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Research paper

# A network analysis of body dysmorphic and obsessive-compulsive symptoms among individuals with and without exposure to trauma

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ABSTRACT

*Background:* BDD and OCD symptoms often co-occur, but the associations between specific symptoms remain unclear. Furthermore, current research suggests that the clinical presentation of emotional disorders can differ in individuals who self-report exposure to trauma, but it is unclear whether this extends to BDD and OCD. The current study aimed to: (a) investigate associations between individual OCD and BDD symptoms and (b) determine whether symptom networks differ in those with self-reported trauma compared to those without self-reported trauma.

*Methods:* Participants ($N = 3127$) were drawn from the Genetic Links to Anxiety and Depression (GLAD) Study and had completed validated self-reported questionnaires to assess BDD and OCD symptoms, and childhood and adulthood experiences of trauma. Network analysis was used to investigate associations between seven BDD symptoms and six OCD symptom domains. Networks of reporters and non-reporters of lifetime trauma were compared using the network comparison test.

*Results:* BDD and OCD symptoms clustered distinctively with some bridging associations between them. The strongest bridging edges highlighted an association between three core BDD symptoms and the OCD domain of obsessional thoughts. BDD and OCD networks of reporters and non-reporters of lifetime trauma did not differ.

*Limitations:* Cross-sectional design, meaning causality cannot be inferred.

*Conclusions:* The findings suggest that BDD and OCD symptoms cluster distinctively, with some bridging associations between core BDD symptoms and obsessional thoughts. Future research is needed to understand the mechanisms underpinning this relationship.

## 1. Introduction

Body Dysmorphic Disorder (BDD) is defined by an excessive preoccupation with a perceived flaw in physical appearance and appearance-related repetitive behaviours, while OCD is characterised by recurrent intrusive thoughts that are accompanied by time-consuming compulsive behaviours (DSM-5; American Psychological Association [APA], 2013). These disorders have similar phenomenology in that they both involve obsessional thinking and compulsive behaviours (Hollander et al., 2011). Furthermore, BDD and OCD frequently co-occur (Bienvenu et al., 2012), and have common risk factors, such as overlapping genetic liability (Monzani et al., 2012). In light of this, within DSM-5 and ICD-11 BDD and OCD have been reclassified together under the category "obsessive-compulsive and related disorders" (Stein et al., 2016; APA, 2013). However, despite evidence for BDD and OCD being closely related, little is known about the relationship between specific symptoms across these two conditions.

Obsessive-Compulsive disorder (OCD) is a heterogeneous condition, with distinct symptoms dimensions, encompassing contamination/cleaning, symmetry/ordering, taboo obsessions, and harm/checking (Mataix-Cols et al., 2005). Few studies have addressed the question of whether distinct OCD symptom have differential associations with BDD symptoms, and findings have been mixed. For instance, one study of people with OCD found sexual/religious obsessions and related compulsions were the only OCD symptom dimension uniquely associated with BDD (Torres et al., 2016). In another study conducted among a

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clinical and community sample of young people with OCD, body-focussed OCD symptoms (obsessions and compulsions) were found to be associated with BDD (Cervin et al., 2022). A third study carried out with people with OCD found that those with comorbid BDD reported greater severity of hoarding obsessions, compulsions, checking, tell/ask/confessing and symmetry/exactness among the OCD dimensions (Stewart et al., 2008). Lastly, a study that focused on heterogeneity within BDD found that BDD patients who had appearance concerns involving symmetry were more likely to have lifetime OCD symptoms, although not OCD-related symmetry symptoms (Hart and Phillips, 2013). The findings of these studies suggest that there may be differential associations between BDD and OCD symptoms, but the extent and nature of the link remains unclear.

Network analysis is a statistical method that uses a dimensional approach to understanding mental health disorders, as opposed to traditional categorical approaches (McNally, 2016). From a network perspective, psychiatric disorders are viewed as a product of causal interactions between symptoms. Networks include nodes and edges; nodes typically represent the focus of study, for example in this study, BDD and OCD symptoms, and edges represents the associations between the symptoms. Network analysis highlights "bridging symptoms" as any symptoms that contribute to traversing more than one disorder (Jones et al., 2019). Some network analysis studies have indicated that central symptoms in mental health disorder networks, those with a high number of strong associations with other symptoms, should be prioritised in theoretical models of the condition and serve as essential treatment targets (Mullarkey et al., 2019).

Differential associations between BDD and OCD symptoms may be further understood through the potential influence of trauma. OCD is known to be associated with physical and sexual abuse (Grisham et al., 2011) and traumatic life events (Cromer et al., 2007) and BDD is shown to be associated with elevated rates of interpersonal trauma (Longobardi et al., 2022). Across internalising disorders, self-reported trauma is associated with different clinical presentations, for example, earlier age of onset in depression and OCD (Adam et al., 2012), greater chronicity (Wiersma et al., 2009), greater severity and poorer outcomes in anxiety and depression (Hovens et al., 2012; White et al., 2015). Therefore, it is possible that trauma may influence the clinical presentation of BDD and OCD, and moderate symptom-links between these disorders.

In summary, BDD and OCD are closely related disorders, which often co-occur. However, the associations between specific symptoms of these disorders remain unclear. Previous research suggests that the clinical presentation of internalising disorders differs in individuals who self-report exposure to trauma compared to those who do not. However, this has not yet been explored with regard to the relationship between BDD and OCD symptoms. Therefore, this study aims to use a network analysis approach in a large, community-derived sample to: (a) investigate associations between BDD and OCD symptoms; and (b) determine whether symptom networks differ in those with self-reported trauma compared to those without self-reported trauma. We predicted that a) BDD and OCD symptoms will cluster distinctly but with bridge symptoms between clusters; and b) that the network pattern will differ in those with and without self-reported trauma exposure.

## 2. Method

### 2.1. Participants and procedure

The sample consisted of participants ($N = 3127$) who completed the Dysmorphic Concern Questionnaire (DCQ; Oosthuizen et al., 1998) and Obsessive-Compulsive Inventory-Revised (OCI-R; Foa et al., 2002) as part of the Genetic Links to Anxiety and Depression (GLAD) Study (Davies et al., 2019). The GLAD Study was an online study of UK participants recruited through NHS services and a nationwide advertising campaign. All GLAD Study participants completed core questionnaires assessing demographics, mental and physical health symptoms and disorders, and environmental experiences including trauma. In addition, there were optional questionnaires which participants could choose to complete, that included assessing BDD and OCD symptoms (Davies et al., 2019).

