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ORIGINAL RESEARCH

Comorbidity Network of Self-Stigma, Insomnia, and Mental Health in Chronic Disease Patients: A Network Analysis

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Background: Patients with chronic illnesses frequently exhibit symptoms including self-stigma, insomnia, depression, and anxiety. While previous research has primarily focused on the effects of individual symptoms, a comprehensive analysis of the complex interactions among these symptoms remains lacking. The present study investigates these interactions using network analysis.

Methods: The study collected data on the psychological status of 406 patients using self-assessment scales (sleep/anxiety/depression scales). We conducted network analyses with the R packages botnet and qgraph to evaluate the bridging relationships between symptom networks and the strength of these networks. Additionally, we analyzed the interrelationships among the various symptoms of self-stigma, insomnia, depression, and anxiety, and explored the core and bridging symptoms within the symptom networks.

Results: Network analyses identified self-stigma emotions and daytime conditions as the core symptoms of self-stigma and insomnia within the dimensional network models of self-stigma, depression, anxiety, and insomnia. The most significant bridging symptoms in these models were anxiety, depression, self-stigma, emotions, and daytime conditions. In contrast, the prominent bridging symptoms in the self-stigma, depression, anxiety, and insomnia dimensional network models were SD6 (Bad mood or unstable mood during the day), AN2 (Unable to stop or control worrying), DP2 (Feeling down, depressed, hopeless), and SS1 (Patient identity is burdens). Additionally, SS9 (Illness-concealed social avoidance) and SD7 (Poor or unstable mental state during daytime physical activities) emerged as the core symptoms of self-stigma and insomnia symptoms, respectively.

Conclusion: This network analysis identified self-stigma cognition and sleep quality as central symptoms within the self-stigma-insomnia network structure. It pinpointed a lack of interest and pleasure in activities, along with the inability to stop or control worrying, as bridge symptoms in the self-stigma-insomnia-depression and self-stigma-insomnia-anxiety network structures.

Keywords: self-stigma, insomnia, anxiety, depressive symptoms, chronic disease states, network analysis, centrality

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Introduction

Self-stigmatization refers to the internalization of negative stereotypes about oneself following an illness, encompassing the acceptance of self-stereotypes, biases, and the emergence of self-discrimination.[1] This internalization results in a loss of status and discrimination.[2] Numerous cross-sectional studies indicate that patients who have experienced major illnesses or acute stress events often undergo varying degrees of self-stigma.[3] Chronic diseases typically refer to long-term conditions that cannot be cured and often involve physical impairments or disabilities.[4] Even when some chronic diseases present subtle symptoms, they can still evoke feelings of shame.[5] Research indicates that individuals with chronic illnesses are subjected stigmatization,[6] which may lead to unemployment, social isolation, delayed medical care, treatment resistance, prolonged disease duration, and preventable hospitalizations.[7–10] Following experiences of self-stigma, individuals may exhibit symptoms of insomnia, such as difficulty falling asleep, reduced sleep efficiency, and daytime dysfunction, which may be either short-term or persistent. Therefore, an in-depth exploration of the relationship between self-stigma and insomnia offers a new perspective on the mechanisms underlying their interaction in mental health. The symptoms linking these two mental disorders are known as bridge symptoms.[11] Identifying and analyzing these bridge symptoms may aid in developing more effective intervention strategies to alleviate associated symptoms, enhance patients' social functioning, shorten the duration of illness, and reduce the burden on healthcare systems.[12]

Previous studies have found a strong link between self-stigma and poor sleep quality. Research indicates that post-COVID-19 stigma is linked to poor sleep quality in recovered patients.[13] Ivan H.C. Wu has reported that breast cancer survivors experience sleep disorders that are partially attributed to feelings of self-stigma and emotional factors.[14] At the same time, Chan et al found that self-stigma has an indelible impact on sleep quality and quality of life in patients with mental disorders.[15] Additionally, a study of breast cancer survivors found that self-stigma heightens social restrictions and further increases ambivalence toward emotional expression (AEE). The AEE can activate physiological responses, leading to sleep disturbances.[14] Despite the varying findings on the influence of self-stigma on sleep patterns across these studies, the differences in sample sources, sizes, and methodologies limit the availability of robust evidence in the context of different patients.[15] Furthermore, most previous studies have generally regarded insomnia as a whole without discussing the association between self-stigma and insomnia in terms of multiple dimensions.[16]

