Current Psychology (2024) 43:10237–10246
https://doi.org/10.1007/s12144-023-05111-0

Network analysis of negative emotion and self-management in Chinese patients with early chronic kidney disease

Yi Cui[1] · Zhihua Guo[2] · Tianqi Yang[2] · Qin Liu[1] · Na Liu[1] · Haoshuang Yang[1] · Lihua Zhang[1] · Hezi Mu[1] · Lanfang Zhang[1] · Yinling Zhang[1]

Accepted: 9 August 2023 / Published online: 2 September 2023

Abstract

The number of patients with chronic kidney disease (CKD) is increasing worldwide, and the disease carries a serious physical and psychological burden that creates negative emotions among patients. The negative emotions limits patients' ability to manage their disease and prevents them from effectively delaying disease progression. In this study, we applied a network analysis to explore the network relationship between negative emotions and self-management in patients with CKD and to investigate the risk or protective effects of different components of negative emotions on self-management. The study was conducted from September 2021 to March 2022 in three tertiary hospitals in China, with data gathered via a convenience sampling method. 360 patients with CKD at stages 1 ~ 3 in the department of nephrology completed the Sociodemographic Questionnaire, Positive Affect and Negative Affect Scale and Chronic Kidney Disease Self-management Instrument. We used R4.1.1 software to estimate the network model and calculate the related indicators. The network showed that among negative emotions "irritated" was negatively correlated with "self-integration", "problem solving", "seeking social support" and "adherence to recommended regimen" in self-management. The correlations between "scared" and "self-integration", "nervous" and "problem solving", and "ashamed" and "seeking social support" were all positive. The bridge expected influence of "irritated" and "adherence to recommended regimen" were the highest, with values of -0.19 and 0.13, respectively. "Irritated" has a more obvious risk effect on self-management. This study provides an important target for interventions to reduce negative emotions and improve self-management ability in patients with CKD.

Keywords Chronic kidney disease · Negative emotion · Self-management · Network analysis · Patients

Yi Cui, Zhihua Guo and Tianqi Yang contributed equally to this work.

✉ Yinling Zhang
zyl-ylz@163.com

Yi Cui
cuiyi0214@163.com

Zhihua Guo
zhguo1016@163.com

Tianqi Yang
youngweather@163.com

Qin Liu
liuqin46@163.com

Na Liu
960589161@qq.com

Haoshuang Yang
1342372346@qq.com

Lihua Zhang
zhanglihua_2021@163.com

Hezi Mu
muhezi2022@163.com

Lanfang Zhang
Pamela_zhang@163.com

[1] Department of Nursing, Air Force Medical University, No.169, Changle West Road, Xi'an, Shaanxi 710032, China

[2] Department of Military Medical Psychology, Air Force Medical University, Xi'an, China

Introduction

Chronic kidney disease (CKD) is a lifelong disease with progressive renal function damage, and it causes incurable harm to the physical and mental health of patients. Studies have shown that the global prevalence of CKD is 14.3%, and the prevalence in China has increased from 10.8% in 2012 to 13.4% in 2017 (Zhang et al., 2012; Nephrologist Branch of Chinese Medical Association, 2021). The number of patients with CKD worldwide has reached 697.5 million, of whom 97.8% of patients are at stages 1 ~ 3. The number of patients in China is as high as 132.3 million, which is equal to the number of patients with diabetes, making China the country with the largest number of CKD patients (Bikbov et al., 2020). According to the guidelines made by the internationally recognized Kidney Disease Outcomes Quality Initiative (K/DOQI), CKD is divided into stages 1 ~ 5 (National Kidney Foundation, 2002). Patients with stages 1 ~ 3 have mild symptoms and only slight discomfort, such as fatigue, lumbar acid, and increased nocturia. However, if uncontrolled in time, renal function will continue to deteriorate, leading to heart failure, hyperkalemia, central nervous system disorder and so on, and may even be life-threatening (Evans et al., 2022). Among hospitalized patients with CKD, the mortality rate is as high as 2.56%, which is higher than that of general inpatients (0.84%) and diabetes inpatients (1.48%) (Zhang et al., 2020). In addition, according to a survey in the United States, medical costs increase with the progression of CKD, creating a large financial burden for patients, and some patients even give up treatment (Saran et al., 2018). At present, delaying the development of kidney disease mainly depends on drug therapy and lifestyle self-management (Zimbudzi et al., 2019). In recent years, due to the impact of coronavirus disease 2019 (COVID-19), patients sometimes could not receive timely treatment and drug supplementation (Akbarialiabad et al., 2020). Therefore, helping patients improve their self-management ability at an early stage and actively participate in decision-making can reduce the financial burden for patients and their families and by a key factor in delaying the progression of the disease.

Self-management is designed to help patients acquire the skills and confidence to cope with illness, be active in their own healthcare, and maintain good physical and mental health (Peng et al., 2019). The management of CKD is the study and practice of achieving the optimal state of overall comprehensive development based on multidisciplinary research in physiology, psychology, and organizational behavior, which involves a series of attitudes, behaviors and skills (van der Gaag et al., 2022). Many scholars believe that patients with early CKD need more optimized self-management to improve disease development, but some people are still in the denial stage and considering expensive treatment costs, strict dietary requirements, tedious treatment procedures and incurable results, which leaves them prone to negative emotions, such as fear, anger and anxiety, and affects self-management behavior (Lin & Hwang, 2020). Negative emotions refer to emotions caused by internal or external factors that are not conducive to work, life or normal thinking. It reflects the general emotional dimension of individual subjective stress experience and unpleasant input, including a series of aversive emotional experiences, such as guilt, shame, nervousness, irritation and so on (Volpato et al., 2021). Miles et al. (2018) found that negative emotions had a negative effect on self-management among diabetic patients. Xie et al. (2021) found that there was a negative correlation between negative emotion and self-management through an investigation of patients after total resection of lung cancer. However, the above studies were all analyzed from the level of the total score of self-management and negative emotion, ignoring the connection between different components and covering the target of intervention in self-management behavior from the perspective of patients' emotions. Therefore, we still need to take a more fine-grained approach to explore the impact of patients' emotions on self-management abilities and how to improve patients' self-management abilities to maintain patients' health status and physical and mental functions in a satisfactory state under the objective fact that the disease cannot be completely cured.

