A Network Analysis of Inner Strength Among University Students with Borderline Personality Disorder Symptoms

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Article

A Network Analysis of Inner Strength Among University Students with Borderline Personality Disorder Symptoms

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Abstract

Inner strength is increasingly recognized as a protective factor in mental health, but its structure and dynamics remain underexplored, particularly in individuals with borderline personality disorder (BPD) symptoms. This study applied network analysis to investigate the complex relationships among inner strengths in individuals exhibiting BPD symptoms, aiming to identify core and bridging strengths that could inform targeted interventions. The sample consisted of 346 Thai university students(25.4% males, 74.6% females; mean age = 21.60 ± 2.24 years) who screened positive for BPD symptoms using the SI-Bord scale. Network analysis revealed that inner strengths formed an interconnected system with both core and peripheral features. The strongest association was observed between generosity and loving-kindness. A cognitive-behavioral cluster comprising perseverance, wisdom, and determination also emerged. Centrality analysis identified loving-kindness as the most influential node in terms of direct connections, while equanimity exhibited the highest bridge centrality. Generosity and determination demonstrated the greatest expected influence. A negative link between truthfulness and equanimity highlighted a potential conflict between absolute honesty and inner balance in this population. These findings suggest that fostering specific inner strengths, particularly equanimity and loving-kindness, may enhance psychological resilience and inform intervention strategies for BPD.

Keywords: borderline personality disorder; inner strength; network analysis; university student; protective factors

1. Introduction

Borderline Personality Disorder (BPD) is a complex psychiatric condition characterized by affective instability, impulsive behavior, identity disturbance, and unstable interpersonal relationships(Association, 2013; Leichsenring et al., 2023; Leichsenring et al., 2011; Morey & Zanarini, 2000). While BPD affects approximately 0.7% to 2.7% of the general population, epidemiological studies show that its prevalence can reach as high as 6.4% among Thai university students(Chapman et al., 2025; Eaton & Greene, 2018; Lohanan et al., 2020).

Notably, BPD symptoms strength often emerge and persist during young adulthood (Videler et al., 2019), a critical developmental stage when university students navigating rapid changes in personality, emotion regulation, and social roles.(Cano et al., 2022; Meaney et al., 2016). As a result, BPD can have profound and long-lasting impacts on students' psychological well-being and social adaptation. (Jia et al., 2022; Mueller, 2023; Nahathai Wongpakaran et al., 2021).

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Addressing these challenges requires a shift in focus from pathology to protective resources. Traditionally, research has examined protective factors such as emotional awareness, conscientiousness, self-compassion, and resilience (Kouklidou et al., 2025; Southward et al., 2023). However, in recent years, attention has increased to the broader construct of inner strength, a multidimensional psychological resource that promotes stability, self-regulation, and growth in the face of adversity. Within the context of positive psychology, inner strength is now recognized as a central asset enabling individuals to maintain coherence and adaptability under stress.(Lundman et al., 2010; Masten, 2001; McNeal, 2024). From the perspective of positive psychology, inner strength constitutes positive, cultivable traits manifested through patterns of thinking, emotion, and behavior that serve as the psychological foundation for an individual's well-being and achievements(Csikszentmihalyi & Seligman, 2000). In the Thai society, the concept of inner strength is deeply rooted in the Theravāda Buddhist framework of "ten perfections" (Pāramī) :Truthfulness, Perseverance, Wisdom, Generosity, Five Precepts, Meditation, Tolerance, Equanimity, Determination, and Loving-kindness (Buddhaghosa, 2020; Kang & Whittingham, 2010; Wongpakaran et al., 2020). These culturally embedded virtues, such as mindfulness, equanimity, and perseverance, are evidenced to promote emotion regulation, reduce maladaptive self-rumination, and provide innovative directions for the psychological treatment of BPD(Fernandes et al., 2022; Glass et al., 2024; Keng & Tan, 2018; Lam & Seiden, 2020; Sripunya et al., 2024).

