# Direct comparisons of anorexia nervosa and body dysmorphic disorder: A systematic review

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## ARTICLE INFO

## ABSTRACT

Anorexia nervosa (AN) and body dysmorphic disorder (BDD) are serious psychiatric conditions, both of which are associated with a disturbance of body image. The aim of this paper was to review those studies that have directly compared groups of individuals with AN and BDD, to determine similarities and differences in presentation between the two conditions. The literature was searched to September 2018, and studies were included if they were English language, empirical research papers published in peer-reviewed journals, specifically comparing AN and BDD patients. Fifteen relevant studies were identified. The results suggested that individuals with AN and BDD share a number of similarities, including their degree of body dissatisfaction. Differences between the conditions included primary concerns with body shape and weight in AN, and much more diffuse concerns (but predominantly the face) in BDD. The small number of studies, along with the limited replication of results emphasises the need for greater research in this area. However, the studies undertaken to date highlight the high degree of overlap between AN and BDD and suggests that the conditions may represent similar body image disorders. This has implications for the nosological status of AN and BDD.

## 1. Introduction

Anorexia nervosa (AN) and body dysmorphic disorders (BDD) are serious psychiatric conditions, both of which are associated with significant disturbances in body image perception and satisfaction. The disorders are currently categorised under separate diagnostic classifications: AN under feeding and eating disorders, and BDD under obsessive compulsive-related disorders. There is limited evidence for these diagnostic classifications and we have thus recently proposed that both AN and BDD may theoretically be more appropriately represented under a new diagnostic classification of 'body image disorders' (Phillipou et al., 2016, 2018).

AN is classified as a feeding and eating disorder and is characterised by significantly low body weight, a fear of weight gain, and disturbance in the experience of one's own body weight or shape (American Psychiatric Association, 2013). The 12-month prevalence of AN is 0.4% among females, and approximately one-tenth of that among males (American Psychiatric Association, 2013). AN appears to be more common in individuals with an upper or upper-middle class social status (Crisp et al., 1976; McClelland and Crisp, 2001), and in industrialised societies where there is an abundance of food and where a slim physique is promoted as an attractive physical trait (Keel and Klump, 2003; Miller and Pumariega, 2001). The typical age of onset is in mid to late adolescence, and AN rarely manifests for the first time over 40 years of age (American Psychiatric Association, 2013). There is great variability in the course and outcome of AN, with some individuals making a full recovery after a single episode; others fluctuating between weight gain and relapse; some experiencing the illness chronically over many years; and some dying from the physical consequences of the condition or by suicide (Norring and Sohlberg, 1993; Steinhausen, 2002; Strober et al., 1997). The long-term recovery rate of AN is estimated to be approximately 50% in surviving patients (Couturier and Lock, 2006; Steinhausen, 2002).

In contrast, BDD presents similarly to AN in that a significant disturbance in body image is present, but is classified as an obsessive compulsive-related disorder and is characterised by a preoccupation with one or more perceived defects or flaws in physical appearance that appear slight or are not observable to others; and repetitive behaviours or mental acts related to the perceived flaw/s (American Psychiatric Association, 2013; Castle et al., 2006; Koran et al., 2008). The

preoccupation can involve any area of the body but most commonly concerns the skin, hair or nose (Phillips et al., 2006a). The preoccupation causes significant distress and/or impairment in social, occupational or other areas of functioning, and is – by definition - not better explained by a diagnosis of an eating disorder. BDD also includes a specific subtype termed muscle dysmorphia (MD) which occurs almost exclusively in males and refers to a preoccupation with the idea that one's body is insufficiently lean or muscular (American Psychiatric Association, 2013). Initially coined 'reverse anorexia' (Pope Jr et al., 1993) despite now being classified as a BDD subtype, MD presents with significant body image disturbances similarly to AN but in the 'reverse' direction, i.e. muscularity is idealised rather than thinness. The prevalence of BDD more broadly is similar between the genders, with an estimated prevalence of 2.2% and 2.5% in US adult males and females, respectively (Koran et al., 2008); though a recent review has suggested a sex ratio for BDD of 1.27 for women to men in the community (Veale et al., 2016). The course of BDD is also similar between males and females. The age of BDD onset is typically in the mid-teens (Bjornsson et al., 2013; Gunstad and Phillips, 2003), though subclinical symptoms are often present several years earlier (Phillips et al., 2005). BDD tends to follow a chronic course, with only a small proportion of patients reported to achieve full remission (approximately 30%), despite receiving mental health treatment (Phillips et al., 2006b).

