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Increased Rates of Eating Disorders and their Symptoms in Women with Major Depressive Disorder and Anxiety Disorders

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Abstract

Background: Individuals with eating disorders (EDs) have increased rates of major depressive disorder (MDD) and anxiety disorders. Yet, few studies have investigated rates of EDs and their symptoms in individuals presenting with MDD/anxiety disorders. Identifying potential disordered eating in people with MDD/anxiety disorders is important because even subclinical disordered eating is associated with reduced quality of life, and undiagnosed eating pathology may hinder treatment progress for both MDD/anxiety disorders and comorbid EDs.

Methods: We compared rates of EDs (anorexia nervosa, bulimia nervosa, binge-eating disorder, and other specified feeding and eating disorders) and their symptoms in 130 women with, and 405 women without, lifetime MDD or an anxiety disorder (GAD, OCD, social phobia, specific phobia, panic disorder, agoraphobia, or PTSD) recruited from the population-based Michigan State University Twin Registry. Lifetime ED and MDD/anxiety diagnoses, and lifetime clinically significant disordered eating behaviors (e.g., binge eating, excessive exercise), were assessed using the Structured Clinical Interview for DSM-IV (SCID).

Results: Among participants with lifetime MDD or any anxiety disorder, 13% met criteria for a lifetime ED and 39% reported engaging in at least one lifetime clinically significant disordered eating behavior (e.g., binge eating) on the SCID. In contrast, only 3% of participants without a history of MDD/an anxiety disorder met criteria for a lifetime ED, and only 11% reported lifetime clinically significant disordered eating behavior.

Conclusions: Our findings suggest that women with MDD and anxiety disorders have elevated rates of EDs, and it is therefore imperative to screen for disordered eating in these populations.

Data Availability Statement: The data that support the findings of this study are available from the corresponding author upon reasonable request.

Conflicts of Interest: The authors have no conflicts to declare.

Keywords

eating disorders; comorbidity; major depressive disorder; anxiety disorders; disordered eating; anorexia nervosa; bulimia nervosa; binge-eating disorder; other specified feeding and eating disorders

Eating disorders (EDs) are accompanied by high rates of psychiatric comorbidity (Brewerton, 2007; Hudson et al., 2007; Hughes, 2012; Kaye et al., 2004). While a range of disorders co-occur with anorexia nervosa (AN), bulimia nervosa (BN), binge-eating disorder (BED), and other specified feeding and eating disorders (OSFEDs), rates of comorbid mood and anxiety disorders are particularly elevated. For example, in a large clinical database of women with EDs, 43% met criteria for a mood disorder, and 53% met criteria for an anxiety disorder (Ulfvebrand et al., 2015). These elevated rates are not limited to clinical samples. In the population-based National Comorbidity Survey Replication (NCS-R), over 80% of adults with lifetime BN had a lifetime anxiety disorder, and over 70% had a lifetime mood disorder (Hudson et al., 2007). High rates of comorbid mood and anxiety disorders have also been found in community samples of adolescents with AN, BN, and BED (Rojo-Moreno et al., 2015; Swanson et al., 2011; Touchette et al., 2011).

The co-occurrence of mood, anxiety, and eating disorders may reflect common risk factors and etiology. Several studies have found that EDs cluster empirically with internalizing psychopathology, including anxiety and depression (Blanco et al., 2015; Forbush & Watson, 2013; Mitchell et al., 2014). This overlap may be due in part to shared underlying risk factors, such as genetic, affective, and neurobiological vulnerabilities (Donofry et al., 2016; Prefit et al., 2019; Watson et al., 2019). In particular, research has found that people with major depressive disorder (MDD) or anxiety disorders and people with EDs tend to be elevated in negative emotionality, a personality trait associated with intense and frequent negative emotions (e.g., anxiety, sadness) (Boschloo et al., 2013; Bulik et al., 2006; Cervera et al., 2003). Alternatively, or additionally, MDD/anxiety disorders and EDs may reciprocally increase risk for each other (e.g., irregular eating patterns may negatively impact mood, and/or dysregulated eating may arise as a coping mechanism to regulate negative emotions).

Importantly, if shared vulnerability factors or reciprocal patterns of risk contribute to internalizing symptoms among people with EDs, we might also anticipate elevated disordered eating among people with MDD/anxiety disorders. While abundant research demonstrates high rates of MDD/anxiety disorders in ED samples, relatively few studies have examined eating pathology in individuals with mood and anxiety disorders. However, the limited research to date is consistent in suggesting elevated rates of EDs among people with MDD/anxiety disorders, including adults with any anxiety disorder or post-traumatic stress disorder (PTSD) (i.e., comorbidity rates between 8% and 20%; Becker et al., 2004; Brewerton, 2007; Dansky et al., 1997; Swinbourne et al., 2012), and adolescents with social phobia, PTSD, or current MDD (i.e., comorbidity rates of 10-25%, with the greatest comorbidity among hospitalized adolescents with PTSD; Lipschitz et al., 1999; Sihvola et al., 2009; Zaider et al., 2000).

