.J., 2012. Lack of exercise is a major cause of chronic diseases. Compr. Physiol. 2 (2), 1143–1211.

Borsboom, D., 2017. A network theory of mental disorders. World Psychiatry 16 (1), 5–13.

Borsboom, D., Cramer, A.O., 2013. Network analysis: an integrative approach to the structure of psychopathology. Annu. Rev. Clin. Psychol. 9, 91–121.

Brooks, S.K., Webster, R.K., Smith, L.E., Woodland, L., Wessely, S., Greenberg, N., Rubin, G.J., 2020. The psychological impact of quarantine and how to reduce it: rapid review of the evidence. Lancet 395 (10227), 912–920.

Buchner, D.M., Beresford, S.A., Larson, E.B., LaCroix, A.Z., Wagner, E.H., 1992. Effects of physical activity on health status in older adults. IIIntervention studies. Annu. Rev. Public Health 13, 469–488.

Buchwald, A.M., Rudick-Davis, D., 1993. The symptoms of major depression. J. Abnorm. Psychol. 102 (2), 197.

Cândea, D.M., Szentagotai-Tătar, A., 2018. Shame-proneness, guilt-proneness and anxiety symptoms: a meta-analysis. J. Anxiety Disord. 58, 78–106.

Canet-Juric, L., Andrés, M.L., Del Valle, M., López-Morales, H., Poó, F., Galli, J.I., Yerro, M., Urquijo, S., 2020. A longitudinal study on the emotional impact cause by the COVID-19 pandemic quarantine on general population. Front. Psychol. 11, 565688.

Cavalera, C., 2020. COVID-19 psychological implications: the role of shame and guilt. Front. Psychol. 11, 571828.

Chan, A.O., Huak, C.Y., 2004. Psychological impact of the 2003 severe acute respiratory syndrome outbreak on health care workers in a medium size regional general hospital in Singapore. Occup. Med. (Lond.) 54 (3), 190–196.

Chan, S.W., Chiu, H.F., Chien, W.T., Thompson, D.R., Lam, L., 2006. Quality of life in Chinese elderly people with depression. Int. J. Geriatr. Psychiatry 21 (4), 312–318.

Chen, M.M., Sheng, L., Qu, S., 2015. Diagnostic test of screening depressive disorder in general hospital with the Patient Health Questionnaire (in Chinese). J.Chin.Ment. Health 29 (4), 241–245.

Chen, K.-Y., Li, T., Gong, F., Zhang, J.-S., Li, X.-K., 2020. Predictors of health-related quality of life and influencing factors for COVID-19 patients, a follow-up at one month. Front.Psychiatry 11, 668.

Chernick, M.R., 2011. Bootstrap Methods: A Guide for Practitioners and Researchers. John Wiley & Sons.

China Academy of Information and Communications Technology (CAICT), 2020. WeChat Employment Impact Report 2019-2020 (in Chinese). http://www.caict.ac.cn/kxyj/qwfb/ztbg/202005/t20200514_281774.htm (access January 11, 2021).

China Daily Global, 2020. Fighting Covid-19: China in Action.