Both AN and BDD manifest significant disturbances in body image, and there has therefore been interest in understanding the similarities and differences between these two conditions. Several studies have found considerable comorbidity between AN and BDD. Grant et al. (2002), for example, reported that 39% of AN patients in their study had a comorbid diagnosis of BDD, with the focus of concerns unrelated to weight; whereas Cerea et al. (2018) reported that 26% of their AN sample had a probable BDD diagnosis when considering non-weight related body concerns. The presence of BDD symptoms has been found to precede the onset of AN, with 25% of AN patients reporting symptoms of BDD for at least six months before the onset of AN (Rabe-Jablonska Jolanta and Sobow Tomasz, 2000). In a group of patients with a primary diagnosis of BDD, on the other hand, 32.5% were reported to have a lifetime comorbid diagnosis of an eating disorder, 9% of whom were a diagnosed with AN (Ruffolo et al., 2006). In addition, a review by Hartmann et al. (2013a) has suggested that individuals with AN and BDD share a number of clinical and personality characteristics.

Given the substantial overlap between BDD and AN, and the underlying body image concern seen in both conditions, the aim of this paper is to provide a comprehensive and systematic narrative review of the literature directly comparing people with AN and BDD. The paper particularly aimed to investigate the overlap between AN and BDD and whether evidence exists for the two conditions to be more appropriately categorised under a new diagnostic classification of 'body image disorders'.

## 2. Methods

The Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) Statement for reporting systematic reviews was followed. The review was not pre-registered. Studies were included in the current review if they met the following criteria: directly compared patients with a confirmed diagnosis of AN with BDD or muscle dysmorphia (MD); written in English; and were empirical research papers published in peer-reviewed journals. The literature was searched to 18th September 2018 in PubMed utilising a combination of the following search terms: {"anorexia nervosa" AND "body dysmorphic disorder" OR "dysmorphophobia" OR "muscle dysmorphia"}. The search resulted in 119 publications, following the removal of duplicates.

Studies were screened independently based on titles and abstracts by two of the authors (AP and SR), with discrepancies resolved by a third author (DC). Of the 119 articles identified, 104 were deemed ineligible for inclusion in the review based on their relevance considering
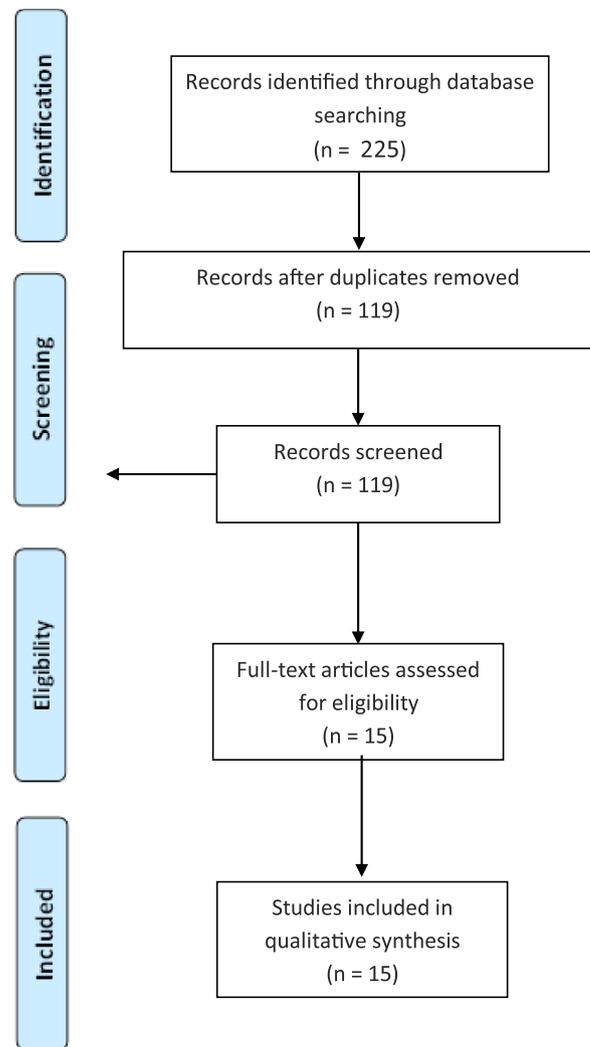