Growing empirical evidence, particularly from East and Southeast Asian populations, supports the psychological benefits of inner strength. For instance, Thai studies have revealed that mindfulness meditation and grit buffered the impact of negative life events on BPD symptoms and depression among medical students(Pongpitpitak et al., 2022), while mindfulness-based practices are found to reduce self-injurious behaviors in patients with BPD(Sripunya et al., 2024). Perseverance has been associated with lower psychological distress, and equanimity shown to moderate the effects of neuroticism and perceived stress(Tsai & Morissette, 2022; N. Wongpakaran et al., 2021).

International studies echo these findings— recovered BPD patients in the United States display significantly higher perseverance (Glass et al., 2024), and mindfulness-based interventions enhanced emotional functioning among adolescents in Hong Kong(Lam & Seiden, 2020). Insights from China indicate that the core values of loving-kindness meditation are evolving, highlighting the need to further clarify the theoretical foundations of inner strength in contemporary contexts(Deng et al., 2025; Lam & Seiden, 2020).

To unravel the complexity of such multidimensional constructs, psychological network analysis offers a novel and powerful methodological approach . Rather than treating psychological characters as isolated variables, network analysis conceptualizes them as interacting nodes within a system. This allows for pinpointing central or "hub" variables that may play a particularly influential role in promoting resilience or maintaining symptoms.(Borsboom & Cramer, 2013; Borsboom et al., 2021; Hevey, 2018; McNally, 2021). Previous network studies have identified core symptoms in BPD and mood disorders, such as affective instability and identity disturbance in BPD(Richetin et al., 2017), or depressed mood and restlessness in depression–anxiety networks, as well as bridge variables that connect clusters of symptoms(Xu et al., 2024). These insights support the utility of network analysis for identifying intervention targets and understanding the intricate interrelations among psychological domains.to identify key symptoms and to understand Despite these advances, research has yet to systematically examine the structural interrelations among the ten dimensions of inner strength as protective factors in individuals with BPD symptoms. Specifically, there is a need for empirical investigation into how these strengths interact, reinforce one another, or serve as key drivers of adaptive functioning. Therefore, the present study aims to address this gap by applying network analysis to systematically explore the unique associations among the ten Buddhist-inspired inner strength dimensions in Thai university students exhibiting BPD symptoms. These findings are expected to shed light on core protective characters and inform culturally tailored, strength-based interventions for this high-risk population.

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2. Materials and Methods

2.1. Study Subjects

This study employed a cross-sectional design and utilized network analysis. The data were derived from a database of a study conducted at Chiang Mai University, Thailand, titled "Association Between Pets and Mental Health in University Students with Borderline Personality Disorder Symptoms"(Khattiya et al., 2025). The original study was approved by the Ethics Committee of Chiang Mai University (Approval No. PSY-2566-0502), and all participants provided written informed consent prior to data collection.

The initial sample consisted of 346 Thai university students aged 20 to 30 years, all of whom were screened for BPD symptoms using the Screening Instrument for Borderline Personality Disorder (SI-Bord) and included if they scored ≥7. To maximize statistical power and utilize all available data, the present study included all 346 participants. The study was approved by the research ethics committee of the Faculty of Medicine, Chiang Mai University (protocol code PSY-2568-0643 and date of approval 30 September 2025).

2.2. Instruments

2.2.1. Screening Instrument for Borderline Personality Disorder (SI-Bord)

SI-Bord is a 5-item self-report tool developed based on the core features of BPD from the DSM-5. It assesses five domains: fear of abandonment, unstable interpersonal relationships, identity disturbance, self-harm behavior, and affective instability. Items are rated on a 4-point Likert scale ranging from 0 (never) to 3 (very often), with total scores ranging from 0 to 15. In this study, a cutoff score of ≥7 was adopted to optimize screening sensitivity, yielding 75.0% sensitivity and 73.1% specificity in a Thai university student sample. The internal consistency reliability (Cronbach's α) of the scale was 0.76(Lohanan et al., 2020).

2.2.2. Inner-Strength-Based Inventory (I-SBI)

I-SBI was developed based on the Buddhist psychological concept of the "Ten Perfections" and aims to measure ten positive inner qualities: Truthfulness, Perseverance, Wisdom, Generosity, Morality(5-Precepts), Meditation, Tolerance, Equanimity, Determination, and Loving-kindness. The scale consists of ten items, each representing one dimension. Responses are recorded on a 5-point scale (e.g., from 1 = "I do not think I am a diligent person at all" to 5 = "I think I am diligent, hardworking, and do extra work"), representing increasing levels of the strength. Psychometric evaluation supported the scale's unidimensionality, good item fit, and reliability, with a person separation reliability of 2.45, person reliability coefficient of 0.86, and item reliability of 0.99(Wongpakaran et al., 2020).

