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Network analysis of burnout, depression, and anxiety with occupational and personal outcomes among clinical nurses in China

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Chinese nurses face staff shortages and heavy workloads, leading to increased depression, anxiety, and burnout. This study aimed to examine the symptom network of burnout, depression, and anxiety and its associations with negative personal and occupational outcomes among Chinese nurses. A total of 2092 nurses were recruited through snowball sampling. Burnout, depression, and anxiety were assessed using the two single-item burnout measures, Patient Health Questionnaire-9 (PHQ-9), and Generalized Anxiety Disorder Scale-7 (GAD-7), respectively. Adverse outcomes, including low quality of life (QOL), suicidal ideation (SI), turnover intention, and medical errors, were also assessed. The network was estimated via the EBICglasso model, and centrality indices and bridge centrality indices were calculated to identify central and bridge symptoms, respectively. The prevalence of depression, anxiety, burnout, low QOL, medical error, turnover intention, and SI was 30.1%, 16.5%, 26.4%, 34.4%, 16.1%, 26.0%, and 26.5%, respectively. Results showed that GAD2 (Uncontrollable worry) was the most central symptom, whereas emotional exhaustion (EX), PHQ8 (Motor), and PHQ4 (Fatigue) were bridge symptoms. Depersonalization (DP) was most strongly associated with adverse work outcomes, and EX was the strongest predictor of poor QOL. The findings highlight the need for early detection and intervention for burnout to mitigate negative impacts.

Keywords Burnout, Mental distress, Adverse outcomes, Nurses, Network analysis

The nursing profession is characterized by a demanding and stressful work environment, placing its practitioners at a heightened risk for significant mental distress[1,2]. The prevalence of these conditions is alarmingly high, with studies indicating that up to one-third of nurses worldwide may suffer from burnout, depression, or anxiety[3–6]. In this context, burnout is understood as a psychological syndrome arising from chronic occupational stress, defined by three dimensions: overwhelming emotional exhaustion (EX), feelings of cynicism and detachment (depersonalization [DP]), and a sense of reduced professional efficacy[7]. Depression is a mood disorder marked by persistent sadness and a loss of interest or pleasure (anhedonia), which impairs daily functioning. While anxiety involves excessive worry and fear, often accompanied by physiological symptoms like a rapid heart rate and restlessness[8,9].

The consequences of this psychological distress are severe, cascading into adverse outcomes that impact nurses both personally and professionally. These include profound effects on personal well-being, such as a diminished quality of life (QOL)—an individual's perception of their position in life—and the presence of suicidal ideation (SI), which encompasses thoughts about or a preoccupation with ending one's own life. The

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impact extends to occupational functioning, leading to more medical errors and higher turnover intention, defined as a conscious and deliberate willfulness to leave the profession[10–12].

Burnout, depression, and anxiety are known to be highly comorbid, yet the intricate relationships between them are not well understood[8,13,14]. Disentangling these conditions is crucial because their symptomatic overlap can lead to misattribution and, consequently, ineffective interventions. A key limitation of traditional research is its reliance on syndrome-level analyses, which use total scale scores to measure severity. This approach assumes all symptoms are equally important and may mask differences and latent interactions between symptoms[15]. Network analysis (NA) provides a powerful, symptom-oriented methodology to quantify the importance of individual symptoms within the comorbidity. By modeling psychopathology as a system of interacting symptoms, NA can identify "central symptoms" that are most influential in maintaining the network and "bridge symptoms" that link the clusters of burnout, depression, and anxiety, offering clear targets for intervention.

Furthermore, network analysis offers a second, distinct advantage: it can directly map the relationships between specific symptoms and adverse outcomes. By incorporating nodes for personal and occupational consequences into the network model, this approach moves beyond simply identifying influential symptoms within the psychopathology. It allows for the precise identification of which individual symptoms—be it from burnout, depression, or anxiety—are most strongly predictive of specific negative outcomes like turnover intention or SI. This provides an even more refined set of targets for interventions aimed not just at alleviating general distress, but at preventing its most damaging consequences.

While a growing body of literature has applied network analysis to healthcare populations, significant gaps remain, particularly concerning nurses. Some studies have explored the network structure of anxiety and depression in nurses, identifying several consistent key central symptoms such as "Trouble relaxing," "Sad mood," and "Uncontrollable worry", with "Nervousness" as a potential bridge symptom[16–18]. However, very few have simultaneously included burnout in these networks, and almost none have gone on to quantify how the tripartite system of burnout, depression, and anxiety symptoms uniquely predicts adverse outcomes[19–21]. Our group has found differential effects of burnout on adverse outcomes in physicians and Chinese residents under standardized residency training[22,23]. Perceived helplessness, perceived self-efficacy, and EX were all most strongly negatively associated with QOL among Chinese residents under standardized residency training and Chinese physicians. However, among Chinese residents under standardized residency training, the "worthless" and "motor" symptoms were closely associated with SI. In contrast, among Chinese physicians, the "worthless," "feeling afraid," and "psychomotor agitation/retardation" symptoms were strongly associated with SI. Such analysis is currently lacking within the nursing population. More importantly, these network structures and their associations with outcomes differ significantly across populations of physicians and residents[22,23]. This underscores the critical need for a population-specific investigation in nurses, as findings from other healthcare groups cannot be assumed to generalize.

Therefore, this study will use network analysis to investigate the interplay of burnout, depression, and anxiety symptoms and their impact on key outcomes in a large sample of clinical nurses. We will address the following research questions: (1) What does the network structure of burnout, depression, and anxiety look like? (2) Which symptoms are most central (influential) within the network, and which symptoms serve as bridges connecting the communities of burnout, depression, and anxiety? (3) What are the unique, symptom-level associations connecting the psychopathology network to adverse personal (QOL, SI) and occupational outcomes?

This study aims to make several significant contributions. Theoretically, using symptom-level network analysis, we have revealed how specific manifestations of burnout, depression, and anxiety dynamically interact to predict adverse personal (QOL, SI) and professional (medical errors, turnover intention) outcomes—a perspective unattainable with traditional total score approaches. It also addresses gaps in prior studies examining these factors in isolation. Practically, our findings identify actionable intervention targets (e.g., central and bridging symptoms), providing a basis for precise, nurse-tailored interventions. For example, if a specific burnout symptom is identified as a key bridge to depression, interventions targeting that symptom could prevent the onset of a full-blown depressive episode.