**Flowchart 1.** PRISMA flowchart.

the inclusion criteria, i.e. they did not directly compare patients with a confirmed diagnosis of AN with BDD or muscle dysmorphia (MD), were not written in English, or were empirical research papers published in peer-reviewed journals

## 3. Results

Fifteen articles met our inclusion criteria. Flowchart 1 describes the records identified through the search, and the number of included and excluded studies. A brief summary of the study characteristics is provided in Tables 1–5. The data within the eligible papers permitted description of comparisons across the following subheadings: sociodemographic characteristics, phenomenology, treatment response, neurocognition and neuroanatomical/neuroimaging findings.

### 3.1. Sociodemographic characteristics

None of the included studies reported sociodemographics as their primary variable of interest; however, a large proportion of studies did compare the sociodemographic features between their groups of BDD and AN patients (Hartmann et al., 2015a, 2014, 2015b, 2013b; Kollei et al., 2012; Li et al., 2015a; Moody et al., 2015; Moody et al., 2017; Murray et al., 2013; Rangaprakash et al., 2018; Rosen and Ramirez, 1998; Toh et al., 2015; Zhang et al., 2016). These studies reported no significant difference in age, gender ratio, ethnicity, marital status, sexual orientation or education level between groups: it should be

**Table 1**
Summary of results from studies assessing sociodemographics.

| Authors | Sample size | Age in years M(SD) | Gender (% female) | Outcomes |
|---|---|---|---|---|
| Hartmann et al.(2015a)ˆ | | | | |
| | AN: 24 | 25.8(10.2) | 91.7 | • Age, gender ratio, race = no group difference |
| | BDD: 23 | 29.7(13.6) | 73.9 | • *Education, marital status = higher in HC; more likely to be married* |
| | HC: 22 | 29.1(10.7) | 68.2 | |
| Hartmann et al. (2014)ˆ | | | | |
| | AN: 24 | 25.8(10.2) | 91.7 | • Age, gender ratio, race, marital status = no group difference |
| | | | | • *Education, marital status = higher in HC; more likely to be married* |
| | BDD: 23 | 29.7(13.6) | 73.9 | |
| | HC: 22 | 29.1(10.7) | 68.2 | |
| Hartmann et al. (2015b) | | | | |
| | AN: 20 | 26.6(11.1) | 90 | • Age, gender ratio, race, marital status = no group difference |
| | BDD: 21 | 28.9(12.7) | 76.2 | |
| | HC: 22 | 29.1(10.7) | 68.2 | |
| Hartmann et al. (2013b) | | | | |
| | AN: 19 | 25.7(10.9) | 89.5 | • Age, gender ratio, race, marital status = no group difference |
| | BDD: 22 | 30.2(13.7) | 72.7 | |
| Kollei et al. (2012) | | | | |
| | AN: 32 | 26.9(9.2) | 93.8 | • Age = no difference |
| | BDD: 31 | 28.7(8.9) | 61.3 | • Gender ratio = more females with AN or BN than HC |
| | BN: 34 | 25.9(8.3) | 97.1 | • Education = more years in BDD and BN than AN |
| | HC: 33 | 26.9(8.5) | 69.7 | |
| Li et al. (2015a) | | | | |
| | wr-AN: 15 | 23.6(3.5) | 86.7 | • Age, gender ratio, education = no group difference |
| | BDD: 15 | 24.9(5.2) | 86.7 | |
| | HC: 15 | 22.1(3.9) | 86.7 | |
| Li et al. (2015b) | | | | |
