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Original Paper

Are there Gender Differences in the Association between Mental Health and Insomnia? Evidence from Network Analyses

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Abstract

The research intended to explore how the symptom network that connects depression, anxiety, stress, and insomnia can be explained based on the 3P model and psychological pathological network theory. Cross-sectional survey on 629 subjects was carried out through the use of the Depression Anxiety Stress Scales-21 (DASS-21) and the Athens Insomnia Scale (AIS). To determine the overall structure of the symptoms and to identify the gender differences, the network analysis was used. The findings revealed a high interrelatedness between depression, anxiety, stress, and insomnia, and daytime well-being and uneasiness as some of the most central symptoms. There was also a gender difference in the network structure; female subjects had higher levels of anxiety symptoms, and male subjects reported higher levels of depressive symptoms. Finally, the relationships between these mental health symptoms and insomnia are different across genders, where depression has a higher effect on insomnia in men, and anxiety has a higher effect on insomnia in women. These results imply gender-based intervention goals in treating insomnia.

Keywords

Insomnia, depression, anxiety, stress, network analysis, gender differences

1. Introduction

Insomnia is often defined by the inability to fall into sleep, remain asleep or obtain restorative sleep. Such problems are frequently associated with impairments during the day (Insomnia : CONTINUUM: Lifelong Learning in Neurology, n.d.). About 30-35 percent of people worldwide complain of having symptoms of insomnia (Morin, Drake, Harvey, Krystal, Manber, Riemann et al.). Insomnia is not only a major factor affecting the mental health of individuals (Drake, Pillai, & Roth, 2014), but it has also been acknowledged as a risk factor of numerous physical diseases, such as cardiovascular disease, obesity, and diabetes (Riemann, Benz, Dressle, Espie, Johann, Blanken et al.; Dong & Yang, 2019). This leads to a significant burden on both individuals and society (Wickwire, Tom, Scharf, Vadlamani, Bulatao, & Albrecht, 2019). But the causes and contributing factors behind insomnia are not clearly established. To be able to have a broad perspective of insomnia, researchers have put forward various theories and frameworks. An example of such a framework is the predisposing, precipitating, and perpetuating factors model (3P model) that provides an overall overview of how the development and maintenance of insomnia occurs (Wright, Tiani, Billingsley, Steinman, Larkin, & McNeil, 2019). The development of insomnia is determined by the interaction between predisposing factors (e.g., genetic vulnerability, family medical history, age, and gender), precipitating factors (e.g., life events, physical trauma, social support and psychopathology), and perpetuating factors (e.g., substance use, social factors, and coping style). As we investigate these factors and connections, we can improve our knowledge about insomnia.

The psychopathology (anxiety and depression) is considered a precipitating factor in the 3P model that can play an important role in the development of insomnia, which is why it is given special consideration. Earlier researches have demonstrated complicated association between anxiety, depression and insomnia (Alvaro, Roberts, & Harris, 2013). Nevertheless, it is still unknown whether these relations are unidirectional or bidirectional. Other studies have shown to have a unidirectional relationship, with anxiety predicting insomnia and insomnia predicting depression, but not vice versa (Johnson, Roth, & Breslau, 2006). Nevertheless, it is still unknown whether these relations are unidirectional or bidirectional. Other studies have shown to have a unidirectional relationship, with anxiety predicting insomnia and insomnia predicting depression, but not vice versa (2016), and reporting that depressive symptoms make one vulnerable to the development of insomnia (Zee, Bertisch, Morin, Pelayo, Watson, Winkelman et al., 2023). Since the relationship among anxiety, depression, and insomnia remains unclear, additional studies are needed.

Stress is also commonly considered as one of the precipitating factors in the 3P model (Wright, Tiani, Billingsley, Steinman, Larkin, & McNeil, 2019), and it can be a major factor in the development of insomnia and it correlates with anxiety and depression (Amamou, Ben Saida, Bejar, Messaoudi, Gaha, & Boussarsar, 2022; Yang, Liu, Liu, Tein, & Jia, 2023). Research has shown that high perceived stress is independently related to the presence of anxiety and depression symptoms and poor sleep quality is

independently linked with higher perceived stress (Amamou, Ben Saida, Bejar, Messaoudi, Gaha, & Boussarsar, 2022). The association between life stress, insomnia and anxiety/depression were found to be bi-directional in a prospective longitudinal study (Yang, Liu, Liu, Tein, & Jia, 2023). Taking into consideration the complexity of insomnia being affected by many factors, including but not limited to anxiety, depression, and stress, it is necessary to examine the associations between these variables.

