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Disordered Eating, Self-Esteem, and Depression Symptoms in Iranian Adolescents and Young Adults: A Network Analysis

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Abstract

Objective: The network theory of psychopathology examines networks of interconnections across symptoms. Several network studies of disordered eating have identified central and bridge symptoms in Western samples, yet network models of disordered eating have not been tested in non-Western samples. The current study tested a network model of disordered eating in Iranian adolescents and college students, as well as models of co-occurring depression and self-esteem.

Method: Participants were Iranian college students ($n = 637$) and adolescents ($n = 1,111$) who completed the Eating Disorder Examination-Questionnaire (EDE-Q), Rosenberg Self-Esteem Scale (RSES) and Beck Depression Inventory, Second Edition (BDI-II). We computed six Glasso networks and identified central and bridge symptoms.

Results: Central disordered eating nodes in most models were a desire to lose weight and discomfort when seeing one's own body. Central self-esteem and depression nodes were feeling useless and self-dislike, respectively. Feeling like a failure was the most common bridge symptom between disordered eating and depression symptoms. With exception of a few differences in some edges, networks did not significantly differ in structure.

Discussion: Desire to lose weight was the most central node in the networks, which is consistent with sociocultural theories of disordered eating development, as well as prior network models from Western-culture samples. Feeling like a failure was the most central bridge symptom between depression and disordered eating, suggesting that very low self-esteem may be a shared

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Conflicts of Interests

Authors have no conflict of interests.

Data Availability Statement

The data that support the findings of this study are available from the corresponding or first author upon reasonable request.

correlate or risk factor for disordered eating and depression in Iranian adolescents and young adults.

Keywords

Disordered eating; Self-esteem; Depression; Network analysis

Introduction

Eating disorders (EDs) affect adolescents and adults, and across the lifespan are best conceptualized as dimensional in nature (Luo et al., 2016). An approach to classifying EDs that incorporates dimensions of comorbid psychopathology might help to elucidate within-group differences in the mechanisms that underlie the expression of disordered eating (Wildes & Marcus, 2013). Low self-esteem and depression symptoms often co-occur with disordered eating (Santos, Richards, & Bleckley, 2007) and have been shown to contribute to disordered eating symptoms (Brechan & Kvale, 2015; Fairburn, Cooper, & Shafran, 2003; Pauli-Pott et al., 2013; Puccio et al., 2017).

Most research on the links between disordered eating symptoms and comorbidities (e.g., depression) has been conceptualized from the perspective that psychopathology symptoms result from a common latent variable (Borsboom, Mellenbergh, & van Heerden, 2003). For instance, these traditional approaches postulate that an underlying latent disease (i.e., depression) produces a variety of psychological symptoms (e.g., low energy, low mood) without symptoms relating to one another. On the other hand, network theory (Fried & Cramer, 2017) is a framework that suggests that symptom-level interrelations are what cause and constitute psychopathology (Borsboom & Cramer, 2013; McNally, 2016). In a network, symptoms are represented as nodes, connected by edges that depict the strength and direction of associations. ‘Central’ symptoms are those that demonstrate the strongest connections to other nodes, and central symptoms are thought to maintain the network (Borsboom & Cramer, 2013; Freeman, 1978; McNally, 2016). With respect to comorbidities, network theory refers to symptoms from one diagnostic cluster that are connected to symptoms in another cluster as ‘bridge’ symptoms.

Network theory has recently been used to conceptualize EDs. Most studies find that overvaluation of weight or shape or desire to lose weight are the most central symptoms (Brown et al., 2020; Calugi et al., 2020; Christian et al., 2020; DuBois et al., 2017; Elliott, Jones, & Schmidt, 2020a; Forrest, Jones, Ortiz, & Smith, 2018; Goldschmidt et al., 2018; Levinson et al., 2017; Wang et al., 2019). Network models have also been used to explore the interrelations among EDs and common comorbidities (Forrest, Sarfan, Ortiz, Brown, & Smith, 2019; Levinson et al., 2018; Levinson et al., 2017; Monteleone et al., 2019). Levinson and colleagues (2017) found that *physical sensations* (i.e., feelings of wobbliness, lack of interest in sex, changes in appetite) were the bridge symptoms between bulimia nervosa and anxiety and depression symptoms. Given that misperception of physiological sensations (i.e., altered interoceptive processing) is implicated in EDs (Jenkinson et al., 2018), depression (Paulus & Stein, 2010), and anxiety (Paulus & Stein, 2010), perhaps interoceptive dysfunction may be an important bridge between EDs and depression and

anxiety. However, little is known about how self-esteem may bridge disordered eating and depression, and most research has been conducted in Western societies among clinical samples.

Although once thought to be an exclusively Western phenomenon, disordered eating and EDs are observed among Iranian adolescents and college-aged individuals (Jalali-Farahani et al., 2015; Rauof et al., 2015; Sahlan, Taravatrooy, Quick, & Mond, 2020). Two studies have found that disordered eating symptoms are higher in adolescent females than males (Jalali-Farahani et al., 2015; Rauof et al., 2015). However, among college students, binge eating frequency is comparable across sex, though sex differences are observed for some individual symptoms (e.g., purging is higher in males vs. females; Sahlan et al., 2020). These data indicate that disordered eating symptoms do occur outside of non-Western societies. Importantly, ED and depression comorbidity occurs at a rate of 16.46% in Iranian children and adolescents (Mohammadi et al., 2020); however, unknown is how *individual* depression and disordered eating symptoms relate to one another among Iranian people. This question is examined for the first time in the current study.

The current study used network analysis to identify central disordered eating symptoms among a large, non-clinical sample of Iranian adolescents and young adults. We also examined bridge symptoms among disordered eating, depression, and self-esteem, and compared networks between adolescents vs. adults and males vs. females. In line with previous studies (e.g., Brown et al., 2020; Calugi et al., 2020), we hypothesized that desire to lose weight would be the most central symptom. Given previous findings (Levinson et al., 2017), we hypothesized that physical sensations would bridge disordered eating and depression symptoms. Finally, as the existing literature on gender and age-related differences in symptom networks is sparse, we examined sex and age-related network models from an exploratory lens.

Method

Participants

Participants ($N = 1,749$) came from two samples. Data from Sample 1 ($n = 637$, 60.3% female) were also used in Sahlan et al. (2020). However, the aims and analyses of the current project are unique and have not been published previously. Additionally, the adolescent sample was not published previously. Potential participants from multiple cities in Iran were approached during class and given information about the study. Participants provided written informed consent, and those who agreed to participate completed questionnaires (provided in Farsi) in the presence of research staff without remuneration. Sample 2 included adolescents ($n = 1,112$, 54.6% female) who were recruited from approximately 4,100 adolescents and 19 schools (9 schools for boys and 10 schools for girls) comprised of 154 classes (Tehran: $n = 7$ schools, $n = 56$ classes; Tabriz: $n = 4$ schools, $n = 36$ classes; Kurdistan: $n = 4$ schools, $n = 30$ classes; Rasht: $n = 4$ schools, $n = 32$ classes). Participation rate was 27.1% in adolescents. All potential participants were approached on campus or during class and were invited to participate in a study that would test psychological issues among college students or adolescents. One adolescent did not include demographic information and was excluded from the analyses. For adolescent participants, school and

regional administrators approved the research procedures and parental consent was obtained prior to their child's participation. Also, adolescents provided assent. Study 1 and 2 were approved by the institutional review board of Iran University of Medical Sciences. Age ranged from 12–19 in the adolescent sample and 18–54 in college students. Descriptive statistics are provided in Table 1.