The GLAD Study received ethical approval from the London-Fulham Research Ethics Committee (REC reference: 18/LO/1218).

### 2.2. Measures

#### 2.2.1. Dysmorphic Concern Questionnaire (DCQ)

The DCQ is a self-report 7-item scale that assesses excessive concern of physical appearance and bodily functioning (Oosthuizen et al., 1998). Each item is rated on a 4-point Likert scale (0 = Not at all, 3 = Much more than most people), with a total score ranging from 0 to 21. It has been shown to be a reliable and valid screening tool for BDD (Mancuso et al., 2010; Stangier et al., 2003), with good test-retest reliability ($r$ = 0.87–0.96) (Khanjani et al., 2019; Senín-Calderón et al., 2017). The DCQ was found to have good internal consistency in this sample ($\alpha = 0.82$). A range of clinical cut-offs have been proposed, ranging from 11 to 17. In the current study, we used the cut-off of $\geq$11 point, which indicates the best balance between sensitivity and specificity for detecting possible BDD (Stangier et al., 2003).

#### 2.2.2. Obsessive-Compulsive Inventory-Revised (OCI-R)

The OCI-R is an 18-item self-report measure of OCD symptoms (Foa et al., 2002). The scale uses a 5-point Likert scale (0 = Not at all, 4 = Extremely), with total scores ranging from 0 to 72, representing the extent to which a symptom was bothersome or distressing in the past month. The OCI-R contains 6 subscales; Washing Concerns, Checking/Doubting, Obsessing, Mental Neutralising, Ordering, and Hoarding. The OCI-R has shown to have good internal consistency ($\alpha$ = 0.84–0.90) and test-retest reliability ($\alpha$ = 0.70–0.82) in a mixed clinical sample of OCD, other anxiety disorders, controls and college samples (Foa et al., 2002; Huppert et al., 2007; Hajcak et al., 2004). The total scale has good internal consistency in this sample ($\alpha = 0.85$). A cut-off score of $\geq$21 has been found to provide the best balance between sensitivity and specificity for detecting OCD (Foa et al., 2002; Belloch et al., 2013).

#### 2.2.3. Childhood Trauma Screener (CTS-5)

The CTS-5 (Glaesmer et al., 2013) is a shortened version of the Childhood Trauma Questionnaire (CTQ) (Bellis et al., 2014). It consists of one 6-point Likert scale item (1 = Never True, 5 = Very Often True, 6 = Prefer not to answer) for each of five types of child maltreatment: physical abuse, physical neglect, emotional abuse, emotional neglect, and sexual abuse. The CTS-5 has been validated against the CTQ with good overall ($r = 0.88$) and satisfactory type-specific correlations ($r$ = 0.55–0.87) (Grabe et al., 2012). The CTQ-5 is a widely used instrument for measuring child maltreatment and has been validated against the actual record of abuse and neglect (Glaesmer et al., 2013; Bernstein et al., 2003).

#### 2.2.4. The Adult Domestic Abuse and Catastrophic Trauma questionnaire (ADACT)

The ADACT is a self-report questionnaire that contains 5 adult domestic abuse items and 6 catastrophic trauma items. The ADACT was developed for the UK Biobank Mental Health Questionnaire (Davies et al., 2019) and adapted from the national crime survey and CTS-5. A 4-point Likert scale was used for each domestic abuse item (1 = Never, 2 = Yes, but not in the last 12 months, 3 = Yes, within the last 12 months, 4 = Very often true), followed by a statement using a 6-point Likert scale that asks how often these domestic abuse items have been true (1 = Never true, 5 = Very often true, 6 = Prefer not to answer). A 4-point Likert scale item was used for each catastrophic trauma (1 = Never, 2 = Yes, but not in the last 12 months, 3 = Yes, within the last 12 months, 4 = Prefer not to answer).

### 2.3. Statistical analyses

Cases with missing data and responses 'prefer not to answer' on one or more OCI-R, DCQ items and CTS-5 and ADACT were excluded from the statistical analyses ($n = 41$). Descriptive statistics were used to examine the characteristics of the study sample. Network analysis was used to investigate associations between OCD and BDD symptoms. We calculated four indices of node centrality - strength, expected influence, closeness and betweenness - as they are the most relevant to network analysis of psychological measures (Costantini et al., 2015). The correlation stability coefficient (CS-coefficient) is the quantifiable measure for centrality stability. According to guidelines, the CS-coefficient should ideally be >0.5 and fall no <0.25 (Epskamp et al., 2018). A value of 0.7 is generally considered a very large effect (Cohen, 1977).

Networks were estimated with the 7 DCQ items and 6 OCI-R subscales representing nodes and their associations as edges. The study used the six subscales of the OCI-R as opposed to all 18 items because centrality estimates in the network may be overestimated due to multiple items that are highly correlated (Fried and Cramer, 2017). This method was previously used in a network study (see Olatunji et al., 2019). The study used R package bootnet (Epskamp et al., 2018) to estimate and visualise Graphical Gaussian Models (GGM) of BDD and OCD symptoms (Kolaczyk, 2009), with polychoric correlations. When estimating a GGM model edges are essentially partial correlations between two symptoms that represent their unique relationship when controlling for associations with all other symptoms in the network. The stability of the order of node centrality and the accuracy of the edge weight estimates were investigated using the same R-package bootnet and bootstrapped difference test (Epskamp and Fried, 2018). The hyperparameter gamma was set to 0.5, which results in more parsimonious models with fewer edges (Epskamp and Fried, 2018; Foygel and Drton, 2010).

To determine whether networks differ in those with self-reported trauma compared to those without self-reported trauma, the sample was first divided into individuals who endorsed trauma versus individuals who did not endorse trauma. Table 1 presents the criteria for endorsing trauma and not endorsing trauma in the CTS-5 and ADACT and thresholds used in this study. The researchers were interested in encompassing trauma as a range of adverse childhood and adult experiences, including emotional abuse.