2.3. Statistical Analyses

2.3.1. Descriptive Statistical Analysis

Data preprocessing and descriptive statistical analyses were conducted using SPSS (v.27.0)(Meyers et al., 2013). A small amount of missing data was handled using the Expectation–Maximization algorithm(Pigott, 2001). Descriptive statistics were subsequently calculated for demographic variables (including age, gender, and years of study) and the ten dimensions of inner strength.

2.3.2. Network Analysis Overview

Network analysis is an innovative statistical approach that conceptualizes psychological constructs as systems of interacting variables (nodes), rather than as isolated factors influenced by

 doi:10.20944/preprints202512.0441.v1

latent variables. In this framework, each node represents a distinct dimension of inner strength, and edges between nodes represent unique associations (partial correlations) after controlling for all other variables in the network. This method enables the identification of direct relationships among strengths, highlights the most central and influential characteristics, and reveals the overall connectivity pattern within the system.

2.3.3. Network Estimation and Visualization

Network analysis and graphical visualization were performed using R (V.2025.05.1+513). A partial correlation matrix was computed, and a partial correlation network was constructed using the qgraph package (V.1.9.8)(Epskamp et al., 2018). The network layout was generated using the spring algorithm, with a minimum edge weight threshold set to 0.1 and a cut value of 0.05. In this undirected network, each node corresponds to a dimension of inner strength, while the edges indicate the strength and direction of the partial correlation between two nodes, after accounting for all other variables. Green edges represent positive correlations, red edges represent negative correlations, and edge thickness corresponds to the strength of the correlation(Fried & Cramer, 2017).

2.3.4. Community Structure Detection

Community detection (also known as clustering) was performed using the Louvain algorithm. Identified communities represent groups of closely interconnected strengths. Community structure within the network was identified using the Louvain algorithm from the igraph package (V.2.2.1)(Epskamp et al., 2018). The Louvain method clusters nodes into communities based on the maximization of modularity, meaning that nodes within the same community are more densely interconnected with each other than with nodes outside the community. Solutions based on positive edge weights were used for interpretation and visualization in the final network model.

2.3.5. Centrality Analysis

We quantified node importance using four centrality indices: Strength, Closeness, Betweenness, and Expected Influence, calculated via the qgraph (V.1.9.8) and networktools (V.1.6.0) (Castro et al., 2019; Epskamp et al., 2012). Centrality values were standardized (z-scores) and illustrated in a centrality profile plot, helping to identify which inner strengths play the most influential roles in the network.

2.3.6. Network Stability and Accuracy

Finally, network stability and accuracy were evaluated using the bootnet(V.1.6)(Epskamp et al., 2018). Nonparametric bootstrapping with 1000 samples generated 95% confidence intervals for edge weights; edge weights were considered stable and interpretable if the confidence intervals were relatively narrow and did not include zero. The robustness of centrality estimates, including strength, closeness, betweenness, and expected influence, was evaluated using case-dropping bootstrapping. The correlation stability (CS) coefficient was calculated for each index to quantify stability; according to established guidelines, a CS coefficient above 0.25 is considered acceptable, while a value above 0.50 indicates good stability. Centrality indices below the 0.25 threshold should be interpreted with caution.

3. Results

3.1. Descriptive Statistics

The study sample consisted of 346 university students recruited for the analysis. Key demographic characteristics, including age, gender, and academic year, are summarized in Table 1.

The mean age of the sample was 21.60 years (SD = 2.24). The majority of participants were female (74.6%). Regarding academic year distribution, 9.5% (n = 33) were first-year students, 24.6% (n = 85)

 doi:10.20944/preprints202512.0441.v1

were in the second year, 27.5% (n = 95) in the third year, 21.7% (n = 75) in the fourth year, and 16.8% (n = 58) were above the fourth year.