| | wr-AN: 20 | 23.4(3.2) | 90 | • Age, gender ratio, education = no group difference |
| | BDD: 20 | 24.6(5.1) | 90 | |
| | HC: 20 | 22.6(4.0) | 90 | |
| Moody et al. (2015) | | | | |
| | wr-AN: 20 | 22.3(4.4) | 90 | • Age, gender ratio, education = no group difference |
| | BDD: 20 | 21.5(3.5) | 75 | |
| | HC: 20 | 23.3(4.6) | 85 | |
| Moody et al. (2017) | | | | |
| | wr-AN: 22 | 21.5(4.5) | 90.9 | • Age, gender ratio, education = no group difference |
| | BDD: 30 | 22.8(5.0) | 80 | |
| | HC: 39 | 21.6(4.6) | 84.5 | |
| Murray et al. (2013) | | | | |
| | AN: 24 | 23.9(5.6) | 0 | • Sexual orientation = no group difference |
| | MD: 21 | 28.3(6.7) | 0 | |
| | GUC: 30 | 28.5(8.3) | 0 | |
| Rangaprakash et al. (2018) | | | | |
| | wr-AN: 25 | 22.1(4.5) | 92 | • Age, gender ratio, education = no group difference |
| | BDD: 32 | 23.5(4.8) | 84.4 | |
| | HC: 37 | 21.7(4.5) | 86.5 | |
| Rosen and Ramirez (1998) | | | | |
| | ED: 11(AN), 34(BN) | 25.0(7.5) | 100 | • Age = lower in ED than BDD and HC |
| | BDD: 51 | 33.0(9.9) | 60.8 | |
| | HC: 50 | 35.2(12.0) | 60 | |
| Zhang et al. (2016) | | | | |
| | wr-AN: 24 | 21.3(4.5) | 95.8 | • Age, gender, duration of education = no group difference |
| | BDD: 29 | 23.2(5.0) | 86.2 | |
| | HC: 31 | 20.9(3.9) | 80.6 | |

Note: AN and BDD group differences in the outcomes column are italicised; AN = anorexia nervosa; wr-AN = weight-restored AN; BDD = body dysmorphic disorder; MD = muscle dysmorphia; HC = healthy control; BN = bulimia nervosa; GUC = gym-using control; ED = eating disorder; ˆ Hartmann et al. (2014, 2015a) utilised the same sample.

noted, however, that these results likely reflect sampling biases used to establish similar comparison groups to address the studies' primary hypotheses (Table 1).

### 3.2. Phenomenology

BDD and AN share several similarities in terms of phenomenology (Table 2). The disturbance of body image experienced by both groups is by definition of clinically significant, but whether the severity of body image disturbance differs between the conditions is unclear, with reports of similar severity by some (Hartmann et al., 2015a), and greater severity and distress in AN (Rosen and Ramirez, 1998) or BDD, by others (Hrabosky et al., 2009). Rosen and Ramirez (1998) found that both their BDD and eating disorder (a mixed group of AN and BN)

groups scored significantly higher than controls on the Body Dysmorphic Disorder Examination (BDDE), Brief Symptom Inventory, and lower on the Rosenberg Self-Esteem Scale. On the specific subscales of the BDDE, both clinical groups were similar in terms of body dissatisfaction, body checking and preoccupation. Similar rates of comorbid OCD and anxiety disorders in BDD and AN have also been also reported; as well as increased levels of perfectionism in both groups, who did not differ from one another when controlling for depression levels – which were higher in AN than BDD (Hartmann et al., 2014). Similar rates of comorbid OCD were also replicated in a more recent study by the same group (Hartmann et al., 2015b).