Network analysis, as a new method to describe the complex interaction between variables using psychological networks, has been widely studied in the fields of clinical psychology and psychiatry (Vanzhula, Kinkel-Ram, & Levinson, 2021). It can find a finer-grained correlation path between the two related variables, which provides a new idea for psychological nursing intervention (Cervin et al., 2020) The network consists of two parts: nodes represent the variables, and edges represent the relationships between variables. Compared with simple correlation methods, network analysis can not only help us find a finer-grained relationship between the two and provide new insights but also reduce the occurrence of false positive correlations to a certain extent by fitting the data through a partial correlation network (Fried & Cramer, 2017). In this study, self-management and negative emotion are complex variables composed of different dimensions. It is reasonable and feasible to regard them as complex systems generated by the interaction between different dimensions (Contreras et al., 2019). The network analysis method can quantitatively compare the connection strength between negative emotional components and self-management through the bridge expected influence index, clarify the protective or risk effect of different negative emotional components on

specific self-management behavior, and discover the two most closely connected and most direct dimensions to provide more targeted potential interventions to improve self-management in patients with early CKD (Jones, Ma, & McNally, 2019).

At present, there is no research on the relationship between different components of self-management and negative emotion in patients with early CKD at home and abroad, and the specific correlation mechanism between them is still unclear. Therefore, this study intends to explore the complex network relationship between self-management and negative emotion by taking stage 1 ~ 3 CKD patients as the research subjects with the advantage of network analysis. This study has two aims. First, to identify the potential correlation pathways linking different components of self-management and negative emotion by establishing a network. Second, to find the most important and influential nodes in the network using the bridge expected influence to provide a new way to interfere with the self-management of chronic diseases from an emotional point of view to improve patients' self-management ability, delay the progression of disease, reduce the occurrence of complications, and slow the progression of early CKD to the end stage.

Methods

Participants

From September 2021 to March 2022, convenience sampling was used to select 360 patients with CKD at stages 1 ~ 3 who were hospitalized in the department of nephrology at three tertiary hospitals in Xi'an, China. The primary inclusion criteria for the participants were as follows: (1) diagnosed with CKD according to the clinical practice guidelines of the National Kidney Foundation Kidney Disease Outcome Quality Initiative; (2) at clinical stage 1 ~ 3; (3) age ≥ 18 years old; and (4) clear consciousness, with normal communication skills and ability to cooperate to complete the questionnaire. The exclusion criteria were as follows: (1) cognitive dysfunction or complications of mental illness; (2) serious cardiovascular, nervous system, lung and other system diseases; and (3) poor compliance. The sample size should be 5 ~ 10 times that of the independent variable based on Kendall's (1975) sample estimation. There were 15 variables in this study, so the sample size was estimated to be 75~150. Assuming 20% of questionnaires would be invalid, the final sample size needed to be at least 90.

Data collection

Data were gathered by questionnaires in this cross-sectional and descriptive survey, and all questionnaires were completed on the second day after admission. Prior to data collection, the researchers used unified instructions to introduce themselves to the patients in face-to-face meetings during which they explained the purpose and significance of the study, matters needing attention and the principle of confidentiality. After obtaining informed consent from the patients, the questionnaires were distributed and completed by the patients. The questionnaires were checked immediately. In this study, 387 questionnaires were finally collected, and 360 questionnaires were valid, for an effective recovery rate of 93.02%. The sample size met the requirements.

Measures

Sociodemographic information

The sociodemographic information included gender, age, marital status, education level, working status, residence, mode of living, monthly income, and stage of disease.

Chronic kidney disease self-management instrument

The Chronic Kidney Disease Self-management Instrument (CKD-SM) is a scale for the evaluation of self-management behavior in patients with early-stage CKD (stage 1 ~ 3). The 29-item survey was compiled by Lin et al. (2012) and revised by Liu et al. (2015) to be applicable to Chinese people, including four items of self-integration, problem solving, seeking social support and adherence to the recommended regimen. The item is rated on a four-point Likert scale, ranging from 1 ("never") to 4 ("always"). The higher the score was, the better the patients' self-management ability. The Chinese version of the CKD-SM has good reliability and validity. In this study, Cronbach's α was 0.96.

Positive and negative affect schedule

The Positive and Negative Affect Schedule (PANAS), which was used to measure the emotional experience of the subjects in the previous 1 to 2 weeks, was compiled by Watson et al. (1988) and revised by Qiu et al. (2008). It includes 18 items to describe positive and negative emotional experiences, rated on a five-point Likert scale, ranging from 1 ("never") to 5 ("almost all the time"). The Chinese version of the PANAS has good reliability and validity. In this study, we mainly used negative emotion in the scale when we analyzed the data, and Cronbach's α was 0.87.

Statistical analysis

First, the data were input and verified in Epidata 3.1 by two researchers. SPSS 26.0 software was used to calculate the mean score and standard deviation of negative emotion and self-management.

Then, R4.1.1 software was used for the network analysis. The qgraph package (Epskamp et al., 2012) was used to establish a partial correlation network model between nine components of negative emotion and four dimensions of self-management, and the least absolute shrinkage and selection operator (LASSO) (Tibshirani, 1996) regularization and extended Bayesian information criterion (EBIC) (Chen & Chen, 2008) were used jointly in the network model construction. The tuning parameter of EBIC was set to 0.5, and the Spearman correlation method was used. In the network model, edges represent the net correlation between two nodes after statistical control of interference from other nodes in the network (Epskamp & Fried, 2018). The network was laid out based on the Frunchterman-Reingold algorithm; in this algorithm, the stronger the nodes are connected, the closer the nodes are placed (Epskamp, Borsboom, & Fried, 2018).

The networktools package (Jones, Ma, & McNally, 2019) was used to evaluate the bridge centrality of nodes. Since the network model in this study contains both positive and negative edges, the bridge centrality index bridge expected influence (BEI) was selected in our study. The BEI of a node represents the sum of edge weights between this node and nodes in another community.