Self-stigma constitutes a self-reinforcing pathogenic triad that links negative stereotypes to depression, anxiety, and insomnia. Initially, internalised stigma elicits persistent self-criticism, shame, guilt, and feelings of inferiority.[17] These negative emotions heighten psychological distress, thereby elevating the risk of depression and anxiety;[18] in turn, depressive and anxious states further intensify self-stigma, perpetuating a vicious cognitive–affective cycle.[19] Insomnia occupies a central role in this cycle. Both depression and anxiety disrupt sleep architecture, resulting in delayed sleep onset, nighttime awakenings, and non-restorative sleep.[20,21] Insufficient sleep or poor sleep quality further impairs emotional regulation, which exacerbates depressive moods, anxiety, and perceived stigma. Consequently, insomnia serves as both a consequence of self-stigma, depression, and anxiety, as well as a factor that exacerbates these symptoms. From a physiological perspective, stress associated with self-stigma chronically activates the hypothalamic-pituitary-adrenal (HPA) axis and the sympathetic nervous system, resulting in elevated cortisol levels and disrupted neurotransmitter balance.[22,23] This neuroendocrine disruption impairs emotional stability and sleep homeostasis.[24] Moreover, insomnia disrupts circadian rhythms and autonomic regulation, increasing the risk of developing affective disorders.[25,26] These bidirectional pathways collectively elucidate the frequent comorbidity of self-stigma, depression, anxiety, and insomnia observed in clinical settings.[27]

Although prior research has consistently examined the isolated impacts of individual symptoms—such as self-stigma, insomnia, depression, and anxiety—on patient outcomes, the intricate interplay among these symptoms remains unexplored. Specifically, how these symptoms coalesce into distinct network clusters (ie, densely connected subgroups of symptoms) and how specific symptoms serve as bridging effects (ie, acting as primary links between otherwise separate clusters) are not yet fully understood. This gap in knowledge hinders our capacity to develop targeted treatments and effective psychological interventions. Consequently, it is imperative to employ network analysis to explore these interactions in greater depth. This approach can reveal both direct and latent reinforcing relationships among symptoms.[28,29] It offers new insights into the functional significance and key roles of specific symptoms in disease

maintenance, such as symptom centrality within the network.[30,31] In network analyses, symptom centrality quantifies causal influence and is typically estimated with centrality metrics to identify optimal treatment targets.[32,33] Elevated Expected Influence (EI) signifies greater immediate, network-wide impact and heightened clinical intervention priority.[34,35]

Method and Population

Clinical data collection was conducted by trained outpatient nursing staff during patients' waiting times in the outpatient clinic. Patients were recruited on-site at the outpatient departments, and anonymous self-assessments were conducted using Wenjuanxing (https://www.wjx.cn/). The researcher explained the study's purpose, its voluntary nature, and the confidentiality of the data to the patients. After obtaining informed consent, the researcher assisted the patients in reading the instructions for completing the questionnaire, ensuring that they answered independently without prompting them for their responses. The study was conducted from October 20, 2023, to February 29, 2024, at the outpatient departments of Xiangya Second Hospital and Xiangya Third Hospital, Central South University. The core inclusion criteria were patients aged 18 years or older who had been diagnosed with at least one confirmed chronic disease (including severe conditions such as chronic heart failure or active malignant tumors) or who had a history of acute emergencies (such as stroke, acute myocardial infarction, or traumatic injury). The core exclusion criteria included patients diagnosed with severe cognitive impairment, dementia, major depression, anxiety disorders, schizophrenia, typical insomnia, or psychosomatic disorders before the current disease episode. Additionally, the study excluded curable diseases (e.g, including appendicitis, cholecystitis, and other treatable internal conditions). Informed consent was obtained from all participants, and the study received approval from the Ethics Committee of Xiangya Third Hospital at Central South University (23688).

Measurements

Self-Stigma Scale-Short (SSS-S)

Use SSS-S to assess self-stigma.[36] SSS-S includes 9 items and could be divided into 3 dimensions, namely self-stigma cognitive (SC), self-stigma affective (SA), and self-stigma behavior (SB) (Table S1). The scores of each item range from 1 to 4, and the total score ranges from 9 to 36, where a higher score in the SSS-S means a higher level of self-stigma, and a cutoff score above the 75th percentile suggests a high level of self-stigma. The Cronbach's alpha for this scale is 0.870.

Athens Insomnia Scale (AIS)

Use the AIS to assess the insomnia status of the subjects.[37] AIS comprises 8 items and can be divided into 2 dimensions, namely sleep quality (SQ) and daytime condition (DC) (Table S2). The scores of each item range from 1 to 4, and the total score ranges from 8 to 32, where a score lower than 11 indicates no insomnia, a score of 12–14 indicates suspected insomnia, and a score exceeding 15 suggests the presence of insomnia. In this study, the Cronbach's alpha for this scale was 0.900.

Patient Health Questionnaire-2 Item (PHQ-2)

Use PHQ-2 to assess depression symptoms.[38] PHQ-2 includes 2 items, namely lack of interest and pleasure in activities and feeling down, depressed, and hopeless. Each item in these scales was rated on a 4-point Likert scale, with a score ranging from 0 ("not at all") to 3 ("nearly every day") and higher scores indicating higher severity of symptoms. For the validated Chinese version used in this study, PHQ-2 scores above 3 indicated mild depressive symptoms.[39] The Cronbach's alpha was 0.839.