Methods

Study procedure and participants. The present cross-sectional questionnaire-based online survey was conducted from October 20, 2020, to December 29, 2020. The online survey was delivered via WeChat (the most popular social media), and participants were invited to forward the survey link to their acquaintances. Participants who met the following criteria were recruited through snowball sampling: (1) Chinese, aged 18–65 years; (2) being able to understand Chinese and willing to participate in the survey; and (3) working as a nurse in the Chinese hospitals for at least one year, regardless of the working departments. Nursing students and those who worked overseas were excluded. Participants were voluntary and gave their informed consent before the start of the survey. They were free to withdraw from the survey at any time point. However, participants were required to complete all questions before submitting the questionnaire. Informed consent for this study was obtained from all participants according to the guidelines of the Ethics Committee. The study was carried out in accordance with the latest version of the Declaration of Helsinki and was approved by the Ethics Committee of the Second Xiangya Hospital of Central South University (JY20200326).

Measurements

Basic information. Age, gender, partnership, education level, hospital grade, practicing year, title, weekly working hours, number of shifts per month, and history of mental illness were collected via a self-designed questionnaire. We additionally posed a validity check question, 'What is the date of the Chinese National Day?' to assess the accuracy of the responses. Participants who responded wrong to this question were excluded from the final analysis.

Burnout. We used two single-item measures to assess the sub-scales of burnout (i.e., EX: "I feel burned out from my work" and DP: "I have become more callous toward people since I started this job"). Participants rated their symptom frequency on a 7-point Likert scale, ranging from 1 (Not at all) to 7 (Every day). Those who responded "once a week" or more frequently on either item were considered burnout. The two single-item measures demonstrated validity comparable to the full-length Maslach Burnout Inventory and were widely used in the study of burnout among medical staff[24–26].

Depression and anxiety. Patient Health Questionnaire-9 (PHQ-9) and Generalized Anxiety Disorder Scale-7 (GAD-7) were used to evaluate depressive and anxiety symptoms, respectively. The two scales demonstrated robust validity and were extensively utilized among healthcare workers in China[27,28]. Both scales applied a 4-point Likert scale, with responses ranging from 0 (Not at all) to 3 (Almost every day). A cutoff of 10 was applied to identify clinically relevant depressive and anxiety symptoms. In this study, the Cronbach's alpha coefficients for the PHQ-9 and GAD-7 scales were 0.89 and 0.92, respectively.

Suicidal ideation. We used the ninth item of PHQ-9 ("Thoughts that you would be better off dead, or thoughts of hurting yourself in some way?") to detect current SI. Participants who scored one or above on this item were classified into the SI group. This single item has been widely employed in prior epidemiological research[29].

Quality of life. We used a standardized linear analog to assess the QOL with scores ranging from 0 (as bad as it can be) to 10 (as good as it can be)[30]. Following a previous study[31], low QOL was defined as a score falling at least one-half of a standard deviation (SD) below the mean score.

Medical error. Nurses were questioned whether they had made any errors (including nursing and other errors) within the last three months. Those who responded "yes" were documented.

Turnover intention. The question "Aside from retirement, how likely are you to leave your current work within two years?" was delivered to all nurses. A 5-point Likert scale was applied. Participants rated their turnover intention from 0 (Impossible) to 4 (Definitely). Participants scoring two or above were categorized as having turnover intention.

Estimation of sample size

For the sample size calculation of the cross-sectional network model, the "Powerly" package in R, developed by Constantin et al.[32], was employed. Specifically, for a network model comprising 18 nodes with a sensitivity of 0.6, a probability of 0.8, and a density of 0.4, the recommended sample size was 1722 participants. This study enrolled a larger sample than the recommended size.

Statistical analysis

We performed the Shapiro-Wilk test and determined that all continuous data exhibited non-normal distribution. Hence, we described the continuous data using medians and interquartile range (IQR). Categorical data were presented as percentages and frequencies. All statistical analyses were conducted using R (version 4.2.0). We employed Harman's single-factor test to address common method bias, given that all variables in this study were self-reported by participants. The test revealed that the first factor explained 44.77% of the total variance, a value below the 50% critical threshold[33]. This indicates no substantial common method bias, thus justifying the continuation of subsequent analyses. We performed five networks. In network 1, we assessed the symptomatic interaction between burnout, depression, and anxiety symptoms. In networks 2–5, we further assessed the association of the three mental problems with four negative consequences (i.e., SI, low QOL, turnover intention, and medical error) at a symptom level.

Network estimation and visualization

We assessed the informativeness and redundancy of each burnout questionnaire, PHQ-9, and GAD-7 item using R packages "psych" and "networktools"[34]. Redundant items or items with low informativeness were excluded. The burnout-depression-anxiety network of the nurses was modeled via the R package "qgraph" and "bootnet"[35]. The Gaussian graphical model was chosen for network construction. The default was set as EBICglasso, using a "spearman" method[36], setting the tuning parameter to 0.5 to balance network sparsity and sensitivity. This value minimizes false-positive edges while preserving clinically meaningful connections[37]. The network was constituted of "nodes" (i.e., the items of PHQ-9, GAD-7, and burnout questionnaire) and "edges" (i.e., the pairwise correlations between two nodes after adjusting for other variables within the network). The presence of thicker edges suggests the existence of more robust and substantial associations[38]. Red edges denoted negative associations, whereas blue edges signified positive associations.

Central and Bridge symptom

Expected influence (EI) of each node was calculated using the R package "qgraph" in order to assess the significance of the node within the network[39]. This measure was selected due to its applicability to negatively weighted networks and its recognition as a relevant centrality metric[40]. Nodes with higher EI were identified as central symptoms, potentially playing a crucial role in the initiation and maintenance of the burnout-depression-anxiety network. We additionally assessed node predictability within the network using the R package "MGM". Highly predictable nodes can be controlled through interventions targeting their adjacent nodes[41]. To identify bridge symptoms within the burnout-depression-anxiety network, we calculated the bridge expected influence (BEI) index[42]. Nodes with higher BEI exhibit stronger associations with symptoms elsewhere. Bridge symptoms were selected based on a threshold corresponding to the 80th percentile of the BEI[43]. Results of other centrality metrics (e.g., betweenness, closeness, strength) are also presented in this study.

Network stability and accuracy

Using the non-parametric bootstrapping procedure with a 1000 bootstrap samples, we tested the accuracy of the edges estimated in the network. The stability of the nodes and BEI were determined by the case-dropping procedure. Correlation Stability Coefficient (CS-C) served as an indicator of network stability, with the value of CS-C above a half implying high network stability[35]. The two procedures were performed via the R package "bootnet".

The association of burnout, depression, and anxiety with negative consequences

In the end, we added the variables "QOL", "medical error", and "turnover intention" into the network. The function "flow" was used to visualize the symptoms directly related to the three negative consequences as well as SI.