Crucially, there are several gaps in research on comorbid eating pathology in individuals with MDD/anxiety disorders. Most studies have examined comorbidity among individuals with a single anxiety disorder or MDD (Brewerton, 2007; Dansky et al., 1997; Lipschitz et al., 1999; Wittchen et al., 1999), making it difficult to determine whether findings generalize across disorders or are specific to certain diagnoses (e.g., PTSD, social phobia). Most research has been conducted in treatment-seeking individuals (e.g., Becker et al., 2004; Lipschitz et al., 1999; Swinbourne et al., 2012) who may experience more severe symptoms and elevated comorbidity compared to people in the general population (Aalto-Setälä et al., 2002), or samples that were not fully representative in other ways (e.g., most participants in Zaider et al. (2000) were recruited from primary care clinics and had more ED symptoms than those recruited from non-clinical settings). Finally, research has focused almost exclusively on ED diagnoses in people with MDD/anxiety disorders rather than behaviors or dimensional symptoms that may not reach the diagnostic threshold but could, nevertheless, adversely impact functioning and quality of life (Mitchison et al., 2013; Mond & Hay, 2007).

These gaps in the literature have clinical implications. Findings that mood and anxiety disorders are common in people with EDs have led clinicians to screen for these disorders in ED populations. Conversely, individuals with MDD/anxiety disorders are rarely screened for EDs or maladaptive eating habits (Jauregui Lobera et al., 2009). If disordered eating is substantially elevated across mood and anxiety disorders, then routine screening for EDs in these populations is also prudent. This is particularly true given that common evidence-based interventions for MDD/anxiety disorders (e.g., cognitive-behavioral therapy) may not directly address core ED symptoms, such as irregular eating patterns and body image disturbances (e.g., Hollon & Ponniah, 2010).

The primary aim of this study was to examine rates of EDs and disordered eating symptoms in women with lifetime MDD or an anxiety disorder broadly defined (i.e., generalized anxiety disorder (GAD), obsessive-compulsive disorder (OCD), PTSD, social phobia, specific phobia, panic disorder, or agoraphobia) in a large, population-based sample. To capture comorbidity across the full spectrum of pathology, we examined both DSM-5 ED diagnoses and core ED symptoms (e.g., binge eating, compensatory behaviors, weight preoccupation). We grouped MDD and anxiety disorders together in primary analyses to increase power to detect effects. This approach is consistent with robust evidence of shared etiology between these disorders (e.g., common genetic influences; Cosgrove et al., 2011) and evidence that liability to internalizing symptoms may be more strongly associated with outcomes than disorder-specific variation (Eaton et al., 2013). Nevertheless, we also examined individual diagnoses in secondary analyses. Finally, we investigated ages of onset for EDs and MDD/anxiety disorders. Although these analyses were limited to retrospective reports of ages of onset, they provide important preliminary information about trajectories of comorbidity in a population-based sample of individuals with MDD/anxiety disorders.

Methods

Participants

Participants included 563 female twins (ages 15-25; mean = 17.60, *SD* = 1.80) from the *Twin Study of Hormones and Behavior Across the Menstrual Cycle* (TSHBMC; Klump et al., 2014). TSHBMC participants were recruited through the Michigan State University Twin Registry (MSUTR), which identifies twins through birth records (Burt & Klump, 2013, 2019; Klump & Burt, 2006). Because TSHBMC focused on ovarian hormones (see Klump et al., 2013, 2014), women had to meet eligibility criteria: 1) regular menstruation for the past 6 months; 2) no hormonal contraceptive use in the past 3 months; 3) no psychotropic/steroid medications in the past 4 weeks; 4) no pregnancy/lactation in the past 6 months; and 5) no genetic/medical conditions known to influence hormones or appetite/weight (Klump et al., 2013). The current sample includes participants from prior analyses (e.g., Klump et al., 2013, 2014), as well as participants excluded from previous reports due to failing to meet inclusion criteria (e.g., regular/ovulatory cycles) that do not affect current analyses.

Participants were demographically representative of Michigan (MDHHS, 2017). The majority identified as White/Caucasian (*n* = 463; 82.2%), followed by Black/African American (*n* = 66; 11.7%), multiracial (*n* = 26; 4.6%), Asian American (*n* = 4; 0.7%), and Native American (*n* = 2; 0.4%). Two participants (0.4%) did not identify their race. Forty-five (8.0%) participants identified as Hispanic/Latina. The mean participant BMI was 23.58 (*SD* = 5.39, range = 15.31-47.51). Participants varied in parental annual income (<$20,000/year = 5.7%; $20,000-$40,000/year = 13.1%; $40,000-$60,000/year = 21.9%; $60,000-$100,000/year = 32.5%; >$100,000/year = 23.5%; missing = 3.4%).

Measures

Definitions of Clinical Disorders—Participants completed a version of the Structured Clinical Interview for DSM-IV (SCID; First et al., 1996) modified to include draft DSM-5 criteria for EDs. Data were therefore available to code DSM-5 ED, and DSM-IV MDD and anxiety disorder, diagnoses. We were unable to code DSM-5 diagnoses for all disorders because criteria for some anxiety disorders differed substantially between DSM-IV and DSM-5 (e.g., changes to required symptoms for PTSD, added requirements that anxiety symptoms be present for 6+ months in adults, no longer requiring that anxiety/obsessions be recognized as excessive/unreasonable). We focused on MDD rather than all mood disorders because rates of bipolar disorder were low in our sample (*n* = 1; 0.2%), which likely reflected exclusion of participants using psychotropic medications and the fact that the average age of our sample was below the median age of onset for bipolar disorder (i.e., early-to-mid 20s; e.g., Schaffer et al., 2006; Subramaniam et al., 2013).

Individuals were categorized as having lifetime MDD or an anxiety disorder (referred to as "MDD/ANX") if they ever had a "definite" (i.e., all criteria met in full) or "probable" (e.g., all criteria met in full except for one, which was present at a subthreshold level) DSM-IV diagnosis of MDD, GAD, panic disorder, agoraphobia, social phobia, specific phobia, OCD, or PTSD. Similarly, participants were categorized as having a lifetime ED if they ever met criteria for a "definite" or "probable" DSM-5 diagnosis of AN, BN, BED, purging disorder,

or an OSFED characterized by clinically significant overvaluation of weight and shape and regular compensatory behaviors (i.e., excessive exercise, fasting, or strict dieting).