The Generalized Anxiety Disorder Scale-2 Item (GAD-2)

Use the GAD-2 to assess the anxiety symptoms.[40] GAD-2 includes 2 items, namely feeling tense, anxious, or on edge, and unable to stop or control worrying. Participants assess their symptoms on a four-point Likert scale format in the questionnaire, rating them from 0 (not at all) to 3 (nearly every day), with higher scores representing more severe

symptoms. For the validated Chinese version used in the present study, GAD-2 scores above 3 indicated mild anxiety symptoms.[39] The Cronbach's alpha for this scale is 0.840.

Statistical Analysis

To ensure the quality of the survey, all completed questionnaires were reviewed to identify inappropriate responses and evaluate the diversity of answers to open-ended questions. Following the review, no questionnaires were found to lack diversity. Descriptive analysis of demographic data and statistical analysis of scale scores were conducted using SPSS version 26.0 software.

Network Estimation

Network models were constructed and analyzed using the qgraph package (version 1.9.2) in the R software (version 4.2.2).[41,42] We used the partial correlation network method to estimate all symptom networks, and then further selected the Gaussian graphical model according to the Bayesian Information Criterion (EBIC) model. Since the data is ordered, the core method was set to "Spearman".[31,43]

In this network, a circle represented an individual symptom (one item from the symptom measures) from the SSS-S, AIS, PHQ-2, and GAD-2. The associations between nodes were represented by lines (or "edges") between nodes. The edges represent dependencies between variables; blue edges indicate positive associations and red edges indicate negative associations. Wider edges indicated stronger associations.[30] In the study, abbreviations were employed to represent each of the 2 PHQ-2 items and 2 GAD-2 items. These abbreviations are utilized in figures illustrating the centrality values of nodes.

The value of node EI is determined by summing the weights of all edges, both positive and negative, that are directly associated with that node.[44] Symptoms exhibiting high EI were identified as central symptoms, indicating a significant influence on other symptoms within the network. Similarly, the Bridge Expected Impact (BEI) was computed, considering only edges connecting nodes in different structures. We classified as "bridge symptoms" those symptoms with BEI values exceeding the 95% one-sided bootstrap upper confidence limit and ranking within the top 10% of the distribution. BEI enabled the identification of symptoms that could serve as bridges across different clusters.

Network Accuracy and Stability Estimation

We used the case-dropping procedure to estimate the accuracy of edges and stability in the network, by using the bootnet R package (version 1.5) with 1000 iterations.[35] We also used the centrality stability coefficient (CS-coefficient) as a reference index. A CS coefficient below 0.25 indicates high instability, and a value greater than or equal to 0.5 is recommended.[45]

Results

A total of 500 self-administered questionnaires were distributed, of which 410 were returned. All patients who completed the questionnaire did so voluntarily. Four questionnaires were excluded due to missing responses on self-stigma, insomnia, depression, or anxiety, resulting in a final sample of 406 outpatients. The mean (SD) age was 36.88 (13.12) years, comprising 255 women (62.8%), 149 men (36.7%), and two individuals (0.5%) for whom gender was not reported. The demographic characteristics of all participants are shown in Table 1. The mean score of each dimension in the SSS-S, AIS, PHQ-2, and GAD-2 is shown in Table S3. The mean value of insomnia severity was 25.69, and the standard deviation was 7.05.

Model 1. Psychopathology of Self-Stigma, Depression, Anxiety, and Insomnia Symptoms

Figure 1A shows the self-stigma, depression, anxiety, and insomnia symptoms network model, and Figure 2A shows the standardized centrality indices of each symptom. The self-stigma symptom with the highest EI was self-stigma affective (EI = 1.80), and the insomnia symptom with the highest EI was daytime condition (EI = 0.22). According to the BEI,

Table 1 Demographic Characteristics (n=406)

Variables	Mean (SD) or N (%)
Age (Years)	36.88 (13.12)
Gender	
Female	255 (62.8)
Male	149 (36.7)
Other gender	2 (0.5)
Education (Years)	12.59 (2.77)
Marriage	
Married	280 (69.0)
Unmarried	114 (28.1)
Divorced	12 (2.9)
Drink [a]	
Yes	278 (68.5)
No	128 (31.5)
Smoke [b]	
Yes	316 (77.8)
No	90 (22.2)
Monthly income (CNY)	
<1000	48 (11.8)
1001-3000	103 (25.4)
3001-5000	136 (33.5)
5001-10,000	92 (22.7)
>10,000	27 (6.6)

Notes: a. The subjects had a history of long-term smoking, which included either recent smoking cessation or recent initiation of smoking, select "yes". b. The subjects had a history of long-term alcohol consumption, which included white wine, red wine, and homemade low-alcohol beverages, select "yes". This group also comprised individuals who had recently quit drinking or had recently initiated alcohol consumption.
Abbreviations: SD, standard deviation; CNY, Chinese Yuan.

anxiety, depression, self-stigma cognitive, and daytime conditions were the four most prominent bridge symptoms in this model (Figure 3A).