Results

Sample characteristics

A total of 2092 nurses responded to the online questionnaire, and after screening, 1975 (94.4%) responses were deemed eligible for further analysis (Table 1). The survey participants had a median age of 31 (IQR, 26–38), and the majority of them were female (1905, 96.5%). Approximately two-thirds of the respondents (1316, 66.6%) were married, and 1209 nurses (61.2%) held a bachelor's degree. The median working hours per week and shifts per month were 40 (35–44) and 5 (2–12), respectively. The majority of the participants worked in a tertiary hospital (1094, 55.4%), followed by secondary (548, 27.7%) and primary (333, 16.9%) hospitals. A junior professional title or below was held by 1179 nurses (59.7%), and the median practicing years were 10 (5–17). Additionally, 94 (4.8%) nurses reported a history of mental disorders. The incidence of anxiety, depression, burnout, low QOL, medical error, turnover intention, and SI was 16.5% ($n = 325$), 30.1% ($n = 595$), 26.4% ($n = 521$), 34.4% ($n = 681$), 16.1% ($n = 318$), 26.0% ($n = 513$), and 26.5% ($n = 523$), respectively.

The burnout–depression–anxiety network of nurses

Table 2 presents the content, mean, and standard deviation (SD) for PHQ-9, GAD-7, and burnout questionnaire. There were no exclusions due to low informativeness or redundancy. The burnout-depression-anxiety symptom network can be seen in Fig. 1. The network is highly dense with 18 nodes and 115 edges. All edges within the network were positive, with an average weight of 0.054, reflecting the overall robustness of connections within

Characteristic	*N* = 1,975*
Age	31 (26–38)
Female	1,905 (96.5%)
Being married	1316 (66.6%)
Education	
Below junior college degree	66 (3.3%)
Junior college degree	648 (32.8%)
Bachelor degree	1,209 (61.2%)
Master or doctoral degree	52 (2.6%)
Junior profession title or below	1179 (59.7%)
Practising years	10 (5–17)
Weekly working hours	40 (35–44)
Number of shifts per month	5 (2–12)
Hospital grade	
Level Ⅰ	333 (16.9%)
Level Ⅱ	548 (27.7%)
Level Ⅲ	1094 (55.4%)
History of mental illness	94 (4.8%)
PHQ-9 score	7 (4–11)
Depressive symptoms	595 (30.1%)
GAD-7 score	5 (2–8)
Anxiety symptoms	325 (16.5%)
Burnout	521 (26.4%)
SI	523 (26.5%)
QOL scores	7 (5–8)
Low QOL	681 (34.4%)
Medical error	318 (16.1%)
Turnover intention	513 (26.0%)

Table 1. Sample characteristics. *Median (IQR); n (%). PHQ-9 = Patient Health Questionnaire-9, GAD-7 = Generalized Anxiety Disorder Scale-7, SI = suicidal ideation, QOL = quality of life.

Items	Content	Mean	SD	EI	Predictability
PHQ1	Anhedonia	1.04	0.77	−0.25	0.49
PHQ2	Sad mood	0.96	0.71	1.10	0.61
PHQ3	Sleep	1.23	0.93	−0.97	0.40
PHQ4	Fatigue	1.32	0.82	0.72	0.54
PHQ5	Appetite	0.89	0.86	−0.98	0.39
PHQ6	Worthless	0.82	0.84	0.27	0.52
PHQ7	Concentration	0.80	0.82	0.06	0.47
PHQ8	Motor	0.48	0.70	−0.09	0.50
PHQ9	Death	0.33	0.60	−1.56	0.40
GAD1	Nervous	1.00	0.77	1.12	0.65
GAD2	Uncontrollable worry	0.79	0.84	1.53	0.69
GAD3	Excessive worry	1.04	0.82	0.33	0.63
GAD4	Trouble relaxing	0.79	0.80	1.47	0.65
GAD5	Restlessness	0.45	0.67	0.12	0.57
GAD6	Irritability	1.06	0.81	0.00	0.52
GAD7	Feeling afraid	0.54	0.72	−0.52	0.52
EX	Emotional exhaustion	3.68	1.60	−0.19	0.47
DP	Depersonalization	2.39	1.64	−2.15	0.31

Table 2. Characteristics of burnout questionnaire, PHQ-9, and GAD-7 items. SD = standard deviation, EI = expected influence, PHQ-9 = Patient Health Questionnaire-9, GAD-7 = Generalized Anxiety Disorder Scale-7.

the network. The most significant edges were PHQ8 (Motor)-GAD5 (Restlessness), PHQ1 (Anhedonia)-PHQ2 (Sad mood), followed by EX-DP, and GAD2 (Uncontrollable worry)-GAD3 (Excessive worry). According to the bootstrap test, these edges were statistically stronger than others (see Supplementary Fig. S1).

The burnout symptoms EX and DP showed different levels of association with depressive and anxiety symptoms. EX was positively associated with 6 out of 9 depression symptoms and 3 out of 7 anxiety symptoms, whereas DP was positively related to 7 depression symptoms and 2 anxiety symptoms. Additionally, EX had the strongest positive relationship with PHQ4 (Fatigue) and GAD1 (Nervous), while DP showed a strong, positive relationship with PHQ1 (Anhedonia) and PHQ8 (Motor). These findings indicate that they serve as critical nodes in the network. Supplementary Table S1 displays the weight of estimated edges within the network.

Figure 2 depicts node centrality within the network. GAD2 (Uncontrollable worry) was the most central symptom, succeeded by GAD4 (Trouble relaxing), GAD1 (Nervous), and PHQ2 (Sad mood), indicating their pivotal roles in the network. These symptoms held significantly higher EI than other nodes within the network (see Supplementary Fig. S2). Figure 3 illustrates the BEI of each node. EX, PHQ8 (Motor), and PHQ4 (Fatigue) were identified as bridge symptoms that play a pivotal role in the burnout-depression-anxiety network.

The average predictability of the nodes was 0.52. Anxiety symptoms, such as GAD2 (Uncontrollable worry), GAD1 (Nervous), GAD4 (Trouble relaxing), and GAD3 (Excessive worry), displayed high predictability (between 0.63 and 0.67). On the other hand, DP showed the lowest predictability with a value of 0.31.

The network exhibited excellent stability and accuracy. CS-C values were 0.52 for betweenness, 0.59 for closeness, 0.75 for strength, 0.75 for EI, and 0.75 for BEI (Fig. 4), indicating that the network exhibits good stability. The results of the non-parametric bootstrapping procedure suggested the high accuracy of the estimated edges (Fig. 5).