Table 1 Sociodemographic characteristics of the patients with early CKD ($N=360$)

Characteristics	Variables	N (%)
Gender	Male	220(61.11)
	Female	140(38.89)
Age	18 ~ 45	182(50.56)
	46 ~ 69	144(40.00)
	≥ 70	34(9.44)
Marital status	Married	278(77.22)
	Unmarried, divorced or widowed	82(22.78)
Education level	Junior middle school and less	182(50.56)
	Senior high school and more	178(49.44)
Working status	On job	267(74.17)
	Unemployed	36(10.00)
	Retired	57(15.83)
Residence	Urban	208(57.78)
	Rural	152(42.22)
Mode of living	Live with family	308(85.56)
	Live alone	52(14.44)
Stage of CKD	1	196(54.44)
	2	81(22.50)
	3	83(23.06)

The bootnet package (Epskamp, Borsboom, & Fried, 2018) was used for the following analysis: first, the accuracy of edge weights was evaluated by estimating the 95% confidence interval using the nonparametric bootstrapping method (1000 bootstrapped samples); second, the case-dropping bootstrapping method (1000 bootstrapped samples) was used to evaluate the stability of the BEI, and the correlation stability coefficient (CS coefficient) was calculated to quantify the stability of the BEI. A CS coefficient larger than 0.5 indicates ideal stability, and a CS coefficient larger than 0.25 indicates acceptable stability. Finally, the bootstrapping method (1000 bootstrapped samples) was used to test the difference of node BEIs and the difference of edge weights of different node pairs ($\alpha=0.05$).

Ethical considerations

The present study was reviewed and approved by the Ethics Committee of the Second Affiliated Hospital of Air Force Medical University (No.202206-02) and was conducted in accordance with the Declaration of Helsinki guidelines. After written informed consent was obtained, participants completed the questionnaires anonymously, and their personal information was not disclosed. They were told they could withdraw from the survey at any time.

Results

Descriptive statistics

The mean age of the final sample was 46.33 ± 16.54 years (mean ± SD, range 18~90 years). Among these participants, 220 were male, 140 were female, 208 were urban residents, and 152 were rural residents; 196 were at stage 1, 181 were at stage 2, and 183 were at stage 3. The total self-management score of these 360 patients was 86.41 ± 20.15. Among them, 41.71% of patients had a low level of self-management. Table 1 shows the sociodemographic characteristics of the participants. Table 2 shows the statistical results of the mean score, standard deviation and BEI of each node of negative emotion and self-management.

Network structure

The network structure of different components of negative emotion and self-management in patients with early CKD is shown in Fig. 1a. There were 15 edges across negative emotion and self-management communities (edge weights ranging from − 0.09 to 0.05), of which 7 were negative and 8 were positive. In the cross-community edges, SI "Self-integration" was positively correlated with NE2 "scared" ($r=0.01$)

Table 2 Mean score, standard deviation and BEI of each node of negative emotion and self-management among patients with early CKD ($N = 360$)

Variables	*M*	*SD*	BEI
Negative emotion	18.12	5.41	-
Afraid	2.13	0.93	0.01
Scared	1.79	0.90	0.04
Guilty	2.01	0.87	0.00
Ashamed	1.64	0.80	0.05
Nervous	2.34	0.84	0.05
Irritated	2.06	0.77	-0.19
Upset	2.28	0.83	-0.02
Fractious	2.13	0.86	-0.03
Jittery	1.73	0.95	0.02
Self-management	86.41	20.15	-
Self-integration	34.44	8.33	0.00
Problem-solving	26.38	0.76	0.09
Seeking social support	13.24	4.44	-0.04
Adherence to recommended regimen	12.34	3.20	-0.13

Abbreviations: *M*, mean; *SD*, standard deviation; BEI: bridge expected influence.

and negatively correlated with NE6 "irritated" (r = -0.01). Among the 6 correlations with PS "problem solving", there was a negative correlation with NE6 "irritated" (r = -0.05) and the 5 positive correlations, among which the strongest correlation was with NE5 "nervous" ($r = 0.05$). Among the 4 correlations with SSS "seeking social support", two were positive and two were negative, and the strongest correlations were NE4 "ashamed" ($r = 0.03$) and NE6 "irritated" (r = -0.05). The 3 correlations with ARR "adherence to recommended regimen" were all negative, and the strongest correlation was with NE6 "irritation" (r = -0.09).

The correlations within the negative emotion community were all positive, among which the strongest correlation was between NE1 "afraid" and NE2 "scared" ($r = 0.35$). The correlations within the self-management community were all positive, among which the strongest correlation was between SI "self-integration" and PS "problem-solving" ($r = 0.57$). The correlation matrix of the network is displayed in Table S1 of the Supplementary Material.

As shown in Fig. 2, the 95% confidence interval of edge weights in the network was relatively narrow, indicating that the evaluation of edge weights was accurate. The result of the difference test of edge weights is shown in Fig. S1 of the Supplementary Material. The edge weight between ARR