The classical latent variable model supposes that all of the manifestations of a disorder are linked to a single latent cause and the symptoms are viewed as independent of one another ignoring the interactions between them (van Bork, Rhemtulla, Waldorp, Kruis, Rezvanifar, & Borsboom, 2021). Nevertheless, the real-life process of mental disorders includes symptom interaction (Borsboom, 2017). In sharp distinction with the classical approach, psychopathological network theory conceptualizes mental disorders as active and multifaceted networks where symptoms influence each other via causal routes and feedback systems (Abplanalp & Green, 2022). The analysis of networks has proven especially helpful in comprehending the relationships between depression, anxiety, stress, and insomnia since it is capable of illustrating the sophisticated interactions between variables (Fonseca-Pedrero, 2017). Despite the fact that only a small number of studies have examined the relationship between the variables using network analysis (Cha, Jeon, & Chung, 2022), results about the central symptoms in the network have been non-uniform (Bard, O'Driscoll, Miller, Henry, Cape, & Espie, 2023). Also, no prior research has taken into account stress, a key aspect in the etiology of insomnia. Thus, the current study will use network analysis to investigate the relationships between depression, anxiety, stress, and insomnia at the level of items in the context of the 3P model.

Gender is recognized as a very important predisposing biological factor in the 3P model and it has a key place in the development of insomnia (Wright, Tiani, Billingsley, Steinman, Larkin, & McNeil, 2019). It has been found that there are significant gender differences in mental health problems such as insomnia, anxiety, depression, somatization and stress reactivity in previous studies (Riecher-Rössler, 2017; Suh, Cho, & Zhang, 2018). As an example, females are 1.5 times more susceptible to insomnia compared to males (Zhang & Wing, 2026). Women are also prone to reporting higher levels of pain and somatic symptoms compared to men (Barsky, Peekna, & Borus, 2001). Anxiety and depression can be found in around 20 percent of people, and women are affected by them twice as much as men (Kuehner, 2017). In addition to this, there is evidence that after acute psychosocial stress, females have greater measures of negative affect and subjective emotional reactivity than males (Bagley, Weaver, & Buchanan, 2011; Doedee, van den Houdt, Widdershoven, & Kupper, 2021). Given the well-documented gender differences in mental health based on extensive empirical research, it is important to explore whether these differences extend to the combined symptom network of depression, anxiety, stress, and insomnia. Since there are well-reported gender differences in mental health according to a large number of empirical investigations, it is critical to examine whether these differences can be applied to the joint symptom cluster of depression, anxiety, stress, and insomnia.

This research has aimed at using network analysis to explore the relationship between insomnia, depression, anxiety, and stress within the general population based on the 3P model. Initially, we examined and provided a description of the network structure of these variables. Then, we compared the aggregated networks of depression, anxiety, stress and insomnia across different sexes. The purpose of the present study was to enrich the knowledge of the interrelationship between depression, anxiety, stress and insomnia.

2. Methods

2.1 Participants

The data was gathered through a survey platform that was available online (www.wjx.cn) in 25 provinces in China. There were no limitations on the occupation, major, gender, or sexual orientation of participants when conducting the data collection process. The responses were made to make sure that the data is of the required quality, and those that took a duration of fewer than 100 seconds to complete and the answers made by people who had not chosen the second option of the attention check question were eliminated. All in all, 629 valid responses were received, both male and female, with 266 males and 363 females, and their average age was 25.16 years (SD=6.13).

2.2 Measurements

2.2.1 21-item Depression, Anxiety, Stress Scale (DASS-21)

DASS-21 is a popular psychological assessment instrument measuring the symptoms of depression, anxiety, and stress in people (Cao, Liao, Jiang, Li, Chen, & Lin, 2023). The present study adopted the Chinese edition of the DASS-21 that comprised 21 items that measure symptoms of each of the three factors. Each item has a score between 0 (absence of symptoms) and 3 (presence of very severe symptoms) which may be applied to determine the severity of an individual's depression, anxiety and stress symptoms. The DASS-21 has been extensively utilized in both research and clinical applications and numerous studies have assessed the symptoms of the condition among different groups such as the general population, patients with psychological disorders, and healthcare practitioners. McDonald values of depression, anxiety, and stress were 0.854, 0.869, and 0.865 respectively.

