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What is compassion connected to, and how does it change?: Gender and age differences in networks of compassion and self-compassion

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Abstract

Compassion is an emotional state experienced in response to witnessing the suffering of others, accompanied by an internal motivation to help. When directed toward the self, it is referred to as self-compassion. Previous research suggests that compassion and self-compassion are closely related to mindfulness and empathy, contributing to reductions in anxiety and depression and to the enhancement of positive affect. Accordingly, this study employed network analysis to explore the complex structure of interactions among these psychological variables. A total of 1,020 Korean adults completed measures of compassion, self-compassion, mindfulness, empathy, well-being, and negative affect (depression, anxiety, and stress). An EBICglasso network was estimated in R (version 4.5.1). Centrality indices were computed, and subgroup networks were constructed by gender and age to compare structural differences. The results showed that compassion was closely connected to empathy, whereas self-compassion was more strongly linked to mindfulness and well-being; the capacities to feel, tolerate, and alleviate suffering emerged as central nodes. In the gender-based networks, compassion and self-compassion among men tended to be organized primarily around cognitive factors, whereas women exhibited a pattern in which the behavioral motivation for compassion was activated relatively immediately, even in the absence of emotional responding. In the age-based networks, the influence of suffering tolerance was most pronounced in middle-aged adults, while the role of empathy diminished and the role of mindfulness expanded in older adults. By examining compassion at the level of its constituent elements and visualizing the interaction structure among related variables, this study provides an empirical foundation for extending theoretical understanding and for developing tailored intervention strategies.

1. Introduction

Compassion is defined as an emotional state that arises when witnessing the suffering of others, involving empathy for that suffering together with a desire to alleviate it (Goetz et al., 2010). In general, compassion is understood to consist of three components: noticing, feeling, and responding. Noticing refers to recognizing the suffering of another person, while feeling denotes empathizing with that suffering. Responding, in turn, represents the behavioral intention to relieve the suffering (Kanov et al., 2004). Thus, compassion can be regarded as a multidimensional emotion in which cognitive, emotional, and behavioral elements operate in an integrated manner, encompassing not only the recognition of and empathy for others' suffering but also a practical attitude aimed at alleviating it.

However, several conditions must be met for compassion to be expressed appropriately. One essential condition is the ability to maintain an appropriate emotional distance from the suffering of others. According to Gilbert (2009a), excessive identification with another person's suffering may lead individuals to avoid the suffering itself, thereby inhibiting compassionate responses. Accordingly, individuals are required to tolerate the emotional discomfort evoked by others' suffering and to adopt an attitude of accepting those feelings without judgment, even when they are experienced as frustration, anger, fear, or disgust.

Moreover, compassion is not confined to close relationships such as those with family members or friends. We are also capable of feeling compassion for people we have never met—for example, children suffering from war or famine (Gilbert, 2005, 2009a; Wang, 2005). Such responses are possible because we recognize the nature of suffering—that is, the understanding that suffering is an inherent part of human life. In other words, the attitude of accepting suffering not as an exceptional event but as a universal human experience can be considered another essential prerequisite for compassion (Dalai Lama, 2005; Strauss et al., 2016).

Building on these theoretical discussions, Strauss et al. (2016) proposed that compassion consists of five core elements: recognizing suffering, understanding the universality of suffering, feeling for the person suffering, tolerating uncomfortable feelings, and motivation to act/acting to alleviate suffering. Furthermore, compassion can arise not only in response to the suffering of others but also when individuals experience their own suffering, and this inward-directed form of compassion is referred to as *self-compassion* (Neff, 2003a). They argued that, except for the fact that the target of suffering is the self, self-compassion shares the same factor structure as compassion.

Meanwhile, Neff (2003a), a leading scholar in the study of self-compassion, proposed that it consists of three components: self-kindness, mindfulness, and common humanity. Moreover, she presented conceptually opposing components—self-judgment, over-identification, and isolation—as factors that stand in direct contrast to these positive dimensions. Among these components, particular attention should be given to mindfulness and over-identification. As noted earlier, excessive identification with the suffering of others can inhibit compassionate responses. A similar phenomenon can be observed in the context of self-compassion. In fact, when individuals become overly absorbed in their own suffering, they may be overwhelmed by emotion and find it difficult to perceive the situation objectively; this state is referred to as *over-identification* (Bennett-Goleman, 2002; Neff, 2003a).

Over-identification can intensify self-criticism and deepen the sense of separation from others, thereby obstructing the recognition that all human beings experience suffering and failure. Therefore, in order to practice self-compassion appropriately, it is essential to maintain a proper distance from one's emotions —often described as securing a mental space—and to cultivate an attitude of accepting inner suffering as it is, without judging or suppressing it. It is precisely *mindfulness* that enables such an attitude (Nolen-Hoeksema, 1991; Epstein, 1995; Bennett-Goleman, 2002; Neff, 2003a; Kabat-Zinn, 2023).

What, then, is the key factor to consider in compassion directed toward others? It is *empathy*. When empathy is insufficiently activated, individuals face fundamental difficulties in understanding or emotionally experiencing the suffering of others (Kanov et al., 2004; Dalai Lama, 2005; Gilbert, 2009a). In general, the most commonly recognized form of empathy is affective empathy, which refers to the capacity to be influenced by another person's emotions and to experience those emotions together (Mehrabian & Epstein, 1972). In contrast, the ability to intellectually understand another person's feelings or perspective is referred to as cognitive empathy (Hogan, 1969).

Davis (1980) argued that cognitive empathy and affective empathy are not separate processes but should be understood in an integrated manner. At the same time, he pointed out that emotional empathy toward another's suffering does not always lead to positive or prosocial responses and introduced the concept of *personal distress*. Personal distress refers to a self-focused empathic reaction in which individuals experience intense discomfort or aversion when confronted with another person's suffering and seek to avoid such situations. This type of response may arise when individuals excessively identify their own emotions with those of others (Singer & Klimecki, 2014).

In addition, there is one important difference between compassion and empathy. Whereas empathy is limited to understanding or feeling the suffering of others, compassion additionally involves a behavioral motivation to alleviate that suffering (Strauss et al., 2016). Particularly in the case of self-compassion, given that the target of suffering is oneself, it can reasonably be expected to be closely related to mental health. Indeed, the most consistent finding in previous research on self-compassion is that it reduces anxiety and depression (Neff, 2003a; Neff et al., 2007; Neff & Dahm, 2015). However, these effects are not confined solely to self-compassion; for example, Saarinen et al. (2019), through a 15-year longitudinal study, demonstrated that compassion is positively correlated with individuals' psychological well-being.

Taken together, compassion and self-compassion are composed of multidimensional components and appear to be strongly influenced by mindfulness and empathy in their development and functioning. These constructs have also been shown to exert positive effects on individuals' mental health. However, such conclusions are largely based on the simple aggregation of findings from individual studies grounded in different theoretical backgrounds, research aims, and methodological approaches, and thus remain limited in their capacity to provide an integrated understanding within a single conceptual framework. Accordingly, the relationships among the various psychological characteristics surrounding compassion and self-compassion need to be examined in an integrated manner within a single study, and the present study is motivated by this need.

Nevertheless, there are limitations in explaining the interaction structure among such diverse psychological characteristics using traditional statistical techniques such as correlation or regression analyses. This is because correlation analysis is a bivariate approach that can capture only simple linear relationships between two variables, while multiple regression analysis makes it difficult to clearly interpret the unique effects of individual variables when multicollinearity exists among predictors. Therefore, a new approach is required to integratively analyze the relationships among multiple highly interrelated variables, and the most suitable method for this purpose is *network analysis* (Seo, 2019).

A network refers to a structure in which multiple variables are interconnected, where each variable is termed a node and the lines representing the connections between nodes are called edges (Borsboom & Cramer, 2013; Costantini et al., 2015; Hevey, 2018). One important characteristic of a network is that not all nodes hold equal importance. Some nodes play relatively more central roles than others, and the index representing the extent of this importance is referred to as centrality (Fonseca-Pedrero, 2018;

Hevey, 2018). In the present study, the aim is to visually present the network structure among various psychological variables related to compassion and self-compassion and, by calculating centrality indices, to identify the variables that play key roles within the network.

In addition, this study seeks to construct subgroup networks by gender and age in order to explore how the patterns of interaction among compassion, self-compassion, mindfulness, empathy, and mental health variables differ according to demographic factors. A review of previous studies indicates that most research considering gender or age has focused primarily on examining differences in the levels or effect sizes of individual variables (Davis, 1980; Charles et al., 2001; Baron-Cohen & Wheelwright, 2004; Rueckert & Naybar, 2008; Yarnell et al., 2015; Alispahic & Hasanbegovic-Anic, 2017; Bluth et al., 2017). Even studies that analyzed relationships among variables have tended not to sufficiently take gender and age differences into account (Birnie et al., 2010; Fernando et al., 2017; Silver et al., 2018; Conversano et al., 2020).

Furthermore, even when studies have considered gender and age in relation to these variables, they have generally included only a limited number of psychological constructs surrounding compassion and self-compassion, rather than adopting a comprehensive approach, and have focused on examining relationships among variables while treating demographic factors as control variables rather than directly comparing differences by gender or age (Bluth & Blanton, 2015; Olson et al., 2015; Helminen et al., 2021). In particular, no study to date has compared the relational structure among these variables by gender or age using network analysis. Accordingly, the present study aims to address this gap for the first time. The findings are expected to contribute to expanding the theoretical understanding of compassion and self-compassion while also providing foundational data for the development of future intervention strategies.