Network analysis was then used to investigate the structure of BDD symptoms and OCD symptoms in these self-reported trauma groups. The R-package NetworkComparisonTest (NCT) was subsequently used (van Borkulo et al., 2017) to compare those who endorsed trauma versus those who did not endorse trauma. The NCT are permutation tests that randomly rearranges group membership and refits the two network models 1000 times, generating a null distribution of what the study would expect the networks to look like if our groupings were meaningless. Three metrics were compared across the two networks; (1) Symptom centrality, a measure of which symptoms are most influential in the network (Epskamp et al., 2018); (2) Global network strength (van Borkulo et al., 2017); and (3) Network structure (van Borkulo et al., 2017). If network structure significantly differs, differences in edge strength were tested to assess which specific edge weights differ across the two networks.

**Table 1**
Child Trauma Screener (CTS) and Adult Domestic Abuse and Catastrophic Trauma questionnaire (ADACT) criteria for those who endorsed trauma and those who did not.

| Measure | Endorsed Trauma when answered… | Did not endorse Trauma when answered… |
|---|---|---|
| CTS | | |
| a. I felt loved (emotional abuse) | ≤ 2 (Rarely true or less) | ≥ 3 (Sometimes true or more) |
| b. People in my family hit me so hard that it left me with bruises or marks (physical abuse) | ≥ 3 (Sometimes true or more) | ≤ 2 (Rarely true or less) |
| c. I felt that someone in my family hated me (emotional abuse) | ≥ 3 (Sometimes true or more) | ≤ 2 (Rarely true or less) |
| d. Someone molested me (sexually) (sexual abuse)* | ≥ 2 (Rarely true or more) | 1 (Never true) |
| e. There was someone to take me to the doctor if I needed it (physical neglect) | ≤ 2 (Rarely true or less) | ≥ 3 (Sometimes true or more) |
| ADACT | | |
| b. A partner or ex-partner deliberately hit me or used violence in any other way | ≥ 3 (Sometimes true or more) | ≤ 2 (Rarely true or less) |
| c. A partner or ex-partner repeatedly belittled me to the extent that I felt worthless | ≥ 3 (Sometimes true or more) | ≤ 2 (Rarely true or less) |
| d. A partner or ex-partner sexually interfered with me, or forced me to have sex against my wishes | ≥ 2 (Rarely true or more) | 1 (Never true) |
| a. Been a victim of a sexual assault, whether by a stranger or someone you knew | ≥ 2 (Yes, but not in the last 12 months or Yes, within the last 12 months) | 1 (Never true) |
| b. Been attacked, mugged, robbed, or been the victim of a physically violent crime | ≥ 2 (Yes, but not in the last 12 months or Yes, within the last 12 months) | 1 (Never true) |
| c. Been in a serious accident that you believed to be life-threatening at the time | ≥ 2 (Yes, but not in the last 12 months or Yes, within the last 12 months) | 1 (Never true) |
| d. Witnessed a sudden violent death (eg. murder, suicide, aftermath of an accident) | ≥ 2 (Yes, but not in the last 12 months or Yes, within the last 12 months) | 1 (Never) |
| e. Been diagnosed with a life threatening illness | ≥ 2 (Yes, but not in the last 12 months or Yes, within the last 12 months) | 1 (Never) |
| f. Been involved in combat or exposed to a war-zone (either in the military or as a civilian) | ≥2 (Yes, but not in the last 12 months or Yes, within the last 12 months) | 1 (Never) |

*Note.* *The threshold for endorsing trauma differed for the sexual abuse item 'd. Someone molested me (sexually)' (≥ 2, Rarely true or more), compared to both the emotional 'c. I felt that someone in my family hated me' and physical 'b. People in my family hit me so hard that it left me with bruises or marks' abuse items (both ≥3, Sometimes true or more). Classifications were based on cut-offs that had the highest sensitivity and specificity (Glaesmer et al., 2013). The threshold is lower for sexual abuse as minor exposure can still be deemed as highly traumatic (Grabe et al., 2012) (see Table 2 of this paper for a list of commonly assessed traumas). The items in the ADACT 'I have been in a confiding relationship' and 'I have had the money to pay my rent/mortgage payment' in domestic abuse items were excluded from the analysis as they do not meet the DSM definition of trauma.

## 3. Results

### 3.1. Sample descriptive characteristics

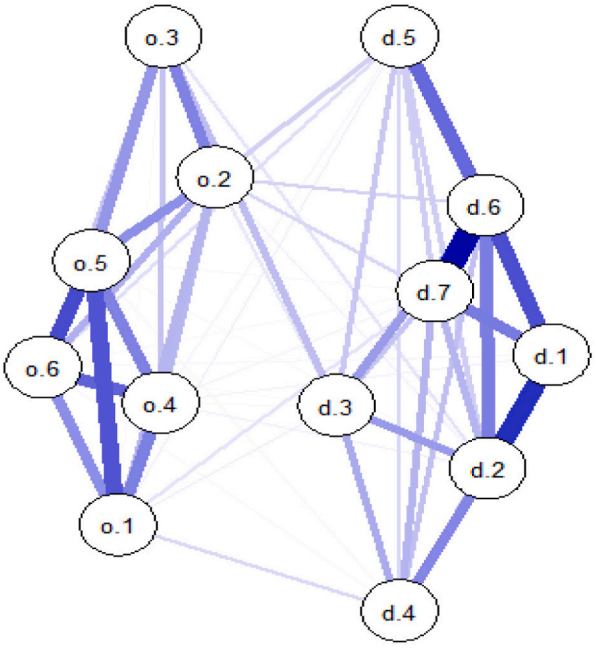
At the time of analysis, 46,725 individuals had participated in the GLAD Study; of these, 3127 participants completed the DCQ and OCI-R and comprise the current study sample (see Table 2). Compared to the full GLAD sample, the current study subsample were significantly younger, had a greater female preponderance, had been in education for longer, were more likely to have self-reported lifetime major depressive disorder (MDD) and less likely to have self-reported lifetime anorexia nervosa (AN) diagnosis, although effect sizes were generally small.