Table 1. Sample Characteristics (N = 346).

Characteristic	Category	Value
Age	-	21.60±2.24
Gender	Male	88(25.4%)
	Female	258(74.6%)
Year of Study	1st year	33(9.5%)
	2nd year	85(24.6%)
	3rd year	95(27.5%)
	4th year	75(21.7%)
	Above 4th year	58(16.8%)

Table 2 shows descriptive statistics for the ten inner strength qualities. The mean scores across ranged from 1.49 to 3.4. Specifically, Generosity recorded the highest mean score (M = 3.48, SD = 1.27), whereas Meditation yielded the lowest (M = 1.49, SD = 0.78). The remaining variables had mean scores ranging from 2.41 to 3.23. The total score for the ten inner strengths had a mean of 28.72 (SD = 5.73), with observed scores ranging from 10 to 41.

An examination of skewness and kurtosis indicated that the score distributions for most variables approximated normality, except for Meditation demonstrated a pronounced positive skew (skewness = 1.98) and a high kurtosis value (kurtosis = 4.58).

Table 2. Descriptive Statistics for Inner Strength(N=346).

Variables	Mean(SD)	Min	Max	Skewness	Kurtosis
Truthfulness	3.20±1.27	1	5	0.18	-1.37
Perseverance	2.41±1.03	1	5	0.61	-0.05
Wisdom	2.95±1.19	1	5	-0.11	-0.80
Generosity	3.48±1.27	1	5	-0.49	-1.08
5-Precepts	2.82±1.22	1	5	0.03	-0.91
Meditation	1.49±0.78	1	5	1.98	4.58
Tolerance	3.17±1.13	1	5	-0.07	-1.05
Equanimity	2.95±1.01	1	5	0.03	-0.64
Determination	3.02±1.11	1	5	0.18	-0.96
Loving-Kindness	3.23±1.23	1	5	-0.45	-1.03
Sum	28.72±5.73	10	41	-0.60	0.08

3.2. Network Analysis

In the regularized partial correlation network constructed from the ten nodes derived from levels of inner strength, the network comprised 45 potential edges, of which 17 were significant (based on 1,000 bootstrap samples, 95% confidence intervals not including zero). The mean weight of these edges was 0.157. Among all significant edges, 16 exhibited positive weights, with a mean of 0.174, whereas one edge exhibited a negative weight (mean = -0.115).

Figure 1 presents the network structure visualized from the original partial correlation matrix. The strongest connection was observed between Generosity and Loving-kindness (r = 0.399), followed by Perseverance and Wisdom (r = 0.318), and Wisdom and Determination (r = 0.295). A

 doi:10.20944/preprints202512.0441.v1

unique negative edge was identified between Truthfulness and Equanimity (r = -0.069) .Detail in Table S1.

Community detection via the Louvain algorithm revealed two prominent communities (clusters), distinguished by node color: Cluster 1 (red) comprises Truthfulness, Generosity, Tolerance, Loving-kindness, and Determination, while Cluster 2 (cyan) comprises Perseverance, Wisdom, 5-Precepts, Meditation, Equanimity, and Determination. Within each community, nodes exhibit more densely interconnected patterns, indicating stronger within-community relationships.