Measures

Items from all measures were included as individual nodes in the networks. All measures are appropriate for use in both adolescents and adults (Eating Disorder Examination Questionnaire [EDE-Q]: Carrard et al., 2015; Mond et al., 2014, Rosenberg Self-Esteem Scale [RSES]: Bagley & Mallick, 2001; Sinclair et al., 2010, Beck Depression Inventory [BDI]: Dardas, Silva, Noonan, & Simmons, 2018; Segal, Coolidge, Cahill, & O'Riley, 2008).

Disordered eating.—The Persian translation of the EDE-Q (Sahlan et al., 2020) assessed disordered eating symptoms over the past 28 days. Twenty-two items are rated on a seven-point scale ranging from 0 (*No days*) to 6 (*Every day*). Five items assess the frequency of disordered eating behaviors. Internal consistency was excellent ($\alpha_s=.90-.92$). Between 13.6–22.4% of participants reported clinical levels of disordered eating (i.e., ≥ 2.5 ; EDE-Q global score, Rø, Reas, & Stedal, 2015). Additionally, between 1.8–26.7% of participants reported recurrent bingeing, or purging (i.e., self-induced vomiting, laxative misuse, and over-exercise) in past 28 days.

Self-esteem.—The Persian translation of the RSES (Shapurian, Hojat, & Nayerahmadi, 1987) assessed global self-esteem. The scale includes ten items rated on a four-point Likert ranging from 1 (*Strongly disagree*) to 4 (*Strongly agree*). Some items were reverse-scored so that higher scores reflect lower self-esteem. Internal consistency was strong ($\alpha_s=.84-.87$).

Depressive symptoms.—The Persian translation of the BDI-II (Ghassemzadeh, Mojtabai, Karamghadiri, & Ebrahimkhani, 2005) assessed depressive symptoms. The scale includes 21 items which rated on a four-point scale ranging from 0 (*Did not apply to me at all*) to 3 (*Applied to me very much, or most of the time*). Internal consistency was excellent ($\alpha_s=.92$).

Data Analytic Procedure

Analyses were conducted using R software. Six *Glasso* networks were estimated using the *estimateNetwork* function in the *bootnet* package (Epskamp & Fried, 2020). Model 1 included the full sample ($N=1,748$) with only the EDE-Q items. Models 2–6 included items from all three measures. Model 2 included the full sample. Model 3 included the college sample. Model 4 included the adolescent sample. Model 5 included males from both samples. Model 6 included females from both samples. The *goldbricker* function in the *networktools* package (Jones, 2019) was used to determine whether any items may measure the same construct by identifying items with highly similar correlations to other items. Goldbricker indicated that *binge eating* and *losing control when eating* appeared to be measuring the same construct, and due to *eating a large amount of food* also conceptually

overlapping with binge eating, we chose to remove the two items and include only *binge eating* in the models. All other items were included in Models 2–6. Table 2 includes the symptoms and corresponding labels.

The *Glasso* function estimates partial correlations between nodes. Networks were estimated using Spearman correlations rather than polychoric correlations, as Spearman correlations produce more stable networks (Epskamp & Fried, 2018). The *Glasso* function utilizes the ‘least absolute shrinkage and selection operator’ (LASSO; Tibshirani, 1996), which causes many of the edge estimates (i.e., correlations) to be reduced to zero, therefore dropping them out of the model. Thus, LASSO estimates a ‘conservative’ network model where only a small number of edges are included in the network structure (Epskamp, Borsboom, & Fried, 2018). Edge weight confidence intervals, which represent the confidence intervals for each individual edge, can be found in Supplementary materials. Stability estimates of each network were calculated with the *bootnet* package (Epskamp & Fried, 2020), which utilizes bootstrapping techniques. Stability values above .50 indicate network stability (Epskamp, Borsboom, & Fried, 2018), such that a stability coefficient of .50 indicates that 50% of the cases could be removed from the analysis while still obtaining a similar network structure.

Strength centrality (i.e., the sum of the absolute values of edges) was calculated using the *centralityplot* function in the *qgraph* package (Epskamp, Cramer, Waldorp, Schmittman, & Borsboom, 2012). We used strength centrality as it is the most stable and has been suggested to be the most appropriate measure of centrality in psychological networks compared to other measures of centrality (i.e., betweenness, closeness; Bringmann et al., 2019).

Centrality difference tests were conducted using the *bootnet* package (Epskamp & Fried, 2020) to determine if specific symptoms were significantly more central than others. Based on the results of each of the centrality difference tests, two to five of the most central symptoms of each network was included in our interpretation of the results. We did not use a standard cut-off value for each network due to variability among networks. Centrality difference tests can be found in Supplementary Materials.

Bridge symptoms were identified using the *bridge* function of the *networktools* package (Jones, 2019). This function allows for groups of symptoms to be analyzed (e.g., psychiatric diagnoses). Each group in this analysis represented disordered eating symptoms, depression, or self-esteem. The *bridge* function of the *networktools* package (Jones, 2019) quantifies the partial correlations between nodes in different symptom clusters with a metric called bridge expected influence (i.e., the sum of the value of all the edges that exist between a node and all nodes in other groups [Jones, 2019]). Stability estimates of bridge expected influence (BEI) were estimated using the *bootnet* package (Epskamp & Fried, 2018). We used BEI estimates to identify the strongest bridge symptoms. BEI difference tests were conducted using the *bootnet* package (Epskamp & Fried, 2018).

When analyzing symptoms from multiple constructs, symptoms commonly cluster by construct or measure due to high correlations between items (Cramer et al., 2010; Borsboom, 2017; Fried & Cramer, 2017). In this study, we expected symptoms to cluster by construct, such that disordered eating, depression, and self-esteem items would be highly

connected. Similar construct clusters have been found in other comorbidity network studies (Afzali et al., 2017; Choi, Batchelder, Ehlinger, Safren, & O’Cleirigh, 2017; Robinaugh, LeBlanc, Vuletic, & McNally, 2014; Ruzzano, Borsboom, & Geurts, 2015).

We compared both the college vs. adolescent samples and males vs. females using the *NetworkComparisonTest* package (van Borkulo et al., 2016). Three estimates were obtained to analyze differences between networks: network invariance (i.e., whether the *structure* of the network is different by measuring the differences in maximum edge strength), global strength invariance (i.e., whether the *overall connectivity* differs across networks by measuring the differences in the sum of the edge strength), and edge invariance (i.e., whether a specific edge between nodes differs between networks by measuring the differences between specific edges; van Borkulo et al., 2016).