Chong, M.Y., Wang, W.C., Hsieh, W.C., Lee, C.Y., Chiu, N.M., Yeh, W.C., Huang, O.L., Wen, J.K., Chen, C.L., 2004. Psychological impact of severe acute respiratory syndrome on health workers in a tertiary hospital. Br. J. Psychiatry 185, 127–133.
Corfield, E.C., Martin, N.G., Nyholt, D.R., 2016. Co-occurrence and symptomatology of fatigue and depression. Compr. Psychiatry 71, 1–10.
Costenbader, E., Valente, T.W., 2003. The stability of centrality measures when networks are sampled. Soc. Networks 25 (4), 283–307.
Courneya, K.S., Friedenreich, C.M., 1999. Physical exercise and quality of life following cancer diagnosis: a literature review. Ann. Behav. Med. 21 (2), 171–179.
Cramer, A.O., Waldorp, L.J., van der Maas, H.L., Borsboom, D., 2010. Comorbidity: a network perspective. Behav. Brain Sci. 33 (2-3), 137–150 discussion 150-193.
Cramer, A.O., van Borkulo, C.D., Giltay, E.J., van der Maas, H.L., Kendler, K.S., Scheffer, M., Borsboom, D., 2016. Major depression as a complex dynamic system. PLoS One 11 (12), e0167490.
Dauwan, M., Begemann, M.J.H., Slot, M.I.E., Lee, E.H.M., Scheltens, P., Sommer, I.E.C., 2021. Physical exercise improves quality of life, depressive symptoms, and cognition across chronic brain disorders: a transdiagnostic systematic review and meta-analysis of randomized controlled trials. J. Neurol. 268 (4), 1222–1246.
Dodgen-Magee, D., 2021. Restart: Designing a Healthy Post-pandemic Life. Rowman & Littlefield, Maryland.
Duggleby, W., Doell, H., Cooper, D., Thomas, R., Ghosh, S., 2014. The quality of life of male spouses of women with breast cancer: hope, self-efficacy, and perceptions of guilt. Cancer Nurs. 37 (1), E28–E35.
Duggleby, W., Thomas, J., Montford, K., Thomas, R., Nekolaichuk, C., Ghosh, S., Cumming, C., Tonkin, K., 2015. Transitions of male partners of women with breast cancer: hope, guilt, and quality of life. Oncol. Nurs. Forum 42 (2), 134–141.
DX Doctor, 2021. COVID-19 Global Pandemic Real-time Report (in Chinese). https://ncov.dxy.cn/ncovh5/view/pneumonia (access April 22, 2021).
Eaton, N.R., 2015. Latent variable and network models of comorbidity: toward an empirically derived nosology. Soc. Psychiatry Psychiatr. Epidemiol. 50 (6), 845–849.
Epskamp, S., Fried, E.I., 2018. A tutorial on regularized partial correlation networks. Psychol. Methods 23 (4), 617–634.
Epskamp, S., Cramer, A.O., Waldorp, L.J., Schmittmann, V.D., Borsboom, D., 2012. qgraph: network visualizations of relationships in psychometric data. J. Stat. Softw. 48 (4), 1–18.
Epskamp, S., Borsboom, D., Fried, E.I., 2018. Estimating psychological networks and their accuracy: a tutorial paper. Behav. Res. Methods 50 (1), 195–212.
Fang, J.-Q., Hao, Y.-T., Li, C.-X., 1999. Reliability and validity for Chinese version of WHO quality of life scale (in Chinese). <sb:contribution><sb:title>Chin. </sb:title></sb:contribution><sb:host><sb:issue><sb:series><sb:title>J. Ment. Health</sb:title></sb:series></sb:issue></sb:host> 13 (4), 203–205+207.
Ferreira, L.N., Pereira, L.N., da Fé Brás, M., Ilchuk, K., 2021. Quality of life under the COVID-19 quarantine. Qual. Life Res. 30 (5), 1389–1405.