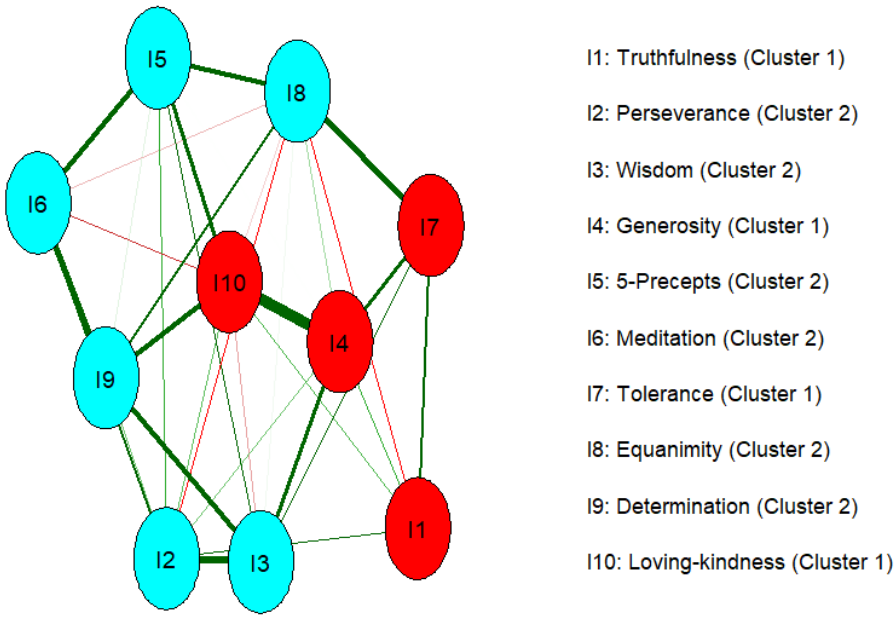

Figure 1. Network of Inner Strength in BPD. Each circle (node) represents the Inner Strength dimension, while lines (edges) indicate relationships between nodes. These relationships are represented by weight values in the network, based on partial correlations. Thicker and darker edges signify stronger relationships. Green edges denote positive relationships, and red edges represent negative ones.

The results of the centrality analysis are presented in Figure 2. Loving-kindness (z = 1.069) and Equanimity (z = 1.58) demonstrated the highest strength centrality, indicating these strengths hold the strongest direct connections with other inner strengths within the network, whereas Generosity (z = 0.897) and Determination (z = 0.882) exhibited higher expected influence centrality. This suggests that these two dimensions, when considering both positive and negative associations, can exert a greater overall impact across the network compared to other attributes. In addition, Equanimity (z = 5) showed markedly highest bridge centrality than other nodes, emphasizing its key role as a connector or bridge between different parts of the network. Closeness centrality values were generally low for all nodes, suggesting that there is no single strength that notably shortens the path between other strengths in the network. This indicates the absence of a clearly identifiable central bridge node and suggests a relatively distributed network structure. Detail in Table S2.

 doi:10.20944/preprints202512.0441.v1

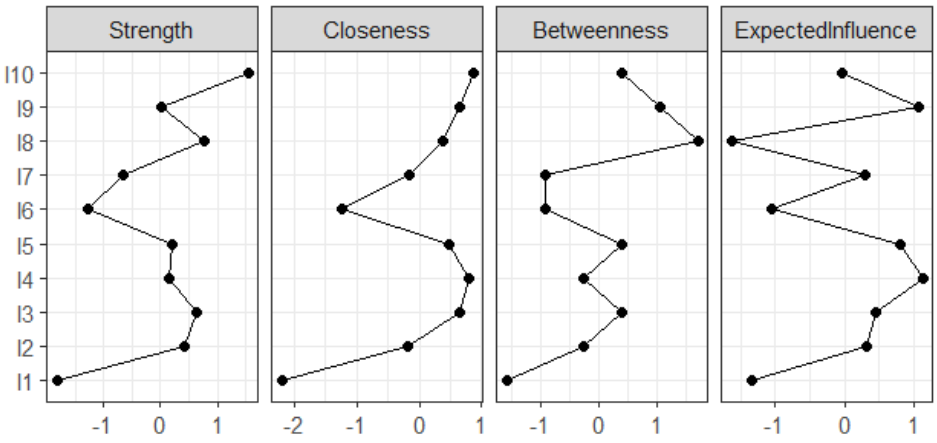

Figure 2.

Figure 3A displays the bootstrapped 95% confidence intervals (CIs) for the estimated edge weights in the network. The red points reflect the original sample edge weights, while the black points indicate the bootstrap means, with the grey bands representing the CIs derived from 1,000 bootstrap samples.

Most edge weights have relatively narrow confidence intervals, suggesting that the strength of the associations between nodes is estimated with good precision and stability. The CIs for most edges do not include zero, indicating that these connections are statistically robust and unlikely to be spurious. This provides further confidence in the interpretability of the network's detected edges.