In terms of the experience of emotion, Kollei et al. (2012) showed that both BDD and AN participants reported higher intensities of negative emotions and lower intensities of positive emotions, but did not

**Table 2**
Summary of results from studies assessing phenomenology.

| Authors | Sample Size | Age in Years M (SD) | Gender (% female) | Outcomes |
|---|---|---|---|---|
| Hartmann et al. (2015a) | | | | |
| | AN: 24 | 25.8(10.2) | 91.7 | • Implicit attractiveness beliefs = no difference between groups<br>• *Depressive symptoms = higher in AN than BDD, who were higher than HC*<br>• *Body image disturbance = higher in BDD and AN than HC*<br>• *Body image coping strategies = poorer in BDD and AN than HC*<br>• *Body image attitudes = increased appearance evaluation and orientation in BDD and AN; increased body dissatisfaction and weight preoccupation in AN than BDD and HC*<br>• *Beliefs about appearance = poorer in both BDD and AN, compared to HC* |
| | BDD: 23 | 29.7(13.6) | 73.9 | |
| | HC: 22 | 29.1(10.7) | 68.2 | |
| Hartmann et al. (2014) | | | | |
| | AN: 24 | 25.8(10.2) | 91.7 | • Comorbid OCD, anxiety disorder = no group difference<br>• *Comorbid major depression = higher in AN than BDD*<br>• *Physical concern, BDD = face, AN = shape and weight*<br>• *Delusionality = higher in BDD*<br>• *Eating disorder symptomatology and depression = lower in BDD*<br>• *Self-esteem = lower in BDD than HC, but higher than AN*<br>• *Perfectionism = higher in BDD and AN than HC* |
| | BDD: 23 | 29.7(13.6) | 73.9 | |
| | HC: 22 | 29.1(10.7) | 68.2 | |
| Hartmann et al. (2015b) | | | | |
| | AN: 20 | 26.6(11.1) | 90 | • Comorbid OCD = no group difference<br>• Comorbid major depression = higher in AN than BDD |
| | BDD: 21 | 28.9(12.7) | 76.2 | |
| | HC: 22 | 29.1(10.7) | 68.2 | |
| Hartmann et al. (2013b) | | | | |
| | AN: 19 | 25.7(10.9) | 89.5 | • Delusionality = higher in BDD |
| | BDD: 22 | 30.2(13.7) | 72.7 | |
| Hrabosky et al. (2009) | | | | |
| | AN: 35 | 26.5(8.7) | 100 | • Body image evaluation = poorer in BDD, AN and BN compared to controls; clinical groups did not differ to one-another<br>• *Overweight preoccupation = greater in AN and BN, than BDD and controls*<br>• Body image distress = poorer in BDD, AN and BN compared to controls; clinical groups did not differ to one-another<br>• Body image disturbance = higher in BDD than AN and BDD, who were higher than controls<br>• Quality of life related to body image disturbance = poorer in BDD than AN and BN, who were higher than controls<br>• Comparisons of BDD to psychiatric controls with OCD = paralleled results above comparing BDD and all clinical controls |
| | BDD: 56 | 29.8(10.0) | 70 | |
| | BN: 26 | 26.7(8.7) | 100 | |
| | MPC: 36 | 37.5(11.8) | 0 | |
| | FPC: 34 | 33.0(12.0) | 100 | |
| Kollei et al. (2012) | | | | |
| | AN: 32 | 26.9(9.2) | 93.8 | • Body dysmorphic symptoms = higher in BDD than HC; higher in BDD than AN and BN in terms of hopelessness, psychosocial impairment due to appearance and familial burden; higher in AN in terms of manipulation of appearance and compulsive checking<br>• Experience of emotion = higher intensities of negative emotions and lower intensities of positive emotions in BDD, AN and BN compared to HC<br>• Thought control strategies = worrying, giving way to impulse and confrontation higher in BDD, AN and BN compared to HC |
| | BDD: 31 | 28.7(8.9) | 61.3 | |
| | BN: 34 | 25.9(8.3) | 97.1 | |
| | HC: 33 | 26.9(8.5) | 69.7 | |
| Murray et al. (2012) | | | | |
| | AN: 24 | 23.9(5.6) | 0 | • Weight and shape concern = no difference between MD and AN, but higher than controls<br>• Appearance intolerance = no difference between MD and AN, but higher than controls<br>• Avoidance and rule driven behaviour = no difference between MD and AN, but higher than controls<br>• Exercise rigidity = no difference between MD and AN, but higher than controls<br>• *Dietary restraint, eating concern = higher in AN than BDD, who were higher than controls*<br>• *Drive for size = higher in BDD than AN and controls* |
| | MD: 21 | 28.2(6.7) | 0 | |
| | GUC: 30 | 28.5(8.3) | 0 | |
| Murray et al. (2013) | | | | |
| | AN: 24 | 23.9(5.6) | 0 | • Increased adherence to masculine norms in MD than AN and controls; lower adherence to feminine norms in MD and controls than AN |
| | MD: 21 | 28.3(6.7) | 0 | |
| | GUC: 30 | 28.5(8.3) | 0 | |