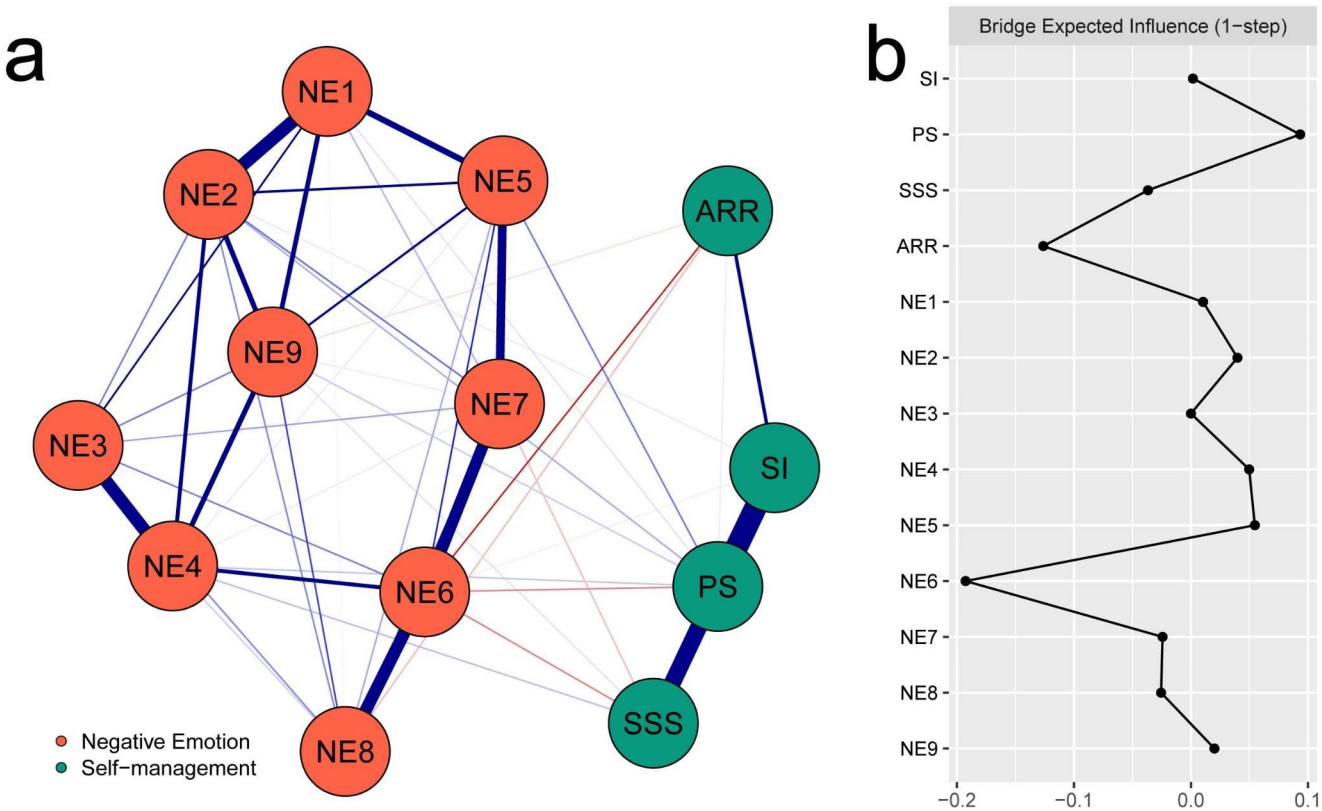


Fig. 1 Network structure of negative emotion and self-management among patients with early CKD and the BEIs in the network. note: (a) The network structure of negative emotion and self-management among patients with early CKD. The blue and red edges represent positive and negative partial correlations among nodes. The thick edge and saturated color represent a strong correlation. (b) The BEIs of the nodes in the network (raw score). SI = Self-integration, PS = Problem-solving, SSS = Seeking social support, ARR = Adherence to recommended regimen, NE1 = Afraid, NE2 = Scared, NE3 = Guilty, NE4 = Ashamed, NE5 = Nervous, NE6 = Irritated, NE7 = Upset, NE8 = Fractious, NE9 = Jittery