Figure 3B displays expected influence (green line): This index demonstrated the highest stability, with a CS coefficient remaining well above the 0.50 threshold (0.595), suggesting robust and reliable estimates even when a considerable portion of the data is omitted whereas the CS coefficients for Strength (blue line) and closeness (red line): Both showed lower stability, with CS coefficients dropping closer to or just above 0.25, indicating that these centrality measures are less robust and should be interpreted cautiously.

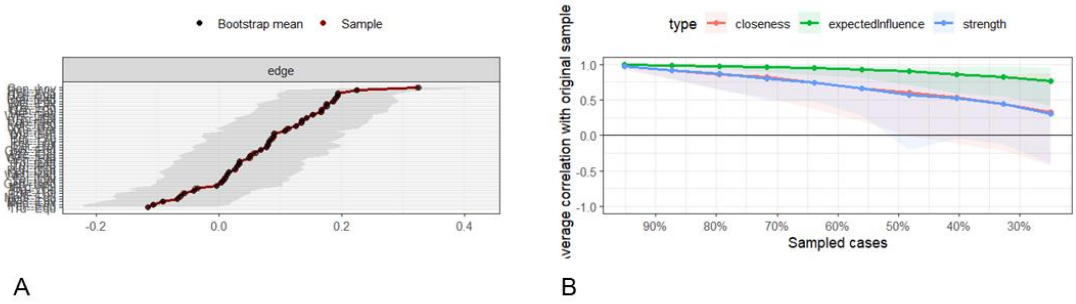

Figure 3.

4. Discussion

This study is the first to employ a network analytic approach to explore the dynamic associative structure of inner strengths among individuals with BPD symptoms. Although previous studies have demonstrated the protective role of inner strength in mental health, most have focused on examining single strength or treated inner strength as a unidimensional construct(Glass et al., 2024; Sripunya et al., 2024).By revealing the complex network of interactions among these strengths, the present study offers a novel perspective for understanding the positive psychological structure underlying BPD.

The network analysis revealed that inner strengths do not exist in isolation but instead form an integrated system characterized by both core and peripheral structures. Among all nodes, the

 doi:10.20944/preprints202512.0441.v1

strongest association was observed between Generosity and Loving-kindness, consistent with Buddhist teachings that regard dāna (generosity) and mettā (loving-kindness) as complementary paths of practice, and supporting prior theoretical assumptions about their synergistic function(Ariyabuddhiphongs, 2016; Dorjey, 2018). In addition, strong connections among Perseverance, Wisdom, and Determination formed a cognitive-behavioral cluster, reflecting the inherent unity of cognitive resources and behavioral motivation in goal-directed functioning. These communities may reflect underlying domains of psychological resources, such as interpersonal virtues and self-regulatory or contemplative strengths, which could serve as synergistic protective factors in psychological functioning. These patterns suggest a shared psychological foundation, potentially indicating their cooperative role in the positive psychological regulation of individuals with BPD.

From the centrality analysis, Loving-kindness exhibited the highest strength centrality, indicating that it had the most direct connections within the network and served as a central hub of the system. This finding carries important clinical implications. As one of the "Four Immeasurable" in Buddhist psychology, loving-kindness has been shown to enhance emotional regulation and interpersonal functioning—core areas of impairment in individuals with BPD(Keng & Tan, 2018). Equanimity demonstrated a distinctive bridging role, suggesting that it acts as a psychological connector linking different clusters of strengths. Given that equanimity represents the capacity to maintain inner balance amid both positive and negative experiences, a capacity often deficient yet essential in individuals with BPD, this finding provides a clear direction for targeted emotion regulation interventions.

Notably, the network analytic approach highlights the unique value of central or "hub" strengths. In network models, central nodes exert substantial influence due to their extensive connections. Stimulating or strengthening these hub strengths, such as loving-kindness and equanimity, can have amplified effects across the entire network, as changes in these nodes tend to "ripple out" and positively affect multiple interconnected strengths. This cascade effect means that targeted interventions aimed at core strengths may foster improvements in other, indirectly connected inner strengths, promoting broader psychological growth and system-wide resilience. Thus, central strengths represent strategic leverage points for efficient and impactful counseling or therapeutic interventions.