Of the current study sample, 2513 (80.4 %) reported trauma (see Table 1 for specific forms of trauma). The most commonly endorsed childhood trauma was emotional abuse (45.5 %), followed by sexual abuse (20.8 %) and physical abuse (20.5 %). The most frequently endorsed adult trauma was sexual assault (48.3 %). The characteristics of those with versus without self-reported trauma were broadly

**Table 2**
Characteristics of the GLAD study, study sample (reported DCQ and OCI-R) and non-reporters and reporters of trauma.

| | Full GLAD sample ($N$ = 46,725) | Current study sample ($N$ = 3127) | Comparison of full GLAD sample and current study sample | Non-reporters of trauma ($N$ = 510) | Reporters of trauma ($N$ = 2513) | Comparison of non-reporters and reporters of trauma |
|---|---|---|---|---|---|---|
| | *M* (*SD*) | *M* (*SD*) | | *M* (*SD*) | *M* (*SD*) | |
| Age (years) | 38.12 (14.58) | 36.02 (13.44) | $t$ (3659) = 8.34* CI: 1.60, 2.59, $d$ = 0.14 | 35.01 (12.43) | 36.03 (13.47) | $t$ (72.78) = −0.68, CI: -4.02, 1.98, $d$ = 0.08 |
| Education (years) | 16.20 (3.79) | 16.75 (3.58) | $t$ (3613) = − 8.16* CI: - 0.68, −0.42, $d$ = 0.15 | 15.99 (3.71) | 16.77 (3.58) | $t$ (64.44) = −1.64, CI: -1.77, 0.17, $d$ = 0.22 |
| | *N* (%) | *N* (%) | | *N* (%) | *N* (%) | |
| Sex (female) | 32,661 (77.91) | 2603 (83.2) | $\chi$2 (1) = 32.37, $V$ = 0.027 | 417 (81.76) | 2119 (83.69) | $\chi$2 (1) = 0.56, $p$ = .45, $V$ = 0.013 |
| Ethnicity (White) | 39,551 (90.72) | 2963 (94.8) | $\chi$2 (5) = 13.74, $V$ = 0.02 | 452 (88.63) | 2413 (84.64) | $\chi$2 (5) = 15.16, $V$ = 0.07 |
| Self-reported diagnosis | | | | | | |
| GAD | 31,257 (66.90) | 2398 (76.69) | $\chi$2 (1) = 1.20, $V$ = 0.01 | 294 (57.64) | 2357 (77.5) | $\chi$2 (1) = 1.14, $V$ = 0.02 |
| MDD | 35,673 (76.35) | 2774 (88.71) | $\chi$2 (1) = 12.59**, $V$ = 0.02 | 366 (71.76) | 2723 (89.5) | $\chi$2 (1) = 0.03, $V$ = 0.00 |
| OCD | 3030 (6.48) | 373 (11.93) | $\chi$2 (1) = 85.47**, $V$ = 0.04 | 10 (14.1) | 363 (11.9) | $\chi$2 (1) = 1.06, $V$ = 0.02 |
| BDD | 1345 (2.88) | 113 (3.61) | $\chi$2 (1) = 1.02, $V$ = 0.00 | 6 (8.5 %) | 107 (3.5) | $\chi$2 (1) = 5.73, $V$ = 0.04 |
| AN | 1671 (3.58) | 33 (1.06) | $\chi$2 (1) = 14.15**, $V$ = 0.02 | 7 (9.9) | 164 (5.4) | $\chi$2 (1) = 3.65, $V$ = 0.03 |
| BN | 1502 (3.21) | 128 (4.09) | $\chi$2 (1) = 1.0, $V$ = 0.01 | 5 (7.0) | 123 (4.0) | $\chi$2 (1) = 1.95, $V$ = 0.03 |
| No self-reported diagnosis | 930 (1.99) | 48 (1.54) | $\chi$2 (1) = 6.67, $V$ = 0.01 | 0 (0.0) | 48 (1.6) | $\chi$2 (1) = 0.18, $V$ = 0.01 |
| | | *M* (*SD*) | | *M* (*SD*) | | |
| OCI-R Score | – | 20.11 (13.20) | – | 16.02 (11.03) | 20.88 (13.13) | $t$ (−8.75) = −8.75*, CI: -5.95, −3.77, $d$ = 0.38 |
| DCQ Score | | 9.29 (6.50) | | 7.72 (4.63) | 9.82 (5.24) | $t$ (792.33) = −9.13*, CI: -2.56, −1.65, $d$ = 0.41 |
| OCI-R cut-off[♂] | | 1285 (41.1 %) | | | | |
| DCQ cut-off[♂] | | 1448 (46.3 %) | | | | |

*Note*: * = $p$-values <. 008 (Bonferroni-corrected), ** = $p$-values < .003 (Bonferroni-corrected), DCQ = Dysmorphic Concern Questionnaire, OCI-R = Obsessive-Compulsive Inventory-Revised, $d$ = Cohen's d, $V$ = Cramer's V, *SD* = standard deviation, $N$ = sample size, $t$ = Student's $t$-test, $\chi 2$ = Chi-squared, CI = Confidence interviews. Current study sample comprised GLAD participants who completed the DCQ and OCI-R; [♂] = OCI-R clinical cut off score 21 ≥ (Foa et al., 2002; Belloch et al., 2013), DCQ clinical cut off score ≥ 11 points indicate possible BDD (Stangier et al., 2003).




**DCQ items**
d.1: Been very concerned about some aspect of your appearance?
d.2: Considered yourself misformed or misshapen in some way (e.g. nose/hair/skin/sexual organs/overall body build?)
d.3: Considered your body to be malfunctional in some way (e.g. excessive body odour, flatulence, sweating)?
d.4: Consulted or felt you needed to consult a plastic surgeon/dermatologist/physician about these concerns?
d.5: Been told by others/doctor that you are normal in spite of you strongly believing that something is wrong with your appearance or bodily functioning?
d.6: Spent a lot of time worrying about a defect in your appearance/bodily functioning?
d.7: Spent a lot of time covering up defects in your appearance/bodily functioning?

**OCI-R Subscales**
o.1: OCI-R Washing
o.2: OCI-R Obsession
o.3: OCI-R Hoarding
o.4: OCI-R Ordering
o.5: OCI-R Checking
o.6: OCI-R Neutralising Subscale

**Fig. 1.** Network visualisation of interrelations between BDD symptoms (DCQ items) and OCD symptoms (OCI-R subscales) ($n$ = 3086, $n$ = 41 missing). Note: Blue lines indicate positive associations. The circles represent DCQ items (BDD symptoms) and OCI-R subscales (OCD symptoms). The thickness of a line corresponds to the strength of the associations. (For interpretation of the references to colour in this figure legend, the reader is referred to the web version of this article.)

similarly, but reporters of trauma were less likely to be White and also scored significantly higher on the DCQ and OCI-R.