Symptoms directly related to negative consequences

Figure 6 shows the symptoms that are directly connected to negative consequences (SI, low QOL, medical error, and turnover intention). We found that PHQ6 (Worthless), GAD7 (Feeling afraid), and GAD5 (Restlessness) exhibited the strongest association with SI. Both turnover intention and medical error were closely related to DP and EX, while they also displayed positive associations with several depression and anxiety symptoms. Low QOL had an association with all mental health symptoms. Notably, EX, PHQ6 (Worthless), and PHQ4 (Fatigue) were mostly negatively correlated with QOL.

Discussion

This is, as far as we know, the first network study to quantify the relationship between depression, anxiety, burnout, and adverse outcomes such as SI, turnover intention, and medical errors among Chinese nurses. Overall, participants exhibited a high prevalence of burnout, depression, anxiety, and adverse outcomes. The prevalence rates for burnout, depression, and anxiety were 26.4%, 30.1%, and 16.5%, respectively. A highly interconnected network structure was revealed by network analysis at the symptom level. Uncontrollable worry was the most central symptom within the network, while EX, PHQ8 (Motor), and PHQ4 (Fatigue) served as bridge symptoms connecting burnout, depression, and anxiety. We also found that burnout is closely related to adverse personal and professional consequences, especially the link to poor QOL, which should attract attention.

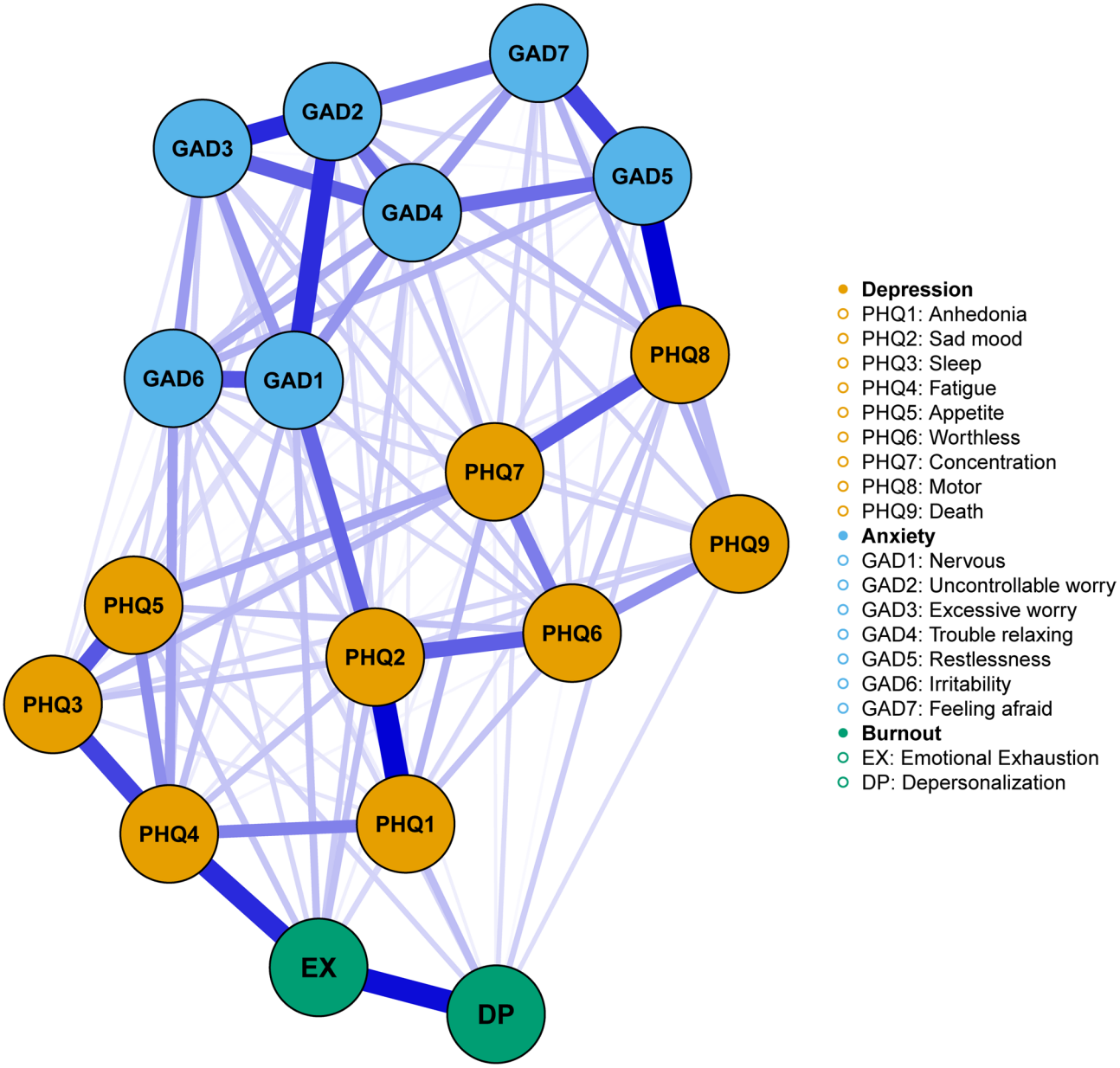

Fig. 1. Network structure of burnout, depression, and anxiety symptoms in nurses. Edge thickness represents the degree of association; All edges within the network were positive.

This study underscored the substantial mental health challenges confronting Chinese nurses, demonstrating that over one-quarter exhibit burnout symptoms. This finding was consistent with previous meta-analyses[44,45]. The consistency emphasized that nurse burnout represented a pervasive problem across healthcare systems, transcending cultural and institutional boundaries. However, a systematic review and meta-analysis involving 12,536 intensive care unit (ICU) nurses reported a burnout prevalence rate of 44%, which was significantly higher than the rate observed in this study[46]. This finding suggested that burnout levels among nurses varied across different regions and work environments. Additionally, the prevalence of depression and anxiety was consistent with previous findings. For example, Zheng et al.[47] reported depression and anxiety prevalence rates of 34.3% and 18.1% among nurses, respectively, thus reinforcing the evidence for the high prevalence of mental health issues in the nursing profession. The high intensity and stress of nursing practice may serve as a primary contributor to these issues. Nurses often face prolonged work hours, complex and changing patient situations, and intense physical labor[48], which can culminate in physical and mood exhaustion and the accumulation of psychological stress. Thus, nurse burnout, depression, and anxiety constitute a complex and multifactorial phenomenon. Unlike prior research, which has primarily focused on prevalence, our study employed network analysis to explore the interrelations among burnout dimensions, psychological symptoms, and adverse outcomes. This approach offers novel insights for developing symptom-level interventions.