Results

Missing Data

Missing data ranged from 0–0.8% in the adolescent sample and 0–0.2% in the college sample. Missing data were handled with pairwise deletion.

Model 1

Model 1 was stable (strength=.75, edge=.75). The symptoms with the highest centrality were: *desire to lose weight* (strength [S]=2.32) and *discomfort when seeing one’s own body* (S =1.51; Figure 1 and Table 3). Strength centrality difference tests indicated that the most central symptoms had significantly greater strength than 84.00% of other symptoms ($ps<.05$).

Model 2

Central symptoms.—Model 2 was stable (strength=.75, edge=.75). The symptoms with the highest centrality were: *desire to lose weight* (S =2.00), *feeling useless* (S =1.73), *discomfort when seeing one’s own body* (S =1.66), *self-dislike* (S =1.58; Figure 2 and Table 3). Strength centrality difference tests indicated that the most central symptoms had significantly greater strength than 83.93% of other symptoms ($ps<.05$).

Bridge symptoms.—BEI was stable (BEI stability=.75). The bridge symptom with the greatest expected influence was *feeling like a failure*. Feeling like a failure was connected to one disordered eating symptom and eight depression symptoms (partial $rs=.02-.07$).

Model 3

Central symptoms.—Model 3 was stable (strength=.60, edge=.67). The symptoms with the highest centrality were: *feeling worthless* (S =2.26) and *desire to lose weight* (S =2.145; Figures 3–4 and Table 3). Strength centrality difference tests indicated that the most central symptoms had significantly greater strength than 85.719% of other symptoms ($ps<.05$).

Bridge symptoms.—BEI was stable (BEI stability=.52). The bridge symptom with the greatest expected influence were *not having much to be proud of*, *feeling like a failure*, and

feeling useless. Not having much to be proud of was connected to four disordered eating symptom and two depression symptoms (partial $r_s=.02-.05$). Feeling like a failure was connected to two disordered eating symptoms and three depression symptoms (partial $r_s=.02-.09$). Feeling useless was connected to one disordered eating symptom and three depression symptoms (partial $r_s=.02-.06$).

Model 4

Central symptoms.—Model 4 was stable (strength=.75, edge=.75). The symptoms with the highest centrality were: *discomfort when seeing one's own body* ($S=1.99$), *self-dislike* ($S=1.79$), *feeling useless* ($S=1.70$), and *desire to lose weight* ($S=1.69$; Figures 3–4 and Table 3). Strength centrality difference tests indicated that the most central symptoms had significantly greater strength than 85.71% of the other symptoms ($p_s < .05$).

Bridge symptoms.—BEI was stable (BEI stability=.67). The bridge symptom with the greatest expected influence was *feeling like a failure*. Feeling like a failure was connected to two disordered eating symptoms and ten depression symptoms (partial $r_s = .02-.07$)

Model 5

Central symptoms.—Model 5 was stable (strength=.60, edge=.67). The symptoms with the highest centrality were: *desire to lose weight* ($S=2.08$), *feeling useless* ($S=1.78$), and *self-dislike* ($S=1.64$; Figures 3–4 and Table 3). Strength centrality difference tests indicated that the most central symptoms had significantly greater strength than 78.57% of other symptoms ($p_s < .05$).

Bridge symptoms.—BEI was stable (BEI stability=.52). The bridge symptoms with the greatest expected influence were *feeling like a failure* and *feeling useless*. Feeling like a failure was connected to one disordered eating symptom and six depression symptoms (partial $r_s=.02-.07$). Feeling useless was connected to one disordered eating symptom and seven depression symptoms (partial $r_s=.02-.05$).

Model 6

Central symptoms.—Model 6 was stable (strength = .75, edge=.75). The symptoms with the highest centrality were: *desire to lose weight* ($S=1.73$) and *discomfort when seeing one's own body* ($S=1.69$; Figures 3–4 and Table 3). Strength centrality difference tests indicated that the most central symptoms had significantly greater strength than 82.14% of other symptoms ($p_s < .05$).

Bridge symptoms.—BEI was stable (BEI stability=.67). The bridge symptom with the greatest expected influence was *feeling like a failure*. Feeling like a failure was connected to six depression symptoms (partial $r_s=.02-.08$).

Network Comparison Tests

Model 3 ($n=637$ college students) was compared to Model 4 ($n=1,111$ adolescents). The Network Invariance test (M) and Global Strength Invariance test (GSI) indicated that the models did not significantly differ ($M=.16, p=.470$; $GSI=.00, p=1.00$). The Edge Invariance

test (E) indicated that the edges between the following symptoms significantly differed: *not having much to be proud of, thoughts about weight affecting concentration* ($E=.01, p=.040$) and *not having much to be proud of and fear of losing control* ($E=.03, p=.010$), *not having much to be proud of and suicidal ideation* ($E=.04, p<.01$), and *feeling like a failure and agitation* ($E=.03, p=.020$). All other bridged edges were not significantly different ($ps >.12$).

Model 5 ($n=757$ males) was compared to Model 6 ($n=991$ females). The Network Invariance test indicated that the models did not significantly differ ($M=.19, p=.100$). The Global Strength Invariance test was significant ($GSI=.23, p=.610$), indicating that the models' overall connectivity differed from each other. The Edge Invariance test indicated that the edges between the following symptoms differed: *feeling like a failure and discomfort seeing one's own body* ($E=.04, p=.030$), *feeling like a failure and loss of pleasure* ($E=.07, p=.010$), *feeling like a failure and tiredness* ($E=.03, p=.040$), *feeling useless and guilt* ($E=.03, p=.020$), *feeling useless and indecision* ($E=.03, p=.050$), and *feeling useless and loss of energy* ($E=.04, p=.050$). All other bridged edges were not significantly different ($p>.09$).

Discussion

Across networks of disordered eating, depression, and self-esteem among a large sample of Iranian adolescents and young adults, *desiring to lose weight* was the most central symptom. Across most models (Model 3), *feeling like a failure* was an influential bridge symptom. With exception of a few differences in edges, no significant differences were found in network structure or global strength. Overall, these findings are consistent with Western-based sociocultural models of EDs. We interpret our findings in the context of a literature comprised mostly of findings from Western, clinical samples. While no disordered eating networks have been compared between Western and non-Western samples, ED networks of clinical and non-clinical samples are more similar than different (Vanzhula et al., 2019; Forrest et al., 2019), which is consistent with dimensional models of EDs (Wildes & Marcus, 2013).

Central Symptoms

Desiring weight loss was the most central symptom across all models, regardless of age and sex. Findings from clinical samples also support that central ED symptoms are similar between adolescents vs. adults (e.g., Brown et al., 2020; Calugi et al., 2020; Forrest et al., 2018; Goldschmidt et al., 2018) and males vs. females (Perko, Forbush, Siew, & Tregarthen, 2019). However, a small proportion of edges differed between adolescents vs. college students. This aligns with Christian and colleagues' (2020) findings that symptom relationships differ across age groups. Unlike most ED network studies, the items assessing shape/weight overvaluation were not highly central in this study. Potential reasons for this could be due to differences in symptom severity, culture, or both.