### 3.2. Associations between OCD and BDD symptoms in the full study sample

Fig. 1 shows the network of BDD and OCD symptoms and Fig. 2 shows the network's centrality indexes: strength, closeness, betweenness, and expected influence. Strength and expected influence reported an excellent level of stability (i.e., both reported CS-coefficient = 0.75). Closeness showed an acceptable level of stability (i.e., CS-coefficient = 0.361) and betweenness reported a low level of stability (i.e., CS- coefficient = 0.128) (Epskamp et al., 2018).

Overall, the network structure of the total sample showed distinct clustering of BDD and OCD symptoms. The most central nodes in terms of strength for the overall network were excessive worry (BDD symptom, DCQ item 6), extreme belief that you are misformed (BDD symptom, DCQ item 2), and excessive checking (OCD symptom, OCI-R subscale Checking). The least central nodes were being told by others you are normal even though you believe something is wrong with your appearance (BDD symptom, DCQ item 5) and extreme hoarding behaviour (OCD symptom, OCI-R subscale Hoarding) (See Fig. 2). The strongest edge in the network was the edge between excessive worry (BDD symptom, DCQ item 6), and excessive cover-up behaviour (BDD symptom, DCQ item 7) (0.37).

The strongest bridging edge between the BDD and OCD symptom clusters were between DCQ item 3 (consider body malfunctional) and the OCI-R hoarding subscale which measures excessive hoarding and collecting (0.09, where significant difference is $\alpha \leq 0.05$). The second strongest bridging edge was between DCQ item 5 (told look normal) and the OCI-R subscale obsession, which assesses taboo obsessions (0.06). The third strongest was between DCQ item 6 (time worrying about appearance), and OCI-R subscale obsession (0.06). The fourth strongest bridging edge was between DCQ item 1 (very concerned about appearance), and OCI-R obsession subscale (0.05). These edges did not significantly differ in strength from each other (see S1).

Bootstrapping demonstrated narrow confidence intervals for the edge weights and stable centrality estimates, indicating good accuracy and stability (S2 & S3).

### 3.3. Comparison of networks in reporters and non-reporters of trauma

Fig. 3 shows the BDD and OCD symptom network estimated for reporters and non-reporters of trauma. For reporters of trauma, the strength and expected influence reached an excellent level of stability (i.e., both reported CS-coefficient = 0.75). Closeness showed an acceptable level of stability (i.e., CS-coefficient = 0.28) and betweenness reported a low level of stability (i.e., CS- coefficient = 0.05). The most central nodes by strength and expected influence were excessive worry (BDD symptom, DCQ item 6), followed by extreme belief that you are misformed (BDD symptom, DCQ item 2), and excessive checking (OCD symptom, OCI-R subscale Checking) (see Fig. 3). The strongest edge in the network was the edge between excessive worry (BDD symptom, DCQ item 6) and excessive cover-up behaviour (BDD symptom, DCQ item 7) (0.36). This edge was significantly stronger than all the edges in the network (see S4). Bootstrapping indicated good accuracy and stability with narrow confidence intervals for the edge weights and stable centrality estimates (see S5 & S6).

For the non-reporters of trauma network, the strength and expected influence also reached an excellent level of stability (i.e., both reported CS-coefficient = 0.75). Closeness and betweenness showed a low level of stability (i.e., both CS-coefficient = 0.21). The most central nodes by strength and expected influence were excessive worry (BDD symptom, DCQ item 6), followed by excessive neutralising (OCD symptom, OCI-R subscale Neutralising) and extreme concern about appearance (BDD symptom, DCQ item 1) (See Fig. 2).

Similar to the first two network structures, the strongest edge in the network was the edge between excessive worry (BDD symptom, DCQ item 6), and excessive cover-up behaviour (BDD symptom, DCQ item 7). This edge was significantly stronger than all the edges in the network (see S7). Bootstrapping indicated good accuracy and stability with narrow confidence intervals for the edge weights and stable centrality estimates (see S8 & S9).