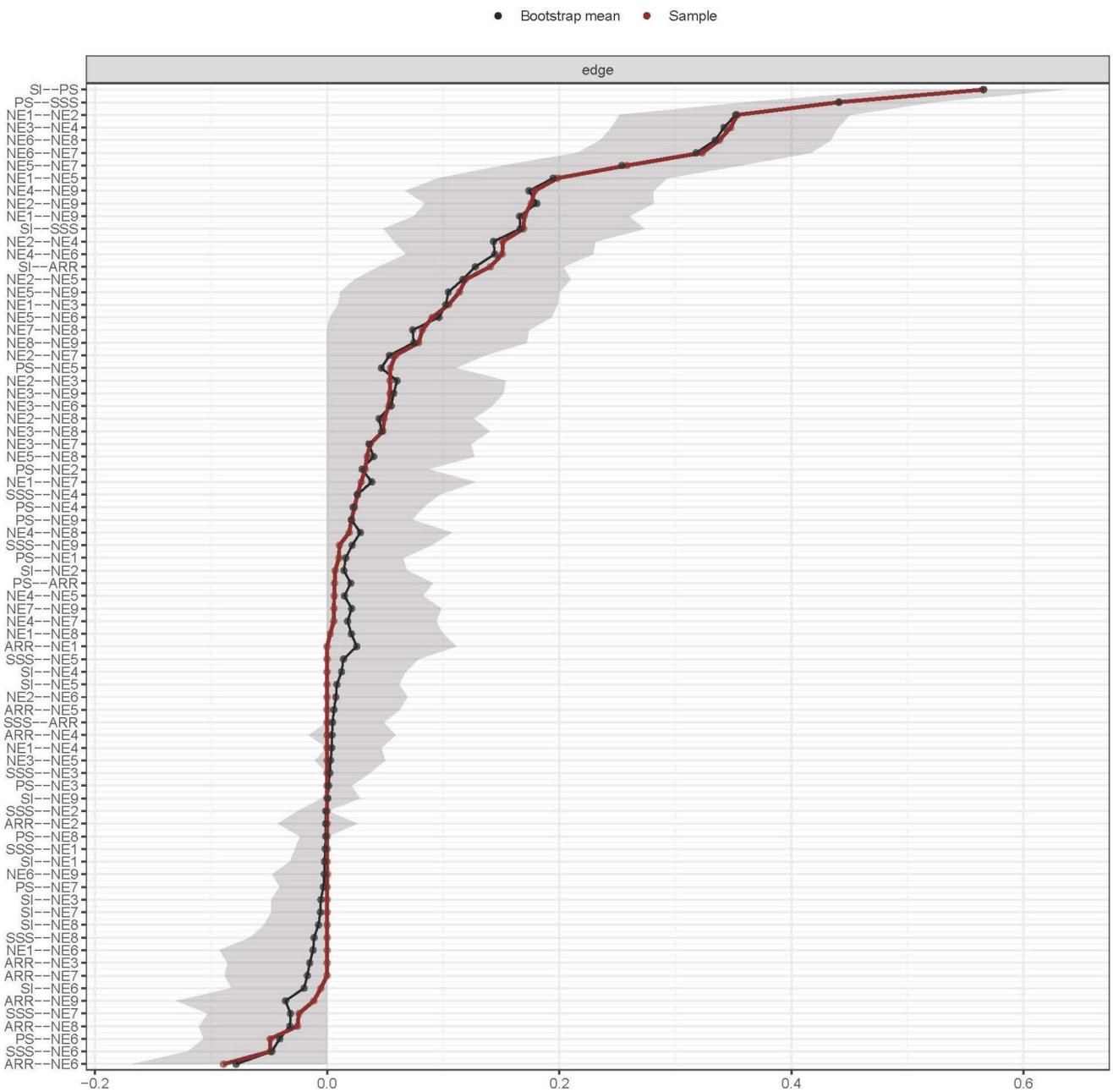


Fig. 2 The accuracy test of edge weights in the network

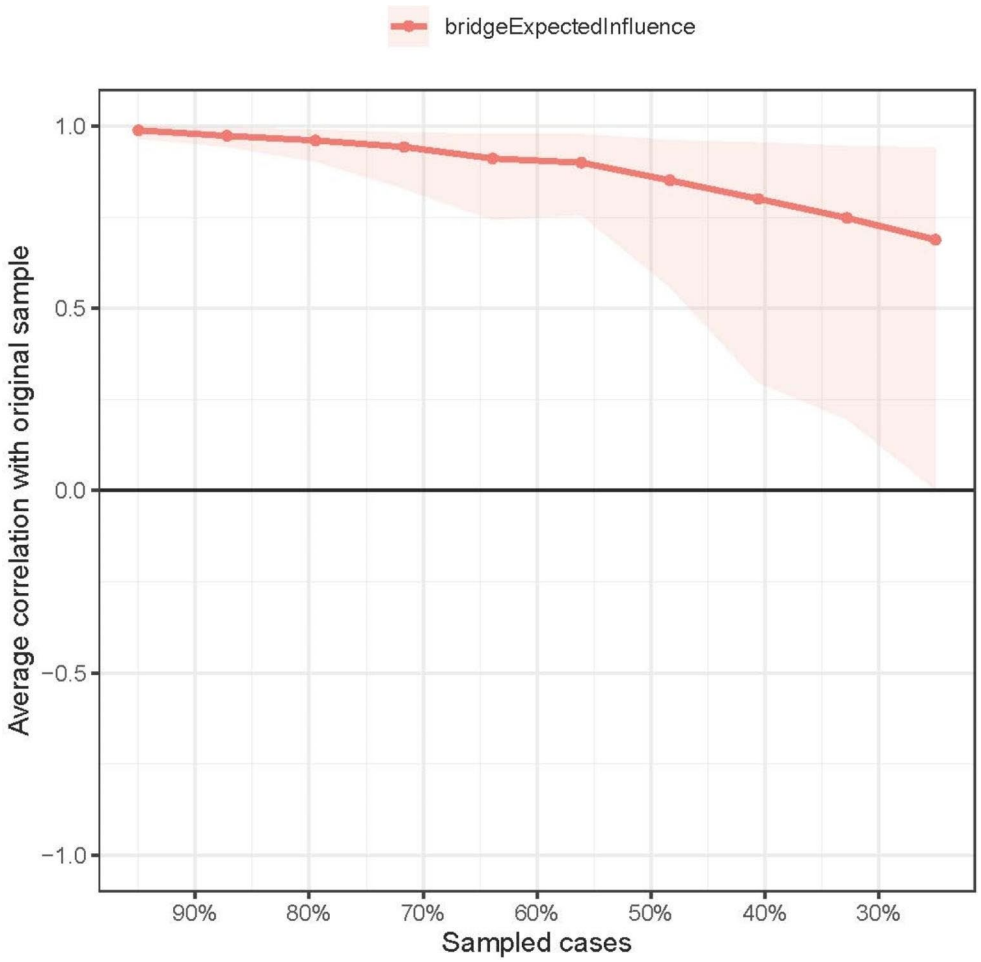
"adherence to recommended regimen" and NE6 "irritated" was significantly different from the edge weights of most other node pairs ($P < 0.05$).

Bridge expected influence

The node BEIs in the network are shown in Fig. 1b. The results suggested that ARR "adherence to recommended regimen" and NE6 "irritated" had the highest absolute values of BEI of the negative emotion community and self-management community (BEI=-0.13, -0.19). In addition, the BEIs of ARR "adherence to recommended regimen" and NE6 "irritated" were significantly different from those of the most other nodes ($P < 0.05$, see Fig. S2 of Supplementary Material).

The stability test result of BEI is shown in Fig. 3. As the sampling proportion decreased, the average correlation with the original sample decreased gently. The CS coefficient of BEI was 0.44, indicating that the stability was acceptable.

Fig. 3 The stability result of BEI



Discussion

The present study is the first attempt to examine the component-level relationship between negative emotion and self-management behavior in patients with early CKD from the perspective of network analysis. Our findings may contribute to providing emotional targets for intervention to improve self-management behavior.

The relationships between different components of negative emotion and self-management behavior were different. From the network structure between the two communities, it was found that there were intense and close negative correlations between "irritated" in negative emotion and "self-integration", "problem solving", "seeking social support" and "adherence to recommended regimen" in self-management behavior. This finding is consistent with that of Travado et al. (2019), who found that negative emotion was negatively correlated with patients' self-management behaviors overall. Patients with more severe negative emotions have fewer healthy behaviors, such as diet management and self-medication (Zhang et al., 2017). This study found that the level of self-management behavior is greatly reduced when patients have negative emotions of irritation. The possible explanation for the result may be that patients with early CKD often have irritated negative emotions due to long treatment processes, frequent hospitalization, outcomes that cannot be cured completely, and restrained living habits (Guerra et al., 2021). When the negative emotion of irritation accumulates to a certain extent, patients are prone to feel powerless and indulge themselves, exhibiting poor self-management behavior (Trick et al., 2016). Therefore, clinical medical workers should detect and eliminate the irritation of patients with early CKD as soon as possible to improve their self-management.