**Table 2** (*continued*)

| | | | |
|---|---|---|---|
| Rosen and Ramirez (1998) | | | |
| **ED:** 11(AN), 34(BN) | 25.0(7.5) | 100 | • Physical concern, BDD = diverse range of body regions, AN = shape and weight<br>• Body dysmorphic symptoms = higher in BDD and ED than HC; higher negative self-evaluation and avoidance of activities in BDD than ED<br>• Psychological symptoms = higher in ED than BDD, who were higher than HC<br>• Self-esteem = lower in ED than BDD, who were lower than HC |
| **BDD:** 51 | 33.0(9.9) | 60.8 | |
| **HC:** 50 | 35.2(12.0) | 60 | |
| Zhang et al. (2016) | | | |
| **wr-AN:** 24 | 21.3(4.5) | 95.8 | • *Delusionality = higher in BDD than AN*<br>• *Anxiety, depression = higher in BDD than AN* |
| **BDD:** 29 | 23.2(5.0) | 86.2 | |
| **HC:** 31 | 20.9(3.9) | 80.6 | |

Note: AN and BDD group differences in the outcomes column are italicised; AN = anorexia nervosa; wr-AN = weight-restored AN; BDD = body dysmorphic disorder; MD = muscle dysmorphia; HC = healthy control; BN = bulimia nervosa; MPC = male psychiatric control; FPC = female psychiatric control; GUC = gym-using control; ED = eating disorder; ˆ Hartmann et al. (2014, 2015a) utilised the same sample.

differ from one another in this regard. Thought control strategies reported in this study were also similar between the clinical groups, with greater utilisation of worrying, giving way to impulse and confrontation, than healthy controls.

Differences are obvious when considering the predominant physical concerns in AN and BDD. Thus – by definition – in individuals with AN the main locus is body weight and shape, whereas BDD patients report more diverse body regions of concerns, especially with their face (Hartmann et al., 2014; Rosen and Ramirez, 1998). In terms of BDD symptomatology, Kollei et al. (2012) reported increased body dysmorphic symptoms specifically related to hopelessness, psychosocial impairment due to appearance and familial burden in BDD patients relative to AN; the BDD patients also engaged more in manipulation of appearance and compulsive checking. On the specific subscales of the Body Dysmorphic Disorder Examination (BDDE), BDD participants have been noted to report more negative self-evaluation and avoidance of activities (such as socialising) that are impacted by self-consciousness about appearance (Rosen and Ramirez, 1998).

The level of delusionality between AN and BDD has consistently been found to differ. For example, Hartmann et al. (2013a, 2013b, 2014) showed that relative to AN, BDD participants scored higher on measures of delusionality. In that study, delusionality was specifically related to concern with body shape and a drive for thinness in the AN participants, whereas in BDD participants it was associated with BDD symptom severity (Hartmann et al., 2013b). Poorer quality of life related to body image disturbance has also been reported in BDD in comparison to both AN patients and a mixed psychiatric control group (Hrabosky et al., 2009). In addition, self-esteem has been reported to be lower in BDD than healthy controls, but higher than in AN (Hartmann et al., 2014; Rosen and Ramirez, 1998). Higher rates of major depression have also been found in AN compared to BDD patients (Hartmann et al., 2015b).