Model 2. Psychopathology of Self-Stigma, Depression, Anxiety, and Insomnia Item

Figure 1B shows the self-stigma, depression, anxiety, and insomnia item network model, and Figure 2B shows the standardized centrality indices of each symptom. The self-stigma symptom with the highest EI was SS9 (I was afraid to make new friends in case they found out I had the disease) (EI = 1.25), the insomnia symptom with the highest EI was SD7 (Poor or unstable mental state during daytime physical activities) (EI = 1.44), the anxious symptom with the highest EI was AN2 (Unable to stop or control worrying) (EI= 0.25), the depression symptom with highest EI was DP2 (Feeling down, depressed, hopeless) (EI = 0.25). According to the BEI, SD6 (Bad mood or unstable mood during the day), AN2, DP2, and SS1 (My identity as a patient as a burden to me) were the four most prominent bridge symptoms in this model (Figure 3B).

Stability Analyses

The stability analyses showed that the network models were stable (see Figure 4). EI stability (model 1 = 0.594, model 2 = 0.672) and BEI stability (both model 1 and model 2 are 0.749) are detailed in Figures S1and S2. In particular, the analyses of edge weight stability indicated the reliable estimation of tie strengths. The stability analyses of node-dropping indicated that the order of the nodes in terms of centrality remained consistent even after removing up to 50% of the nodes in each network. Strength centrality was observed to be the most consistent of the centrality measures.

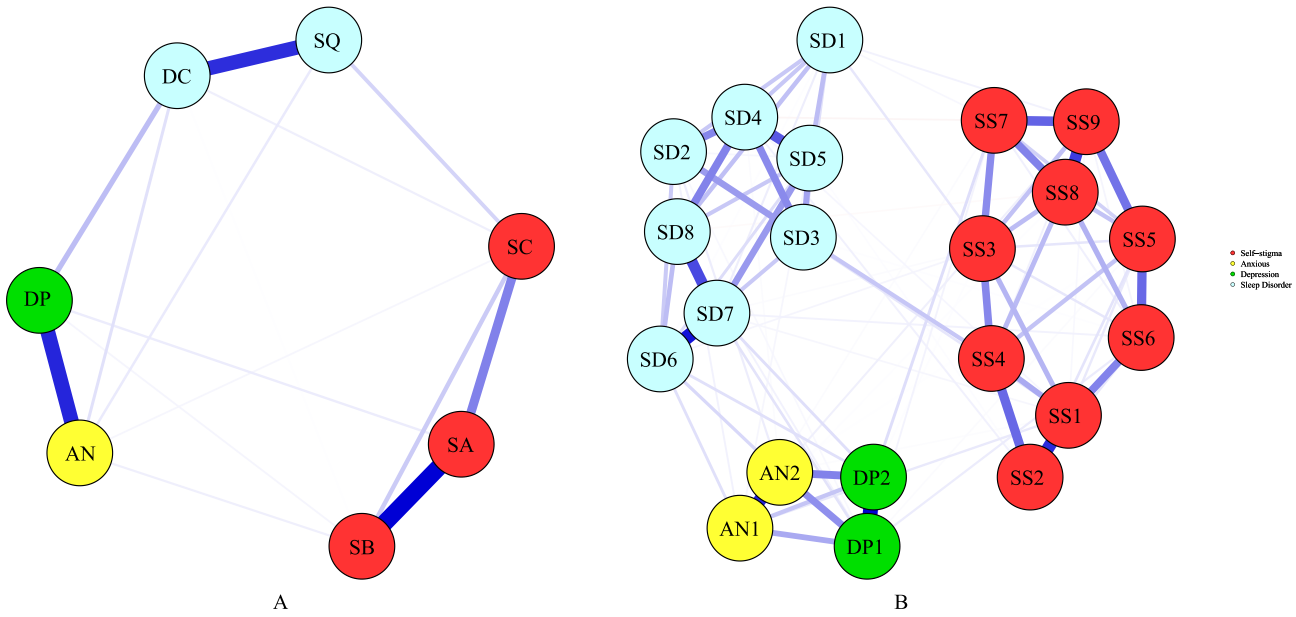

Figure 1 The self-stigma, depression, anxiety, and insomnia symptom network, the self-stigma, depression, anxiety, and insomnia item network.
Notes: (**A**) shows the self-stigma, depression, anxiety, and insomnia symptoms network model. (**B**) shows the self-stigma, depression, anxiety, and insomnia item network model. Labels for self-stigma. SS1 to SS9 represent the 9 items of the SSS-S scale. Labels for depression symptoms. DP1 and DP2 represent the 2 items of the PHQ-2 scale. Labels for anxiety symptoms. AN1 and AN2 represent the 2 items of the GAD-2 scale. Labels for insomnia. SD1 to SD7 represent the 7 items of the AIS scale. Expected Influence is indicated by the thickness of lines between nodes, with thicker lines representing stronger ties.
Abbreviations: SC, Self-stigma cognitive; SA, Self-stigma affective; SB, Self-stigma behavior; DP, Depression; AN, Anxious; SQ, Sleep quality; DC, Daytime condition; SD, Sleep-disorder.