Foster, S., 2021. Shaping the post-pandemic recovery plan. Br. J. Nurs. 30 (3), 201.
Fried, E.I., Nesse, R.M., 2014. The impact of individual depressive symptoms on impairment of psychosocial functioning. PLoS One 9 (2), e90311.
Garabiles, M.R., Lao, C.K., Xiong, Y., Hall, B.J., 2019. Exploring comorbidity between anxiety and depression among migrant filipino domestic workers: a network approach. J. Affect. Disord. 250, 85–93.
Gebhart, C., Erlacher, D., Schredl, M., 2011. Moderate exercise plus sleep education improves self-reported sleep quality, daytime mood, and vitality in adults with chronic sleep complaints: a waiting list-controlled trial. Sleep Disord. 2011, 809312.
Geiselmann, B., Bauer, M., 2000. Subthreshold depression in the elderly: qualitative or quantitative distinction? Compr. Psychiatry 41 (2 Suppl 1), 32–38.
Genta, F.D., Rodrigues Neto, G.B., Sunfeld, J.P.V., Porto, J.F., Xavier, A.D., Moreno, C.R., Lorenzi-Filho, G., Genta, P.R., 2021. COVID-19 pandemic impact on sleep habits, chronotype, and health-related quality of life among high school students: a longitudinal study. J. Clin. Sleep Med. 17 (7), 1371–1377.
Gu, Y., Zhu, Y., Xu, F., Xi, J., Xu, G., 2021. Factors associated with mental health outcomes among patients with COVID-19 treated in the fangcang shelter hospital in China. Asia Pac. Psychiatry 13 (2), e12443.
Hartung, T.J., Fried, E.I., Mehnert, A., Hinz, A., Vehling, S., 2019. Frequency and network analysis of depressive symptoms in patients with cancer compared to the general population. J. Affect. Disord. 256, 295–301.
Hegerl, U., 2016. Prevention of suicidal behavior. Dialogues Clin. Neurosci. 18 (2), 183–190.
Hu, D., Kong, Y., Li, W., Han, Q., Zhang, X., Zhu, L.X., Wan, S.W., Liu, Z., Shen, Q., Yang, J., He, H.G., Zhu, J., 2020. Frontline nurses' burnout, anxiety, depression, and fear statuses and their associated factors during the COVID-19 outbreak in Wuhan, China: a large-scale cross-sectional study. EClinicalMedicine 24, 100424.
Jakobsen, M.D., Sundstrup, E., Brandt, M., Andersen, L.L., 2017. Psychosocial benefits of workplace physical exercise: cluster randomized controlled trial. BMC Public Health 17 (1), 798.
Jiang, W., Ren, Z., Yu, L., Tan, Y., Shi, C., 2020. A network analysis of post-traumatic stress disorder symptoms and correlates during the COVID-19 pandemic. Front. Psychiatry 11, 568037.
Jones, P., 2020. networktools: Tools for Identifying Important Nodes in Networks. R package version 1.2.3. https://CRAN.R-project.org/package=networktools.
Kılınçel, Ş., Kılınçel, O., Muratdağı, G., Aydın, A., Usta, M.B., 2021. Factors affecting the anxiety levels of adolescents in home-quarantine during COVID-19 pandemic in Turkey. Asia Pac. Psychiatry 13 (2), e12406.
Lee, A.M., Wong, J.G.W.S., McAlonan, G.M., Cheung, V., Cheung, C., Sham, P.C., Chu, C.-M., Wong, P.-C., Tsang, K.W.T., Chua, S.E., 2007. Stress and psychological distress among SARS survivors 1 year after the outbreak. Can. J. Psychiatry 52 (4), 233–240.