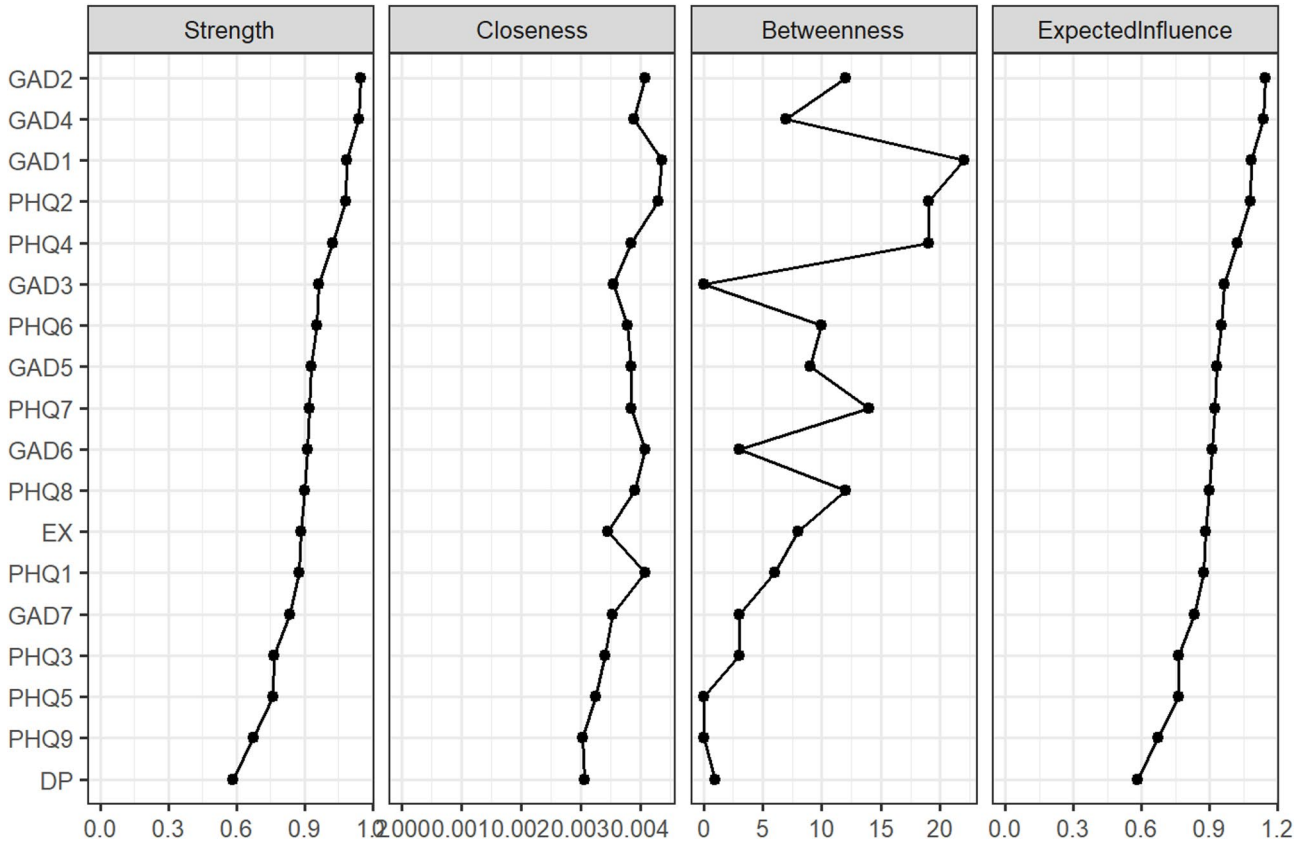

Fig. 2. The central symptoms of the burnout-depression-anxiety network. The centrality (betwenness, closeness, strength and expected influence) plot.

Using the network approach, our study highlighted the importance of burnout in the mental distress of nurses. Consistent with prior studies in Swiss medical students[36], our study suggested that burnout displayed substantial associations with depressive and anxiety symptoms. Another study on the network analysis of psychiatrists similarly reached a consistent conclusion, highlighting a strong association between burnout and other mental health variables, particularly the depressive symptom cluster[49]. These connections showed how closely burnout was related to an individual's ability to experience happiness and positivity. Previous studies have shown that feelings of despair and an absence of pleasure contribute to the exacerbation of EX[50,51]. Meanwhile, EX emerged as the bridge symptom across the network and was mostly negatively correlated with QOL. These results are consistent with previous research findings that EX is a core symptom of burnout[49,52] and that EX plays not only a key role in the interplay of mental health issues but may also exacerbate existing conditions. This study underscored that burnout, particularly EX, should not only be simply recognized as an occupational syndrome but rather as a cross-occupational phenomenon[53]. Hence, regular screening for burnout is recommended among nurses. Particular attention should be paid to depression, anxiety, and impaired QOL among nurses with burnout. Interventions such as positive thought-based stress reduction training and cognitive-behavioral therapy should also be widely implemented in healthcare settings to alleviate EX among nurses[54,55].

Our study also showed that GAD2 (Uncontrollable worry) was the most central symptom in the burnout-depression-anxiety network. The high centrality of uncontrollable worry was consistent with previous network analyses conducted in both general and clinical populations[16,56–58]. This may be closely linked to the high workload intensity, stressors, and frequent emergency situations in nursing practice[59]. These factors contribute to excessive anxiety and stress among nurses, thereby exacerbating burnout and depression. EX, PHQ8 (Motor), and PHQ4 (Fatigue) were identified as bridge symptoms. The findings have also been confirmed in previous network analysis studies of clinicians and nurses[17,60,61]. Feeling tired or losing energy may reduce nurses' outdoor physical and recreational opportunities[62], thereby hindering the relief of mental distress. Our findings suggested a need for targeted monitoring and intervention in pivotal symptoms within this network among the nursing population. This study recommends that to reduce symptoms of burnout in nurses, at the practical level, managers should implement measures to enhance the work environment, ensure adequate staffing and patient care resources, and deliver targeted training in relaxation techniques[63].