With respect to symptom severity differences, Western-based sociocultural theories of ED development (e.g., Pennesi & Wade, 2016; Schaefer & Thompson, 2018; Stice, 2001; Thompson, Heinberg, Altabe, & Tantleff-Dunn, 1999; Weissman, 2019) propose that thin-ideal internalization, which could manifest as desiring weight loss, is a *risk* factor for body dissatisfaction, which then increases risk for EDs. Indeed, two studies conducted among

Iranian samples support that thin-ideal internalization is strongly and positively associated with body dissatisfaction (Shahyad, Pakdaman, Shokri, & Saadat; 2018; Sahlan, Akoury, & Taravatroy, *under review*). However, body dissatisfaction is dimensional and only severe manifestations are indicative of clinical EDs (e.g., American Psychological Association, 2013). Specifically, shape and weight overvaluation manifests as the belief that one's body shape or weight is one of the most important indicators of one's self-worth. Shape and weight overvaluation is thought to be a critical *maintenance* factor for ED psychopathology (Fairburn et al., 2003) and consistently emerges as one of the most highly central symptoms in ED network studies (e.g., Forrest et al., 2018; Levinson et al., 2017; Wang et al., 2019). Taken together, desiring weight loss emerging as central in a nonclinical sample (perhaps reflective of "normative discontent"), versus the presence of shape and weight overvaluation emerging as central in clinical samples, could be considered consistent with theories that differentiate between risk (e.g., thin-ideal internalization) vs. maintenance (e.g., shape and weight overvaluation) factors for EDs (Rodin, Silberstein, & Striegel-Moore, 1984). However, additional research is needed to empirically determine whether desiring weight loss is actually more consistent with weight dissatisfaction vs. overvaluation. We find it notable that desiring weight loss and weight overvaluation are both weight-related cognitive ED symptoms, which have strong connections to other ED network symptoms among Western and non-Western and clinical and non-clinical samples alike.

Women in Iran are mandated to wear the hijab (i.e., Islamic head cover), which may confer protective effects against extreme forms of body dissatisfaction. Indeed, comparisons of British Muslim women who do vs. do not wear the hijab reveal that women who wear the hijab place less importance on appearance than women who do not wear the hijab (Swami, Miah, Noorani, & Taylor, 2014). It may make sense that discomfort seeing one's body was among the highly central symptoms in the full sample model (Model 2), adolescent model (Model 4), and female model (Model 6). Arguably, Iranian people have less exposure to seeing female bodies relative to cultures without mandates that women dress in hijab. While these dress codes may positively impact the way others interact with Muslim women (e.g., reduced experiences of sexual objectification; Tolaymat & Moradi, 2011) and could protect against shape and weight overvaluation, wearing the hijab may lead Muslim people to have negative reactions to seeing women's bodies. In this cultural context, seeing women's bodies could cue anxiety due to it being a novel and somewhat forbidden experience. Wearing the hijab may also not guarantee that women have positive experiences of seeing their *own* bodies. Indeed, disordered eating and key ED risk factors have a small yet notable prevalence among Iranian people (Abdollahi & Mann, 2001; Mohammadi et al., 2020; Sahlan et al., 2020).

Bridge Symptoms

Feeling like a failure was the most influential bridge symptom connecting disordered eating symptoms, depression symptoms, and self-esteem in the combined model (Model 2), the adolescent-only model (Model 4), the male-specific model (Model 5), and the female-specific model (Model 6). In the college student-only model (Model 3), not having much to be proud of, feeling like a failure, and feeling useless were the most influential bridge symptoms. Very low self-esteem may be a shared correlate or risk factor for multiple forms

of psychopathology. Indeed, several network analysis studies investigated symptoms that may represent illness pathways from disordered eating to depression/anxiety (Levinson et al., 2017, 2018). Results consistently point to indicators of very low self-esteem, such as feeling like a failure or feeling worthless or useless, as bridge symptoms (Elliott et al., 2020a; Smith et al., 2018). Even though the current study sample differed from those of previous studies, the similarity in bridge symptoms is notable and consistent with dimensional approaches to psychopathology (e.g., Wildes & Marcus, 2013). Moreover, outside of network studies, a large body of research supports that self-esteem may increase risk for both depression and EDs (see review in Becker, Plasencia, Kilpela, Briggs, & Stewart, 2014).

Clinical Implications

Network theory predicts that clinical interventions targeted to central symptoms should lead to reductions in other symptoms (Borsboom & Cramer, 2013; Fried & Cramer, 2017). Similarly, clinical interventions targeted to bridge symptoms should theoretically improve symptoms transdiagnostically (Jones, Ma, & McNally, 2019). While some evidence supports that centrality corresponds to treatment outcomes (Elliott et al., 2020a; Olatunji, Levinson, & Calebs, 2018), item variance is also associated with treatment outcomes (Elliott et al., 2020b; Rodebaugh et al., 2018). To fully understand the utility of centrality specifically in relation to treatment outcomes, experimental and longitudinal research are needed. With this caveat in mind, results suggest that, broadly, intervention targets may change based on whether an intervention's primary objective is to prevent EDs overall vs. prevent EDs and common comorbidities (e.g., depression).

With respect to ED prevention specifically, one prevention program that has demonstrated efficacy is the *Body Project* (e.g., Le, Barendregt, Hay, & Mihalopoulos, 2017). The *Body Project* is a dissonance-based program that directly targets thin-ideal internalization and greatly decreases risk for ED development among females (Stice, Marti, Shaw, & Rohde, 2019; Stice, Rohde, Shaw, & Gau, 2011). The *Body Project* has not been evaluated in Iranian people, and only preliminary evidence is available for males (Brown & Keel, 2015). Because a symptom related to thin-ideal internalization was consistently central across groups (i.e., desiring weight loss) and thin-ideal internalization is conceptualized as a “trans-ethnicity risk factor for EDs” (Stice et al., 2019, p. 103), implementation of the *Body Project* with Iranian adolescents and young adults could be efficacious in preventing EDs.

However, the *Body Project* is not designed to prevent EDs with comorbid depression and does not produce changes in depression over time (Christian et al., 2019; Stice et al., 2011). If a prevention program intends to target both disordered eating and comorbid symptoms, intervening on shared risk factors may be necessary (Becker et al., 2014). In the case of preventing both disordered eating and depression, prevention efforts may need to target low self-esteem. Indeed, a version of the effective Student Bodies prevention program (Jacobi, Völker, Trockel, & Taylor, 2012) designed to reduce ED and comorbid pathology among those at very high risk for ED onset was shown to be more effective than controls in improving ED attitudes and behaviors (Taylor et al., 2016) and could be adapted for use in

Iran. Media literacy approaches have also demonstrated efficacy (Wilksch et al., 2017, 2018) and should be evaluated in this context.