Li, W., Yang, Y., Liu, Z.H., Zhao, Y.J., Zhang, Q., Zhang, L., Cheung, T., Xiang, Y.T., 2020. Progression of mental health services during the COVID-19 outbreak in China. Int. J. Biol. Sci. 16 (10), 1732–1738.
Li, T., Sun, S., Liu, B., Wang, J., Zhang, Y., Gong, C., Duan, J., 2021. Prevalence and risk factors for anxiety and depression in patients with COVID-19 in Wuhan,China. Psychosom. Med. 83 (4), 368–372.
Liu, C., Lee, Y.C., Lin, Y.L., Yang, S.Y., 2021. Factors associated with anxiety and quality of life of the Wuhan populace during the COVID-19 pandemic. Stress. Health 37 (5), 887–897.
Lizana, P.A., Vega-Fernadez, G., Gomez-Bruton, A., Leyton, B., Lera, L., 2021. Impact of the COVID-19 pandemic on teacher quality of life: a longitudinal study from before and during the health crisis. Int. J. Environ. Res. Public Health 18 (7), 3764.
Luck, T., Luck-Sikorski, C., 2020. Feelings of guilt in the general adult population: prevalence, intensity and association with depression. Psychol.Health Med. 1–11.
Ma, Y.F., Li, W., Deng, H.B., Wang, L., Wang, Y., Wang, P.H., Bo, H.X., Cao, J., Wang, Y., Zhu, L.Y., Yang, Y., Cheung, T., Ng, C.H., Wu, X., Xiang, Y.T., 2020. Prevalence of depression and its association with quality of life in clinically stable patients with COVID-19. J. Affect. Disord. 275, 145–148.
Mak, I.W., Chu, C.M., Pan, P.C., Yiu, M.G., Chan, V.L., 2009. Long-term psychiatric morbidities among SARS survivors. Gen. Hosp. Psychiatry 31 (4), 318–326.
Marchetti, I., 2018. Hopelessness: a network analysis. Cogn. Ther. Res. 43 (3), 611–619.
Maunder, R.G., Lancee, W.J., Balderson, K.E., Bennett, J.P., Borgundvaag, B., Evans, S., Fernandes, C.M., Goldbloom, D.S., Gupta, M., Hunter, J.J., McGillis Hall, L., Nagle, L.M., Pain, C., Peczeniuk, S.S., Raymond, G., Read, N., Rourke, S.B., Steinberg, R.J., Stewart, T.E., VanDeVelde-Coke, S., Veldhorst, G.G., Wasylenki, D. A., 2006. Long-term psychological and occupational effects of providing hospital healthcare during SARS outbreak. Emerg. Infect. Dis. 12 (12), 1924–1932.
McIlvenny, S., DeGlume, A., Elewa, M., Fernandez, O., Dormer, P., 2000. Factors associated with fatigue in a family medicine clinic in the United Arab Emirates. Fam. Pract. 17 (5), 408–413.
Mehnert, A., Veers, S., Howaldt, D., Braumann, K.M., Koch, U., Schulz, K.H., 2011. Effects of a physical exercise rehabilitation group program on anxiety, depression, body image, and health-related quality of life among breast cancer patients. Onkologie 34 (5), 248–253.
Menting, J., Tack, C.J., Bleijenberg, G., Donders, R., Droogleever Fortuyn, H.A., Fransen, J., Goedendorp, M.M., Kalkman, J.S., Strik-Albers, R., van Alfen, N., van der Werf, S.P., Voermans, N.C., van Engelen, B.G., Knoop, H., 2018. Is fatigue a disease-specific or generic symptom in chronic medical conditions? Health Psychol. 37 (6), 530–543.
Minihan, E., Gavin, B., Kelly, B.D., McNicholas, F., 2020. COVID-19, mental health and psychological first aid. Ir. J. Psychol. Med. 37 (4), 259–263.