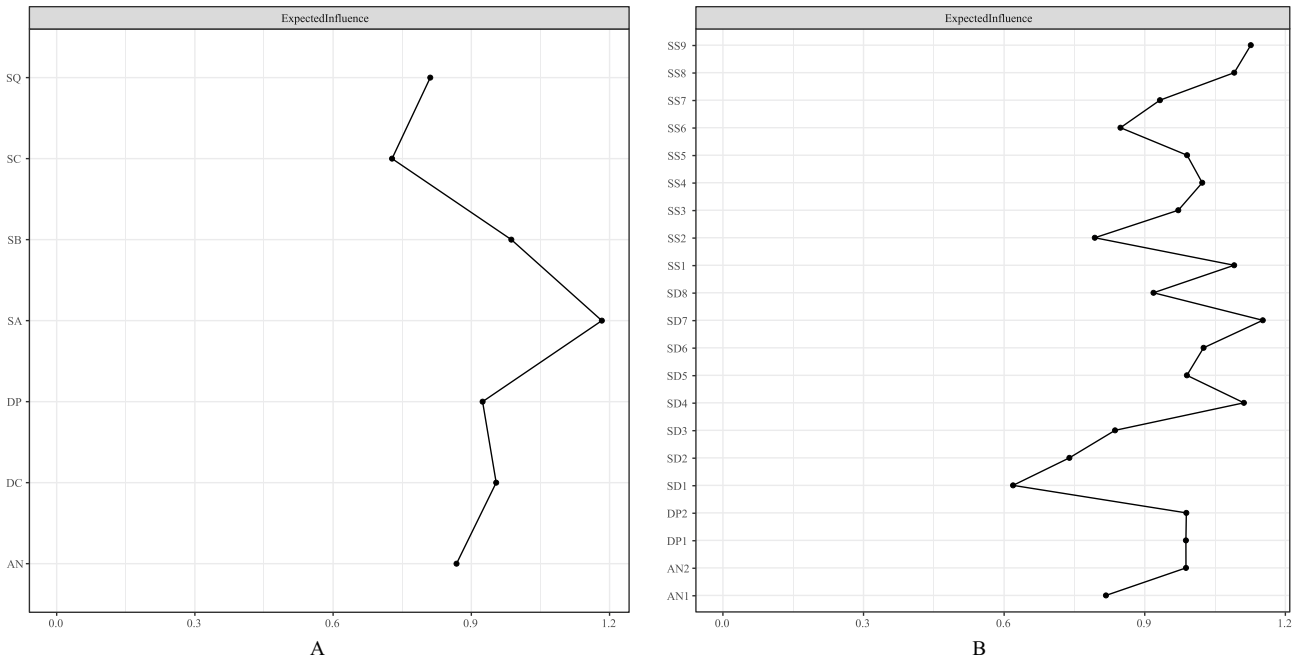

Figure 2 Symptom-specific centrality metrics (standardized). Note: Symptoms exhibiting high EI were identified as central symptoms, indicating a significant influence on other symptoms within the network. (**A**) Centrality (expected influence, EI) of symptoms within the self-stigma, depression, anxiety, and insomnia dimensions. The self-stigma emotional symptom attains the highest EI (0.18). (**B**) Indicates self-stigma, depression, anxiety, and insomnia project network. SS9 (I am afraid to make new friends, worried they will discover I have this disease) exhibits the highest EI (1.25). Among insomnia symptoms, SD7 (Poor or unstable mental state during daytime physical activities) shows the greatest EI (1.44).