Mixed findings have been reported when comparisons have been made between muscle dysmorphia (MD; a subtype of BDD) and AN. Where AN is characterised by a disturbance of body image leading to significantly low weight, MD is characterised by a disturbance of body image where the body is seen as 'puny' and the individual pursues a 'bulked up' ideal (Phillipou and Castle, 2015). A recent study by Murray et al. (2012) investigated commonalities between the presentations of people with MD and AN; gym-using controls used as a comparison group. Similarities were found between MD and AN participants in a number of domains, including body image disturbance, and eating and compulsive exercise behaviours; while differences were consistent with the opposing physiques strived for by each condition, i.e. increased dietary restraint and eating concern in AN, and increased 'drive for size' in MD. In a more recent study, the same group of authors reported greater adherence to masculine norms in males with MD, whereas greater adherence to feminine norms was found in males with AN (Murray et al., 2013).

### 3.3. Treatment response

We found only one study that compared the efficacy of therapeutic interventions between BDD and AN patients (Table 3). Hartmann et al. (2015b) compared a number of strategies (acceptance/mindfulness, cognitive restructuring and distraction strategies) targeting intrusive negative appearance-related thoughts. After a five-minute period in which participants were asked to count the frequency of intrusive thoughts, they were randomised to one of the three interventions. Following this, they were asked to again count the frequency of these thoughts during a five-minute period, this time while applying their specified strategy. The investigators reported a decrease in negative appearance-related thoughts post-intervention, but this was irrespective of diagnostic group or intervention strategy. Positive affect, on the other hand, was found to be increased in the BDD patients using acceptance/mindfulness strategies, whereas AN patients benefited most

**Table 3**
Summary of results from studies assessing treatment response.

| Authors | Sample Size | Age in Years M (SD) | Gender (% female) | Relevant details | Outcomes |
|---|---|---|---|---|---|
| Hartmann et al. (2015b) | | | | | |
| | **AN:** 20 | 26.6(11.1) | 90 | Acceptance/mindfulness, cognitive restructuring and distraction strategies administered to assess the short-term effectiveness | • *Appearance concerns = higher in BDD than HC, but lower than AN; decrease in appearance-related thoughts post-intervention regardless of group or intervention strategy* |
| | **BDD:** 21 | 28.9(12.7) | 76.2 | | • *Affect = lower positive and higher negative affect in AN compared to BDD and HC; positive affect increased using acceptance/mindfullness in BDD but decreased in HC; positive affect increased using distraction in AN but decreased in HC* |
| | **HC:** 22 | 29.1(10.7) | 68.2 | | • *Appraisal ratings = more dysfunctional strategies related to thoughts in BDD and AN compared to HC; greater acceptance in AN using cognitive restructuring in AN whereas HC benefitted most from distraction* |

Note: AN and BDD group differences in the outcomes column are italicised; AN = anorexia nervosa; BDD = body dysmorphic disorder; HC = healthy control.

**Table 4**
Summary of results from studies assessing neurocognition.

| Authors | Sample Size | Age in Years M(SD) | Gender (% female) | Relevant details | Outcomes |
|---|---|---|---|---|---|
| Moody et al. (2017) | | | | | |
| wr-AN: 22 | 21.5(4.5) | | 90.9 | Presented with high, low and normal spatial frequency faces and bodies | • Attractiveness ratings = lower in AN and BDD, than HC, for high and low spatial frequency images |
| BDD: 30 | 22.8(5.0) | | 80 | | • Thoughts about own appearance = AN and BDD more triggered to think of their own appearance, than HC |
| HC: 39 | 21.6(4.6) | | 84.5 | | • Body size ratings = higher in AN and BDD, than HC |

Note: AN and BDD group differences in the outcomes column are italicised; wr-AN = weight-restored AN; BDD = body dysmorphic disorder; HC = healthy control.

in terms of positive affect from using distraction strategies. Appraisal ratings were also found to differ in AN patients post-intervention, with greater acceptance of appearance-related thoughts in those using cognitive restructuring; whereas, healthy controls benefitted most from distraction strategies.