2. Method

2.1 Participants

The data used in this study were collected through an online survey company in South Korea. Invitation emails describing the study were sent to panel members registered with the company who were aged 19 years or older, and the survey was administered to individuals who voluntarily agreed to participate. Participants responded anonymously to a total of 147 items, including demographic questions. After completing the survey, participants received a small monetary reward as compensation for their time. The survey company organized and verified the collected responses and subsequently provided the final raw dataset to the research team. As a result, data from a total of 1,020 adult participants were included in the final analyses.

The mean age of the total sample was 49 years (SD = 16.95, range = 18–94), with 51% identifying as male (n = 519) and 49% as female (n = 501). To compare networks across age groups, participants were categorized into three age groups: young adults (18–39 years), middle-aged adults (40–59 years), and

older adults (60–94 years), with 340 participants in each group. The young adult group had a mean age of 29.69 years (SD = 5.72), with an equal distribution of males and females (50%, n = 170 each). The middle-aged adult group had a mean age of 48.76 years (SD = 5.51), also with an equal gender distribution (50%, n = 170 each). The older adult group had a mean age of 68.55 years (SD = 6.54), with 53% identifying as male (n = 179) and 47% as female (n = 161).

2.2 Measures

2.2.1 Sussex-Oxford Compassion Scale

The Sussex-Oxford Compassion Scale (SOCS) is a tool designed to measure compassion. It was originally developed by Gu et al. (2020) and later translated and validated in Korean by Kim and Seo (2021). The SOCS consists of two subscales: the Sussex-Oxford Compassion for Others Scale (SOCS-O), which measures compassion for others, and the Sussex-Oxford Compassion for the Self Scale (SOCS-S), which measures self-compassion. Both scales share the same five subcomponents: (1) *recognizing suffering*, (2) *understanding the universality of suffering*, (3) *feeling for the person suffering*, (4) *tolerating uncomfortable feelings*, and (5) *motivation to act/acting to alleviate suffering*. Each subscale comprises 20 items, and respondents rated each item on a 5-point Likert scale ranging from 1 (Not at all true of me) to 5 (Always true of me). In the present study, both the SOCS-O and SOCS-S were administered. However, the subcomponent “understanding the universality of suffering” was excluded from the analysis, as it overlaps conceptually with *common humanity*, a subscale of the Self-Compassion Scale (Neff, 2003a). Both the original and Korean versions of the SOCS-O and SOCS-S have demonstrated high reliability and validity. In the current study, the Cronbach’s α for both SOCS-O and SOCS-S was .93, indicating excellent internal consistency.

2.2.2 Five Facet Mindfulness Questionnaire

The Five Facet Mindfulness Questionnaire (FFMQ) is a scale developed by Baer et al. (2006) to assess mindfulness. It was translated into Korean and validated by Won and Kim (2006). In the present study, the short-form version developed by Cheong et al. (2017), the FFMQ-15, was used. This scale consists of five subcomponents: (1) *observing*, (2) *describing*, (3) *acting with awareness*, (4) *nonjudging of inner experience*, and (5) *nonreactivity to inner experience*. Considering that most participants in this study had no prior experience with mindfulness meditation, items related to the “observing” subcomponent were excluded from the analysis. The FFMQ-15 uses a 7-point Likert scale ranging from 1 (Strongly disagree) to 7 (Strongly agree). In the current study, the Cronbach’s α for all items combined was .62. Subscale-specific Cronbach’s α values were as follows: describing, .80; acting with awareness, .83; nonjudging of inner experience, .67; and nonreactivity to inner experience, .73.

2.2.3 Self-Compassion Scale

The Self-Compassion Scale (SCS) was developed by Neff (2003b) and translated into Korean and validated by Kim et al. (2008). It is used to measure self-compassion and consists of 26 items. The scale includes six subcomponents: (1) *self-kindness*, (2) *self-judgment*, (3) *common humanity*, (4) *isolation*, (5)

mindfulness, and (6) *over-identification*. Among these, the “mindfulness” subcomponent was excluded from the analysis in the present study, as it overlaps conceptually with the FFMQ-15. Participants rated how well each item described them using a 5-point Likert scale ranging from 1 (Not at all true of me) to 5 (Almost always true of me). The original and Korean versions of the SCS demonstrated high internal consistency, with Cronbach’s α values of .92 and .87, respectively. In the present study, Cronbach’s α for the SCS was .89.

2.2.4 Interpersonal Reactivity Index

The Interpersonal Reactivity Index (IRI) is a tool developed by Davis (1980) to measure empathy, and it was translated into Korean and validated by Kang et al. (2009). The scale consists of 28 items divided equally across four subcomponents: (1) *perspective taking*, (2) *fantasy*, (3) *empathic concern*, and (4) *personal distress*. In the present study, the “fantasy” subcomponent was excluded from the analysis due to its low conceptual relevance to compassion. Each item is rated on a 5-point Likert scale ranging from 1 (Does not describe me well) to 5 (Describes me very well). The Korean version of the IRI demonstrated acceptable internal consistency, with a Cronbach’s α of .80 for the total scale. Subscale-specific Cronbach’s α were as follows: perspective taking, .61; empathic concern, .73; and personal distress, .71. In the current study, the Cronbach’s α for the total scale was .66, and the subscale α values were: perspective taking, .61; empathic concern, .64; and personal distress, .75.

2.2.5 Warwick-Edinburgh Mental Well-Being Scale

The Warwick-Edinburgh Mental Well-Being Scale (WEMWBS) was developed by Stewart-Brown et al. (2009) and was translated into Korean and validated by Kim et al. (2014). This scale consists of 14 items and is designed to assess mental well-being. Participants were asked to rate how well each item described their recent state of well-being, using a 5-point Likert scale ranging from 1 (None of the time) to 5 (All of the time). The Korean version of the WEMWBS demonstrated excellent internal consistency, with a Cronbach’s α of .94. In the present study, the Cronbach’s α was also .94.

2.2.6 Depression Anxiety Stress Scale

The Depression Anxiety Stress Scale (DASS) was developed by Lovibond and Lovibond (1995) to assess negative affect, which was later shortened to 21 items (DASS-21) by Henry and Crawford (2005). In the present study, the Korean version of the DASS-21 validated by Lee et al. (2019) was used. The scale consists of three subcomponents: (1) *depression*, (2) *anxiety*, and (3) *stress*, with seven items assigned to each subcomponent. Participants were asked to rate the extent to which each item described their negative emotional experiences using a 4-point Likert scale ranging from 0 (Did not apply to me at all) to 3 (Applied to me very much or most of the time). Both the original and Korean versions of the DASS-21 have demonstrated excellent reliability and validity. In the current study, the Cronbach’s α was .96, indicating a very high level of internal consistency.

2.3 Data Analysis

The present study employed R (version 4.5.1) to conduct network analysis, which was carried out in three stages. In the first stage, an EBICglasso network was constructed and its structure analyzed using the *bootnet* and *qgraph* packages. EBICglasso is a network estimation method based on the Gaussian Graphical Model (GGM), in which edge weights represent partial correlations. It incorporates the Least Absolute Shrinkage and Selection Operator (LASSO) technique—commonly used in regression analysis—to minimize unnecessary connections, while the Extended Bayesian Information Criterion (EBIC) is applied to balance model fit and complexity, ultimately yielding an optimal network structure (Costantini et al., 2015; Epskamp and Fried, 2018).

A total of six EBICglasso networks were constructed in this study: one based on the full sample, two based on gender (male and female), and three based on age group (young adults, middle-aged adults, and older adults). For network visualization, the Fruchterman–Reingold algorithm was applied to position highly connected nodes toward the center and place closely related nodes near each other (Fruchterman and Reingold, 1991). In EBICglasso, the balance between model fit and sparsity can be adjusted using the γ (gamma) parameter (Epskamp and Fried, 2018); in this study, the default value of γ = 0.5 was applied to all networks. Additionally, edges with absolute partial correlation values below 0.1 were considered to have low statistical significance and were therefore omitted from the visualizations.

In the second stage, the *qgraph* package was used to compute centrality indices for the full-sample network. First, expected influence centrality (EI) was calculated to assess the extent to which each node influences the entire network. Unlike degree centrality, EI does not convert negative edge weights into absolute values and takes into account both direct and indirect connections, thereby providing a more nuanced understanding of node importance (Robinaugh et al., 2016). Next, closeness centrality was computed to evaluate how close a given node is to all other nodes in the network. Higher closeness centrality values indicate that a node can reach other nodes with fewer average steps, suggesting that it occupies a more central position within the network. Finally, betweenness centrality was analyzed to determine how frequently a node lies on the shortest paths between pairs of other nodes. This index is commonly used to assess the extent to which a node functions as a bridge within the network (Opsahl et al., 2010).

In the third stage, the *bootnet* package was used to assess the stability of the networks through two types of bootstrapping. First, the stability of the three centrality indices in the full-sample network was evaluated using case-drop bootstrapping. This method repeatedly reconstructs the network after randomly removing a subset of cases and calculates the correlation stability coefficient (CS-coefficient) to assess the reliability of the centrality indices. Generally, a CS-coefficient of .50 or higher is considered acceptable, indicating that even when 50% of the sample is dropped, the rank correlation coefficient of centrality indices remains above .70. Next, to assess the accuracy of edge weight estimations, nonparametric bootstrapping was conducted for all networks, and the 95% confidence interval (CI) was examined. A wider CI suggests lower estimation accuracy, whereas a narrower CI indicates higher precision (Epskamp et al., 2018; Fried et al., 2022).