Individuals who met some criteria for a disorder, but fell further below the threshold (i.e., 2 symptoms short), were given a "possible" diagnosis. Participants who only met criteria for a "possible" MDD/anxiety disorder (n = 11, 2.0%) were excluded from primary analyses, as it is difficult to categorize them as having MDD/ANX or having no MDD/ANX. However, results were very similar when including participants with "possible" MDD/ANX in the MDD/ANX group (see Results and Table S4). Participants who did not meet definite/probable/possible criteria were identified as having no diagnosis. Note that participants who did not meet criteria for any MDD/ANX or eating disorder may still have met criteria for another disorder not examined herein (e.g., a substance use disorder). The algorithms for definite, probable, and possible diagnoses are provided in Table S1 in Supplemental Material.

Independent raters blind to diagnostic status listened to recorded SCID interviews and re-coded diagnoses to establish reliability. Interrater reliability was good for the presence of MDD (κ = 1.00), any anxiety disorder (κ = .766), and any ED (κ = .803). Reliability was not examined for individual anxiety disorders and EDs due to the small number of cases for some disorders.

ED Behaviors and Symptoms—Five ED behaviors were assessed using the SCID: objective binge eating (OBEs – i.e., eating an objectively large amount of food over a short period of time, accompanied by lack of control over eating), subjective binge eating (SBEs – i.e., eating an amount of food that is not objectively large, but that the participant felt was too much, accompanied by lack of control), loss of control over other eating episodes (LOC – i.e., feeling that one could not control what/how much they were eating outside of OBEs/SBEs), purging behaviors (i.e., vomiting or use of laxatives or other medications to control weight), and non-purging compensatory behaviors (i.e., excessive exercise, fasting, or strict dieting) (see Table 1 for frequencies of ED behaviors). These behaviors not only represent key features of clinical EDs, but also prospectively predict the development of EDs (e.g., Stice et al., 2008; Tanofsky-Kraff et al., 2011) and are associated with reduced quality of life (e.g., Ackard et al., 2011; Mond et al., 2004). We assessed for LOC outside of OBEs/SBEs because some people (particularly youth) may experience LOC episodes that do not fit traditional criteria for a binge (e.g., Tanofsky-Kraff et al., 2008), such as feeling a lack of control despite eating a typical amount of food, or loss of control that occurs while grazing for several hours. SCID skip-out rules were modified so that all behaviors were assessed for all participants.

Even people not actively engaging in disordered eating may experience cognitive and behavioral ED symptoms (e.g., body dissatisfaction, preoccupation with food/weight) associated with psychological distress (Johnson & Wardle, 2005) and increased risk for later eating pathology (Stice & Shaw, 2002). To determine whether these symptoms are elevated in people with MDD/ANX, we examined the Total Score and Body Dissatisfaction, Weight Preoccupation, Binge Eating, and Compensatory Behavior subscales from the Minnesota Eating Behavior Survey (MEBS) (von Ranson et al., 2005)[1]. The MEBS scales successfully

discriminate between girls with and without EDs and show substantial test-retest correlations across significant delays (mean scale correlations = .51-.80 across three years; von Ranson et al., 2005). Internal consistency for most MEBS scales is excellent in women and older adolescent girls (alphas = .65-.89), though somewhat lower for the Compensatory Behavior subscale (alphas = .53-.69) due to infrequent item endorsement (Luo et al., 2016; von Ranson et al., 2005).

Age of Onset—We examined age of onset for MDD/ANX and EDs to better understand the developmental trajectory of their comorbidity. For most disorders and ED behaviors on the SCID (except LOC outside of OBEs/SBEs), participants were asked when the symptoms started. For BN, purging disorder, and non-purging OSFED, the age at which all behaviors for the diagnosis were present was recorded as the age of onset (e.g., age of onset for BN was the age by which both binge eating and purging had onset). Among participants with an anxiety disorder, 36 (32.7%) reported having symptoms “as long as they could remember”; in these cases, age of onset was coded as 5 years old (importantly, substituting an earlier age of onset did not alter results). If the participant reported current MDD, but no past MDD, the participant’s age at assessment was used as the age of onset for MDD.

Analyses focused on four categories of disorders/behaviors: MDD, any anxiety disorder, any ED, and any ED behavior. If a participant had multiple disorders/behaviors in a given category, the earliest age of onset was used. Age of onset was missing for 1 (2.7%) participant with MDD, 2 (1.8%) participants with an anxiety disorder, 1 (3.6%) participant with an ED, and 13 (12.9%) participants with ED behaviors (including 7 (6.9%) whose only behavior was LOC).

Statistical Analyses

For all analyses, $p < .01$ was used as the threshold for statistical significance to account for multiple comparisons. Because findings did not differ when using more complex multilevel models that account for increased similarity between twins (see Table S2), we report results as t-tests and chi-square tests to facilitate interpretability. While primary analyses grouped EDs together, and MDD/ANX disorders together, follow-up analyses by individual disorder were included for disorders that affected at least 15 participants (the approximate number needed to detect a large between-group difference of $d = .80$; this included MDD, any anxiety disorder, OCD, social phobia, and specific phobia). When calculating percentages, participants with “possible” MDD/ANX or missing diagnoses/behaviors were excluded from the total.