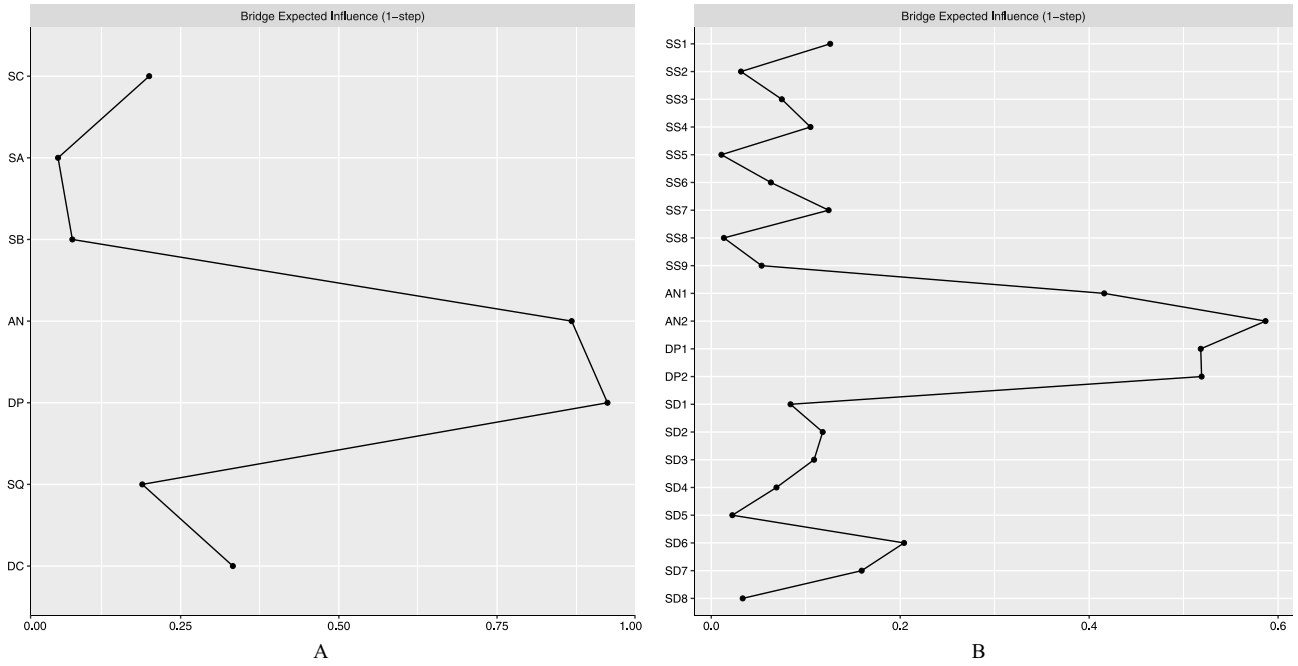

Figure 3 The bridge expected influence (BEI) plot.
Note: A higher BEI signifies a stronger immediate bridging influence, identifying the node as pivotal. (**A**) BEI for the network integrating self-stigma, depression, anxiety, and insomnia dimensions. Anxiety, depression, self-stigma, and daytime status emerge as the four principal bridge symptoms. (**B**) BEI in the item-level network of self-stigma, depression, anxiety, and insomnia; SD6, AN2, DP2, and SS1 constitute the four primary bridge symptoms.

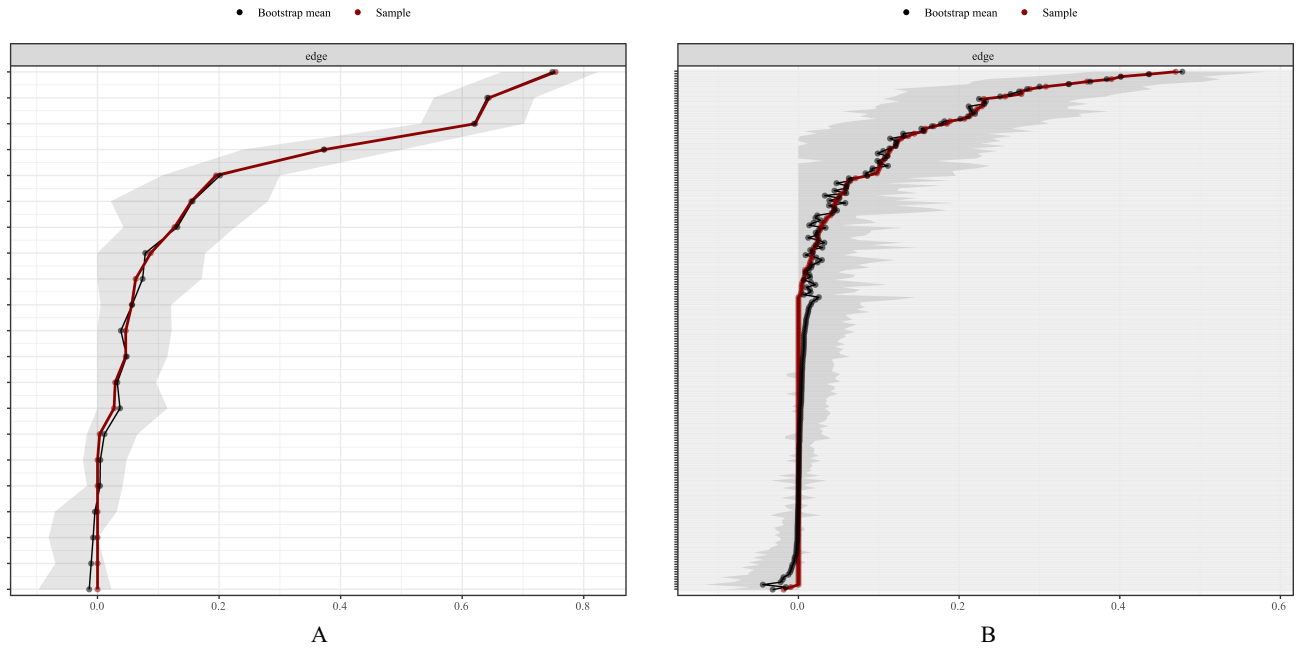

Figure 4 The accuracy of the network edges is determined by non-parametric bootstrapping.
Notes: The gray area represents the bootstrap 95% confidence interval. (**A**) Edge-weight accuracy in the self-stigma, depression, anxiety, and insomnia dimension network. (**B**) Edge-weight accuracy in the item-level network of self-stigma, depression, anxiety, and insomnia.