2.2.2 Athens Insomnia Scale (AIS)

AIS is a popular psychometric instrument often applied to measure the severity of insomnia of a person (Chung, Kan, & Yeung, 2011). The Chinese version of the AIS was used in this study with 8 items that measured signs like having problems in falling sleep, waking up at night, early morning awakening, and sleep quality. Each item has scores ranging between 0 (no symptoms) and 3 (severe symptoms), and can be applied to evaluate the severity of an individual with insomnia. AIS has been extensively applied in both research and clinical settings. McDonalds ω of the AIS was 0.878.

2.3 Statistical Analyses

The data were processed using SPSS 22.0, which involved various steps, such as handling missing values, assigning variables, and reclassifying the data. The processed data were then analysed using JASP 0.16.2, which included descriptive statistics, independent-sample tests, Pearson correlation analyses (with a heatmap), and network analysis. To control for various factors, such as gender, marital status, educational attainment, smoking, alcohol consumption, occupation, and length of service, we included these variables in Pearson's product moment correlation analysis. Network analysis was conducted following the suggestions of Borsboom et al. (PubMed, n.d.) in terms of: (1) network structure estimation, (2) network description (node centrality and network comparisons), and (3) network stability analysis.

This paper has employed the EBICglasso (Extended Bayesian Information Criterion Graphical Lasso) technique to create network edge plots, network centrality plots as well as network robustness test plots. EBICglasso is a statistical tool to estimate sparse precision (inverse covariance) matrices in high dimension data. It involves the combination of the EBIC, a criterion of model selection, and the glasso method, which constructs a sparse graphical model of relationships between variables (Epskamp, Borsboom, & Fried, 2018). Individuals are represented by nodes in a network, whereas edges indicate the connection between them. Sparsity is the proportion of existing edges over possible edges in a network. Sparse networks have fewer connections among nodes and thus cannot exert much influence on each other. Conversely, dense networks have more connections which can easily interact. Measures of centrality within a network are betweenness centrality, indicating the number of occurrences of a node on the shortest path between other nodes (Mengyuan, Wang, & Zheng, 2022). High betweenness centrality nodes are usually referred to as bridges in the network. The closeness centrality is the inverse of the mean shortest path distance of a node to all the other nodes. The nodes that have high closeness centrality are regarded as central nodes in the network (Fried, Epskamp, Nesse, Tuerlinckx, Borsboom, 2016). Degree centrality is the number of nodes that a given node connects to other nodes (ScienceDirect, n.d.). Nodes with high degree centrality tend to be referred to as hubs of the network. Expected influence centrality is an indicator of how much a node can potentially influence other nodes based on behavior or state. Network analysis robustness testing determines if a network will change significantly when nodes or edges are inserted or eliminated (ScienceDirect, n.d.).

3. Results

3.1 Descriptive Sstatistics

The results of depression, anxiety, stress, and insomnia in males and females are presented in Table 1. There were no significant differences between males and females in terms of depression, anxiety, stress, and insomnia (t<1.219, P>0.223).

Table 1. Mean Values, Standard Deviations and Comparisons of Depression, Anxiety, Stress and Insomnia between Males and Females

	$M_T \pm SD$	$M_F \pm SD$	$M_M \pm SD$	*t*	*P*	Cohen's *d*
Depression	3.946±3.955	3.860±3.944	4.064±3.974	0.640	0.522	0.052
Anxiety	3.660±3.609	3.510±3.560	3.865±3.672	1.219	0.223	0.098
Stress	5.052±4.244	4.912±4.074	5.244±4.465	0.971	0.332	0.078
Insomnia	7.645±5.217	7.493±5.126	7.853±5.340	0.855	0.393	0.069

Note: M±SD means mean and standard deviation. T refers to the total sample, F refers to the female sample, M refers to the male sample, and Cohen's *d* represents the effect size.

3.2 Correlation Analysis

The correlations among all items of depression, anxiety, stress, and insomnia is shown in Figure 1; significant positive correlations were observed between all items.