Strengths and Limitations

A notable strength is investigating how disordered eating and other psychological symptoms interconnect among Middle Eastern adolescents and adults. Moreover, we investigated differences by age and sex. This is important considering that most disordered eating theories and research are based on findings among women, and the extent to which these generalize to men remains understudied.

Several limitations deserve mention. First, we included a non-clinical sample. While this is consistent with dimensional models of EDs, results do not indicate which symptoms may be at the core of ED psychopathology among Iranian individuals with EDs. Second, our study was cross-sectional and utilized single items as indicators of symptoms. To enhance reliability and validity of findings, future studies should consider inclusion of composite measures instead of single items. Third, although Bringmann and colleagues (2019) suggest that strength centrality is the best current measure of network centrality, the reliability and validity of strength centrality have limits as is the case with any statistical analysis. Future research may benefit from replicating these findings and measuring the reliability and validity of strength centrality, as well as identifying alternative measures of centrality in network analysis. Fourth, our assessment of disordered eating did not include items specifically tailored to males, which may be needed to fully capture the extent of males' symptoms (Forrest et al., 2019). Fifth, item variability may influence centrality (Elliott et al., 2020b). Continued work is needed to determine (1) the utility of centrality in predicting treatment outcomes and (2) mechanisms explaining why item variability and/or centrality are related to treatment outcomes.

In conclusion, we found that desiring weight loss was the most central item, which is consistent with sociocultural theories of ED development and transdiagnostic models of EDs. Feeling like a failure was the central bridge symptom in most networks, which is consistent with the conceptualization of very low self-esteem as a shared risk factor for both disordered eating symptoms and depression. Results are largely consistent with Western conceptualizations of EDs and identify potential targets for the prevention of disordered eating and depression.

Supplementary Material

Refer to Web version on PubMed Central for supplementary material.

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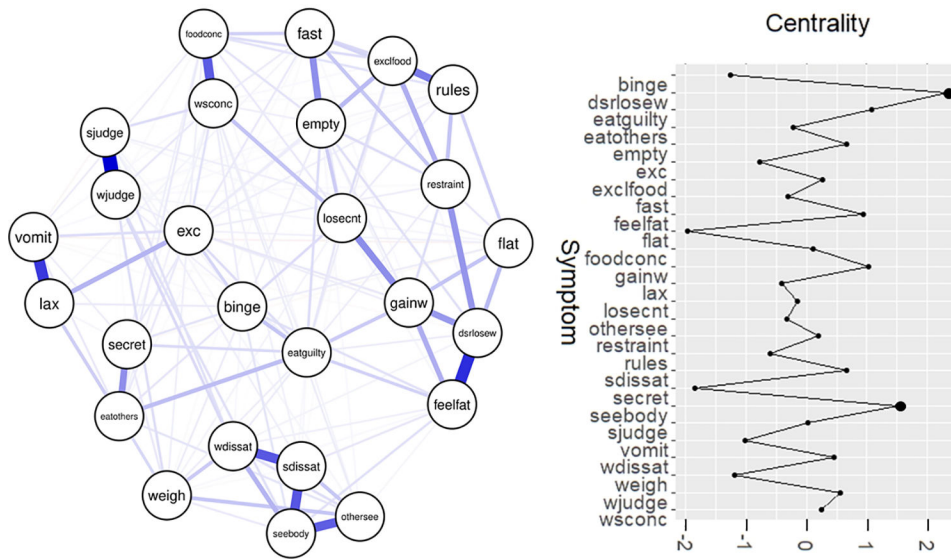


Figure 1. Model 1 network and centrality plot.

Notes: See Table 2 for a list of all node names and their corresponding symptoms/measure items. Larger dots on the centrality graph (right) denote the most central symptoms.

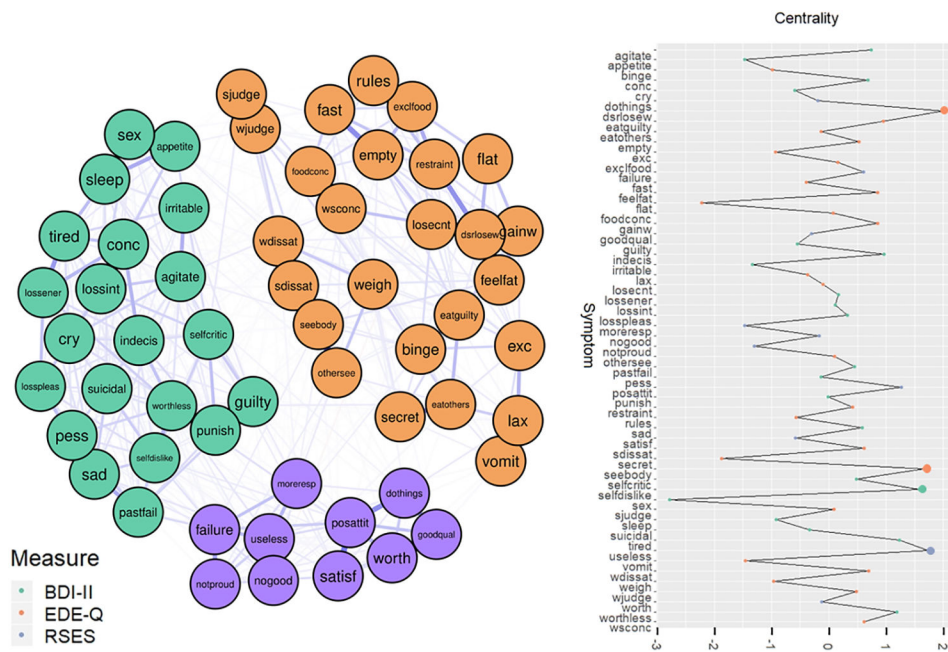


Figure 2. Model 2 network and centrality plot.

Notes: Orange items = EDE-Q items; purple items = RSES items; green items = BDI-II items. Larger dots on the centrality graph (right) denote the most central symptoms. Model 2 is made up of the full sample ($N = 1,748$). See Table 2 for a list of all node names and their corresponding symptoms/measure items.