The study also found that "scared", "nervous" and "ashamed" emotions were positively associated with "self-integration", "problem solving" and "seeking social support" in self-management, respectively, which is contrary to previous studies. A large number of previous studies have suggested that nervousness and fear can lead to poor self-management behavior (Huang, Li, & Zheng, 2021). This result may be explained by the fact that people are diagnosed with CKD at younger ages, and their education level is constantly improving (Heath et al., 2017). When patients

are in a state of fear, they can find a suitable adjustment method through the knowledge they have acquired (Sarker et al., 2022). When patients feel nervous, they turn stress into motivation through the usual experience of study, work and life and take the initiative to solve problems (Pereira et al., 2021). When patients feel ashamed, they are more determined to overcome the disease out of a sense of responsibility to their families, and they do not want to be a burden (Darwish et al., 2020). They will actively seek support, learn theoretical knowledge about CKD through the internet and books or by asking others for advice to promote self-management (Khodarahimi et al., 2021). Therefore, this suggests that in the process of clinical psychological nursing, it is necessary to make patients with early CKD aware of the seriousness of the disease and how to mitigate the negative emotions of being scared, nervous and ashamed, which can improve the level of self-management behavior at an early stage.

Another important finding was that "irritated" is a key factor in the risk effect on self-management behavior. Bridge centrality represents the effect of a node on other community nodes. In the negative emotion and self-management behavior network in this study, the greater the bridge expected influence of the node in the negative emotion community, the stronger the impact on the self-management behavior community. Its positive or negative value indicates the protective or risk effect on self-management behavior. Within the negative emotion community, the absolute value of the bridge expected influence of "irritated" was the highest and the original value was negative, implying that the activation of "irritated" is most likely to have a risky effect on self-management behavior, which was consistent with the results of previous studies (Russell, Smith, & Smyth, 2016). It has been found that the appearance of irritation can seriously affect the regulation of daily life among patients with chronic disease. In clinical studies, irritation is also an imperative predictor of adverse clinical outcomes (Gramling et al., 2021). Irritation is often a combination of specific uncomfortable experiences and related perceptions that arise when events such as setbacks or dashed hopes occur (Kassinove & Sukhodolsky, 1995). When patients with early CKD learn that they are sick and cannot be cured, it is difficult for them to accept it in the moment. Patients often become uncontrollably angry, lose hope in life, and feel that illness is a punishment, and they may engage in some irrational behaviors (Eloia et al., 2021). Therefore, nurses taking the "irritated" of negative emotion as the target can play a more comprehensive and effective role in improving self-management behavior compared with other negative emotions when they intervene in self-management behavior by suppressing negative emotions. In the psychological nursing of patients, we should be good at discovering and identifying irritation in patients with early CKD. We can adopt the methods of catharsis, thought transfer, mind control and meditation to reduce irritation to help patients understand the disease correctly and build confidence in dealing with the disease (Lin et al., 2019).

There are limitations in our study. First, this study developed a network structure of negative emotion and self-management behavior in Chinese patients with early CKD at the group level, which may be different from the structure at the individual level. Second, although this study was multicenter, it was still a cross-sectional study, which limited causality statements. Further studies using longitudinal analysis need to be conducted around the disease progression of CKD to determine whether components of negative emotion affect self-management or vice versa. Third, this study includes multiple stages of CKD, and we did not examine differences in the network among different stages. Therefore, further research should be carried out to extend the current study results by comparing different stage groups, and these may find various targeted interventions for patients at different stages.

Conclusions

This study explored the association patterns between different components of negative emotion and self-management behavior with the advantage of network analysis and highlighted that an "irritated" state of mind has the most obvious risk effect and the deepest influence on self-management behavior. Therefore, targeting "irritated" for interventions will help to improve self-management behavior in patients with early CKD to a greater extent, which will be conducive to delaying the progression of kidney disease.

Supplementary Information The online version contains supplementary material available at https://doi.org/10.1007/s12144-023-05111-0.

Authors' contributions YC and YZ designed the research. YC, ZG and TY wrote the original draft manuscript. QL, NL, HY, LZ (Lanfang Zhang), LZ (Lihua Zhang) and HM were responsible for data collection. TY and ZG contributed to the analysis of the data. YC, QL, NL, HY, LZ (Lihua Zhang) and HM revised and checked the manuscript. YZ reviewed and editing the manuscript. All authors contributed to the article and approved the submitted version.

Funding No funds, grants, or other support was received.

Data Availability The datasets generated during and/or analysed during the current study are available from the corresponding author on reasonable request.

Declarations

Conflict of interest The authors declare that there is no conflict of interests.

Ethics approval and consent to participate The present study was reviewed and approved by the Ethics Committee of the Second Affiliated Hospital of Air Force Medical University (No.202206-02) and was conducted in accordance with the Declaration of Helsinki guidelines. After written informed consent was obtained, participants completed the questionnaires anonymously, and their personal information was not disclosed. They were told they could withdraw from the survey at any time.

References

Akbarialiabad, H., Kavousi, S., Ghahramani, A., Bastani, B., & Ghahramani, N. (2020). COVID-19 and maintenance hemodialysis: A systematic scoping review of practice guidelines. *BMC Nephrology*, *21*(1), 470. https://doi.org/10.1186/s12882-020-02143-7.

Bikbov, B., Purcell, C. A., Levey, A. S., Smith, M., Abdoli, A., Abebe, M., et al. (2020). Global, regional, and national burden of chronic kidney disease, 1990–2017: A systematic analysis for the global burden of disease study 2017. *Lancet*, *395*(10225), 709–733. https://doi.org/10.1016/S0140-6736(20)30045-3.

Cervin, M., Lázaro, L., Martínez-González, A. E., Piqueras, J. A., Rodríguez-Jiménez, T., Godoy, A., et al. (2020). Obsessive-compulsive symptoms and their links to depression and anxiety in clinic- and community-based pediatric samples: A network analysis. *Journal of Affective Disorders*, *271*, 9–18. https://doi.org/10.1016/j.jad.2020.03.090.

Chen, J., & Chen, Z. (2008). Extended bayesian information criteria for model selection with large model spaces. *Biometrika*, *95*(3), 759–771. 10.1093/ biomet/asn034.