3. Result

3.1 Descriptive Statistics

A total of 24 variables were included in the present study. Table 1 presents the description, abbreviation, and descriptive statistics (means and standard deviations) for each variable. Overall, variables related to compassion, mindfulness, empathy, and well-being showed average scores above the midpoint of their respective scales. For example, *Feeling for the Person Suffering* (FPS-O)—a subcomponent of the SOCS-O measuring compassion for others—had a mean score of 3.63 (SD = 0.6) on a 5-point Likert scale. *Acting with Awareness* (Awa), a subcomponent of the FFMQ-15 measuring mindfulness, had a mean score of 4.28 (SD = 1.12) on a 7-point Likert scale. One exception was that *Self-Kindness* (S-Kind)—a subcomponent of the SCS measuring self-compassion—showed a mean score of 2.87 (SD = 0.74), which falls below the midpoint of 3 on the 5-point Likert scale.

However, variables reflecting negative psychological tendencies all showed mean scores at or below the midpoint of their respective scales. For example, *Self-Judgment* (S-Jud), the opposite construct of S-Kind, had a mean score of 2.53 (SD = 0.84). *Personal Distress* (PD), a subcomponent of the IRI measuring empathy, had a mean of 2.92 (SD = 0.6) on a 5-point Likert scale. In addition, all three subcomponents of the DASS-21—*Depression* (Dep), *Anxiety* (Anx), and *Stress* (Str)—showed mean scores below 1 (SDs < 0.7), which corresponds to a low level on the 0–3 Likert scale. These results suggest that the participants generally exhibited adaptive psychological characteristics.

3.2 Network of Compassion, Self-Compassion, Mindfulness, Empathy and Mental Health

3.2.1 Network Structure

Figure 1 illustrates the structure of the network comprising compassion for others, self-compassion, mindfulness, empathy, well-being, and negative affect among all participants. If all 24 nodes in the network were fully connected, a theoretical maximum of 276 edges could be formed. However, to maintain explanatory power while minimizing complexity, the EBICglasso method was applied, resulting in a total of 140 (51%) significant edges. Among these, 94 (67%) were classified as positive edges and 46 (33%) as negative edges.

The patterns of connections among the network variables were as follows. Compassion was organized around *Feeling for the Person Suffering* (FPS-O). FPS-O was positioned between *Recognizing Suffering* (RS-O), *Tolerating Uncomfortable Feelings* (TUF-O), and *Motivation to Act/Acting to Alleviate Suffering* (MAAS-O), and was also directly connected to *Empathic Concern* (EC) (edge weight = 0.25). *Nonreactivity to Inner Experience* (Non-R), a subcomponent of mindfulness, was connected to TUF-S and *Self-Kindness* (S-Kind) (edge weights: TUF = 0.27, S-Kind = 0.16).

Well-Being (WB) showed direct connections with multiple psychological variables. WB was positively associated with *Describing* (Des) (edge weight = 0.16) and with S-Kind (edge weight = 0.23), and was negatively associated with *Depression* (Dep) (edge weight = − 0.21). A positive association was observed between *Over-Identification* (O-Ide) and *Personal Distress* (PD) (edge weight = 0.16), and both nodes were negatively associated with *Acting with Awareness* (Awa) (edge weights: O-Ide = − 0.17, PD = − 0.13). In addition, O-Ide formed a self-critical cluster with *Self-Judgment* (S-Jud) and *Isolation* (Iso), and PD showed negative associations with Non-R and WB (edge weights: Non-R = − 0.13; WB = − 0.15).

3.2.2 Network Centrality and Stability

The centrality indices calculated based on the full-sample network are presented in Table 2. According to the expected influence centrality (EI), *Feeling for the Person Suffering* (FPS-O = 1.23, FPS-S = 1.07), *Tolerating Uncomfortable Feelings* (TUF-O = 1.03, TUF-S = 0.97), and *Motivation to Act/Acting to Alleviate Suffering* (MAAS-O = 1.04, MAAS-S = 1.04) exerted the greatest influence within the network. In contrast, *Nonjudging of Inner Experience* (Non-J = − 0.51), *Acting with Awareness* (Awa = − 0.39), and *Personal Distress* (PD = − 0.25) had negative effects on the network. In terms of closeness centrality, *Well-Being* (WB = 2.34), *Empathic Concern* (EC = 1.55), FPS-O (1.40), *Self-Judgment* (S-Jud = 1.24), *Nonreactivity to Inner Experience* (Non-R = 1.00), and *Depression* (Dep = 1.00) showed the highest values. Regarding betweenness centrality, Non-R (1.95), WB (1.79), *Describing* (Des = 1.69), *Self-Kindness* (S-Kind = 1.08), PD (0.88), and TUF-S (0.55) exhibited relatively high scores.

As a result of the case-drop bootstrap conducted for the three centrality indices, the CS-coefficient for expected influence was 0.75, indicating a high level of stability. The CS-coefficients for closeness centrality and betweenness centrality were 0.67 and 0.52, respectively—lower than that of expected influence but still within an acceptable range indicating reasonably stable centrality estimates. Next, nonparametric bootstrapping revealed that the average width of the 95% confidence interval for edge weights was 0.09. The minimum width was 0.03 (*Perspective Taking–Stress*; edge weight = − 0.003), and the maximum width was 0.14 (*Acting with Awareness–Nonjudging of Inner Experience*; edge weight = 0.19). Graphs illustrating the stability of the centrality indices and the accuracy of edge weight estimates for this network are presented in Fig. 2.

3.3 Networks by Gender and Age

3.3.1 Gender-Based Networks

After dividing all participants by gender and constructing subnetworks, the EBICglasso method was applied. In the male network, a total of 140 edges (51%) were found to be significant, with 98 (70%) being positive and 42 (30%) negative. In the female network, 127 edges (46%) were identified as significant, of which 87 (69%) were positive and 40 (31%) negative. The structures of each network are presented in Fig. 3, and the results of the nonparametric bootstrap assessing the accuracy of edge weight estimates can be found in Supplementary material 1.

Several structural differences were identified when comparing the gender-based networks. In the male network, a connection between *Perspective Taking* (PT) and *Common Humanity* (C-Hum) was observed (edge weight = 0.16). In addition, the negative association between *Personal Distress* (PD) and *Acting with Awareness* (Awa) was stronger in males than in females (edge weights: male = − 0.15, female = − 0.11), and, unlike in the female network, PD in males was also connected to *Nonreactivity to Inner Experience* (Non-R) (edge weight = − 0.14).

The connection between *Recognizing Suffering* (RS-S) and *Motivation to Act/Acting to Alleviate Suffering* (MAAS-S) was stronger in males (edge weights: male = 0.18, female = 0.13), whereas a connection between RS-O and MAAS-O, which was not observed in the male network, emerged in the female network (edge weight = 0.13). Furthermore, additional connections were identified in the female network between *Tolerating Uncomfortable Feelings* (TUF-O) and PT (edge weight = 0.15), and between *Self-Kindness* (S-Kind) and MAAS-S (edge weight = 0.15). Moreover, the negative association between *Well-Being* (WB) and *Depression* (Dep) was stronger in females than in males (edge weights: male = − 0.17, female = − 0.21).

3.3.2 Age-Based Networks

After dividing participants into age groups, sub-networks were constructed using the EBICglasso method. In the young adult network, a total of 130 edges (47%) were found to be significant, of which 88 (68%) were positive and 42 (32%) were negative. In the middle-aged adult network, 123 edges (45%) were significant, with 83 (67%) being positive and 40 (33%) negative. Similarly, in the older adult network, 123 edges (45%) were also significant, consisting of 90 positive edges (73%) and 33 negative edges (27%). The structures of each network are presented in Fig. 4, and the results of nonparametric bootstrapping for assessing the accuracy of edge weight estimations are shown in Supplementary material 2.

Examination of the network structures by age group revealed several notable differences. In the young adult network, *Recognizing Suffering* (RS-O) and *Motivation to Act/Acting to Alleviate Suffering* (MAAS-O) were directly connected (edge weight = 0.12). A connection was also observed between *Nonreactivity to Inner Experience* (Non-R) and *Self-Kindness* (S-Kind); this connection was present in the middle-aged group as well but was considerably stronger in the young adult group (edge weights: young adults = 0.28, middle-aged adults = 0.12). In addition, a positive association was found between *Common Humanity* (C-Hum) and *Well-Being* (WB) (edge weight = 0.11).

In the middle-aged network, as in the female network, *Tolerating Uncomfortable Feelings* (TUF-O) was connected to *Perspective Taking* (PT) (edge weight = 0.12). Compassion and self-compassion were directly linked not only through RS-O and RS-S (edge weight = 0.13) but also through TUF-O and TUF-S (edge weight = 0.15), as well as FPS-O and FPS-S (*Feeling for the Person Suffering*; edge weight = 0.10). Furthermore, positive associations were observed between RS-S and TUF-S (edge weight = 0.13), between PT and WB (edge weight = 0.11), and between *Isolation* (Iso) and *Depression* (Dep) (edge weight = 0.12).

In the older adult network, *Empathic Concern* (EC) and PT were isolated without connections to other nodes. Compassion and self-compassion were not directly connected; instead, they were indirectly linked through the mindfulness components *Describing* (Des) and Non-R. In addition, MAAS-S showed positive associations with S-Kind and WB (edge weights: S-Kind = 0.18, WB = 0.12), while *Acting with Awareness* (Awa) was negatively associated with *Over-Identification* (O-Ide) and Iso (edge weights: O-Ide = − 0.14, Iso = − 0.16). Finally, O-Ide was positively connected to *Anxiety* (Anx), and *Personal Distress* (PD) was positively connected to Dep, with both edge weights of 0.13.