[1]The Minnesota Eating Behavior Survey (MEBS; previously known as the Minnesota Eating Disorder Inventory [M-EDI]) was adapted and reproduced by special permission of Psychological Assessment Resources, 16204 North Florida Avenue, Lutz, Florida 33549, from the Eating Disorder Inventory (collectively, EDI and EDI-2) by Garner, Olmstead, Polivy, Copyright 1983 by Psychological Assessment Resources. Further reproduction of the MEBS is prohibited without prior permission from Psychological Assessment Resources.

Results

ED Diagnoses

Rates of MDD/ANX and EDs in the full sample are presented in Table 1. One hundred thirty participants (24.3%) had lifetime DSM-IV MDD/ANX. Rates of MDD/ANX (20.4% with any anxiety disorder and 6.7% with MDD) were slightly lower than previously reported in population-based samples of young adults (e.g., 30% prevalence of any anxiety disorder and 15% prevalence of MDD in people ages 18-29 in the NCS-R; Kessler et al., 2005), which could reflect the younger average age of our sample and the fact that our eligibility criteria excluded people taking psychotropic medication. Twenty-eight participants (5.1%) had a lifetime DSM-5 ED, including 13 (2.4%) with AN, BN, or BED and 15 (2.7%) with purging disorder or non-purging OSFED. Again, these rates were slightly lower than those reported in the NCS-R (i.e., 7.5% of women ages 18-29 with lifetime AN, BN, or BED; Hudson et al., 2007), though similar to rates found in a population-based study of DSM-5 diagnoses (i.e., 1.4% of adult women with lifetime AN, 0.5% with lifetime BN, and 1.3% with lifetime BED; Udo & Grilo, 2018). Consistent with prior studies, just over half (55.6%) of participants with a lifetime ED also had lifetime MDD/ANX.

Chi-square tests were used to compare rates of EDs in women with and without lifetime MDD/ANX (see Table 2). Participants with lifetime MDD/ANX were more likely to have a lifetime ED (12.6% versus 3.0%; p <.001; risk ratio = 4.22). Sensitivity analyses including "possible" ED diagnoses showed similar results (14.8% of participants with MDD/ANX had an ED, versus 3.0% without MDD/ANX; p < .001, risk ratio = 4.94). Rates of comorbid EDs remained elevated when participants with "possible" MDD/ANX were included in the MDD/ANX group (11.5%, versus 3.0% among participants without MDD/ANX; p < .001, risk ratio = 3.87). Elevated rates of EDs were also observed when only one randomly selected twin from each family was included in analyses (16.4% of participants with MDD/ANX had a lifetime ED, versus 3.0% without MDD/ANX; risk ratio = 5.44), suggesting that grouping of twins within families did not unduly influence findings.

Interestingly, rates of AN (2.3% versus 0.5%; risk ratio = 4.69), BN (3.2% versus 0.2%; risk ratio = 12.96), and BED (4.0% versus 0.2%; risk ratio = 16.16) were all notably higher among women with MDD/ANX, while rates of non-purging OSFED (3.1% versus 1.5%; risk ratio = 2.09) and purging disorder (0.8% versus 0.7%; risk ratio = 1.04) were more similar between groups. When examining individual MDD/ANX diagnoses, rates of EDs were highest among women with lifetime MDD (29%; risk ratio = 8.15), though rates by individual disorders should be interpreted with caution (and significance tests were not conducted) given small sample sizes (see Table 3).

ED Behaviors from the SCID

In the full sample, 101 participants (18.2%) reported at least one clinically significant ED behavior on the SCID (see Table 1). Participants with lifetime MDD/ANX were significantly more likely to have ED behaviors (39.2% versus 11.3%; p <.001; risk ratio = 3.49) (see Table 2). This remained true when including participants with "possible" MDD/ANX in the MDD/ANX group (38.3% versus 11.3%; p <.001; risk ratio = 3.40), and when only one

randomly selected twin from each family was included in analyses (39.4% versus 10.6%; risk ratio = 3.71). When examined individually, almost every type of ED behavior was more common in participants with MDD/ANX, including OBEs (17.7% versus 2.0%; p <.001; risk ratio = 8.96), SBEs (9.4% versus 3.5%; p = .006; risk ratio = 2.73), LOC (7.4% versus 0.8%; p <.001; risk ratio = 9.81), and non-purging compensatory behaviors (26.2% versus 7.4%; p <.001; risk ratio = 3.52). Purging behaviors were also more common among participants with MDD/ANX (3.8% versus 1.5%; risk ratio = 2.60), but this group difference was not significant.

Rates of ED behaviors for individual mood/anxiety disorders are reported in Table 3. These behaviors were consistently elevated across disorders, and were endorsed by a majority of women with lifetime MDD (56.8%). The lowest rate was found among women with lifetime specific phobia (35.0%). Interestingly, the rate of ED behaviors was more than 10% higher among women with social phobia (45.7%) than among women with specific phobia.

Dimensional Disordered Eating Symptoms

Welch's unequal variances t-tests were used to compare dimensional disordered eating symptoms in participants with and without lifetime MDD/ANX. Because participants with MDD/ANX were also more likely to have an ED (see above), we examined group differences in dimensional disordered eating symptoms both including and excluding women with EDs.

When looking at the full sample (including people with EDs), participants with lifetime MDD/ANX had a significantly higher MEBS Total Score (p <.001, d = .60), as well as higher scores on the MEBS Binge Eating (p <.001, d = .58), Body Dissatisfaction (p <.001, d = .53), and Weight Preoccupation (p <.001, d = .41) subscales. While scores on the MEBS Compensatory Behavior subscale were also higher for participants with MDD/ANX, this difference was smaller (d = .27) and did not reach our p < .01 cutoff (see Table 4). Results were unchanged when including participants with "possible" MDD/ANX in the MDD/ANX group (see Table S4). Results for individual disorders are reported in Table 5.