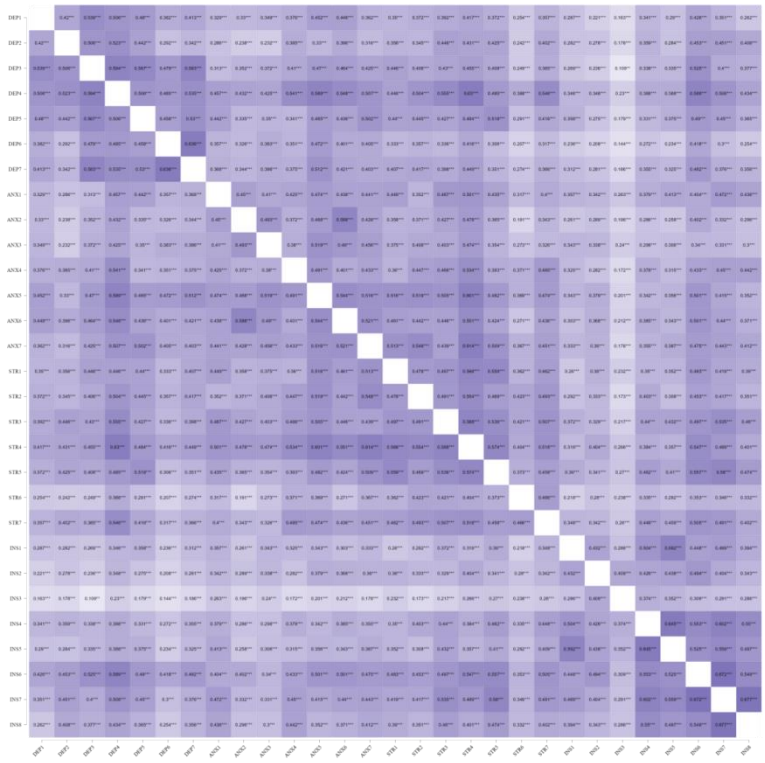


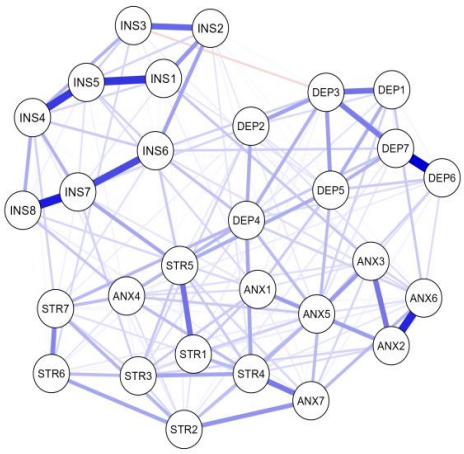
Figure 1. The Correlation Heatmap of Depression, Anxiety, Stress, and Insomnia Symptoms

Note: Purple indicates positive correlations, with lighter shades indicating weaker correlations and darker shades indicating stronger correlations.

3.3 Network Analysis

3.3.1 Network Analysis of Mental Health and Insomnia

We conducted a network analysis to examine the associations among symptoms of depression, anxiety, stress, and insomnia using all items from the AIS-8 and DASS-21. We have found that the two scales possessed their internal structural properties in the item network analysis. One should also keep in mind that we have three distinct clusters of insomnia symptoms including the nighttime awakenings, the overall sleep duration and the quality of life during the day. Besides, depression, anxiety, and stress also had their own cluster (see Figure 2). Moreover, we discovered that the day-time wellbeing symptoms along with uneasiness, panic and feeling blue (INS6, STR4, ANX5 and DEP4 respectively) were placed in the middle of the network. The implication of this is that they are central to the relationships between depression, anxiety, stress, and insomnia symptoms (see Figure 3).



DEP1	No positive	STR1	Sestlessness
DEP2	Initiative	STR2	Allergy
DEP3	Hopelessness	STR3	Consumption
DEP4	Blue	STR4	Feelings of unease
DEP5	Enthusiastic	STR5	Nervous
DEP6	Self-depreciation	STR6	Low patience
DEP7	Meaninglessness	STR7	Irritability
ANX1	Dry mouth	INS1	Sleep induction
ANX2	Breathing difficulty	INS2	Awakenings during night
ANX3	Trembling	INS3	Final awakening earlier
ANX4	Social anxiety	INS4	Total sleep duration
ANX5	Panic	INS5	Sleep quality
ANX6	Arrhythmia	INS6	Daytime-wellbeing
ANX7	Scared	INS7	Daytime functioning capacity
		INS8	Daytime sleepiness