4. Discussion

In the present study, network analysis was conducted to integratively explore the relationships among compassion, self-compassion, mindfulness, empathy, well-being, and negative affect, and to identify structural differences according to demographic factors. The results indicated that compassion was most closely associated with empathy, which may be because compassion inherently includes the capacity to emotionally experience the suffering of others as a core component. Indeed, the central factor linking compassion and empathy in this study was the ability to feel and emotionally respond to others' emotions. Furthermore, it was found that, following this emotional response process, the motivation and actions aimed at helping a person who is suffering were more readily activated.

In contrast, self-compassion was strongly related to mindfulness, and the key factor connecting these two constructs was an attitude of tolerating one's own emotional discomfort and refraining from reacting to it. Conversely, a tendency to feel intense discomfort toward one's own suffering and to become restless appeared to undermine mindfulness, which in turn may lead to the deactivation of self-compassion. These findings are consistent with previous research suggesting that, in order to practice self-compassion, an attitude of not being overwhelmed by one's emotions must precede, and that the psychological mechanism enabling this process is mindfulness (Baer et al., 2012; Neff, 2003a).

An interesting finding was that experiences of being overwhelmed by the suffering of others could also inhibit self-compassion. Previous studies have reported that mindfulness is effective in alleviating negative emotions experienced in social relationships (Britton et al., 2012; Christodoulou et al., 2025). In the present study, not only excessive identification with one's own suffering but also personal distress—defined as a reaction of discomfort toward others' suffering accompanied by a desire to avoid it—showed a direct negative association with mindfulness. However, as noted earlier, mindfulness was positioned closer to self-compassion than to compassion, and no direct link was observed between compassion and personal distress in this study. This suggests that excessive identification with others' suffering may weaken compassion toward the self before it undermines compassion toward others.

This pattern may be understood in the following context. First, personal distress is inherently regarded as a self-focused emotional response (Davis, 1980, 1983; Batson et al., 1987). Although it is triggered by another person's suffering and may lead to behaviors aimed at avoiding that suffering, the target of the distress experienced in this process ultimately remains the self. Moreover, from an evolutionary

neurophysiological perspective, Gilbert (2009b) proposed that stimuli that elicit instinctive avoidance responses are accompanied by emotional surges such as anxiety, anger, and disgust. Under such emotionally threatening conditions, individuals may find it difficult to observe their own suffering in a nonjudgmental manner or to maintain an appropriate psychological distance. Consequently, when the activation of personal distress brings individuals face to face with emotions perceived as threatening to the self, mindfulness may naturally weaken; accordingly, self-compassion—which is more closely linked to mindfulness—may deteriorate more rapidly than compassion toward others.

According to the centrality indices, the nodes with the greatest influence within the network were the components of compassion and self-compassion proposed by Strauss et al. (2016). Among these components, the attitude of feeling suffering, accepting it, and seeking to alleviate it emerged as the most central factor within the network. Meanwhile, Well-Being and Nonreactivity to Inner Experience were positioned at the center of the network, mediating various psychological characteristics. These connections primarily involved factors related to self-compassion, mindfulness, negative affect, and personal distress. In contrast, compassion and empathy were not included in this central connectivity structure and tended to form a relatively independent domain within the network, mainly centered on their mutual relationships.

The interactions among psychological characteristics surrounding compassion and self-compassion exhibited distinct patterns depending on demographic factors. In the gender comparison, the male group showed that cognitively understanding others' suffering and recognizing it as a universal human experience played a crucial role in forming compassion toward both the self and others, as well as in shifting the focus between these two targets. Previous studies have reported that men tend to regulate negative emotions more effectively at a cognitive level (Birditt & Fingerman, 2003) or to use cognitive control strategies more frequently to counteract negative affect (Thayer et al., 1994). Moreover, in the interaction between emotion and cognition, women have been found to show greater activation in emotion-related regions such as the amygdala and orbitofrontal cortex, whereas men exhibit broader activation in the prefrontal–parietal–cingulate network, suggesting that cognitive mechanisms are more actively recruited in emotional situations (Koch et al., 2007). The prominence of cognitive factors in the male network observed in the present study may reflect this context.

In the female group, it was suggested that the motivation and behaviors aimed at alleviating suffering were activated relatively rapidly upon witnessing others' suffering, even without prior emotional identification. This contrasts with the pattern observed in males, in which immediate alleviation motivation and behavior were primarily activated only when their own suffering was recognized. The present study raises the possibility that this difference may be related to gender-based sociocultural role expectations. Supporting this interpretation, Gilligan (1982) proposed that masculinity emphasizes justice and individual rights, whereas femininity emphasizes care and responsibility for others. Women who have internalized such social norms may naturally display prosocial behavior upon recognizing another person's suffering (Eisenberg & Lennon, 1983; Karniol et al., 2003).

Differences were also observed in the age-based networks. Previous research has suggested that mindfulness can strengthen a more accepting and compassionate attitude toward oneself (Neff, 2003a; Baer et al., 2012; Britton et al., 2012; Bluth & Blanton, 2014). The present study further revealed that this pattern was more pronounced at younger ages. In addition, young adulthood is a period characterized by the most active social interaction, during which stress and failure can have a substantial impact on mental health. Recognizing that one is not alone in experiencing such suffering may serve as an important protective factor for psychological stability in this age group (Neff & Pommier, 2013), and the current findings provide support for this interpretation.

Middle adulthood is a period characterized by a substantial increase in relational responsibilities and emotional burdens, as individuals often assume the dual role of supporting both children and aging parents. According to Erikson's (1963) psychosocial developmental theory, the central developmental task of middle adulthood is generativity, which develops through caring for others and nurturing the next generation. Furthermore, individuals at this stage are expected to take full responsibility not only for others but also for themselves. In this context, the finding that compassion and self-compassion exhibited the most integrated structure in the middle-aged group can be considered theoretically plausible. Specifically, whereas the young adult group tended to understand their own and others' suffering similarly at a primarily cognitive level, the middle-aged group demonstrated an expansion of this understanding beyond the cognitive domain to the emotional domain. In this process, the ability to tolerate suffering and accept it without judgment played the most central role.

In contrast, in the older adult group, the connection between compassion and self-compassion appeared relatively weak, and mindfulness, rather than empathy, was more closely associated with compassion. This suggests that older adults may be less inclined to link others' suffering with their own and may express compassionate responses more selectively when their personal emotional stability is secured. Indeed, as individuals transition from middle to older adulthood, the scope of social relationships tends to narrow, and they are increasingly relieved of occupational roles and responsibilities such as childrearing and caregiving, thereby reducing opportunities for direct engagement with others' suffering. Moreover, due to general declines in physical and psychological energy, greater resources may be required for emotional recovery when exposed to negative affect. In this context, older adults may place greater emphasis on maintaining their own emotional stability and may be less likely to closely associate others' suffering with their own (Carstensen, 1995; Mather, 2012; Baez-Lugo et al., 2023).

Meanwhile, the connections among nodes representing negative characteristics became stronger with increasing age. In particular, in the middle-aged group, social isolation was associated with depression, whereas in the older adult group, experiences of being excessively overwhelmed by one's own or others' suffering were related to depression and anxiety. These findings suggest that, in middle adulthood, disconnection from others may function as an emotional risk factor, whereas in older adulthood, maintaining emotional distance may play a more important role in stabilizing personal affect. This interpretation is also consistent with the psychological characteristics of later life discussed earlier.

4.1 Implications of the Present Study

The implications of the present study are as follows. First, the study empirically supported and reinforced previous findings on the associations among compassion, self-compassion, mindfulness, empathy, and mental health. In addition, it explored and identified novel relational patterns that had been difficult to detect in earlier research. Second, most network studies including self-compassion have focused on the three components proposed by Neff (2003a) (Moroń & Kocur, 2023; Huang et al., 2024; Quinn-Nilas & Milhausen, 2024; Heng et al., 2025; Hou et al., 2026). The present study extended this approach by incorporating the five elements proposed by Strauss et al. (2016), thereby enabling the simultaneous analysis of compassion and self-compassion and allowing for a more nuanced understanding of these constructs. Third, although a few studies have conducted network analyses using variables similar to those examined in the present research (Roca et al., 2019, 2021; Medvedev et al., 2021), no study was identified that constructed networks by demographic subgroups and systematically compared them as in the present study. This study represents the first attempt to undertake such an approach and yielded meaningful findings.

Fourth, the findings of this study carry not only academic but also practical implications. Identifying central factors through centrality indices in network analysis may help establish more efficient and targeted intervention strategies in clinical settings (Borsboom & Cramer, 2013). In this context, the emotional experience of suffering, its acceptance, and the motivation and behavior to alleviate it—each of which demonstrated high expected influence—may be proposed as priority targets in future compassion-based interventions. Moreover, the distinct network structures observed across gender and age groups highlight the need for differentiated intervention strategies and mental health programs that take demographic characteristics into account, while also providing empirical support for such approaches. For example, in men diagnosed with narcissistic personality disorder, cognitive approaches that reframe personal suffering as part of the shared human experience may facilitate the expansion of compassion toward others. Meanwhile, mental health programs targeting middle-aged adults may promote reductions in depressive symptoms and enhancements in well-being by incorporating strategies that foster social interaction and emotional communication.

4.2 Limitations and Suggestions for Future Research

The limitations of the present study are as follows. First, because this study was based on cross-sectional data, it was not possible to observe changes in interactions over time, which constrains the ability to infer causal relationships among variables. Future research should collect longitudinal data on the key variables examined in this study in order to clarify the directionality of these relationships more precisely. Second, as data were collected through an online survey, the sample of older adults was primarily composed of individuals with basic computer skills and access to the internet. Therefore, the older adults who participated in this study may have possessed relatively higher levels of education and information literacy compared to the general older population, which may impose certain limitations on the generalizability of the findings.