Morris, G., Maes, M., 2014. Oxidative and nitrosative stress and immune-inflammatory pathways in patients with myalgic encephalomyelitis (ME)/chronic fatigue syndrome (CFS). Curr. Neuropharmacol. 12 (2), 168–185.
Moser, A., Carlander, M., Wieser, S., Hämmig, O., Puhan, M.A., Höglinger, M., 2020. The COVID-19 social monitor longitudinal online panel: real-time monitoring of social and public health consequences of the COVID-19 emergency in Switzerland. PLoS One 15 (11), e0242129.
Mullarkey, M.C., Marchetti, I., Beevers, C.G., 2019. Using network analysis to identify central symptoms of adolescent depression. J. Clin. Child Adolesc. Psychol. 48 (4), 656–668.
National Health Commission of the People's Republic of China, 2020. Coronavirus Disease 2019 Prevention and Control Plan 7th edition (in Chinese). http://www.nhc.gov.cn/cms-search/xxgk/getManuscriptXxgk.htm?id=318683cbfaee4191aee29cd774b19d8d (access January 2012, 2020).
National Health Commission of the People's Republic of China, 2020. Scientific Knowledges to the Public About the Novel Coronavirus (in Chinese).
Pacheco, D.R., Silva, M.J., Alexandrino, A.M., Torres, R.M., 2012. Exercise-related quality of life in subjects with asthma: a systematic review. J. Asthma 49 (5), 487–495.
Pae, C.-U., Lim, H.-K., Han, C., Patkar, A.A., Steffens, D.C., Masand, P.S., Lee, C., 2007. Fatigue as a core symptom in major depressive disorder: overview and the role of bupropion. Expert. Rev. Neurother. 7 (10), 1251–1263.
Pan, X., Xiao, Y., Ren, D., Xu, Z.M., Zhang, Q., Yang, L.Y., Liu, F., Hao, Y.S., Zhao, F., Bai, Y.H., 2022. Prevalence of mental health problems and associated risk factors among military healthcare workers in specialized COVID-19 hospitals in Wuhan, China: a cross-sectional survey. Asia Pac. Psychiatry 14 (1), e12427.
R Core Team, 2020. R: a language and environment for statistical computing. URL. R Foundation for Statistical Computing, Vienna, Austria. https://www.R-project.org.
Reyes-Gibby, C.C., Aday, L.A., Anderson, K.O., Mendoza, T.R., Cleeland, C.S., 2006. Pain, depression, and fatigue in community-dwelling adults with and without a history of cancer. J. Pain Symptom Manag. 32 (2), 118–128.
Schmittmann, V.D., Cramer, A.O., Waldorp, L.J., Epskamp, S., Kievit, R.A., Borsboom, D., 2013. Deconstructing the construct: a network perspective on psychological phenomena. New Ideas Psychol. 31 (1), 43–53.
Spitzer, R.L., Kroenke, K., Williams, J.B., 1999. Validation and utility of a self-report version of PRIME-MD: the PHQ primary care studyPrimary Care Evaluation of Mental Disorders. Patient Health Questionnaire. Jama 282 (18), 1737–1744.
Stahl, S.M., 2002. Does depression hurt? J.Clin.Psychiatry 63 (4), 273–274.
Stewart, D., Abbey, S., Meana, M., Boydell, K.M., 1998. What makes women tired?A community sample. J. Womens Health 7 (1), 69–76.
Sun, R., Qi, J., Huang, J., Zhou, X., 2021. Network analysis of PTSD in college students across different areas after the COVID-19 epidemic. Eur. J. Psychotraumatol. 12 (1), 1920203.
Swain, M.G., 2000. Fatigue in chronic disease. Clin. Sci. (Lond.) 99 (1), 1–8.