Figure 2. Combined Symptom Network of Insomnia, Anxiety, Depression and Stress

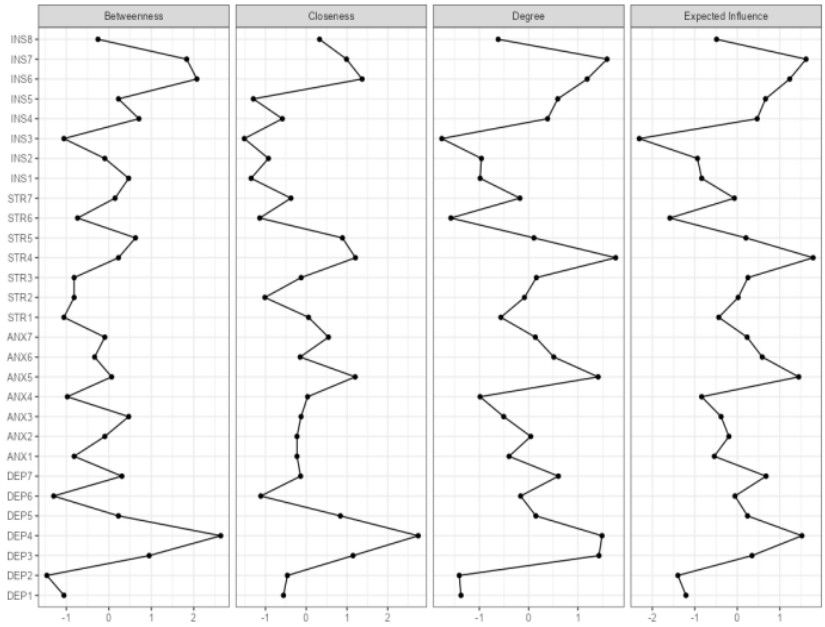


Figure 3. Centrality Index of the Combined Symptom Network of Insomnia, Anxiety, Depression and Stress

3.3.2 Gender Differences in Network Structure

In order to make a more detailed comparison of associations between depression, anxiety, stress, and insomnia symptoms by gender, we have made project network analysis graphs based on gender (Figure 4) and we have tested the structural stability and centrality of networks. The mean correlation with the original sample decreased below 0.5 when the sample size was decreased to 70 percent of its initial size. Concerning the connectivity and sparsity of network nodes, the male network had a 158/406 nonzero edges with a sparsity of 0.611 and the female network had 159/406 nonzero edges with a sparsity of 0.608. Even though the number of connections between nodes and their degrees were not significantly different, we did find other differences. Connections between nodes in the male network were significantly thicker than those in the female network, which indicated higher correlations between symptoms in men. We saw some gender differences in the insomnia symptom network when we focused on certain areas (see Figure 4). In female sample, AIS-8 items created three small clusters, whereas in male sample, the connection between INS2 and INS3 was less strong and the connection between other projects appeared stronger. In the depression network, DEP7 and DEP4 correlated most in males, whereas in females, DEP7 and DEP6 correlated most. In the anxiety network, ANX3, ANX2, and ANX6 were strongly correlated among the males, whereas they were less strongly correlated among the females. We also found that STR3 and STR4 showed high correlation in the male sample but this correlation was lower in the female sample.

We also discovered that the associations between insomnia, depression, anxiety, and stress in the variable network model are relatively consistent across both men and women. The main predictor of insomnia was stress. Nevertheless, in the men sample, the correlation between insomnia and depression was higher, and in the female sample, the correlation between insomnia and anxiety was higher (Figure 5).

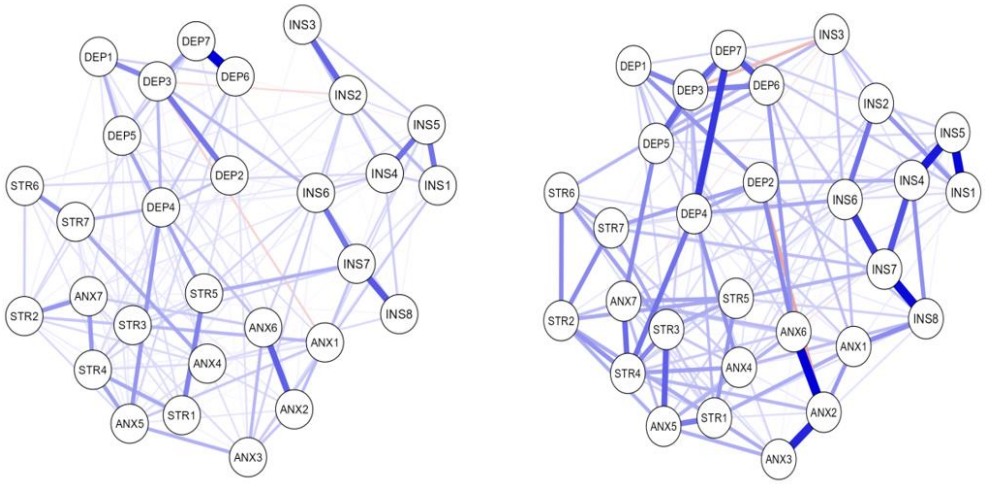


Figure 4. Combined Symptom Networks of Insomnia, Anxiety, Depression and Stress in Females (left) and Males (right)