Third, centrality indices were not calculated for the gender- and age-specific networks. This decision was made because subdividing the sample would have reduced the number of participants in each group, raising concerns about a substantial decline in the stability of the centrality estimates. However, centrality indices are regarded as core interpretive tools in network analysis; therefore, future studies should aim to secure larger samples in order to examine potential differences in centrality according to demographic factors. Fourth, network analysis is inherently a data-driven exploratory method, and thus the results may vary depending on the characteristics of the collected data. Accordingly, the novel findings presented in this study should be viewed as exploratory interpretations rather than as confirmatory evidence, and future research should systematically test the hypotheses derived from this study using more rigorous methodologies.

Fifth, there are conceptual and measurement-related limitations associated with the Sussex-Oxford Compassion Scale (SOCS) used in this study. Theoretically, the behavioral component of compassion may be distinguished into the motivation to alleviate suffering and the actual behavior aimed at alleviating it, and such behaviors may further be subdivided into verbal and nonverbal forms (Julia et al., 2024). However, the behavioral subfactor of the SOCS—*Motivation to Act/Acting to Alleviate Suffering*—assesses these elements in an integrated manner without differentiating between motivation and behavior. Moreover, even items intended to capture actual behavior do not clearly distinguish between verbal and nonverbal actions. Therefore, when interpreting findings related to the behavioral factor in this study, it is important to consider that this construct represents a composite indicator encompassing both motivation and behavior. Future research is needed to assess the behavioral component of compassion in a more differentiated manner and to examine how these distinct elements are associated with other variables.

Sixth, there are limitations regarding the reliability and validity of the Five Facet Mindfulness Questionnaire (FFMQ) used in this study. In the Korean validation study conducted by Won and Kim (2006), *Nonjudging of Inner Experience* (Non-J) showed a significant correlation only with *Acting with Awareness* (Awa; r = .33), and not with *Nonreactivity to Inner Experience* (Non-R; r = .04) or *Describing* (Des; r = .06). Moreover, in the confirmatory factor analysis (CFA), Non-J and Non-R were negatively correlated (r = − .13), and in the hierarchical CFA examining whether the five facets of the FFMQ could be subsumed under a single higher-order construct, Non-J was found not to adequately reflect the overarching concept of mindfulness (λ = −.07). These issues were replicated in the present study. The Cronbach's α values for Non-J and Non-R remained relatively low at .67 and .73, respectively, and the partial correlation between the two facets was − .14, a result inconsistent with theoretical assumptions. Such problems with reliability and correlation coefficients suggest that certain facets of the Korean version of the FFMQ—particularly Non-J—may be measured inconsistently or may be conceptually unstable. Therefore, caution is warranted when interpreting relationships involving nodes connected to Non-J in this study, and future research is encouraged to employ instruments with stronger reliability and validity.

Declarations

Ethics approval and consent to participate

The present study received ethical approval from the Institutional Review Board of Jeonbuk National University. All research procedures involving human participants were carried out in compliance with the ethical standards of the institutional research committee and the principles outlined in the Declaration of Helsinki. Written informed consent was obtained from all participants prior to their inclusion in the study.

Consent for publication

Not applicable.

Competing interests

The authors declare that there are no competing interests.

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Author Contribution

SL led the conception and design of the study, carried out all statistical analyses, and wrote the first draft of the manuscript. JS provided academic guidance on the study design and interpretation of the results and contributed to the critical revision of the manuscript. All authors reviewed and approved the final version of the manuscript.

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Not applicable.

Data Availability

The data supporting the findings of this study are not publicly accessible due to ethical considerations and the need to protect participant confidentiality. However, the datasets may be made available by the corresponding author upon reasonable request.

References

1. Alispahic S, Hasanbegovic-Anic E. Mindfulness: Age and gender differences on a Bosnian sample. Psychol Thought. 2017;10(1):155–66.

2. Baer RA, Lykins EL, Peters JR. Mindfulness and self-compassion as predictors of psychological wellbeing in long-term meditators and matched nonmeditators. J Posit Psychol. 2012;7(3):230–8.
3. Baer RA, Smith GT, Hopkins J, Krietemeyer J, Toney L. Using self-report assessment methods to explore facets of mindfulness. Assessment. 2006;13(1):27–45.
4. Baez-Lugo S, Deza-Araujo YI, Maradan C, Collette F, Lutz A, Marchant NL, Chételat G, Vuilleumier P, Klimecki O. Exposure to negative socio-emotional events induces sustained alteration of resting-state brain networks in older adults. Nat aging. 2023;3(1):105–20.
5. Baron-Cohen S, Wheelwright S. The empathy quotient: an investigation of adults with Asperger syndrome or high functioning autism, and normal sex differences. J Autism Dev Disord. 2004;34(2):163–75.
6. Batson CD, Fultz J, Schoenrade PA. Distress and empathy: Two qualitatively distinct vicarious emotions with different motivational consequences. J Pers. 1987;55(1):19–39.
7. Bennett-Goleman T. Emotional alchemy: How the mind can heal the heart. Harmony; 2002.
8. Birditt KS, Fingerman KL. Age and gender differences in adults' descriptions of emotional reactions to interpersonal problems. Journals Gerontol Ser B: Psychol Sci Social Sci. 2003;58(4):P237–45.
9. Birnie K, Speca M, Carlson LE. Exploring self-compassion and empathy in the context of mindfulness-based stress reduction (MBSR). Stress Health. 2010;26(5):359–71.
10. Bluth K, Blanton PW. Mindfulness and self-compassion: Exploring pathways to adolescent emotional well-being. J Child Fam stud. 2014;23(7):1298–309.
11. Bluth K, Blanton PW. The influence of self-compassion on emotional well-being among early and older adolescent males and females. J Posit Psychol. 2015;10(3):219–30.
12. Bluth K, Campo RA, Futch WS, Gaylord SA. Age and gender differences in the associations of self-compassion and emotional well-being in a large adolescent sample. J Youth Adolesc. 2017;46(4):840–53.
13. Borsboom D, Cramer AO. Network analysis: an integrative approach to the structure of psychopathology. Ann Rev Clin Psychol. 2013;9(1):91–121.
14. Britton WB, Shahar B, Szepsenwol O, Jacobs WJ. Mindfulness-based cognitive therapy improves emotional reactivity to social stress: results from a randomized controlled trial. Behav Ther. 2012;43(2):365–80.
15. Carstensen LL. Evidence for a life-span theory of socioemotional selectivity. Curr Dir Psychol Sci. 1995;4(5):151–6.
16. Charles ST, Reynolds CA, Gatz M. Age-related differences and change in positive and negative affect over 23 years. J Personal Soc Psychol. 2001;80(1):136.
17. Cheong MJ, Chae EY, Lyu YS, Kang HW. The validation of Korean version of Five Facet Mindfulness Questionnaire short form. J Orient Neuropsychiatry. 2017;28(3):207–16.
18. Christodoulou V, Ilia C, Hadjigeorgiou S. Can mindfulness and self-compassion protect from relational aggression and victimization in college? J Coll Student Mental Health. 2025;39(1):24–48.

19. Conversano C, Ciacchini R, Orrù G, Di Giuseppe M, Gemignani A, Poli A. Mindfulness, compassion, and self-compassion among health care professionals: What's new? A systematic review. Front Psychol. 2020;11:1683.
20. Costantini G, Epskamp S, Borsboom D, Perugini M, Mõttus R, Waldorp LJ, Cramer AO. State of the aRt personality research: A tutorial on network analysis of personality data in R. J Res Pers. 2015;54:13–29.
21. Dalai Lama. Essence of the heart sutra. Wisdom Publication, Sommerville; 2005.
22. Davis MH. (1980). A multidimensional approach to individual differences in empathy.
23. Davis MH. Measuring individual differences in empathy: evidence for a multidimensional approach. J Personal Soc Psychol. 1983;44(1):113.
24. Eisenberg N, Lennon R. Sex differences in empathy and related capacities. Psychol Bull. 1983;94(1):100.
25. Epskamp S, Borsboom D, Fried EI. Estimating psychological networks and their accuracy: A tutorial paper. Behav Res Methods. 2018;50(1):195–212.
26. Epskamp S, Fried EI. A tutorial on regularized partial correlation networks. Psychol Methods. 2018;23(4):617.
27. Epstein M. Thoughts without a thinker: Buddhism and psychoanalysis. Psychoanal Rev. 1995;82(3):391.
28. Erikson EH. Childhood and society. Volume 2. Norton New York; 1963.
29. Fernando AT, Skinner K, Consedine NS. Increasing compassion in medical decision-making: can a brief mindfulness intervention help? Mindfulness. 2017;8(2):276–85.
30. Fonseca-Pedrero E. Network analysis in psychology. Papeles del Psicólogo. 2018;39(1):1–12.
31. Fried EI, Epskamp S, Veenman M, van Borkulo CD. Network stability, comparison, and replicability. Network psychometrics with r. Routledge; 2022. pp. 133–53.
32. Fruchterman TM, Reingold EM. Graph drawing by force-directed placement. Software: Pract experience. 1991;21(11):1129–64.
33. Gilbert P. Compassion and cruelty: A biopsychosocial approach. Compassion. Routledge; 2005. pp. 9–74.
34. Gilbert P. (2009a). *The compassionate mind*. Robinson.
35. Gilbert P. Introducing compassion-focused therapy. Adv Psychiatr Treat. 2009b;15(3):199–208.
36. Gilligan C. In a Different Voice: Psychological Theory and Women's Development. Harvard University Press; 1982.
37. Goetz JL, Keltner D, Simon-Thomas E. Compassion: an evolutionary analysis and empirical review. Psychol Bull. 2010;136(3):351.
38. Gu J, Baer R, Cavanagh K, Kuyken W, Strauss C. Development and psychometric properties of the Sussex-Oxford compassion scales (SOCS). Assessment. 2020;27(1):3–20.