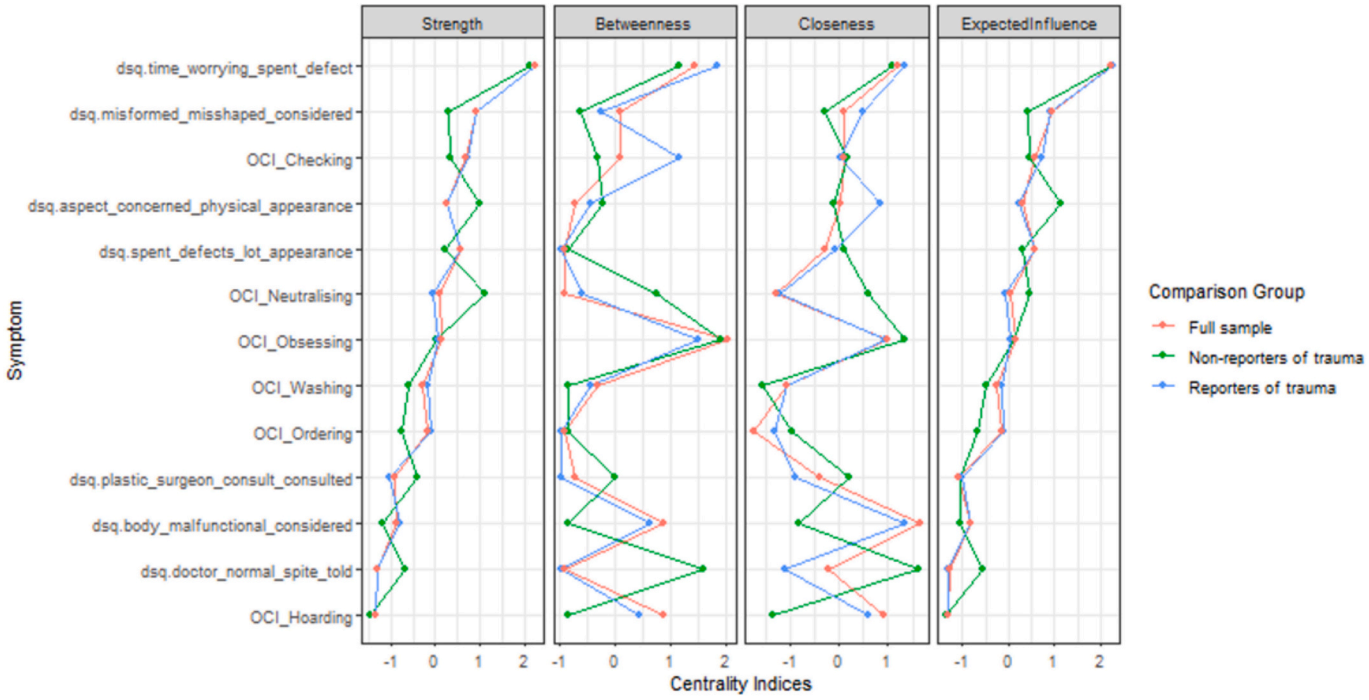
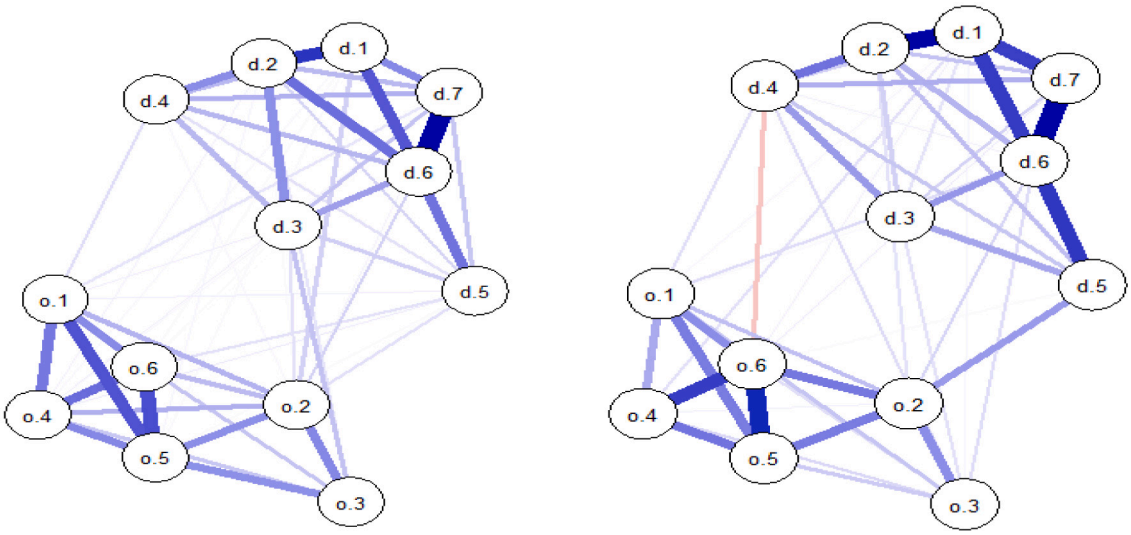



**Fig. 2.** Centrality indices of BDD and OCD symptoms shown as standardised values z scores in the total sample, the non-reporter ($n = 506$) and reporters of trauma ($n = 2513$). (For colour version of this figure, the reader is referred to the web version of this article).

(i) Reported Trauma (n =2513) (ii) Did not report trauma (n=506)




**DCQ items**
d.1: Been very concerned about some aspect of your appearance?
d.2: Considered yourself misformed or misshapen in some way (e.g. nose/hair/skin/sexual organs/overall body build?)
d.3: Considered your body to be malfunctional in some way (e.g. excessive body odour, flatulence, sweating)?
d.4: Consulted or felt you needed to consult a plastic surgeon/dermatologist/physician about these concerns?
d.5: Been told by others/doctor that you are normal in spite of you strongly believing that something is wrong with your appearance or bodily functioning?
d.6: Spent a lot of time worrying about a defect in your appearance/bodily functioning?
d.7: Spent a lot of time covering up defects in your appearance/bodily functioning?

**OCI-R Subscales**
o.1: OCI-R Washing
o.2: OCI-R Obsession
o.3: OCI-R Hoarding
o.4: OCI-R Ordering
o.5: OCI-R Checking
o.6: OCI-R Neutralising Subscale

**Fig. 3.** (i & ii) Network visualisation of differences in BDD and OCD symptoms connectivity between a group that reported trauma and a group that did not report trauma. (For colour version of this figure, the reader is referred to the web version of this article).

### *3.4. Network comparison*

Fig. 4 presents the results of the network comparison test. The red triangle on the x-axis represents the estimated difference between the networks derived from non-reporters and reporters of trauma. The test revealed that the networks of non-reporters and reporters did not significantly differ in global strength ($S$) (5.49 compared to 5.27, $S$ = 0.21, $p$ = .216) or network structure, based upon the maximum difference of any edge weight ($M$) ($M$ = 0.10, $p$ = .716). The $P$-values for network structure and global strength were larger than 0.05. Furthermore, none of the nodes differed in centrality between the two groups (all $p$ values were between $p$ 0.26–1.00) (see S10).

## 4. Discussion

The present study explored the network structure of OCD and BDD symptoms and tested whether this differed among those who self-reported trauma compared to those who did not. The key findings were that OCD and BDD symptoms clustered distinctively (subnetworks) with some bridging associations between OCD obsessions and core BDD symptoms. We also found that there were no significant differences between the network structures of those with versus without self-reported trauma.

Two of the most central symptoms in the overall network were found in the BDD subnetwork. They were BDD extreme worry about appearance and BDD belief about being misformed. In addition, the strongest association in the network was between extreme appearance worry and covering up perceived defects. This is consistent with the conceptualising of appearance preoccupation being a cardinal feature of BDD, that subsequently drives repetitive maladaptive behaviours (Greenberg et al., 2013). The least central item in the subnetwork was the DCQ item 5: "Been told by others/doctor that you are normal in spite of you strongly believing that something is wrong with your appearance of bodily functioning?". The low centrality of this item may be due to this question capturing insight, which may be inherently challenging to assess in self-report measures and therefore result in weaker associations with other symptoms. Moreover, while insight is an important phenomenon in BDD, it is not a core feature set out in the ICD-11 and DSM-5 diagnostic criteria. From this perspective, it is not surprising that BDD insight (DCQ item 5) had lower centrality than items capturing appearance preoccupation and repetitive behaviours.