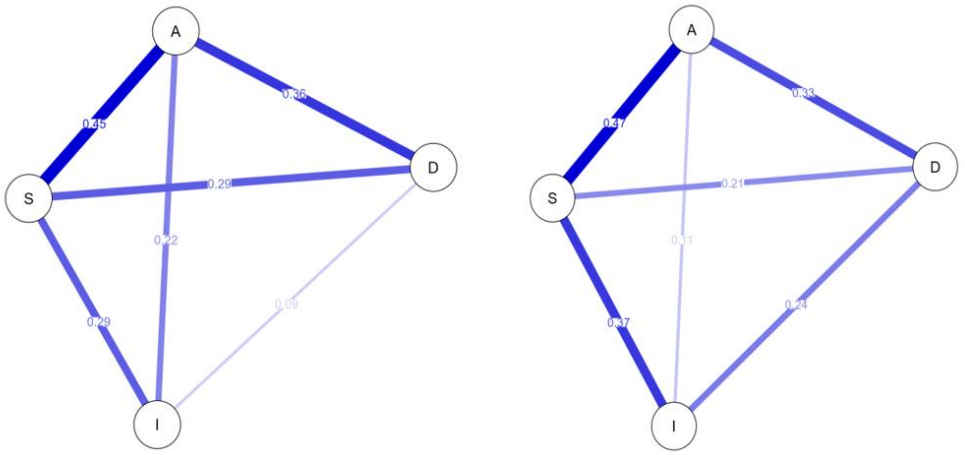


Figure 5. Variable Network in Females (left) and Males (right)

3.3.3 Gender Differences in Network Centrality

In Figure 6, the orange lines represent males, while the green lines represent females. We found that INS7 and DEP4 not only had high centrality but also showed consistent trends between genders.

However, males exhibited stronger centrality of DEP2, DEP7, ANX2, and STR4, while females exhibited stronger centrality of DEP3, ANX3, ANX5, STR5, INS2, and INS6 (see Figure 6).