Additionally, the analysis revealed a negative association was observed between Truthfulness and Equanimity. This may reflect a specific psychological mechanism among individuals with BPD, in which rigid adherence to absolute honesty may conflict with inner peace. Clinically, some BPD patients are observed to pursue authenticity inflexibly, neglecting contextual adaptability and consequently experiencing interpersonal conflict and internal turmoil(Dammann et al., 2011). This finding underscores the need to consider the complex interplay among different strengths when cultivating inner strength, rather than assuming that all components are uniformly beneficial.

The findings of the current study also demonstrate robust network stability and accuracy. The correlation stability (CS) coefficients for edge weights and expected influence exceeded the recommended threshold for stable interpretation (CS > 0.50), indicating reliable and reproducible estimates for these indices. However, strength and closeness centrality exhibited lower CS values, suggesting these metrics should be interpreted with greater caution. Bootstrapped confidence intervals for edge weights were generally narrow and rarely included zero, providing further support for the reliability of the identified associations.

From a theoretical perspective, the findings support and extend the framework of inner strength proposed by Wongpakaran et al.(Wongpakaran et al., 2020). Network analysis visually demonstrated how inner strength operates as a dynamic system, revealing the synergistic interactions through which strengths collectively sustain psychological adaptation. This result also resonates with Baumeister's self-regulation theory(Baumeister & Vohs, 2007)， suggesting that inner strengths jointly enhance emotional and behavioral regulation capacities through coordinated mechanisms.

 doi:10.20944/preprints202512.0441.v1

4.1. Implication of the Study

The findings of this study offer important clinical insights for interventions targeting BPD. First, the identification of core nodes provides an empirical foundation for precision-based intervention strategies. Given the centrality of Loving-kindness, it is recommended that loving-kindness meditation be systematically integrated into existing psychotherapeutic programs. Considering the bridging role of Equanimity, mindfulness-based interventions should focus on cultivating patients' capacity to maintain emotional balance under interpersonal stress, aligning with the distress tolerance skills emphasized in dialectical behavior therapy (DBT)(Linehan, 1993).

Furthermore, Generosity and Determination, which exhibited high expected influence, may serve as novel targets for behavioral activation interventions. Structured exercises involving altruistic behaviors and goal setting could directly strengthen these strengths while producing broader network effects that promote positive change across the inner strength system. This strength-based intervention approach may complement traditional pathology-focused treatments, enhancing both motivation and engagement in therapy.

4.2. Limitations and Future Study

This study has several limitations. First, some centrality measures (strength and closeness) revealed limited stability, possibly due to sample size or unique population characteristics, and thus interpretations of these indices should be considered preliminary. Second, the study utilizes secondary cross-sectional data, which restricts the ability to draw causal inferences. Future studies should employ longitudinal or experimental designs to examine causal relationships among network connections. Third, the sample consisted of Thai university students, and cultural factors may have influenced the expression of inner strength; thus, replication across diverse cultural contexts is warranted. Finally, although major psychiatric comorbidities were excluded, individuals with BPD frequently present with multiple mood disorders or other comorbidities that may affect the manifestation of inner strength.

Nevertheless, this study's contribution lies in applying network analysis to a relatively large sample of individuals with BPD symptoms, offering new insights into the mechanisms and interrelationships of inner strength within this population. This approach illuminates the complex interactions among components of inner strength in BPD. It provides empirical support for theories rooted in Buddhist and positive psychology that emphasize the multifaceted nature of protective factors. Such understanding highlights the intricate and dynamic mechanisms of inner strength in BPD and offers valuable implications for future research and therapeutic innovation.

5. Conclusion

This study, using a network analytic approach, systematically revealed the structure of inner strength among individuals with Borderline Personality Disorder symptoms and identified key strengths such as Loving-kindness, Equanimity, Generosity, and Determination as key nodes. These findings deepen our understanding of the positive psychological resources in Borderline Personality Disorder and provide empirical support for the development of culturally sensitive, strength-based psychological interventions.

Supplementary Materials: The following supporting information can be downloaded at the website of this paper posted on Preprints.org, Table S1: Partial Correlation Matrix; Table S2: Network Centrality.

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Informed Consent Statement: Patient consent was waived because the study used secondary data.

Conflicts of Interest: The authors declare no conflicts of interest.

Data availability: The raw data supporting the conclusions of this article will be made available by the authors on request.

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