Tangney, J.P., 1995. Shame and Guilt in Interpersonal Relationships. Guilford Press, New York.
Tangney, J.P., Dearing, R.L., 2003. Shame and Guilt. Guilford Press, New York.
The WHOQOL GROUP, 1998. Development of the World Health Organization WHOQOL-BREF quality of life assessment. The WHOQOL Group. Psychol. Med. 28 (3), 551–558.
Tilghman-Osborne, C., Cole, D.A., Felton, J.W., 2010. Definition and measurement of guilt: implications for clinical research and practice. Clin. Psychol. Rev. 30 (5), 536–546.
Tilghman-Osborne, C., Cole, D.A., Felton, J.W., 2012. Inappropriate and excessive guilt: instrument validation and developmental differences in relation to depression. J. Abnorm. Child Psychol. 40 (4), 607–620.
Valente, T.W., 2012. Network interventions. Science 337 (6090), 49–53.
van Borkulo, C.D., van Bork, R., Boschloo, L., Kossakowski, J.J., Tio, P., Schoevers, R.A., Borsboom, D., Waldorp, L.J., 2022. Comparing network structures on three aspects: a permutation test. Psychol. Methods.
Wang, W., Bian, Q., Zhao, Y., Li, X., Wang, W., Du, J., Zhang, G., Zhou, Q., Zhao, M., 2014. Reliability and validity of the Chinese version of the Patient Health Questionnaire (PHQ-9) in the general population. Gen. Hosp. Psychiatry 36 (5), 539–544.
Wang, Y., Hu, Z., Feng, Y., Wilson, A., Chen, R., 2020. Changes in network centrality of psychopathology symptoms between the COVID-19 outbreak and after peak. Mol. Psychiatry 25 (12), 3140–3149.
Winters, C.A., Cudney, S., Sullivan, T., 2010. Expressions of depression in rural women with chronic illness. Rural Remote Health 10 (4), 1533.
Witard, O.C., McGlory, C., Hamilton, D.L., Phillips, S.M., 2016. Growing older with health and vitality: a nexus of physical activity, exercise and nutrition. Biogerontology 17 (3), 529–546.
World Health Organization, 2020. Naming the coronavirus disease (COVID-19) and the virus that causes it. https://www.who.int/emergencies/diseases/novel-coronavirus-2019/technical-guidance/naming-the-coronavirus-disease-(covid-2019)-and-the-virus-that-causes-it (access February 2011, 2020).
World Health Organization, 2020. Novel Coronavirus – China. https://www.who.int/csr/don/12-january-2020-novel-coronavirus-china/en/ (access January 2012, 2020).
World Health Organization, 2020. WHO Director-General's opening remarks at the media briefing on COVID-19 - 11 March 2020. https://www.who.int/dg/speeches/detail/who-director-general-s-opening-remarks-at-the-media-briefing-on-covid-19—11-march-2020 (access March 2011, 2020).
Xinhua Net, 2020. Normalized becoming epidemic control and prevention, normal life is coming back to Wuhan (in Chinese). http://www.xinhuanet.com/2020-05/03/c_1125939488.htm (access May 3, 2020).
Xinhua Net, 2020. A quick report on Wuhan "Unsealed" (in Chinese). http://m.xinhuanet.com/2020-04/08/c_1125828448_3.htm (access April 8, 2020).
Xu, Y., Wu, H.S., Xu, Y.F., 2007. The application of Patient Health Questionnaire 9 in community elderly population: reliability and validity. <sb:contribution><sb:title>Shanghai Arch. </sb:title></sb:contribution><sb:host><sb:issue><sb:series><sb:title>Psychiatry</sb:title></sb:series></sb:issue></sb:host> 19 (05), 257–259+276.
Yuan, K., Gong, Y.M., Liu, L., Sun, Y.K., Tian, S.S., Wang, Y.J., Zhong, Y., Zhang, A.Y., Su, S.Z., Liu, X.X., Zhang, Y.X., Lin, X., Shi, L., Yan, W., Fazel, S., Vitiello, M.V., Bryant, R.A., Zhou, X.Y., Ran, M.S., Bao, Y.P., Shi, J., Lu, L., 2021a. Prevalence of posttraumatic stress disorder after infectious disease pandemics in the twenty-first century, including COVID-19: a meta-analysis and systematic review. Mol. Psychiatry 1–17.
Yuan, Y., Zhao, Y.J., Zhang, Q.E., Zhang, L., Cheung, T., Jackson, T., Jiang, G.Q., Xiang, Y.T., 2021b. COVID-19-related stigma and its sociodemographic correlates: a comparative study. Glob.Health 17 (1), 54.
Zhao, Y.J., Jin, Y., Rao, W.W., Li, W., Zhao, N., Cheung, T., Ng, C.H., Wang, Y.Y., Zhang, Q.E., Xiang, Y.T., 2021. The prevalence of psychiatric comorbidities during the SARS and COVID-19 epidemics: a systematic review and meta-analysis of observational studies. J. Affect. Disord. 287, 145–157.
Zivdir, P., Sohbet, R., 2017. Effect of feelings of guilt and shame on life quality of women in menopause. J. Menopausal Med. 23 (1), 5–14.