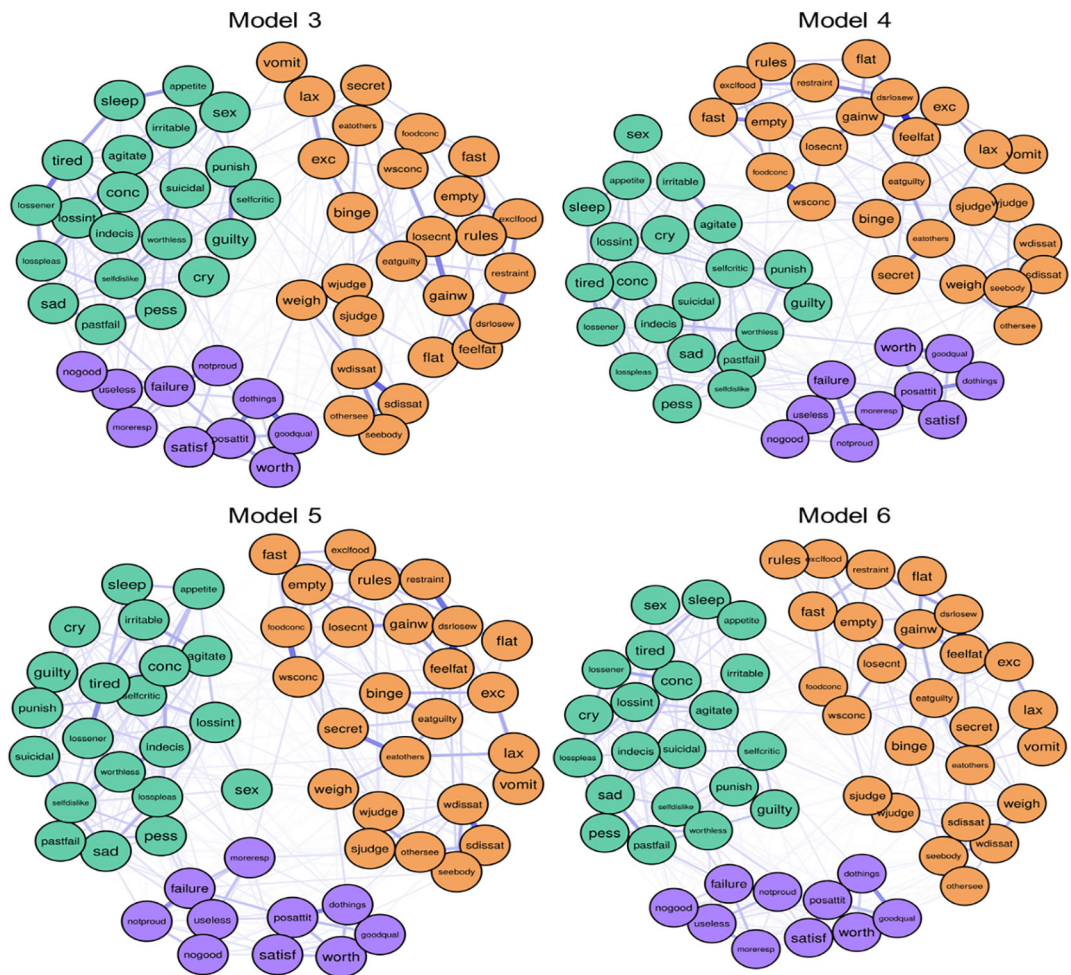


Figure 3. Models 3–6 networks.

Notes: Orange items = EDE-Q items; purple items = RSES items; green items = BDI-II items. Model 3 is made up of a college sample ($n = 637$). Model 4 is made up of an adolescent sample ($n = 1,111$). Model 5 is made up of a male sample ($n = 757$). Model 6 is made up of a female sample ($n = 991$). See Table 2 for a list of all node names and their corresponding symptoms/measure items.

Means and standard deviations for disordered eating symptoms, depressive symptoms, and self-esteem

Table 1.

	Full sample <i>n</i> = 1,748		College <i>n</i> = 637		Adolescents <i>n</i> = 1,111		Males <i>n</i> = 757		Females <i>n</i> = 991	
	<i>n</i> (%)	<i>M</i> (<i>SD</i>)	<i>n</i> (%)	<i>M</i> (<i>SD</i>)	<i>n</i> (%)	<i>M</i> (<i>SD</i>)	<i>n</i> (%)	<i>M</i> (<i>SD</i>)	<i>n</i> (%)	<i>M</i> (<i>SD</i>)
EDE-Q clinical threshold ^a	325 (18.60)	215 (19.40)	110 (17.30)	103 (13.60)	222 (22.40)					
Recurrent eating disorder behavior ^b										
Binging	390 (22.80)	168 (26.70)	222 (20.30)	156 (20.70)	234 (23.40)					
Self-induced vomiting	58 (3.40)	11 (1.80)	47 (4.40)	35 (4.50)	23 (2.30)					
Laxative misuse	88 (5.20)	13 (2.30)	75 (6.90)	41 (5.40)	47 (4.70)					
Over-exercise	326 (18.70)	74 (11.80)	252 (23.0)	151 (21.10)	175 (17.50)					
	<i>M</i> (<i>SD</i>)	<i>M</i> (<i>SD</i>)	<i>M</i> (<i>SD</i>)	<i>M</i> (<i>SD</i>)	<i>M</i> (<i>SD</i>)	<i>M</i> (<i>SD</i>)	<i>M</i> (<i>SD</i>)	<i>M</i> (<i>SD</i>)	<i>M</i> (<i>SD</i>)	<i>M</i> (<i>SD</i>)
Age	17.86 (3.96)	21.89 (3.62)	15.55 (1.59)	17.53 (3.76)	18.11 (4.09)	12–54				
BMI	21.53 (3.61)	22.21 (3.49)	21.15 (3.62)	21.78 (3.79)	21.35 (3.46)	11.10–39.18				
Eating Disorder Examination–Questionnaire										
Restraint	1.64 (2.16)	1.42 (2.06)	1.78 (2.21)	1.43 (2.07)	1.81 (2.22)	0–6				
Fasting	0.87 (1.55)	0.82 (1.53)	0.89 (1.56)	0.75 (1.48)	0.95 (1.60)	0–6				
Excluding food	1.02 (1.75)	0.93 (1.67)	1.07 (1.79)	0.90 (1.70)	1.11 (1.78)	0–6				
Food rules	1.30 (1.87)	1.31 (1.85)	1.30 (1.88)	1.27 (1.92)	1.33 (1.83)	0–6				
A desire to have an empty stomach	0.96 (1.73)	0.79 (1.57)	1.07 (1.80)	0.73 (1.50)	1.14 (1.86)	0–6				
A desire to have a flat stomach	3.35 (2.56)	3.23 (2.53)	3.42 (2.57)	3.19 (2.58)	3.47 (2.54)	0–6				
Difficulty concentrating because of thoughts of food	0.98 (1.66)	0.89 (1.52)	1.03 (1.74)	0.87 (1.56)	1.06 (1.73)	0–6				
Difficulty concentrating because of thoughts of weight/shape	1.15 (1.81)	1.02 (1.66)	1.22 (1.89)	1.06 (1.71)	1.22 (1.88)	0–6				
Fear of losing control over eating	1.26 (1.97)	1.15 (1.85)	1.32 (2.03)	0.88 (1.69)	1.54 (2.12)	0–6				
Fear of weight gain	1.93 (2.34)	1.75 (2.23)	2.04 (2.40)	1.44 (2.11)	2.30 (2.44)	0–6				
Feeling fat	1.78 (2.28)	1.70 (2.20)	1.83 (2.33)	1.39 (2.07)	2.08 (2.39)	0–6				
Desire to lose weight	2.24 (2.63)	1.91 (2.40)	2.42 (2.73)	1.88 (2.46)	2.50 (2.72)	0–6				
Eating in secret	0.50 (1.15)	0.34 (0.85)	0.58 (1.28)	0.57 (1.24)	0.44 (1.07)	0–6				
Feeling guilty after eating	0.97 (1.56)	0.93 (1.53)	0.99 (1.58)	0.77 (1.38)	1.12 (1.67)	0–6				
Concerns about others seeing one eat	0.69 (1.37)	0.54 (1.20)	0.78 (1.45)	0.72 (1.40)	0.67 (1.34)	0–6				
Overvaluation of weight	1.83 (2.01)	1.84 (1.97)	1.83 (2.03)	1.74 (2.03)	1.91 (1.99)	0–6				