39. Helminen EC, Scheer JR, Felver JC. Gender differences in the associations between mindfulness, self-compassion, and perceived stress reactivity. Mindfulness. 2021;12(9):2173–83.
40. Heng H, Zheng Y, Zheng F, Su H, Tang L, Zhao Y, He Y, Yang G. The role of self-compassion in mental health among early adulthood with ADHD symptoms: a network psychometric approach. BMC Psychol. 2025;13(1):777.
41. Henry JD, Crawford JR. The short-form version of the Depression Anxiety Stress Scales (DASS-21): Construct validity and normative data in a large non-clinical sample. Br J Clin Psychol. 2005;44(2):227–39.
42. Hevey D. Network analysis: a brief overview and tutorial. Health Psychol Behav Med. 2018;6(1):301–28.
43. Hogan R. Development of an empathy scale. J Consult Clin Psychol. 1969;33(3):307.
44. Hou Y, Luo X, Zhao D, Wan S, Yuan H. Self-compassion, mindful self-compassion intervention, and test anxiety in adolescent students: Combining latent profile analysis and network analysis. Pers Indiv Differ. 2026;249:113498.
45. Huang J, Xie T, Xu W. How does self-compassion interact with depression and anxiety among old people? Evidence from cross-lagged panel network analysis. Mindfulness. 2024;15(10):2568–81.
46. Julia GJ, Romate J, Allen JG, Rajkumar E. Compassionate communication: a scoping review. Front Communication. 2024;8:1294586.
47. Kabat-Zinn J. (2023). *Wherever you go, there you are: Mindfulness meditation in everyday life*. Hachette UK.
48. Kang I, Kee S, Kim S-E, Jeong B, Hwang J-H, Song J-E, Kim J-W. (2009). Reliability and validity of the Korean-version of Interpersonal Reactivity Index. J Korean Neuropsychiatric Association, 352–8.
49. Kanov JM, Maitlis S, Worline MC, Dutton JE, Frost PJ, Lilius JM. Compassion in organizational life. Am Behav Sci. 2004;47(6):808–27.
50. Karniol R, Grosz E, Schorr I. Caring, gender role orientation, and volunteering. Sex roles. 2003;49(1):11–9.
51. Kim G, Lee U, Chae S, Lee G. The validation study of the Korean version of the Self-Compassion Scale. Korean J Health Psychol. 2008;13(4):1023–44.
52. Kim J, Seo JW. Assessing compassion in Korean population: psychometric properties of the Korean version of Sussex-Oxford Compassion Scales. Front Psychol. 2021;12:744481.
53. Kim S, Jung H-Y, Na K-S, Lee SI, Kim S-G, Lee AR, Cho JT. A validation study of the Korean version of warwick-edinburgh mental well-being scale. J Korean Neuropsychiatric Association. 2014;53(4):237–45.
54. Koch K, Pauly K, Kellermann T, Seiferth NY, Reske M, Backes V, Stöcker T, Shah NJ, Amunts K, Kircher T. Gender differences in the cognitive control of emotion: An fMRI study. Neuropsychologia. 2007;45(12):2744–54.

55. Lee E-H, Moon SH, Cho MS, Park ES, Kim SY, Han JS, Cheio JH. The 21-item and 12-item versions of the depression anxiety stress scales: psychometric evaluation in a Korean population. Asian Nurs Res. 2019;13(1):30–7.
56. Lovibond PF, Lovibond SH. Manual for the Depression Anxiety Stress Scales. 2nd ed. Psychology Foundation; 1995.
57. Mather M. The emotion paradox in the aging brain. Ann N Y Acad Sci. 2012;1251(1):33–49.
58. Medvedev ON, Cervin M, Barcaccia B, Siegert RJ, Roemer A, Krägeloh CU. Network analysis of mindfulness facets, affect, compassion, and distress. Mindfulness. 2021;12(4):911–22.
59. Mehrabian A, Epstein N. (1972). A measure of emotional empathy. J Pers.
60. Moroń M, Kocur D. Self-Compassion and Obsessive–compulsive symptoms in a non-clinical sample: Insights from Network Analysis and Canonical Correlation Analysis. Mindfulness. 2023;14(12):3052–68.
61. Neff K. Self-compassion: An alternative conceptualization of a healthy attitude toward oneself. Self identity. 2003a;2(2):85–101.
62. Neff KD. The development and validation of a scale to measure self-compassion. Self identity. 2003b;2(3):223–50.
63. Neff KD, Dahm KA. (2015). Self-compassion: What it is, what it does, and how it relates to mindfulness. *Handbook of mindfulness and self-regulation*, 121–137.
64. Neff KD, Kirkpatrick KL, Rude SS. Self-compassion and adaptive psychological functioning. J Res Pers. 2007;41(1):139–54.
65. Neff KD, Pommier E. The relationship between self-compassion and other-focused concern among college undergraduates, community adults, and practicing meditators. Self identity. 2013;12(2):160–76.
66. Nolen-Hoeksema S. Responses to depression and their effects on the duration of depressive episodes. J Abnorm Psychol. 1991;100(4):569.
67. Olson K, Kemper KJ, Mahan JD. What factors promote resilience and protect against burnout in first-year pediatric and medicine-pediatric residents? J evidence-based Complement Altern Med. 2015;20(3):192–8.
68. Opsahl T, Agneessens F, Skvoretz J. Node centrality in weighted networks: Generalizing degree and shortest paths. Social networks. 2010;32(3):245–51.
69. Quinn-Nilas C, Milhausen RR. Mindfulness networks: Analyzing associations with self-compassion, other-compassion, need fulfillment, and satisfaction in midlife married Canadians. Personal Relationships. 2024;31(2):578–602.
70. Robinaugh DJ, Millner AJ, McNally RJ. Identifying highly influential nodes in the complicated grief network. J Abnorm Psychol. 2016;125(6):747.
71. Roca P, Diez G, Castellanos N, Vazquez C. Does mindfulness change the mind? A novel psychonectome perspective based on Network Analysis. PLoS ONE. 2019;14(7):e0219793.

72. Roca P, Diez G, McNally RJ, Vazquez C. The impact of compassion meditation training on psychological variables: a network perspective. Mindfulness. 2021;12(4):873–88.
73. Rueckert L, Naybar N. Gender differences in empathy: The role of the right hemisphere. Brain Cogn. 2008;67(2):162–7.
74. Saarinen A, Keltikangas-Järvinen L, Cloninger CR, Veijola J, Elovainio M, Lehtimäki T, Raitakari O, Hintsanen M. The relationship of dispositional compassion for others with depressive symptoms over a 15-year prospective follow-up. J Affect Disord. 2019;250:354–62.
75. Seo JW. A Network Analysis of Capability for Suicide. Korean J Health Psychol. 2019;587–606. //dx.doi.org/10.17315/kjhp.2019.24.3.004. https://doi.org/http:.
76. Silver J, Caleshu C, Casson-Parkin S, Ormond K. Mindfulness among genetic counselors is associated with increased empathy and work engagement and decreased burnout and compassion fatigue. J Genet Couns. 2018;27(5):1175–86.
77. Singer T, Klimecki OM. Empathy and compassion. Curr Biol. 2014;24(18):R875–8.
78. Stewart-Brown S, Tennant A, Tennant R, Platt S, Parkinson J, Weich S. Internal construct validity of the Warwick-Edinburgh mental well-being scale (WEMWBS): a Rasch analysis using data from the Scottish health education population survey. Health Qual Life Outcomes. 2009;7:1–8.
79. Strauss C, Taylor BL, Gu J, Kuyken W, Baer R, Jones F, Cavanagh K. What is compassion and how can we measure it? A review of definitions and measures. Clin Psychol Rev. 2016;47:15–27.
80. Thayer RE, Newman JR, McClain TM. Self-regulation of mood: strategies for changing a bad mood, raising energy, and reducing tension. J Personal Soc Psychol. 1994;67(5):910.
81. Wang S. A conceptual framework for integrating research related to the physiology of compassion and the wisdom of Buddhist teachings. Compassion. Routledge; 2005. pp. 75–120.
82. Won D, Kim K. Validation of the Korean version of five-factor mindfulness questionnaire. Korean J Health Psychol. 2006;11(4):871–86.
83. Yarnell LM, Stafford RE, Neff KD, Reilly ED, Knox MC, Mullarkey M. Meta-analysis of gender differences in self-compassion. Self identity. 2015;14(5):499–520.