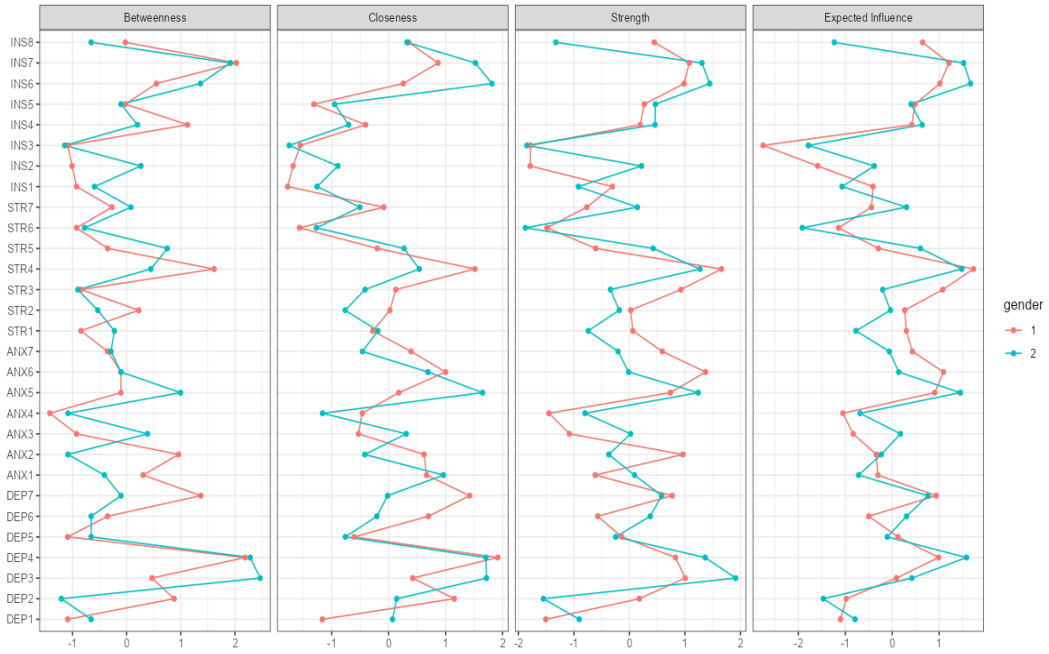


Figure 6. Symptoms Network Centrality Index in Males and Females

4. Discussion

With the help of the 3P model, we used network analysis to examine the interconnections between depression, anxiety, stress, and insomnia in the general population as well as to identify possible gender differences in these associations. The validity analyses performed provide evidence on the strength of our results. We found that daytime well-being and feelings of unease were the most central symptoms in the network. In addition, we found gender differences in the combined networks of depression, anxiety, stress, and insomnia. Namely, in the female network, insomnia had a stronger association with anxiety, and in the male network, it had a stronger association with depression. These results can be applied to gender-based clinical interventions on insomnia.

We found out that the daytime well-being was the most central symptom in the network as it coincides with earlier findings made by other researchers empirically and clinically (Cai, Zhao, Xing, Tian, Qian, Liang et al., 2022). Earlier network studies have also indicated that daytime symptoms play a significant role in the networks of insomnia, including fatigue, poor daytime mood, and poor daytime function (Chen, Zhang, Sha, Lam, Lok, Chow et al., 2023). As an example, Bai et al. defined interference with daytime functioning as the most central symptom in the insomnia network of residents of Macao (Bai, Zhao, Cai, Sha, Zhang, Lei et al., 2022). Likewise, Cai et al. identified interference with daytime functioning as a central symptom in a joint network of insomnia and anxiety

in clinicians (Cai, Zhao, Xing, Tian, Qian, Liang et al., 2022). The daytime symptoms are the main clinical manifestations of insomnia (Espie, Emsley, Kyle, Gordon, Drake, Siriwardena et al., 2019), since people usually resort to medical help when their daytime functioning is compromised (Kalmbach, Cheng, Arnedt, Cuamatzi-Castelan, Atkinson, Fellman-Couture et al., 2019). Based on the findings in our study and other past empirical evidence, there is a strong justification to give priority to the interventions focusing on daytime symptoms of insomnia. Also, we found feeling of unease as another central symptom in the network. It is a common symptom of both depression and anxiety and is often experienced in either of these conditions (Kalmbach, Pillai, Roth, & Drake, 2014). In our study, feelings of unease as an indicator of negatively valenced emotional arousal took on a central position within the insomnia network, as has been noted previously (Bard, O'Driscoll, Miller, Henry, Cape, & Espie, 2023).

The findings of the latent variable model in our study showed that there is no significant gender difference in respect to depression, anxiety, stress and insomnia. Nonetheless, when using network analysis (Fonseca-Pedrero, 2017), we were able to find gender differences in combined networks of these four variables. Our findings of different network characteristics in males and females based on the theoretical framework proposed by the 3P model, which holds that gender is a biological predisposing factor that can interact with precipitating factors like anxiety, depression, and stress leading to the development of insomnia (Wright, Tiani, Billingsley, Steinman, Larkin, & McNeil, 2019), provide an indication of possible interaction between gender and precipitating factors and therefore partially support the 3P model. Particularly, we saw that the connections between the symptoms in the whole network were higher and stronger in males compared to females. It indicates that a positive change in one symptom could have a higher effect on the overall network of symptoms in males. Moreover, the network analysis showed that in males, the association between depression and insomnia was strong, whereas in females, the association between anxiety and insomnia was strong. These observations are consistent with the ones noted by Ma et al. (Ma, Yang, Xu, Zhang, Kang, Wang et al., 2022), in their article concerning gender differences in the mental health networks of college students. Evidence of the gender-specific associations observed in our study has also been reported in previous research (Price, Zachariae, Butow, deFazio, Chauhan, Espie et al., 2009). As an illustration, an Australian study involving women with a diagnosis of ovarian cancer showed that anxiety, and not depression, was a significant predictor of insomnia (Price, Zachariae, Butow, deFazio, Chauhan, Espie et al., 2009). In another Chinese study, it was noted that the symptoms of insomnia were more often associated with the symptoms of depression in men aged 45-59 years (2023). The reasons behind these gender differences are yet to be determined. We hypothesize that numerous factors could explain them. Firstly, people with insomnia may have specific personality traits, including high neuroticism, anxiety, and perfectionism, which are found to be more common in females (Suh, Cho, & Zhang, 2018). Secondly, females have a tendency to suffer from role overload because of multiple roles and

responsibilities, which has been found to cause increased anxiety and insomnia (Park, Cho, Lee, Kim, Shim, Youm et al., 2020). Nevertheless, it should be noted that although our results are backed by previous studies, additional research is required to confirm these gender network differences, as other studies have not discovered such differences.