When people with EDs were excluded from both MDD/ANX and no MDD/ANX groups, the MEBS Total Score and Body Dissatisfaction subscale score remained significantly higher for participants with MDD/ANX, though effect sizes were somewhat attenuated (ds = .40 and .43, respectively; see Table 4). Women with MDD/ANX also continued to have higher scores on the Binge Eating (d = .32; p = .015) and Weight Preoccupation (d = .24; p = .052) subscales, but these differences did not reach significance at p < .01.

Age of Onset

In the full sample (mean age = 17.60, SD = 1.80, range = 15-25), anxiety disorders had the earliest average age of onset (mean = 9.38, SD = 4.15, range = 4-17.5), followed by EDs (mean = 15.74, SD = 2.75, range = 11-22), SCID ED behaviors (mean = 15.78, SD = 2.49, range = 6-22), and MDD (mean = 16.54, SD = 2.51, range = 12-21). Age of onset for MDD or anxiety disorders did not significantly differ (all ps > .30) according to the presence/absence of an ED or ED behavior (mean (SD) age of onset for MDD without/with an ED: 16.54 (2.46)/17.50 (2.53); MDD without/with ED behaviors: 16.75 (2.29)/16.38 (2.72);

anxiety disorders without/with an ED: 9.51 (4.15)/8.78 (4.18); anxiety disorders without/with ED behaviors: 9.15 (4.15)/9.76 (4.19)). Similarly, ages of onset for EDs/ED behaviors were not significantly different for participants without/with MDD/ANX (mean (*SD*) age of onset for ED without/with MDD/ANX: 16.00 (2.63)/15.43 (3.01); ED behaviors without/with MDD/ANX: 16.05 (2.05)/15.40 (2.87); all *p*s > .20). Age of onset of MDD/ANX did not significantly predict the presence of an ED (OR = 1.37, $p = .257$) or ED behaviors (OR = 1.22, $p = .420$), and was not significantly related to the MEBS Total Score ($\beta = .01$, $p = .890$). Additionally, there were no significant differences in the types of ED behaviors (e.g., rates of binge eating or compensatory behaviors) reported by participants who had MDD/ANX first, versus participants who had disordered eating first or had disordered eating and MDD/ANX onset simultaneously ($p > .10$ for all chi-square tests).

Interestingly, anxiety disorders overwhelmingly began before disordered eating, while MDD was more likely to onset after disordered eating (see Table S3). The anxiety disorder onset first in 77.8% (7/9) of participants with an anxiety disorder and an ED, and 81.8% (27/33) with an anxiety disorder and ED behaviors. Conversely, only 25.0% (2/8) of participants with MDD and an ED, and only 17.6% (3/17) with MDD and ED behaviors, experienced MDD first.

Discussion

Women with lifetime MDD/ANX from a population-based sample had significantly elevated rates of lifetime EDs, ED behaviors (e.g., binge eating, non-purging compensatory behaviors), and dimensional disordered eating symptoms. Women with a history of MDD/ANX were more than four times as likely to have a lifetime ED than women without MDD/ANX, and almost 40% of women with MDD/ANX reported clinically significant lifetime ED behaviors. Correspondingly, dimensional ED symptoms were elevated even among women with MDD/ANX who did not have a diagnosable ED. Together, these results indicate that disordered eating is common in women with MDD/ANX.

Our findings are consistent with the limited past research showing increased rates of EDs among people with MDD (Sihvola et al., 2009; Zaider et al., 2000) and anxiety disorders (Becker et al., 2004; Brewerton, 2007; Dansky et al., 1997; Lipschitz et al., 1999; Swinbourne et al., 2012). Our findings significantly extend this research by demonstrating increased disordered eating across multiple measures (i.e., diagnoses, behaviors, dimensional symptoms) even among women in a population-based sample. Overall, we observed more similarities than differences across MDD/ANX diagnoses; even disorders that have been less commonly linked with EDs (e.g., specific phobia) were accompanied by elevated rates of disordered eating, suggesting that internalizing pathology in general may be associated with increased risk.

Moving forward, it will be important to further investigate the factors linking eating and internalizing pathology. While our sample sizes were too small to conduct full twin models examining shared genetic/environmental influences, we observed that cotwins of participants with MDD/ANX were more likely to have EDs/ED behaviors (particularly among monozygotic twins; see Table S5). This was true even among cotwins of participants

with MDD/ANX but no EDs/ED behaviors (i.e., 21.9% of cotwins had an ED/ED behaviors in these pairs, versus 13.3% whose cotwin had no MDD/ANX or EDs/ED behaviors). Shared vulnerabilities may therefore contribute to comorbidity between MDD/ANX and EDs, as suggested by past twin research on anxiety disorders and EDs (e.g., Keel et al., 2005).

One potential shared risk factor is negative emotionality, which could contribute to both core MDD/ANX symptoms (e.g., worry, depressed mood) and disordered eating in people with MDD/ANX. To explore this possibility, we conducted post-hoc analyses examining associations between MDD/ANX and EDs/ED symptoms controlling for scores on the Negative Emotionality subscale of the Multidimensional Personality Questionnaire–Brief Form (assessing emotional lability, negative affect, and negative interpersonal beliefs; Patrick et al., 2002). As shown in Table S6, associations between MDD/ANX and dimensional disordered eating symptoms were attenuated (i.e., effect sizes were reduced by 30-60%) when controlling for negative emotionality. These findings highlight predisposition to negative moods as a potentially important transdiagnostic contributor to MDD/ANX and disordered eating. Nonetheless, negative emotionality did not fully account for associations (particularly with ED diagnoses), suggesting that additional shared mechanisms likely exist (e.g., reward-based processes that may contribute to MDD/ED comorbidity; Clark & Watson, 1991; Ma et al., 2020).