Tables

Table 1

Study Variables, Abbreviations, and Descriptive Statistics

Instrument	Variable	Abbreviation	*M (SD)*
SOCS-O	Recognizing Suffering	RS-O	3.36 (0.62)
	Feeling for the Person Suffering	FPS-O	3.63 (0.60)
	Tolerating Uncomfortable Feelings	TUF-O	3.52 (0.61)
	Motivation to Act/Acting to Alleviate Suffering	MAAS-O	3.51 (0.64)
SOCS-S	Recognizing Suffering	RS-S	3.76 (0.70)
	Feeling for the Person Suffering	FPS-S	3.54 (0.68)
	Tolerating Uncomfortable Feelings	TUF-S	3.43 (0.68)
	Motivation to Act/Acting to Alleviate Suffering	MAAS-S	3.60 (0.71)
FFMQ-15	Describing	Des	4.25 (1.07)
	Acting with Awareness	Awa	4.28 (1.12)
	Nonjudging of Inner Experience	Non-J	3.97 (1.07)
	Nonreactivity to Inner Experience	Non-R	4.22 (0.98)
SCS	Self-Kindness	S-Kind	2.87 (0.74)
	Self-Judgment	S-Jud	2.53 (0.84)
	Common Humanity	C-Hum	3.06 (0.74)
	Isolation	Iso	2.62 (0.90)
	Over-Identification	O-Ide	2.73 (0.86)
IRI	Perspective Taking	PT	3.27 (0.46)
	Empathic Concern	EC	3.37 (0.50)
	Personal Distress	PD	2.92 (0.60)
WEMWBS	Well-Being	WB	3.29 (0.74)
DASS-21	Depression	Dep	0.82 (0.68)
	Anxiety	Anx	0.70 (0.64)

Note. SOCS-O = Sussex-Oxford Compassion for Others Scale; SOCS-S = Sussex-Oxford Compassion for the Self Scale; FFMQ-15 = Five Facet Mindfulness Questionnaire; SCS = Self-Compassion Scale; IRI = Interpersonal Reactivity Index; WEMWBS = Warwick-Edinburgh Mental Well-Being Scale; DASS-21 = Depression Anxiety Stress Scales.

Instrument	Variable	Abbreviation	*M (SD)*
	Stress	Str	0.93 (0.63)

Note. SOCS-O = Sussex-Oxford Compassion for Others Scale; SOCS-S = Sussex-Oxford Compassion for the Self Scale; FFMQ-15 = Five Facet Mindfulness Questionnaire; SCS = Self-Compassion Scale; IRI = Interpersonal Reactivity Index; WEMWBS = Warwick-Edinburgh Mental Well-Being Scale; DASS-21 = Depression Anxiety Stress Scales.

Table 2

Expected Influence, Closeness, and Betweenness Centrality in the Network

Node	Expected Influence	Closeness	Betweenness
RS-O	0.77	-0.11	-0.01
FPS-O	**1.23**	**1.40**	0.04
TUF-O	**1.03**	-0.74	-1.07
MAAS-O	**1.04**	-0.97	-1.23
RS-S	0.75	-1.05	-0.93
FPS-S	**1.07**	-0.74	-0.28
TUF-S	**0.97**	0.29	**0.55**
MAAS-S	**1.04**	-0.03	0.43
Des	0.70	0.76	**1.69**
Awa	-0.39	-1.21	-1.38
Non-J	-0.51	-0.42	-0.39
Non-R	0.51	**1.00**	**1.95**
S-Kind	0.83	0.05	**1.08**
S-Jud	0.57	**1.24**	0.46
C-Hum	0.88	-0.34	0.52
Iso	0.66	-1.21	-0.76
O-Ide	0.80	0.05	-0.20
PT	0.61	-0.66	-0.79
EC	0.50	**1.55**	0.47
PD	-0.25	-0.18	**0.88**
WB	0.38	**2.34**	**1.79**
Dep	0.67	**1.00**	-0.38
Anx	0.76	-1.05	-1.19
Str	0.96	-0.97	-1.24

Note. Closeness and Betweenness centrality values were standardized (z-scores) to facilitate comparison and interpretation, whereas Expected Influence was reported in its original form to preserve the interpretability of directionality. Boldface indicates values in the top 25% within each centrality index; for Expected Influence, the top 25% was determined based on absolute values. Detailed descriptions of each node are provided in Table 1.

Figures

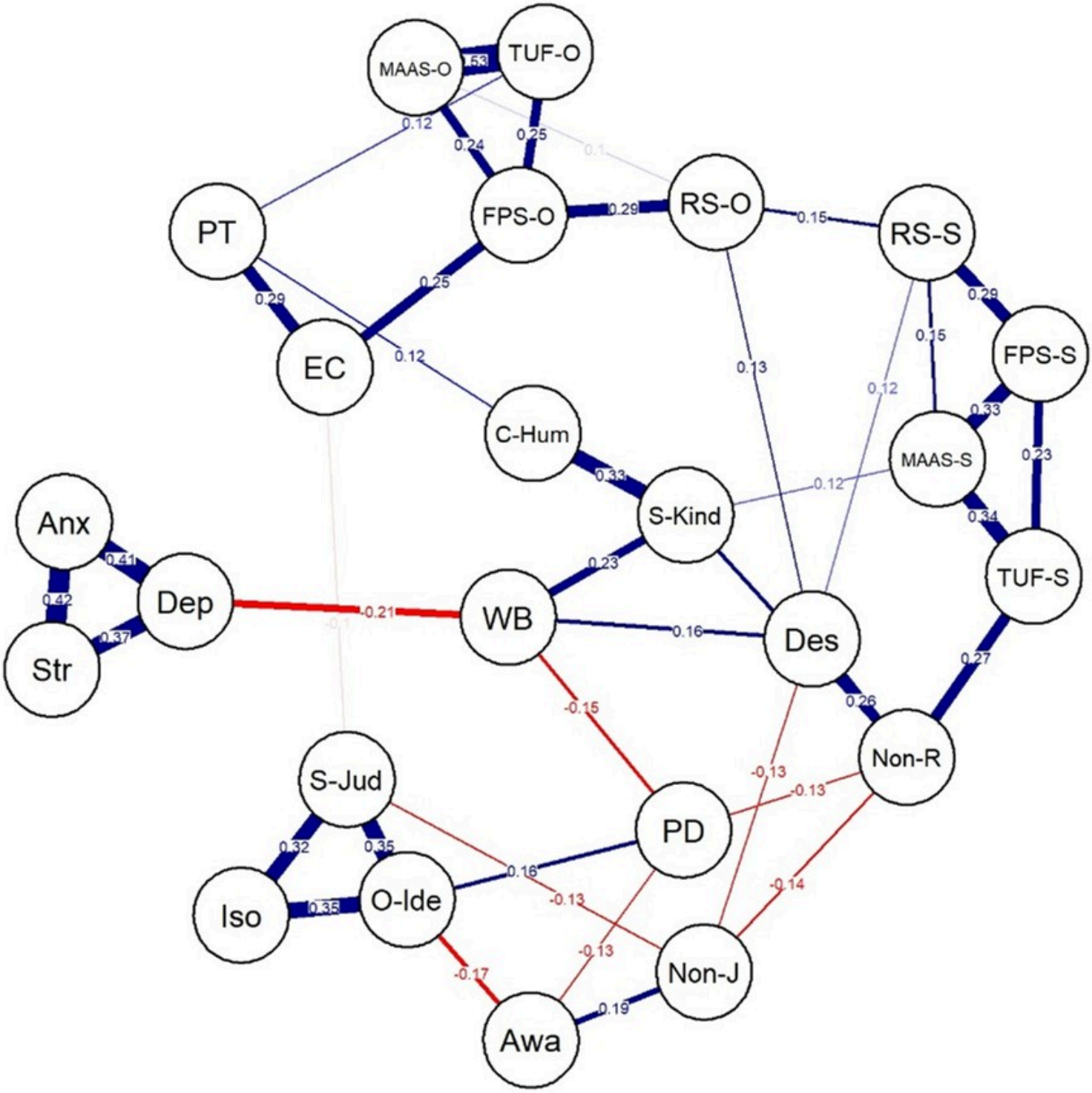


Figure 1

The Network Structure of Compassion, Self-Compassion, Mindfulness, Empathy, and Mental Health

Note. n = 1020. Edges represent partial correlations between pairs of nodes. Blue edges indicate positive correlations, whereas red edges indicate negative correlations. Edge thickness reflects the degree of association between nodes. The partial correlation coefficient (i.e., edge weight) is displayed on each

edge. To improve clarity, edges with an absolute weight below 0.1 were omitted from the visualization. Detailed descriptions of each node are provided in Table 1.