Female network: The most central symptoms were hopelessness, trembling, panic, and tension, whereas, in the male network, the most prominent ones were initiative, hopelessness, and breathing difficulty. These results are in line with another network analysis that found anxiety symptoms to be central in the female network and depression symptoms to be central in the male network (Ma, Yang, Xu, Zhang, Kang, Wang et al., 2022). Other researchers have shown that females are prone to experiencing greater degrees of anxiety and anxiety-related conditions. This has been explained by a mix of psychosocial and biological influences (Farhane-Medina, Luque, Tabernero, & Castillo-Mayén, 2022), such as greater vulnerability to anxiety, genetics, the structure of the brain, and variations in sex hormones (Norr, Albanese, Allan, & Schmidt, 2015). Also, because women generally take on a complex array of social roles, they might be more emotionally sensitive and susceptible to self-absorption or rumination as strategies to cope with stress (Akanni, Olashore, Osasona, & Uwadiae, 2020). These are the reasons why the severity of anxiety symptoms is higher among women, which can influence other symptoms, such as insomnia, depression, and stress. Inversely, men are not as likely to report anxiety, somatic distress or pain, and emotional anguish caused by insomnia (Zhang, Lam, Li, Tang, Yu, Li et al., 2012). This might be explained by the fact that masculinity is a protective factor against anxiety (Farhane-Medina, Luque, Tabernero, & Castillo-Mayén, 2022). This might also be explained by the fact that society expects men to have a higher pain threshold when it comes to reporting pain and sickness (Barsky, Peekna, & Borus, 2001). If people get to the stage where they report insomnia and seek treatment of such problems, it is possible that they already have developed symptomatic mental health problems, such as feelings of hopelessness and absence of interest and motivation (Sagar-Ouriaghli, Godfrey, Bridge, Meade, & Brown, 2019).

5. Implications

The findings of this research can be applied to clinical practice in a number of ways. Firstly, because the interrelationships between depression, anxiety, stress and insomnia are very complicated, it is necessary to take into account how these factors work together to develop treatment plans and prevention programs to address insomnia. Secondly, the presence of central symptoms, i.e., daytime well-being and unease, implies that the treatment of these symptoms can significantly enhance the general array of mental health symptoms. Approaches to therapy that have proven to be effective in enhancing daytime functioning and encouraging relaxation, including Digital Cognitive-Behavioral Therapy (dCBT) (Luik, van der Zweerde, van Straten, & Lancee, 2019) and Relaxation Training (RTs) (Biondi & Valentini, 2014), might also prove useful in treating insomnia and its accompanying

symptoms. Finally, gender differences in the joint network of depression, anxiety, stress and insomnia underline the necessity of gender-based preventive strategies. Precisely, treatments to reduce anxiety symptoms might be better suited to women whereas treatments to alleviate depressive symptoms might be more suited to men.

6. Limitation

The existing literature has many constraints in the current research that should be highlighted. To begin with, the application of self-report measures in the given research also introduces the threat of self-report bias. Clinician-rated measures or interviews could be beneficial to incorporate in the future work to measure the symptoms of insomnia, anxiety, and depression. The second limitation is that the cross-sectional design of the present study restricts our ability to draw causal inferences between variables. Longitudinal studies would have been helpful in investigating these symptoms over time. Three, the non-clinical population considered in this study can hinder the applicability of our findings to the clinical population. Additional studies should seek to duplicate these results in clinical populations so as to improve the external reliability of the findings. Finally, a more holistic approach to the connection between depression, anxiety, stress, and insomnia may be obtained with future research that eliminates these shortcomings.

7. Conclusion

In the present research, it has been found that there are gender differences in the relationships between depression, anxiety, stress, and insomnia. In particular, the symptom network seemed to be more interrelated amongst males as compared to females. Depression had a stronger effect on insomnia in males, whereas anxiety was also more influential in females. These results are significant because they suggest that treatment of insomnia can be gender-based.

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