Overvaluation of shape	2.14 (2.12)	2.28 (2.07)	2.05 (2.14)	2.10 (2.14)	2.17 (2.10)	0-6
Upset with weighing oneself more than once a week	1.27 (1.79)	1.12 (1.62)	1.36 (1.87)	1.13 (1.72)	1.38 (1.83)	0-6
Weight dissatisfaction	2.08 (2.09)	2.16 (2.02)	2.02 (2.13)	1.78 (1.96)	2.30 (2.16)	0-6
Shape dissatisfaction	2.09 (2.06)	2.20 (1.95)	2.02 (2.12)	1.90 (1.98)	2.23 (2.11)	0-6
Discomfort when seeing one's own body	1.67 (1.95)	1.75 (1.84)	1.62 (2.00)	1.38 (1.78)	1.90 (2.03)	0-6
Discomfort when others see one's body	1.50 (1.93)	1.38 (1.75)	1.57 (2.03)	1.25 (1.73)	1.69 (2.05)	0-6
Binging	2.78 (5.22)	2.88 (4.79)	2.72 (5.45)	2.66 (5.08)	2.86 (5.32)	0-50
Self-induced vomiting	0.37 (1.82)	0.16 (0.79)	0.50 (2.19)	0.49 (1.91)	0.29 (1.74)	0-28
Laxative misuse	0.63 (2.66)	0.34 (1.95)	0.80 (2.98)	0.65 (2.53)	0.61 (2.75)	0-28
Over-exercise	2.40 (5.51)	1.45 (4.33)	2.94 (6.02)	2.56 (5.66)	2.27 (5.40)	0-30
Rosenberg Self-Esteem Scale						
Feeling worthy	1.66 (0.76)	1.54 (0.62)	1.73 (0.82)	1.65 (0.78)	1.67 (0.74)	1-4
Having good qualities	1.55 (0.66)	1.46 (0.55)	1.60 (0.72)	1.56 (0.69)	1.54 (0.64)	1-4
Being capable	1.72 (0.73)	1.64 (0.67)	1.77 (0.76)	1.71 (0.75)	1.72 (0.71)	1-4
Having a positive self-attitude	1.72 (0.78)	1.67 (0.73)	1.75 (0.80)	1.67 (0.75)	1.77 (0.79)	1-4
Satisfaction with one's self	1.91 (0.84)	1.91 (0.81)	1.90 (0.86)	1.87 (0.84)	1.94 (0.85)	1-4
Not having much to be proud of ^c	1.93 (0.86)	2.01 (0.81)	1.88 (0.89)	1.91 (0.87)	1.94 (0.86)	1-4
Feeling like a failure ^c	1.89 (0.85)	1.95 (0.82)	1.85 (0.87)	1.85 (0.85)	1.91 (0.85)	1-4
Wishing for more respect for one's self ^c	2.25 (0.99)	2.28 (0.96)	2.23 (1.01)	2.17 (1.00)	2.30 (0.99)	1-4
Feeling useless ^c	1.88 (0.92)	1.98 (0.88)	1.82 (0.93)	1.81 (0.92)	1.93 (0.91)	1-4
Thinking one is no good ^c	1.88 (0.91)	2.02 (0.89)	1.80 (0.92)	1.80 (0.90)	1.94 (0.92)	1-4
Beck Depression Inventory-II						
Sadness	0.64 (0.80)	0.64 (0.72)	0.65 (0.84)	0.51 (0.74)	0.75 (0.83)	0-3
Pessimism	0.70 (1.00)	0.69 (0.96)	0.71 (1.02)	0.62 (0.93)	0.76 (1.04)	0-3
Past failure	0.62 (0.92)	0.65 (0.91)	0.60 (0.93)	0.54 (0.88)	0.68 (0.95)	0-3
Loss of pleasure	0.69 (0.92)	0.65 (0.87)	0.71 (0.95)	0.59 (0.85)	0.76 (0.97)	0-3
Feeling guilty	0.62 (0.84)	0.56 (0.80)	0.65 (0.86)	0.55 (0.82)	0.67 (0.85)	0-3
Feeling like one is being punished	0.65 (0.96)	0.62 (0.92)	0.67 (0.98)	0.60 (0.89)	0.69 (1.00)	0-3
Self-dislike	0.52 (0.88)	0.47 (0.80)	0.54 (0.92)	0.44 (0.81)	0.57 (0.92)	0-3
Self-criticism	0.80 (0.94)	0.85 (0.89)	0.77 (0.96)	0.70 (0.86)	0.88 (0.98)	0-3
Suicidal ideation	0.47 (0.84)	0.34 (0.71)	0.55 (0.90)	0.42 (0.78)	0.52 (0.88)	0-3

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Crying	0.75 (1.03)	0.70 (1.02)	0.77 (1.03)	0.51 (0.93)	0.92 (1.06)	0-3
Agitation	0.60 (0.91)	0.50 (0.82)	0.66 (0.96)	0.55 (0.90)	0.63 (0.92)	0-3
Loss of interest	0.78 (1.00)	0.68 (0.90)	0.83 (1.05)	0.69 (0.97)	0.84 (1.02)	0-3
Indecision	0.61 (0.92)	0.65 (0.91)	0.59 (0.93)	0.50 (0.84)	0.70 (0.97)	0-3
Feeling worthless	0.46 (0.85)	0.43 (0.80)	0.48 (0.87)	0.43 (0.83)	0.48 (0.86)	0-3
Loss of energy	0.60 (0.86)	0.59 (0.83)	0.61 (0.88)	0.51 (0.82)	0.67 (0.88)	0-3
Sleep disturbance	0.85 (0.89)	0.77 (0.81)	0.89 (0.93)	0.79 (0.88)	0.89 (0.90)	0-3
Irritability	0.50 (0.81)	0.41 (0.70)	0.55 (0.87)	0.54 (0.85)	0.47 (0.79)	0-3
Changes in appetite	0.89 (0.97)	0.89 (0.94)	0.89 (0.98)	0.76 (0.90)	0.99 (1.01)	0-3
Difficulty concentrating	0.66 (0.86)	0.66 (0.83)	0.66 (0.88)	0.57 (0.83)	0.73 (0.88)	0-3
Tiredness	0.73 (0.93)	0.67 (0.84)	0.77 (0.97)	0.62 (0.88)	0.82 (0.95)	0-3
Loss of interest in sex	0.54 (0.86)	0.45 (0.77)	0.60 (0.91)	0.52 (0.82)	0.56 (0.90)	0-3

Note: EDE-Q = Eating Disorder Examination Questionnaire.