We also found some intriguing differences between disorders that warrant further investigation. Women with MDD were particularly likely to experience disordered eating, with the majority reporting lifetime ED behaviors. MDD was also more likely than an anxiety disorder to onset *after* EDs, consistent with developmental patterns observed previously in clinical samples (e.g., Godart et al., 2015; Swinbourne et al., 2007). Anxiety disorders may therefore presage disordered eating, while MDD may more often be a consequence. As the salience of body image increases at adolescence, an anxious child may begin to worry about weight/shape, and poor body image and disrupted eating patterns could lead to MDD over time. Additional research is needed to investigate the unfolding of these potential mechanisms across development.

Our findings have significant clinical implications. Given elevated rates of disordered eating among individuals with MDD/ANX, screening for EDs and their symptoms in this population is warranted. Even subclinical levels of disordered eating negatively impact wellbeing (Wade et al., 2012), and supplemental screening could detect ED symptoms that may otherwise go overlooked, providing an opportunity for improved clinical care and outcomes. More research is needed to identify how best to treat disordered eating in people with a primary MDD/ANX diagnosis, and whether this differs from the optimal approach in people with a primary ED.

Although this study contributes to our knowledge of disordered eating in people with MDD/ANX, it has some limitations. Our sample was entirely female; additional research is needed to examine disordered eating across gender in people with MDD/ANX. Research suggests that associations between some anxiety disorders and EDs (i.e., OCD and AN; Cederlöf et al., 2015) may be even stronger for males than for females, indicating that males with

MDD/ANX may also be at risk for disordered eating. Although population-based and representative of the recruitment region, our sample was mostly White. Additional research in more racially/ethnically diverse samples is needed. The age range of our sample was somewhat limited, though it captures the window of greatest vulnerability for development of EDs (Klump, 2013). Finally, participants were required to have regular hormone functioning and could not be taking psychotropic medications, which may have led to exclusion of individuals with more severe MDD/ANX or medical conditions associated with both disordered eating and anxiety/depression (e.g., polycystic ovary syndrome; Deeks et al., 2010; Lee et al., 2017). It also precluded us from examining disordered eating in people with bipolar disorder, which is an important area for future research. However, inclusion of participants taking psychotropic medication would have likely produced *higher*, rather than lower, estimates of comorbidity. The current study therefore provides compelling evidence that EDs are elevated even among women with MDD/ANX in the community who may be less severely affected than those who seek clinical care.

Supplementary Material

Refer to Web version on PubMed Central for supplementary material.

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Table 1.

Descriptive statistics for primary study variables in the full sample (N = 563 women)

Diagnosis	**Number Affected (% of Total)**
MDD or Any DSM-IV Anxiety Disorder Combined	130 (24.3%)
Any DSM-IV Anxiety Disorder Only (Excluding MDD)	110 (20.4%)
MDD	37 (6.7%)
OCD	30 (5.4%)
PTSD	8 (1.5%)
Social Phobia	46 (8.4%)
Specific Phobia	40 (7.2%)
Panic Disorder	7 (1.3%)
AWOPD	2 (0.4%)
GAD	6 (1.1%)
Eating Disorders	**Number Affected (% of Total)**
Any DSM-5 Eating Disorder	28 (5.1%)
Anorexia Nervosa	5 (0.9%)
Bulimia Nervosa	5 (0.9%)
Binge-Eating Disorder	6 (1.1%)
Purging Disorder	4 (0.7%)
Non-Purging OSFED	11 (2.0%)
Disordered Eating Behaviors from the SCID	**Number Affected (% of Total)**
Any Disordered Eating Behavior	101 (18.2%)
OBE	32 (5.7%)
SBE	28 (5.0%)
Loss of Control Over Eating Outside of OBEs/SBEs	13 (2.4%)
Excessive Exercise, Fasting, or Strict Dieting	67 (12.0%)
Purging, Laxatives, or Other Medication	11 (2.0%)

Dimensional Disordered Eating Symptoms	**Mean (SD)**	**Observed Range**	**Possible Range**
MEBS Total Score	5.40 (4.99)	0-24	0-30
MEBS Binge Eating	1.05 (1.37)	0-7	0-7
MEBS Body Dissatisfaction	1.52 (1.91)	0-6	0-6
MEBS Weight Preoccupation	2.16 (2.19)	0-8	0-8
MEBS Compensatory Behaviors	0.15 (0.43)	0-3	0-6

Note: OBE = objective binge eating; SBE = subjective binge eating; MDD = major depressive disorder; OCD = obsessive-compulsive disorder; PTSD = post-traumatic stress disorder; AWOPD = agoraphobia without panic disorder; GAD = generalized anxiety disorder; OSFED = other specified feeding or eating disorder; any anxiety disorder = a lifetime diagnosis of at least one of the following: OCD, PTSD, social phobia, specific phobia, panic disorder, AWOPD, or GAD; MEBS = Minnesota Eating Behavior Survey. N's represent lifetime "definite"/"probable" diagnoses and lifetime behaviors.

Table 2.