Burnout symptoms also displayed varied levels of association with different negative outcomes. Although the associations between EX, DP, and SI were weak, our analyses confirmed previously reported findings[23,36]. This suggested that the association between burnout and SI may be fully mediated by other depressive and anxiety symptoms[64]. In line with previous studies[65], we found burnout was positively associated with turnover

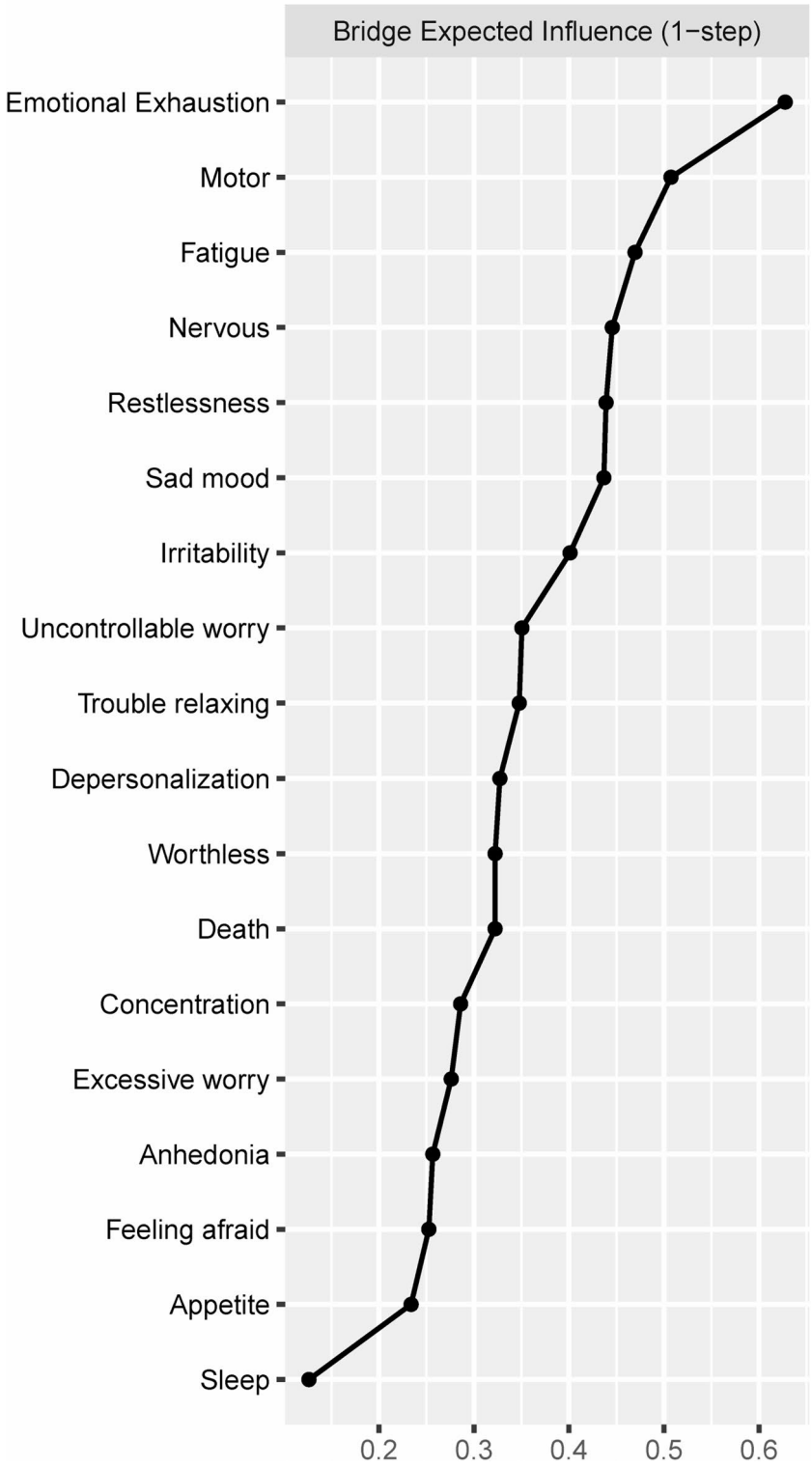

Fig. 3. The bridge symptoms of the burnout-depression-anxiety network. The bridge expected influence plot.

intention and medical errors. DP denotes a motivational and interpersonal distancing component of burnout, characterized by a negative, callous, or excessively detached reaction to various facets of the job[66]. Consistent with our findings, the DP dimension of burnout was particularly correlated with turnover as one of the strongest predictors[67]. A previous review has also shown that increasing DP may increase nurses' intention to leave more than other healthcare workers[65]. Burnout may affect the whole life of the employees. Those who experience it will tend to quit for their protective instincts, which means employees with a high level of burnout are more likely to have a higher rate of turnover. Studies have shown burnout is strongly linked to medical errors[68,69].