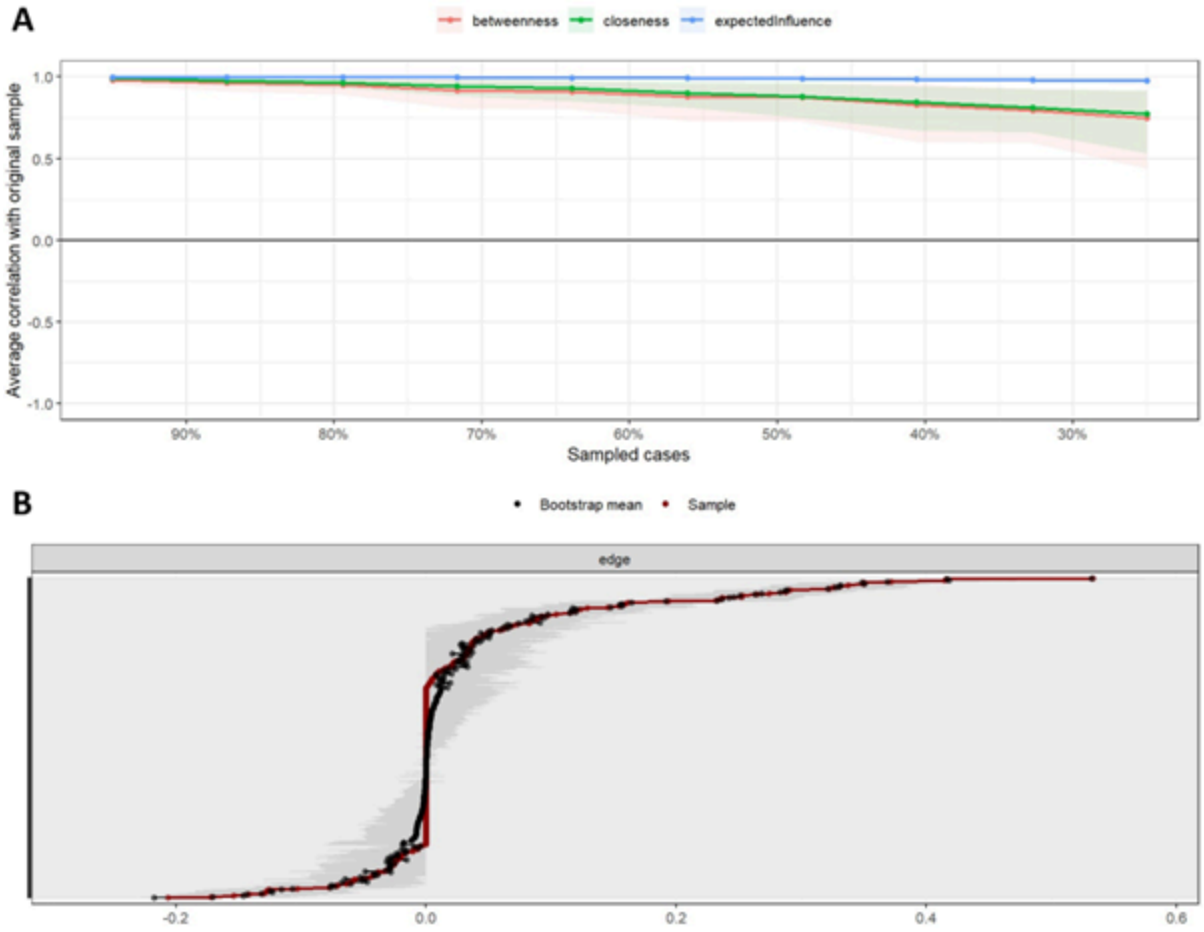


Figure 2

Centrality Stability and Edge Weight Accuracy in the Network

Note. Panel A shows the results of a case-drop bootstrap analysis (n = 1000) conducted to evaluate the stability of centrality indices. The X-axis represents the proportion (%) of the full sample retained, and the Y-axis indicates the average rank correlation between the centrality indices in the subsampled and original data. The shaded areas surrounding each line represent the 95% confidence intervals for each index. Panel B shows the results of a non-parametric bootstrap analysis (n = 2500) conducted to assess the accuracy of edge weight estimation. The X-axis represents edge weights, and the Y-axis orders the edges by weight magnitude. Black dots indicate the bootstrap mean values for each edge, red dots indicate the observed edge weights, and the shaded areas represent the 95% confidence intervals.

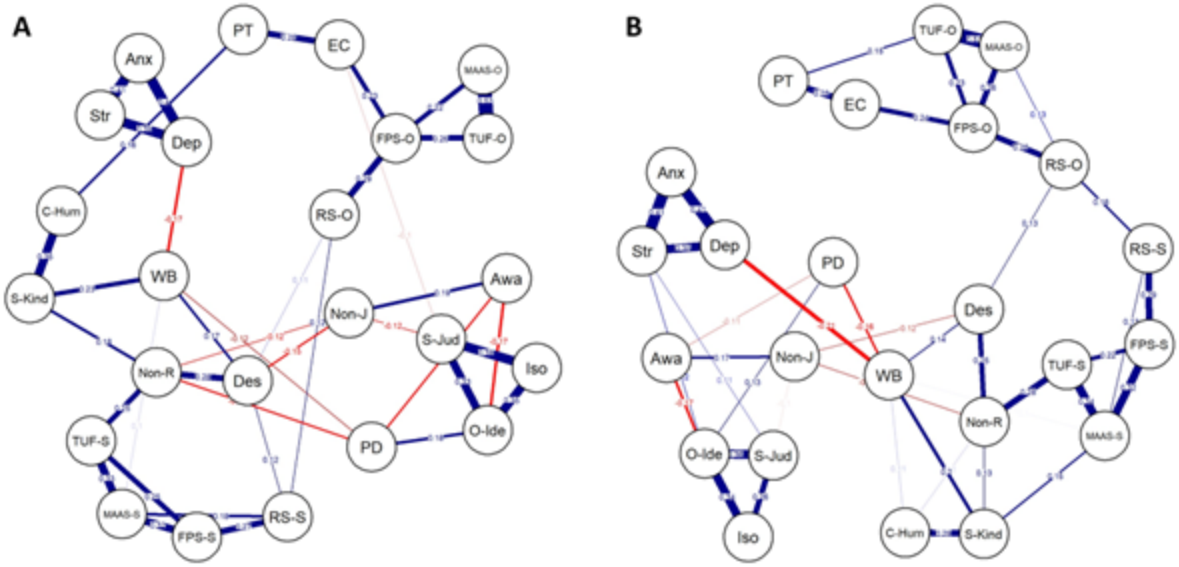


Figure 3

The Network Structure of Compassion, Self-Compassion, Mindfulness, Empathy, and Mental Health by Gender

Note. A = male (n = 519); B = female (n = 501). Edges represent partial correlations between pairs of nodes; blue edges indicate positive correlations, and red edges indicate negative correlations. Edge thickness reflects the degree of association between nodes, and the partial correlation coefficient (i.e., edge weight) is displayed on each edge. For visual clarity, edges with an absolute weight below 0.1 were omitted from the visualization. Detailed descriptions of each node are provided in Table 1.

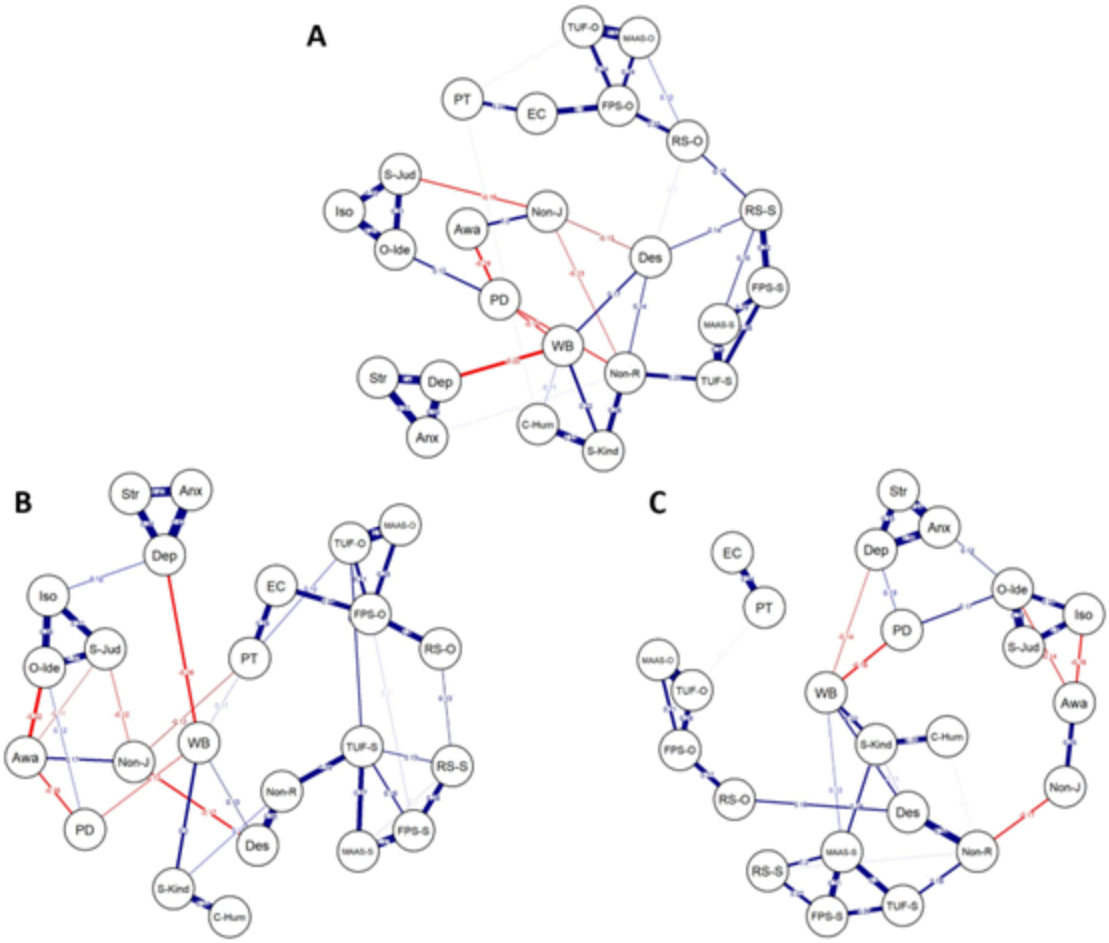


Figure 4

The Network Structure of Compassion, Self-Compassion, Mindfulness, Empathy, and Mental Health by Age

Note. A = young adults (ages 18–39, n = 340); B = middle-aged adults (ages 40–59, n = 340); C = older adults (ages 60–94, n = 340). Edges represent partial correlations between pairs of nodes; blue edges indicate positive correlations, and red edges indicate negative correlations. Edge thickness reflects the degree of association between nodes, and the partial correlation coefficient (i.e., edge weight) is displayed on each edge. For visual clarity, edges with an absolute weight below 0.1 were omitted from the visualization. Detailed descriptions of each node are provided in Table 1.

Supplementary Files

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- Supplementarymaterial.docx