Contreras, A., Nieto, I., Valiente, C., Espinosa, R., & Vazquez, C. (2019). The study of psychopathology from the network analysis perspective: A systematic review. *Psychotherapy and Psychosomatics*, *88*(2), 71–83. https://doi.org/10.1159/000497425.

Darwish, M. M., Hassan, S. H., Taha, S. F., Abd El-Megeed, H. S., & Ismail, T. A. A. M. (2020). Family impact and economic burden among caregivers of children with chronic kidney disease in Assiut, Egypt. *The Journal of the Egyptian Public Health Association*, *95*(1), 27. https://doi.org/10.1186/s42506-020-00058-7.

Eloia, S. M. C., Ximenes, M. A. M., Eloia, S. C., Galindo Neto, N. M., Barros, L. M., & Caetano, J. (2021). Religious coping and hope in chronic kidney disease: A randomized controlled trial. *Revista da Escola de Enfermagen da USP*, *55*, https://doi.org/10.1590/1980-220x-reeusp-2020-0368.

Epskamp, S., & Fried, E. I. (2018). A tutorial on regularized partial correlation networks. *Psychological Methods*, *23*(4), 617–634. https://doi.org/10.1037/met0000167.

Epskamp, S., Cramer, A. O. J., Waldorp, L. J., Schmittmann, V. D., & Borsboom, D. (2012). Network visualizations of relationships in psychometric data. *Journal of Statistical Software*, *48*, https://doi.org/10.18637/jss.v048.i04.

Epskamp, S., Borsboom, D., & Fried, E. I. (2018). Estimating psychological networks and their accuracy: A tutorial paper. *Behavior Research Methods*, *50*(1), 195–212. https://doi.org/10.3758/s13428-017-0862-1.

Evans, M., Lewis, R. D., Morgan, A. R., Whyte, M. B., Hanif, W., Bain, S. C., et al. (2022). A narrative review of chronic kidney disease in clinical practice: Current challenges and future perspectives. *Advances in Therapy*, *39*(1), 33–43. 10.1007 / s12325-021-01927-z.

Fried, E. I., & Cramer, A. O. J. (2017). Moving forward: Challenges and directions for psychopathological network theory and methodology. *Perspectives on Psychological Science*, *12*(6), 999–1020. https://doi.org/10.1177/1745691617705892.

Gramling, R., Straton, J., Ingersoll, L. T., Clarfeld, L. A., Hirsch, L., Gramling, C. J., et al. (2021). Epidemiology of fear, sadness, and anger expression in palliative care conversations. *Journal of Pain and Symptom Management*, *61*(2), 246–53e1. https://doi.org/10.1016/j.jpainsymman.2020.08.017.

Guerra, F., Di Giacomo, D., Ranieri, J., Tunno, M., Piscitani, L., & Ferri, C. (2021). Chronic kidney disease and its relationship with mental health: Allostatic load perspective for integrated care. *Journal Personalized Medicine*, *11*(12), 1367. https://doi.org/10.3390/jpm11121367.

Heath, J., Norman, P., Christian, M., & Watson, A. (2017). Measurement of quality of life and attitudes towards illness in children and young people with chronic kidney disease. *Quality of Life Research*, *26*(9), 2409–2419. https://doi.org/10.1007/s11136-017-1605-6.

Huang, X., Li, C., & Zheng, P. (2021). Correlation of self-perceived burden, fear of pain, and self-management behavior in elderly patients with chronic pain. *Chinese Nursing Research*, 35(15), 2675-81. doi: https://doi.org/10.12102/j.issn.1009-6493.2021.15.009.

Jones, P. J., Ma, R., & McNally, R. J. (2019). Bridge centrality: A network approach to understanding comorbidity. *Multivariate Behavioral Research*, *56*(2), 353–367. https://doi.org/10.1080/00273171.2019.1614898.

Kassinove, H., & Sukhodolsky, D. G. (1995). Anger disorders: Basic science and practice issues. *Issues in Comprehensive Pediatric Nursing*, *18*(3), 173–205. https://doi.org/10.3109/01460869509087270.

Kendall, M. (1975). *Multivaraiate Anlysis*. Charles Griffiffiffin and Company Limited.

Khodarahimi, S., Veiskarami, H. A., Mazraeh, N., Sheikhi, S., & Rahimian Bougar, M. (2021). Mental health, social support, and death anxiety in patients with chronic kidney failure. *The Journal of Nervous and Mental Disease*, *209*(11), 809–813. https://doi.org/10.1097/NMD.0000000000001386.

Lin, C. C., & Hwang, S. J. (2020). Patient-centered self-management in patients with chronic kidney disease: Challenges and implications. *International Journal of Environmental Research and Public Health*, *17*(24), 9443. https://doi.org/10.3390/ijerph17249443.

Lin, C. C., Wu, C. C., Wu, L. M., Chen, H. M., & Chang, S. C. (2012). Psychometric evaluation of a new instrument to measure disease self-management of the earlystage chronic kidney disease patients. *Journal of Clinical Nursing*, *22*(7–8), 1073–1079. https://doi.org/10.1111/j.1365-2702.2011.04048.x.

Lin, F. L., Yeh, M. L., Lai, Y. H., Lin, K. C., Yu, C. J., & Chan, J. S. (2019). Two-month breathing-based walking improves anxiety,

depression, dyspnoea and quality of life in chronic obstructive pulmonary disease: a randomised controlled study. *Journal of Clinical Nursing*, 28(19–20), 3632-40. doi: https://doi.org/10.1111/jocn.14960.

Liu, Y., Jia, Q., Xu, H., Ji, M., & Ma, L. (2015). Revision of the Taiwan instrument of early stage chronic kidney disease self-management. *Journal of Nursing Science*, *30*(03), 18–21. doi: CNKI: SUN: HLXZ.0.2015-03-010.

Miles, S. R., Khambaty, T., Petersen, N. J., Naik, A. D., & Cully, J. A. (2018). The role of affect and coping in diabetes self-management in rural adults with uncontrolled diabetes and depressive symptoms. *Journal of Clinical Psychology in Medicical Settings*, *25*(1), 55–65. https://doi.org/10.1007/s10880-017-9527-6.