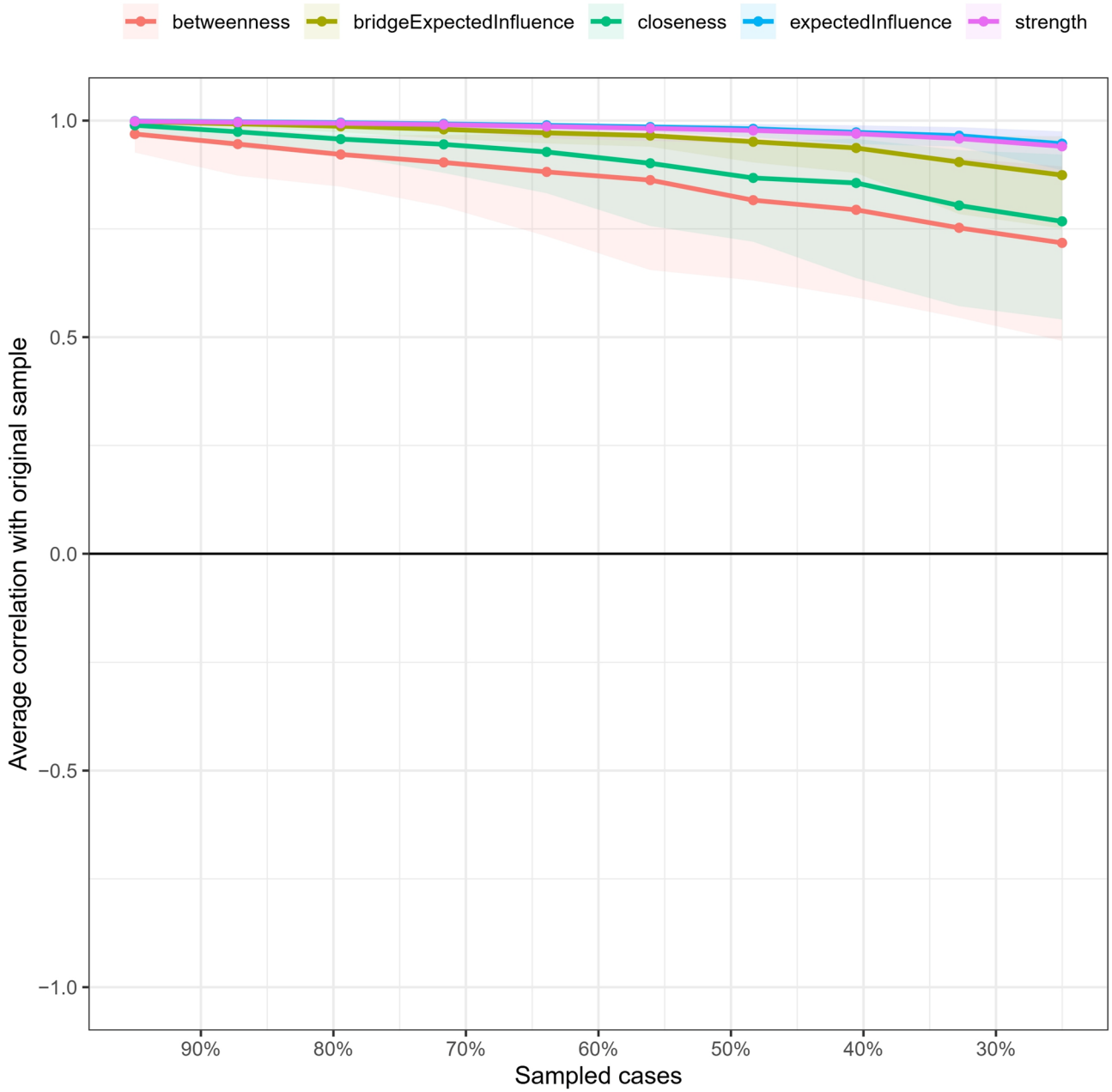

Fig. 4. The stability of the burnout-depression-anxiety network. The stability of centrality indices and bridge expected influence by case-dropping bootstrap. The correlation stability coefficient values indicated that the network has a good stability.

Employees who are overworked may experience burnout, which can ultimately result in fatigue, irritability, and reduced cognitive functioning[70]. All of these factors exert pressure on personal work performance, leading to a decline in care quality and, consequently, an increased risk of errors. Therefore, nurses identified with burnout should be assessed for anxiety and depression, with timely interventions implemented to prevent more severe adverse outcomes.

There are several implications for hospital and nursing managers. Firstly, we observed a high prevalence of depression, anxiety, and burnout in the nurses. This result is similar to the rate among healthcare professionals worldwide[3,4]. We suggest that nurses, as high-risk groups in high-pressure environments for a long time, systematically assess their anxiety, depression, and burnout. Secondly, we highlighted the strong association of burnout with mental distress and adverse personal and occupational outcomes. EX was the strongest predictor for impaired QOL among nurses. Therefore, burnout should not only be recognized as an occupational syndrome but also as a key factor affecting nurses' overall well-being. Thirdly, our study identified several pivotal symptoms, including GAD2 (Uncontrollable worry), PHQ4 (Fatigue), and PHQ8 (Motor), which may significantly contribute to the initiation and perpetuation of the depression-anxiety-burnout network. These key

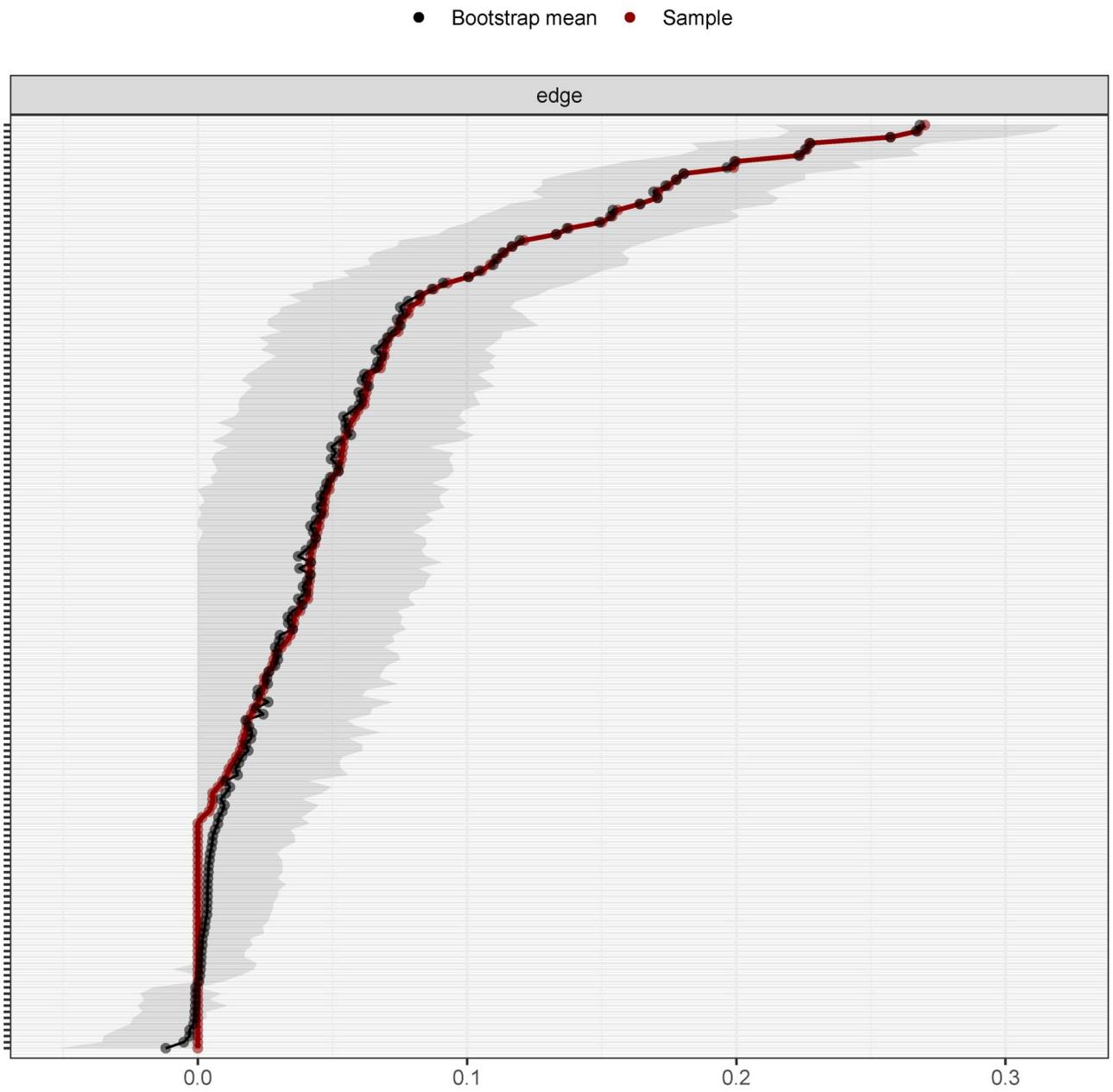

Fig. 5. The accuracy of the burnout-depression-anxiety network. The accuracy of the network edges by nonparametric bootstrapping. The grey area represents the bootstrap 95% confidence interval, which was narrow and indicated high accuracy.

symptoms represent promising targets for intervention. Previous research has suggested that adequate sleep and appropriate physical activity may contribute to reducing exhaustion and energy depletion[71].