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Discussion

This study represents the inaugural attempt to map the multidimensional symptom network comprising self-stigma, insomnia, depression, and anxiety. It identifies several core symptoms as well as bridging symptoms within the self-stigma-insomnia symptom cluster, between the self-stigma and insomnia and depression symptom clusters, and between the self-stigma and insomnia and anxiety symptom clusters. In the *self-stigma-insomnia* network, the core symptoms identified are "self-stigma emotions" and "daytime functioning". The bridging symptoms connecting these two dimensions include "self-stigma emotions" and "daytime functioning" at the dimension level, as well as "self-stigma cognition (SS1)" and "daytime emotional instability (SD6)" at the item level. In the *self-stigma–insomnia–depression* network, core symptoms are depressed mood (DP2), self-stigma behavior, and daytime functioning; bridges are self-stigma cognition, daytime functioning, and anhedonia. In the *self-stigma–insomnia–anxiety* network, core symptoms are uncontrollable worry (AN2), self-stigma emotions, and daytime functioning; bridges are self-stigma cognition, self-stigma emotions, and daytime functioning. Overall, self-stigmatizing emotions and daytime functioning are the nodes exerting the greatest cross-dimensional influence, while self-stigmatizing cognition plays a crucial role in all three bridging pathways. These findings suggest that interventions targeting these nodes may yield cross-diagnostic benefits.

Self-stigma cognitive, and sleep quality were identified as the central symptoms in the self-stigma and insomnia network model. Some studies have indicated a significant association between self-stigma and sleep quality,[13,46,47] and this association is often mediated by factors such as psychological resilience, social support, and quality of life.[48–50] While the findings mentioned above may not directly corroborate our perspective, they do highlight the central role of self-stigma cognitive, and sleep quality symptoms within the network of self-stigma and insomnia, which is a significant discovery in our study. These symptoms served as the focal point of the network, exhibiting the strongest and most prevalent connections with other symptoms of self-stigma and insomnia. From a clinical standpoint, bridge symptoms can be considered transdiagnostic, suggesting that targeted interventions could be beneficial for addressing both disorders.[51] According to cognitive-behavioral theory (CBT), self-stigma and insomnia both possess similar negative cognitions, including the acknowledgment and internalization of negative beliefs and stereotypes, surrender and acceptance of the current situation, as well as excessively low expectations and despair for the future.[52] Existing research indicates that negative sleep-related cognitive beliefs associated with insomnia play a significant role in the maintenance and exacerbation of insomnia.[53–55] Therefore, despite the lack of direct evidence showing a direct link between self-stigma cognitive and insomnia, we have reason to believe that self-stigma cognitive may impact sleep quality by inducing negative sleep-related cognitive beliefs associated with insomnia.

Self-stigma is associated with depressive symptoms,[56] and insomnia and depressive symptoms can also develop independently and affect each other[27] Many studies have explored the relationship between morningness-eveningness, stigma, and depressive symptoms. Maciej Stolarski et al found that perceived discrimination partly mediates the effects of morningness-eveningness on depressive affect,[57] Joanna Gorgol et al discovered that self-stigma also could mediate the links between diurnal preference and depression,[58] and then Jessica R Deitch et al proposed that undergraduates exhibited mainly negative implicit and explicit stigma towards evening chronotypes in comparison to morning types.[59] Therefore, we inferred that depressive symptoms might affect the self-stigma-insomnia correlation. To verify this view, we created a network model for the psychopathology of self-stigma, insomnia, and the associated depression and found that self-stigma affective, daytime condition, and lack of interest and pleasure in activities might be bridging symptoms connecting self-stigma or insomnia to depressive symptoms. This result is consistent with previous research, indicating that self-stigmatization can impact depressive symptoms through implicit affectivity, thereby affecting daytime conditions.[60–62]

In addition, self-stigma is also associated with anxiety symptoms and insomnia and anxiety symptoms can also develop independently and affect each other.[63] Many studies have explored the relationship between insomnia, stigma, and anxious symptoms. Michael P Craven et al found the significant indirect effects of internalized weight stigma on poorer global sleep quality and daytime condition through anxiety, and the results of Kara A Christensen Pacella et al serve as further evidence to support it.[64] At the same time, it has been found that internalized HIV stigma was indirectly associated with poorer global sleep quality and daytime sleep dysfunction among the HIV population.[65] Moreover,

studies have shown that individuals with chronic insomnia may have an increased risk of experiencing stigma due to psychological factors such as anxiety.[16] Therefore, we inferred that anxiety symptoms might also affect the self-stigma-insomnia correlation. To verify this view, we created a network model for the psychopathology of self-stigma, insomnia, and the associated anxiety and found that self-stigma behavior, daytime condition, and unable to stop or control worrying might be bridging symptoms connecting self-stigma or insomnia to anxiety symptoms. An explanation for this result could be that self-stigma behavior may lead individuals to be in a chronic stress environment, resulting in dysregulation of the hypothalamic-pituitary-adrenocortical axis, which could trigger anxiety and impact daytime conditions.[66,67]