National Kidney Foundation. (2002). K/DOQI clinical practice guidelines for chronic kidney disease: Evaluation, classification, and stratification. *American Journal of Kidney Diseases*, *39*(2 Suppl 1), S1–266.

Nephrologist Branch of Chinese Medical Association. (2021). Chinese clinical practice guidelines for nutritional treatment of chronic kidney disease. *National Medical Journal of China*, *101*(08), 539–559. https://doi.org/10.3760/cma.j.cn112137-20201211-03338.

Peng, S., He, J., Huang, J., Lun, L., Zeng, J., Zeng, S., et al. (2019). Self-management interventions for chronic kidney disease: A systematic review and meta-analysis. *BMC Nephrology*, *20*(1), 142. https://doi.org/10.1186/s12882-019-1309-y.

Pereira, R. A., Alvarenga, M. S., Avesani, C. M., & Cuppari, L. (2021). Strategies designed to increase the motivation for and adherence to dietary recommendations in patients with chronic kidney disease. *Nephrology Dialysis Transplantation*, *36*(12), 2173–2181. https://doi.org/10.1093/ndt/gfaa177.

Qiu, L., Zheng, X., & Wang, Y. (2008). Revision of positive and negative affect scale (PANAS). *Chinese Journal of Applied Psychology*, *14*(03), 249–254. doi: CNKI: SUN: YXNX.0.2008-03-009.

Russell, M. A., Smith, T. W., & Smyth, J. M. (2016). Anger expression, momentary anger, and symptom severity in patients with chronic disease. *Annals of Behavioral Medicine*, *50*(2), 259–271. https://doi.org/10.1007/s12160-015-9747-7.

Saran, R., Robinson, B., Abbott, K. C., Agodoa, L. Y., Bhave, N., Bragg-Gresham, J., et al. (2018). epidemiology of kidney disease in the United States. *American Journal of Kidney Diseases*, *71*(4), 501. 10.1053 /j.ajkd.2018.01.002. US renal data system 2017 annual data report:.

Sarker, M. H. R., Moriyama, M., Rashid, H. U., Rahman, M. M., Chisti, M. J., Das, S. K., et al. (2022). Chronic kidney disease awareness campaign and mobile health education to improve knowledge, quality of life, and motivation for a healthy lifestyle among patients with chronic kidney disease in Bangladesh: Randomized controlled trial. *Journal of Medical Internet Research*, *24*(8), e37314. https://doi.org/10.2196/37314.

Tibshirani, R. (1996). Regression shrinkage and selection via the lasso. *Journal of the Royal Statistical Society: Series B (Methodological)*, *58*, 267–288. https://doi.org/10.1111/j.2517-6161.1996.tb02080.x.

Travado, L., Reis, J. C., Antoni, M. H., Almeida, S. D., & Oliveira, F. (2019). Self-management skills as predictors of positive affect and social well-being in metastatic breast cancer patients. *Breast*, *48*(2), S63–S64. https://doi.org/10.1016/s0960-9776.

Trick, L., Watkins, E., Windeatt, S., & Dickens, C. (2016). The association of perseverative negative thinking with depression, anxiety and emotional distress in people with long term conditions: A systematic review. *Journal of Psychosomatic Research*, *91*, 89–101. https://doi.org/10.1016/j.jpsychores.2016.11.004.

van der Gaag, M., Heijmans, M., Ballester, M., Orrego, C., Niño de Guzmán, E., Ninov, L., et al. (2022). Preferences regarding self-management intervention outcomes of dutch chronically ill patients with limited health literacy. *Frontiers in Public Health*, *10*, 842462. https://doi.org/10.3389/fpubh.2022.842462.

Vanzhula, I. A., Kinkel-Ram, S. S., & Levinson, C. A. (2021). Perfectionism and difficulty controlling thoughts bridge eating disorder and obsessive-compulsive disorder symptoms: A network analysis. *Journal of Affective Disorders*, *283*, 302–309. https://doi.org/10.1016/j.jad.2021.01.083.

Volpato, E., Toniolo, S., Pagnini, F., & Banfi, P. (2021). The relationship between anxiety, depression and treatment adherence in chronic obstructive pulmonary disease: A systematic review. *International Journal of Chronic Obstructive Pulmonary Disease*, *16*, 2001–2021. https://doi.org/10.2147/COPD.S313841.

Watson, D., Clark, L. A., & Tellegen, A. (1988). Development and validation of brief measures of positive and negative affect: The PANAS scales. *Journal of Personality and Social Psychology*, *54*(6), 1063–1070. https://doi.org/10.1037/0022-3514.54.6.1063.

Xie, Y., Hou, X., Wang, Y., & Zheng, Z. (2021). Effect of self-management on negative emotion after total gastric cancer resection. *Oncology Progress*, *19*(04), 419–421. https://doi.org/10.11877/j.issn.1672-1535.2021.19.04.25.

Zhang, L., Wang, F., Wang, L., Wang, W., Liu, B., Liu, J., et al. (2012). Prevalence of chronic kidney disease in China: A cross-sectional survey. *Lancet*, *379*(9818), 815–822. https://doi.org/10.1016/s0140-6736(12)60033-6.

Zhang, H., Gao, T., Gao, J., Kong, Y., Hu, Y., Wang, R., et al. (2017). A comparative study of negative life events and depressive symptoms among healthy older adults and older adults with chronic disease. *The International Journal of Social Psychiatry*, *63*(8), 699–707. https://doi.org/10.1177/0020764017736543.

Zhang, L., Zhao, M., Zuo, L., Wang, Y., Yu, F., Zhang, H., et al. (2020). China kidney disease network (CK-NET) 2016 annual data report. *Kidney International Supplements*, *10*(2), e97–185. https://doi.org/10.1016/j.kisu.2020.09.001.

Zimbudzi, E., Lo, C., Kerr, P. G., & Zoungas, S. (2019). A need-based approach to self-management education for adults with co-morbid diabetes and chronic kidney disease. *BMC Nephrology*, *20*(1), 113. https://doi.org/10.1186/s12882-019-1296-z.