Of the OCD items in the subnetwork, checking was the most central node and hoarding was least central. Checking behaviour is common in OCD and is considered one of the core symptoms of OCD (Rachman, 2002; Salkovskis, 1985). This finding, however, differs from a previous OCD network study that demonstrated that the most central symptom in OCD was obsessive symptoms (Olatunji et al., 2019). However, these authors also observed that there were likely to be a genuine causal

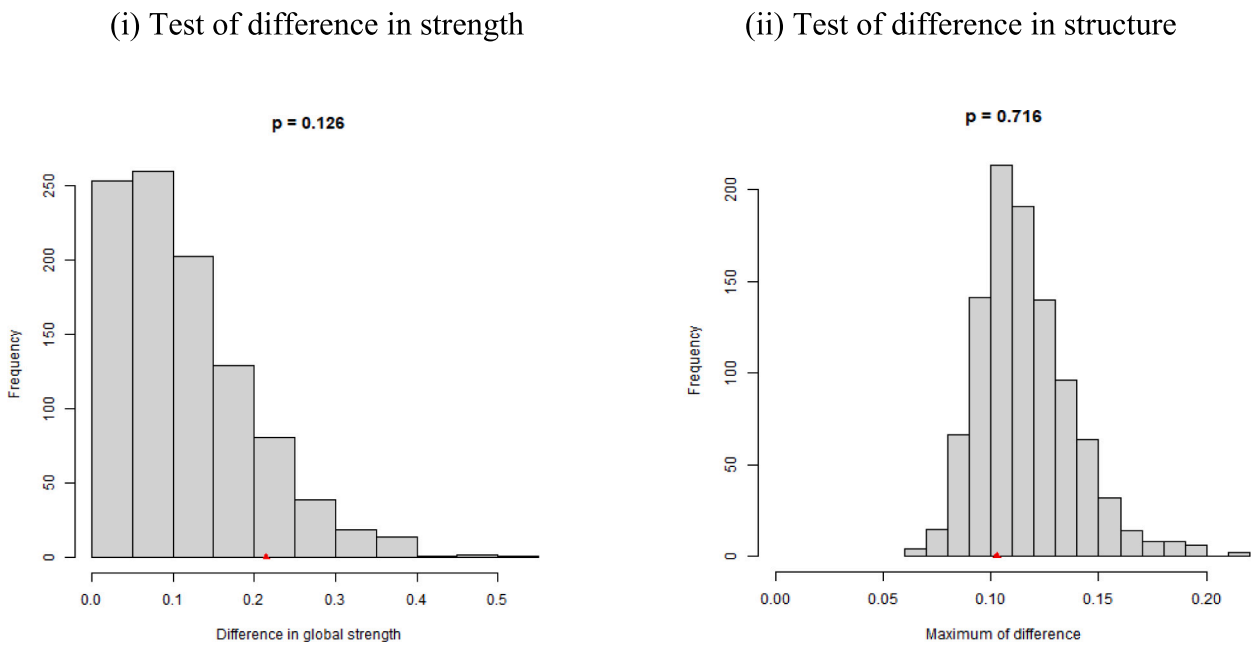



**Fig. 4.** Permutation testing results for network comparisons of network structure and global strength between reported trauma and did not report trauma groups. (i) the panels represent the distribution of differences in global network strength (S). (ii) The panels represent the distribution of the maximum difference in edge weights (M). The P-value equals the proportion of network differences from 1000 randomly regrouped subsamples at least as extreme as the network differences in the original subsamples. The red triangle on the x-axis indicates the difference between the original two networks. (For interpretation of the references to colour in this figure legend, the reader is referred to the web version of this article.)

connection between worry and checking symptoms due to the observed strong association found between anxiety nodes and checking behaviour nodes, despite obsessive symptoms being the most central in terms of strength. Our finding that hoarding is peripheral to the OCD subnetwork structure, is in line with previous studies showing hoarding to correlate relatively weakly with other OCD symptom (Abramowitz et al., 2008). Moreover, while hoarding can be a symptom of OCD, it can also represent a related but nevertheless distinct disorder (APA, 2013). Thus, in the current study it is plausible that hoarding items may have captured symptoms of hoarding disorder rather than OCD for some participants.

In relation to our primary aim, we found several bridges between the OCD and BDD subnetworks. For example, there was a strong association between the BDD item that captures “extreme beliefs that their body is malfunctional” and the OCI-R subscale hoarding. This finding is somewhat in contrast to previous research which suggests that hoarding dimensions were less associated with BDD symptoms (Conceição Costa et al., 2012). Notably, this DCQ item refers to body odour and “malfunction” which may measure broader constructs outside of BDD. Furthermore, it is important to note that both nodes were located on the periphery of the network, suggesting that they are not central features of BDD and OCD, respectively.

In terms of other significantly strong bridging edges in the overall network, the study found that three BDD symptoms linked most strongly with the OCI-R obsessions subscale. OCD obsessions, as measured using the OCI-R, capture difficulties in casting aside “nasty thoughts”, the amount of distress caused from these thoughts, and difficulties in controlling thoughts in general. This is broadly consistent with earlier research suggesting that sexual-religious dimensions of OCD, an obsessive symptom, is uniquely associated with BDD (Torres et al., 2016). There are several possible explanations for the strong bridging associations between BDD symptoms and obsessional thoughts. First, it may in part be a product of measurement overlap where one person who endorsed BDD obsessional worries about their appearance might also have endorsed OCD obsessions. Second, there is a theory that there may be a genuine causal association whereby OCD-related obsessional thoughts render an individual vulnerable to dysmorphic concerns or vice versa. For example, repugnant thoughts in OCD often create a disturbance in one's self-concept and are linked to experiences of shame (Laving et al., 2023), both of which have could increase propensity to developing BDD symptoms (Clerkin et al., 2014). Third, the BDD symptoms and obsessional thoughts may share genetic risk. Previous twin studies have shown shared, as well as unique, genetic influences on body dysmorphic concerns and obsessive-compulsive traits (Monzani et al., 2012). In addition, there is evidence from twin studies for distinct genetic influences on different OCD subtypes (Iervolino et al., 2011). Future research should seek to establish whether obsessional thoughts have a greater genetic correlation with BDD than other OCD symptom dimensions.