^aThe clinical threshold of the EDE-Q is a global score 2.5.

^bRecurrent eating disorder behavior was defined as engaging in bingeing, self-induced vomiting, laxative misuse, and over exercise 4 times during the past 28 days.

^cItems were reverse coded such that higher scores indicated lower self-esteem to facilitate ease of interpretation of the network model.

Table 2.

Network node labels with their corresponding symptom and item wording

Node label	Symptom	Item
Disordered Eating Symptoms (EDE-Q)		
restraint	Restraint	Have you been deliberately trying to limit the amount of food you eat to influence your shape or weight (whether or not you have succeeded)?
fast	Fasting	Have you gone for long periods of time (8 waking hours or more) without eating anything at all in order to influence your shape or weight?
exclfood	Excluding food	Have you tried to exclude from your diet any foods that you like in order to influence your shape or weight (whether or not you have succeeded)?
rules	Food rules	Have you tried to follow definite rules regarding your eating (for example, a calorie limit) in order to influence your shape or weight (whether or not you have succeeded)?
empty	Desire to have an empty stomach	Have you had a definite desire to have an empty stomach with the aim of influencing your shape or weight?
flat	Desire to have a flat stomach	Have you had a definite desire to have a totally flat stomach?
foodconc	Difficulty concentrating because of thoughts of food	Has thinking about food, eating, or calories made it very difficult to concentrate on things you are interested in (for example, working, following a conversation, or reading)?
wscnc	Difficulty concentrating because of thoughts of weight/shape	Has thinking about shape or weight made it very difficult to concentrate on things you are interested in (for example, working, following a conversation, or reading)?
losecnt	Fear of losing control over eating	Have you had a definite fear of losing control over eating?
gainw	Fear of weight gain	Have you had a definite fear that you might gain weight?
feelfat	Feeling fat	Have you felt fat?
dsrlosew	Desire to lose weight	Have you had a strong desire to lose weight?
secret	Eating in secret	Over the past 28 days, on how many days have you eaten in secret (i.e., furtively)?
eatguilty	Feeling guilty after eating	On what proportion of the times that you have eaten have you felt guilty (felt that you've done wrong) because of its effect on your shape or weight?
eatothers	Concerns about others seeing one eat	Over the past 28 days, how concerned have you been about other people seeing you eat?
wjudge	Overvaluation of weight	Has your weight influenced how you think about (judge) yourself as a person?
sjudge	Overvaluation of shape	Has your shape influenced how you think about (judge) yourself as a person?
weigh	Upset with weighing oneself more than once a week	How much would it have upset you if you had been asked to weigh yourself once a week (no more, or less, often) for the next four weeks?
wdissat	Weight dissatisfaction	How dissatisfied have you been with your weight?
sdissat	Shape dissatisfaction	How dissatisfied have you been with your shape?
seebody	Discomfort when seeing one's own body	How uncomfortable have you felt seeing your body (for example, seeing your shape in the mirror, in a shop window reflection, while undressing or taking a bath or shower)?
othersee	Discomfort when others see one's body	How uncomfortable have you felt about others seeing your shape or figure (for example, in communal changing rooms, when swimming, or wearing tight clothes)?

Node label	Symptom	Item
binge	Binging	Had a sense of losing control over your eating and ate an unusually large amount of food.
vomit	Self-induced vomiting	Made yourself sick (vomit) for shape or weight concerns.
lax	Laxative misuse	Taken laxatives for shape or weight concerns.
exc	Over-exercise	Exercised in a "driven" or "compulsive" way for shape or weight concerns.
Self-Esteem (RSSES)		
worth	Feeling worthy	I feel that I'm a person of worth, at least on an equal plane with others.
goodqual	Having good qualities	I feel that I have a number of good qualities.
dothings	Being capable	I am able to do things as well as most other people.
posattit	Having a positive self-attitude	I take a positive attitude toward myself.
satisf	Satisfaction with one's self	On the whole, I am satisfied with myself.
notproud	Not having much to be proud of	I feel I do not have much to be proud of.
failure	Feeling like a failure	All in all, I am inclined to feel that I am a failure.
moreresp	Low self-respect	I wish I could have more respect for myself.
useless	Feeling useless	I certainly feel useless at times.
nogood	Thinking one is no good	At times I think I am no good at all.
Depression Symptoms (BDI-II)		
sad	Sadness	I am so sad and unhappy that I can't stand it.
peess	Pessimism	I feel the future is hopeless and will only get worse.
pastfail	Past failure	I feel I am a total failure as a person.
losspleas	Loss of pleasure	I can't get any pleasure from the things I used to enjoy.
guilty	Feeling guilty	I feel guilty all of the time.
punish	Feeling like one is being punished	I feel I am being punished.
selfdislike	Self-dislike	I dislike myself.
selfcritic	Self-criticism	I blame myself for everything bad that happens.
suicidal	Suicidal ideation	I would kill myself if I had the chance.
cry	Crying	I feel like crying, but I can't.
agitate	Agitation	I am so restless or agitated that I have to keep moving or doing something.
lossint	Loss of interest	It's hard to get interested in anything.
indecis	Indecision	I have trouble making any decisions.
worthless	Feeling worthless	I feel utterly worthless.
lossener	Loss of energy	I don't have enough energy to do anything.

Node label	Symptom	Item
sleep	Sleep disturbance	I sleep most of the day <i>or</i> I wake up 1–2 hours early and can't get back to sleep.
irritable	Irritability	I am irritable all the time.
appetite	Changes in appetite	I have no appetite at all <i>or</i> I crave food all the time.
conc	Difficulty concentrating	I find I can't concentrate on anything.
tired	Tiredness	I am too tired or fatigued to do most of the things I used to.
sex	Loss of interest in sex	I have lost interest in sex completely.

Networks and their most central symptoms, in order of the most consistent central symptoms.

Table 3.

Model 2 (full sample)	Central Symptoms	Bridge Symptoms
	Desire to lose weight Feeling useless Discomfort when seeing one's own body Self-dislike	Feeling like a failure
Model 3 (college students)	Central Symptoms	Bridge Symptoms
	Desire to lose weight Feeling worthless	Not having much to be proud of Feeling like a failure Feeling useless
Model 4 (adolescents)	Central Symptoms	Bridge Symptoms
	Desire to lose weight Feeling useless Discomfort when seeing one's own body Self-dislike	Feeling like a failure Feeling like a failure Feeling like a failure
Model 5 (males)	Central Symptoms	Bridge Symptoms
	Desire to lose weight Feeling useless Self-dislike	Feeling like a failure Feeling like a failure Feeling like a failure
Model 6 (females)	Central Symptoms	Bridge Symptoms
	Desire to lose weight Discomfort when seeing one's own body	Feeling like a failure