Rates of DSM-5 eating disorders (EDs) and disordered eating behaviors in individuals with and without a lifetime history of MDD and/or an anxiety disorder

	With MDD/Anxiety Disorder (Total N = 130)	No MDD or Anxiety Disorder (Total N = 405)	Chi-Square (*df*, N)	*p*	Risk Ratio
DSM-5 Eating Disorder Diagnoses:					
DSM-5 AN, BN, or BED (“probable”/“definite” dx only)	8.3% (10/120)	0.7% (3/402)	21.906 (1, N = 522)	<.001	11.17
DSM-5 AN, BN, BED, or OSFED (“probable”/“definite” dx only)	12.6% (15/119)	3.0% (12/402)	17.293 (1, N = 521)	<.001	4.22
DSM-5 AN, BN, BED, or OSFED (including “possible” dx)	14.8% (18/122)	3.0% (12/402)	24.019 (1, N = 524)	<.001	4.94
Disordered Eating Behaviors Reported on the SCID:					
Any Behavior	39.2% (51/130)	11.3% (45/400)	51.789 (1, N = 530)	<.001	3.49
OBE	17.7% (23/130)	2.0% (8/405)	44.535 (1, N = 535)	<.001	8.96
SBE	9.4% (12/127)	3.5% (14/405)	7.468 (1, N = 532)	.006	2.73
LOC	7.4% (9/122)	0.8% (3/399)	18.225 (1, N = 521)	<.001	9.81
Excessive Exercise, Fasting, or Strict Dieting	26.2% (34/130)	7.4% (30/404)	32.702 (1, N = 534)	<.001	3.52
Vomiting, Laxatives, or Other Medication	3.8% (5/130)	1.5% (6/405)	2.733 (1, N = 535)	.098	2.60

Note: MDD = major depressive disorder; AN = anorexia nervosa; BN = bulimia nervosa; BED = binge-eating disorder; OSFED = other specified feeding or eating disorder; OBE = objective binge eating; SBE = subjective binge eating; LOC = loss of control over eating outside of OBEs/SBEs; SCID = Structured Clinical Interview for DSM-IV; dx = diagnosis. N’s represent lifetime diagnoses and behaviors. Anxiety disorders include DSM-IV obsessive-compulsive disorder, post-traumatic stress disorder, social phobia, specific phobia, panic disorder, agoraphobia, and generalized anxiety disorder. OSFED includes purging disorder and non-purging disorders characterized by a consistent pattern of excessive exercise, strict dieting, or fasting to control weight accompanied by overvaluation of weight or shape. N’s for some comparisons are smaller than the total N’s for MDD/anxiety disorder and no MDD/anxiety disorder groups because some participants had missing ED diagnoses/behaviors, and because participants with “possible” EDs were excluded from primary analyses of diagnoses.

Table 3.

Rates of DSM-5 eating disorders (EDs) and disordered eating behaviors by MDD and individual anxiety disorder diagnoses

	With the Diagnosis/Behavior	Without the Diagnosis/Behavior	Chi-Square (*df*, N)	*p*	Risk Ratio
DSM-5 Eating Disorder Diagnoses:					
MDD	29.0% (9/31)	3.6% (18/505)	—	—	8.15
Any DSM-IV Anxiety Disorder	8.9% (9/101)	4.0% (17/424)	—	—	2.22
OCD	10.0% (3/30)	4.9% (25/511)	—	—	2.04
Social Phobia	12.5% (5/40)	4.7% (23/494)	—	—	2.68
Specific Phobia	8.6% (3/35)	4.5% (23/506)	—	—	1.89
Disordered Eating Behaviors Reported on the SCID:					
MDD	56.8% (21/37)	15.2% (77/508)	40.467 (1, N = 545)	<.001	3.74
Any DSM-IV Anxiety Disorder	37.3% (41/110)	12.8% (54/423)	35.796 (1, N = 533)	<.001	2.92
OCD	40.0% (12/30)	17.0% (88/519)	10.110 (1, N = 549)	.001	2.36
Social Phobia	45.7% (21/46)	15.5% (77/497)	25.892 (1, N = 543)	<.001	2.95
Specific Phobia	35.0% (14/40)	16.0% (81/507)	9.349 (1, N = 547)	.002	2.19

Note: MDD = major depressive disorder; OCD = obsessive-compulsive disorder; any anxiety disorder = a lifetime diagnosis of at least one of the following: OCD, post-traumatic stress disorder, social phobia, specific phobia, panic disorder, agoraphobia, or generalized anxiety disorder; SCID = Structured Clinical Interview for DSM-IV. N's represent lifetime "definite"/"probable" diagnoses and lifetime behaviors. Eating disorders include anorexia nervosa, bulimia nervosa, binge-eating disorder, purging disorder, and non-purging disorders characterized by a consistent pattern of excessive exercise, strict dieting, or fasting to control weight accompanied by overvaluation of weight or shape. Disordered eating behaviors include objective binge eating, subjective binge eating, loss of control over other eating episodes, or compensatory behaviors (such as vomiting or excessive exercise) to control weight.

Table 4.