The second aim of this study was to determine whether the networks differ in those with self-reported trauma compared to those without self-reported trauma. We found no significant differences between the networks of those who reported trauma and those who did not. This contrasts with the findings of some studies suggesting that the clinical presentation of internalising disorders may differ in those with versus without experience of trauma (Adam et al., 2012 l; Wiersma et al., 2009; Hovens et al., 2012; White et al., 2015). However, it is important to note that in the current study, most of the study sample reported trauma. The sample size differences and the study sample generally having very high rates of reported trauma may indicate that they are not reflective of the whole clinical population that these disorders apply to. Thus, interpretation of these findings should be approached with caution.

The findings in this study have several clinical implications. First, the network theory implies that there is a causal interactive relationship (Borsboom et al., 2003), and that central symptoms may not only be more predictive of disorder course but may also be more influential (Robinaugh et al., 2016). Thus, in the present study, the cross-sectional network analysis suggests that BDD worry symptoms, BDD extreme beliefs, and BDD behaviours, and OCD obsessions, may be importantly influential in the network. These symptoms, in theory, are likely to directly influence each other and have their own psychological, genetic, and neural foundations (Borsboom, 2017). The findings are in line with

a previous study whereby central nodes, interference in functioning due to BDD appearance-related compulsions, were strongly predictive of other symptoms in the network, such as avoidance behaviours and feelings of worthlessness (Summers et al., 2020). .

The nodes between bridging associations could further help with detection, diagnosis, and formulation. Clinicians working with OCD clients with "forbidden obsessions" should be vigilant to BDD and similar for clinicians working with BDD. Since both BDD and "forbidden obsessions" are associated with high levels of shame and are often concealed, clinicians should actively screen by asking directly or using self-report measures. The bridging associations between the cognitive, emotion and behavioural nodes is also consistent with cognitive behavioural formulation for BDD, where essential thoughts, feelings, and behaviours are linked in a vicious cycle (Wilhelm et al., 2014).

In addition, these undirectional networks are also relevant when considering interventions, as symptoms that have many strong associations with others in the network may represent more suitable clinical targets than peripheral symptoms with fewer associations. Treatment could target central nodes such as BDD extreme worry and BDD negative appearance beliefs first, by introducing cognitive techniques at the beginning of interventions, with the aim that it will impact simultaneous symptoms of preoccupied beliefs and, in turn foster fewer BDD related behaviours such as checking of appearance, covering-up and other safety behaviours. For example, cognitive behavioural therapy (CBT) can help individuals to develop an increased awareness of when they are internally focused and encourage shifting to an external focus of attention with aim of reducing ruminations/worries (Veale and Neziroglu, 2010). In a more recent network analysis study examining the 'active' elements of CBT for BDD, it was demonstrated that targeting cognitive restructuring in earlier sessions while emphasizing exposure and ritual prevention later, lead to first a change in problematic cognitions and subsequently a reduction in BDD rituals (Bernstein et al., 2021). By focusing on intervening at the node level clinicians could attempt to reduce frequency or severity of that node and consequently reduce other symptoms in the network.

The large sample was a strength in this study. Given that BDD and OCD are often underreported and underdiagnosed in clinical settings (Dyl et al., 2006; Grant et al., 2001; Zimmerman and Mattia, 1998), the use of a community sample versus a non-clinical sample may be more representative of people with BDD. Another strength of this study is use of a novel statistical method, network analysis, to further the literature in BDD and OCD symptom-link research. However, this study also has some limitations. Excluding missing data may reduce the sample size and statistical power of the analysis, although it is notable that this study used a sample size of >500, where $n = 500$ is deemed large for psychological studies (Epskamp et al., 2018). Additionally, excluding missing data may introduce biases, affecting the degree distribution within centrality or density of nodes or edges, and resulting in a network that is less representative of the population (Krause et al., 2018). For example, it is possible that individuals who chose not to complete the trauma questions, and who were excluded from our analyses, may have had more severe trauma histories and psychological sequelae, and avoided these questions because they found them too distressing (Bonanno et al., 2003; Latiff et al., 2024). This, in turn, may have reduced any potential effect of trauma on the network in our analyses.

The edges represented in the network are cross-sectional associations only and thus, direction of effects cannot be causally inferred. In other words, the results from the study do not tell us about timing, whether symptoms of OCD obsession occur after the onset of BDD or vice versa. Furthermore, it is unknown whether the activation of some symptoms has longitudinal value in terms of association with later symptoms. Another limitation was this study used retrospective report of trauma. Low agreement has been demonstrated between prospective type measures of trauma and retrospective self-report (Baldwin et al., 2019), suggesting that the collection method of trauma exposure may lead to different aspects of trauma being captured, thus, the results in this study should be interpreted with caution. Moreover, the participants recruited typically had lifelong experiences of repeated anxiety and depression and high rates of trauma (Davies et al., 2019), thus a sample recruited another way may likely have lower trauma rates.

Future studies are warranted to address these limitations. They may include using network analysis (including concentration networks) to look at links between BDD and other disorders in clinical samples, while controlling for sex, age, and diagnosis (e.g. anxiety by using measures of anxiety such as the GAD-7; Spitzer et al., 2006). Future studies may also wish to include network analysis examining other psychological constructs that might explain some of the associations found in this study such as shame and self-criticism. It would also be interesting to carry out studies focusing on compassion focused interventions that target BDD and OCD obsessions. Due to the cross-sectional nature of this study, causality must be approached with caution, thus, future studies may benefit from using the network approach in a longitudinal design.

Overall, this present study concludes that BDD and OCD symptoms cluster distinctively and there were no differences between the network between those who reported trauma and those who did not, suggesting that the relationship between BDD and OCD symptoms is not influenced substantially by experiences of trauma. Importantly, we identified some bridging associations between BDD and OCD symptoms. In particular, core BDD symptoms showed a strong association with the OCD dimension of obsessional thoughts. Further research is needed to understand the mechanisms underpinning this association.

## CRediT authorship contribution statement

**Li-Ling Song:** Writing – review & editing, Writing – original draft, Methodology, Investigation, Conceptualization. **Alica J. Peel:** Writing – review & editing, Methodology, Formal analysis. **David Veale:** Writing – review & editing, Supervision. **Thalia C. Eley:** Writing – review & editing, Supervision. **Georgina Krebs:** Writing – review & editing, Supervision.

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## Declaration of competing interest

None to declare.

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## Appendix A. Supplementary data

Supplementary data to this article can be found online at https://doi.org/10.1016/j.jad.2025.01.146.

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