Implication

This study indicates that affective symptoms within self-stigma and sleep quality are core symptoms in the self-stigma and insomnia network. This suggests that interventions targeting these core symptoms may play a crucial role in improving the stability of the overall symptom network for patients. Clinicians should focus on assessing patients' emotional states related to self-stigma and evaluating sleep quality during initial assessments, designing targeted treatment plans to alleviate these core symptoms. The Collaborative Care Model is widely used in primary care settings in the United States and many other countries, particularly for comorbid issues like depression, anxiety, and insomnia. In this model, clinicians can closely monitor patients' self-stigma and sleep quality, utilizing strategies such as CBT to intervene in bridging symptoms, reduce symptom transmission, and improve overall mental health.[68,69] Additionally, the chronic disease self-management program (CDSMP), originally designed for chronic physical conditions, offers extensive self-management strategies, such as stress management, healthy behavior development, and strengthening social support networks, which are equally effective in managing mental health. CDSMP encourages patients to take an active role in managing their health, providing valuable insights for the continuous intervention and self-regulation of self-stigma, insomnia, depression, and related symptoms.[70] eHealth and mHealth programs also offer more convenient solutions for alleviating self-stigma. For example, applications like "Headspace" and "Sleepio" incorporate multidimensional interventions, including meditation, emotional management, and sleep training, which help improve sleep quality, emotional well-being, and mental health status.[71,72]

Although the current study has its merits, it also has certain limitations. Firstly, the cross-sectional study design poses limitations. Although patients diagnosed with non-mental illnesses or disorders for the first time were included in the study, the possibility of pre-existing underlying mental symptoms cannot be ruled out. Furthermore, this design does not facilitate the examination of causal relationships or dynamic changes among self-stigma, insomnia, depression, and anxiety. A longitudinal study design may be more effective for investigating the temporal relationships among these variables. Second, the data we have collected so far is rather limited, and in the future, it should be considered to include scales related to sleep rhythm or sleep cognitive beliefs, such as dysfunctional beliefs and attitudes about sleep. Third, the omission of gender's impact on network analysis in this study was likely due to insufficient data volume. Moving forward, we plan to increase the sample size to delve deeper into potential gender differences. Fourth, this study primarily included patients with chronic diseases without categorizing the severity of these conditions into distinct levels. Although screening was performed during the distribution of the research questionnaire, some patients with atypical chronic diseases may still have been included, potentially leading to sample heterogeneity. Finally, although the hospital exerts significant domestic influence and the study subjects include individuals from various regions, limitations regarding the generalizability of the findings still exist.

In summary, we found that self-stigma cognitive, and sleep quality were core symptoms in the self-stigma and insomnia network model, and they also were bridge symptoms. We also found that lack of interest and pleasure in activities symptoms might be a link between self-stigma, insomnia, and depressive symptoms, and the inability to stop or control worrying symptoms might be the link between self-stigma, insomnia, and anxiety symptoms. Future research should examine whether interventions focused on the core symptoms of self-stigma cognition could enhance the improvement of other symptoms. Additionally, it is important to investigate whether interventions targeting the bridge symptoms could break the connection between self-stigma, insomnia, and depressive or anxiety symptoms. It is hoped that our findings could guide the development of specific interventions to reduce the impact of core symptoms and bridge symptoms.

Conclusion

Network analysis identified self-stigma and sleep quality as central symptoms within the self-stigma-insomnia network structure. Additionally, it identified a lack of interest and pleasure in activities, as well as an inability to stop or control worrying, as bridging symptoms in both the self-stigma-insomnia-depression and self-stigma-insomnia-anxiety network structures.

Highlights

- Mapping the comorbidity network of chronic disease patients.
- Stigmatized emotions and daytime functioning form the core symptoms of the network.
- Loss of interest and fear of losing control serve as bridges connecting network symptom.

Data Sharing Statement

The data presented in this study are available from the corresponding author. The data are not publicly available due to our laboratory's policies.

Ethical Approval and Consent to Participate

This study was conducted by the Declaration of Helsinki and approved by the Ethics Committee of the Third Xiangya Hospital of Central South University (23688). Informed consent was obtained from all participants included in the study.

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Author Contributions

All authors made a significant contribution to the work reported, whether that is in the conception, study design, execution, acquisition of data, analysis and interpretation, or in all these areas; took part in drafting, revising or critically reviewing the article; gave final approval of the version to be published; have agreed on the journal to which the article has been submitted; and agree to be accountable for all aspects of the work.

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