Dimensional disordered eating symptoms in individuals with and without a lifetime history of MDD or an anxiety disorder

Symptom Scale	With MDD/Anxiety Disorder *Mean (SD)*	No MDD or Anxiety Disorder *Mean (SD)*	*D*	*t(df)*	*p*
Including Participants with a Lifetime DSM-5 Eating Disorder:					
MEBS Total Score	7.62 (5.94)	4.70 (4.43)	0.60	5.12 (175.36)	<.001
MEBS Binge Eating	1.63 (1.82)	0.87 (1.12)	0.58	4.47 (159.69)	<.001
MEBS Body Dissatisfaction	2.27 (2.14)	1.28 (1.77)	0.53	4.75 (189.30)	<.001
MEBS Weight Preoccupation	2.83 (2.47)	1.94 (2.06)	0.41	3.66 (188.57)	<.001
MEBS Compensatory Behaviors	0.23 (.56)	0.11 (.35)	0.27	2.14 (161.17)	.034
Excluding Participants with a Lifetime DSM-5 Eating Disorder:					
MEBS Total Score	6.14 (5.01)	4.41 (4.16)	0.40	3.21 (140.92)	.002
MEBS Binge Eating	1.18 (1.39)	0.81 (1.06)	0.32	2.47 (134.66)	.015
MEBS Body Dissatisfaction	1.95 (2.03)	1.19 (1.69)	0.43	3.51 (143.24)	<.001
MEBS Weight Preoccupation	2.33 (2.28)	1.85 (2.00)	0.24	1.96 (146.61)	.052
MEBS Compensatory Behavior	0.12 (0.38)	0.09 (0.31)	0.08	0.64 (138.55)	.520

Note: MDD = major depressive disorder; MEBS = Minnesota Eating Behavior Survey. Analyses excluding participants with a lifetime ED excluded those with definite, probable, or possible DSM-5 anorexia nervosa, bulimia nervosa, binge-eating disorder, purging disorder, or non-purging other specified feeding or eating disorder from both the MDD/anxiety disorder and no MDD/anxiety disorder groups. Means (SD) for participants with a “definite”/“probable” DSM-5 ED were as follows: MEBS Total Score: 13.07 (5.82); MEBS Binge Eating: 2.96 (2.22); MEBS Body Dissatisfaction: 3.48 (2.08); MEBS Weight Preoccupation 4.68 (2.25); MEBS Compensatory Behavior: .85 (.91); DEBQ Emotional Eating: 1.53 (.51).

Table 5.

Dimensional disordered eating symptoms by MDD and individual anxiety disorder diagnoses

Symptom Scale	Participants with the Diagnosis *Mean (SD)*	Participants without the Diagnosis *Mean (SD)*	*D*	*t(df)*	*p*
MDD:					
MEBS Total Score	9.84 (5.88)	5.06 (4.77)	0.98	4.83 (39.74)	<.001
MEBS Binge Eating	2.41 (2.09)	0.95 (1.25)	1.10	4.19 (38.02)	<.001
MEBS Body Dissatisfaction	2.92 (2.17)	1.40 (1.84)	0.81	4.15 (40.14)	<.001
MEBS Weight Preoccupation	3.46 (2.47)	2.06 (2.14)	0.65	3.36 (40.33)	.002
MEBS Compensatory Behavior	0.32 (0.75)	0.13 (0.39)	0.45	1.54 (37.57)	.131
Any DSM-IV Anxiety Disorder:					
MEBS Total Score	7.26 (5.94)	4.93 (4.61)	0.47	3.79 (142.27)	<.001
MEBS Binge Eating	1.48 (1.70)	0.94 (1.22)	0.41	3.12 (137.02)	.002
MEBS Body Dissatisfaction	2.25 (2.14)	1.35 (1.82)	0.48	4.02 (151.37)	<.001
MEBS Weight Preoccupation	2.68 (2.48)	2.03 (2.10)	0.29	2.48 (149.99)	.014
MEBS Compensatory Behavior	0.23 (0.54)	0.12 (0.38)	0.27	2.04 (135.58)	.043
OCD:					
MEBS Total Score	7.79 (5.82)	5.28 (4.93)	0.50	2.28 (30.45)	.030
MEBS Binge Eating	1.38 (1.54)	1.03 (1.36)	0.25	1.19 (30.65)	.244
MEBS Body Dissatisfaction	2.30 (2.20)	1.48 (1.89)	0.43	2.01 (31.71)	.054
MEBS Weight Preoccupation	3.28 (2.66)	2.11 (2.16)	0.53	2.33 (30.27)	.027
MEBS Compensatory Behavior	0.28 (0.45)	0.14 (0.43)	0.31	1.56 (31.05)	.130
Social Phobia:					
MEBS Total Score	8.54 (6.60)	5.11 (4.75)	0.70	3.44 (49.60)	.001
MEBS Binge Eating	1.93 (1.97)	0.96 (1.27)	0.73	3.29 (48.67)	.002
MEBS Body Dissatisfaction	2.72 (2.10)	1.42 (1.87)	0.69	4.04 (52.14)	<.001
MEBS Weight Preoccupation	2.93 (2.58)	2.09 (2.14)	0.39	2.17 (51.26)	.035
MEBS Compensatory Behavior	0.28 (0.62)	0.13 (0.41)	0.35	1.60 (48.81)	.117
Specific Phobia:					
MEBS Total Score	7.00 (6.19)	5.20 (4.82)	0.37	1.78 (41.81)	.083
MEBS Binge Eating	1.59 (1.90)	0.99 (1.29)	0.45	1.94 (40.88)	.060
MEBS Body Dissatisfaction	1.95 (2.08)	1.46 (1.88)	0.26	1.43 (43.18)	.160
MEBS Weight Preoccupation	2.51 (2.43)	2.11 (2.17)	0.19	1.01 (43.10)	.317
MEBS Compensatory Behavior	0.21 (0.57)	0.14 (0.41)	0.16	0.74 (41.21)	.466

Note: MDD = major depressive disorder; OCD = obsessive-compulsive disorder; MEBS = Minnesota Eating Behavior Survey; any anxiety disorder = a lifetime diagnosis of at least one of the following: OCD, post-traumatic stress disorder, social phobia, specific phobia, panic disorder, agoraphobia, or generalized anxiety disorder.