Several limitations need to be noted regarding our study. First, the study's design was cross-sectional and the causality of depression, anxiety, and burnout with negative consequences cannot be determined. Second, the snowball sampling method used in this study may limit the generalizability of the results to the whole population of nurses. Third, we used the two single-item burnout questionnaire to evaluate burnout. The dimension of reduced personal accomplishment was not measured, which limited the study's findings. However, the individual items employed were specifically developed to assess EX and DP among medical professionals[72] and have been widely used[73]. Meanwhile, all questionnaires used self-rating scales, which may be susceptible to common method bias.

Conclusion

To conclude, our study provided the first network of burnout, depression, and anxiety among nurses. The results highlighted that burnout is a phenomenon that goes beyond the workplace—a phenomenon not only highly

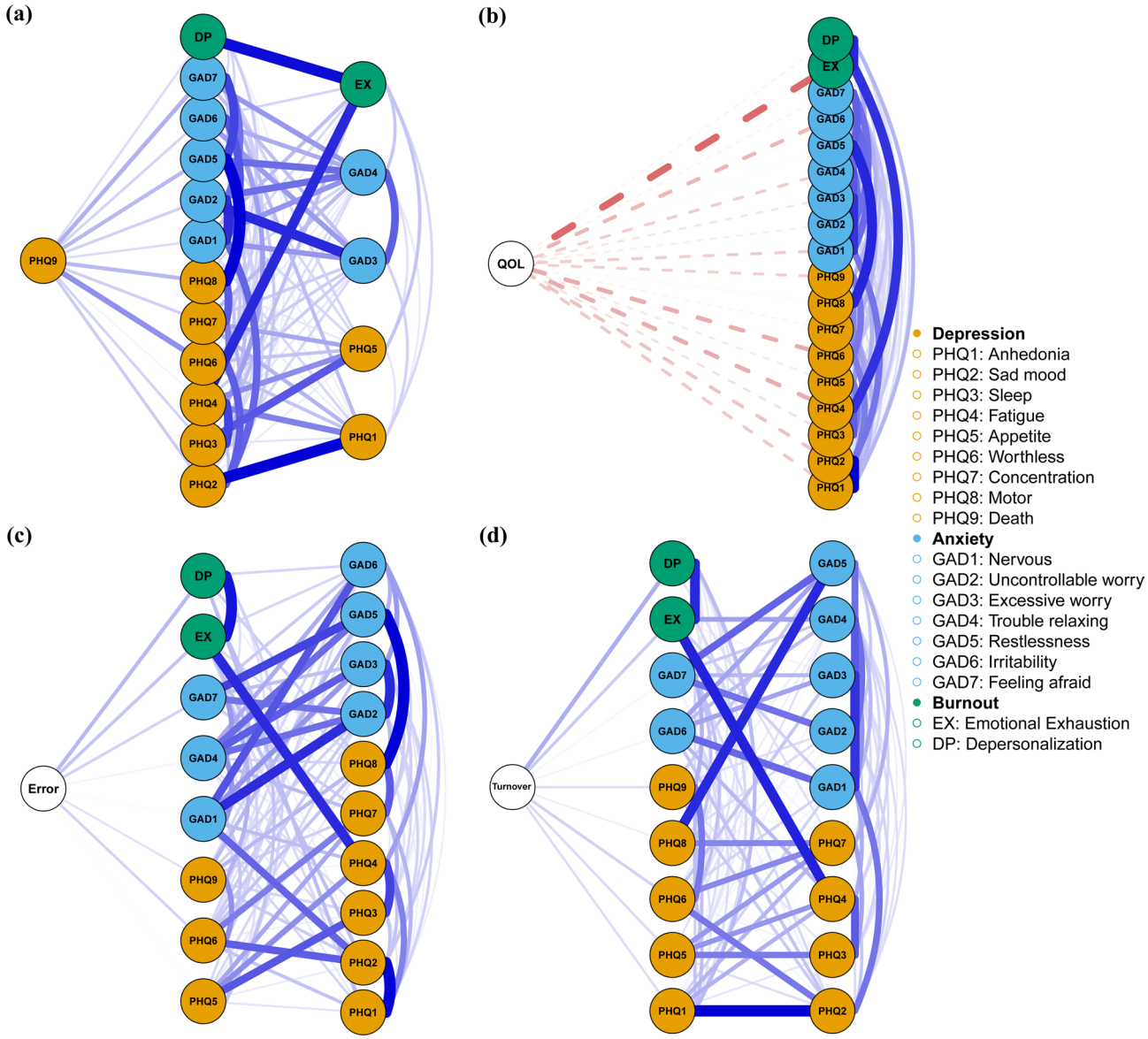

Fig. 6. Flow network of adverse personal and occupational outcomes for nurses. It showed the symptoms directly related to these adverse outcomes. Blue (solid) edges indicate positive associations, while red (dashed) edges indicate negative associations. Thicker edges imply stronger relationships. (a) Flow network of suicidal ideation. (b) Flow network of quality of life (QOL). (c) Flow network of medical error. (d) Flow network of turnover intention.

associated with depression and anxiety but also strongly linked to a range of adverse personal and professional outcomes.

Data availability

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

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Author contributions

Q. Wu and Y. Tang provided the design and supervision for this study. Z. Li, X. Wang, P. Li, K. Yan were responsible for data collection. Data analysis and interpretation were performed by P. Peng. The initial draft of the manuscript was prepared by H. Xu and L. Liu, and critically revised by T. Liu, P. Peng, Y. Tang, and Q. Wu. All authors listed meet the authorship criteria according to the latest guidelines of the International Committee of Medical Journal Editors, and all co-authors revised and agreed to publish the final version of the manuscript.

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Declarations

Competing interests

The authors declare no competing interests.

Additional information

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