### 3.4. Neurocognition

Our review revealed one study reporting upon neurocognition in AN and BDD, specifically (neurocognitive tasks undertaken during neuroimaging are reported in the section below). The study presented high, low and normal spatial frequency faces and bodies to patients with BDD, individuals with AN (weight-restored) and HC (Moody et al., 2017). Participants were required to rate the attractiveness, body sizes, and how triggering they found the stimuli in relation to thinking about their own appearance. Relative to HCs, both BDD and AN participants reported lower attractiveness and increased body size ratings for high and low spatial frequency images. High and low spatial frequency images were also more triggering regarding thoughts about their own appearance in both clinical groups, compared to HCs. Both BDD and AN severity were associated with greater triggering of thoughts and greater endorsement of overweight ratings for body stimuli. BDD patients were, however, more triggered to think of their own facial appearance, in comparison with AN patients (Table 4).

### 3.5. Neuroanatomical/neuroimaging

The search resulted in five studies investigating neurobiological differences between AN and BDD groups (Table 5). In a series of studies undertaken by the same research group, patients were presented with high- and low-spatial frequency images of houses and faces during electroencephalography (EEG) and functional magnetic resonance imaging (fMRI). The purpose of these studies was to examine altered spatiotemporal activity in BDD and weight-restored AN patients. The P100 component and N170 component were specifically examined, with larger P100 amplitudes evoked by low spatial frequency faces and houses (early configural processing) and the N170 being evoked robustly by face stimuli in general (both configural and face processing).

In the first of these studies – with just EEG (Li et al., 2015b) – both P100 and N170 amplitudes were found to be lower in AN relative to controls, though a trend for lower N170 amplitudes was also found for the BDD group. N170 latencies were found to be increased in AN participants relative to healthy controls; and although only a trend for increased latencies were found in BDD patients, the two clinical groups did not statistically differ from one another. In relation to spatial frequency of images, lower amplitude N170 components were found for AN patients in response to high spatial frequency images relative to controls; whereas BDD patients showed reduced amplitudes for unaltered images.

Findings from combined fMRI and EEG, on the other hand, revealed hypoactivity of similar dorsal visual regions in both AN and BDD groups, relative to controls, for low spatial frequency images of faces in the N170 component, whereas the P100 component did not differ between groups for facial images of any spatial frequency (Li et al., 2015a). For house images, BDD and AN groups demonstrated hypoactivity in similar early visual regions for low spatial frequency images in the P100 component. In the N170 component, BDD participants showed - in relation to house images - hyperactivity in response to high spatial frequency images in the posterior fusiform cortex, and hypoactivity in both ventral and dorsal visual regions for low spatial frequency stimuli, compared to healthy controls. AN participants, on the other hand, displayed hypoactivity in ventral visual regions, relative to healthy controls.

The final study within this series employed fMRI alone. Thus, Moody et al. (2015) investigated functional connectivity of the right fusiform face area in BDD, AN and healthy control participants, during

**Table 5**
Summary of results from studies assessing neuroanatomy/neuroimaging.

| Authors | Sample Size | Age in Years M (SD) | Gender (% female) | Relevant details | Outcomes |
|---|---|---|---|---|---|
| Li et al. (2015a) | | | | EEG and fMRI during viewing of high and low spatial frequency images of faces and houses during a matching task | • Response to faces = no group difference in P100 component; hypoactivity in precuneus, lateral occipital cortex for low spatial frequency images for the N170 component in BDD and AN compared to HC<br>• Response to houses = hypoactivity in occipital fusiform for low spatial frequency images in the P100 components in BDD and AN compared to HC; in BDD compared to HC, hyperactivity in posterior fusiform for high spatial frequency images and hypoactivity in the occipital fusiform, temporal fusiform and lateral occipital cortices, and superior parietal lobule for low spatial frequency images; in AN compared to HC, hyperactivity in occipital fusiform cortex, occipital pole and precuneus |
| | **wr-AN:** 15<br>**BDD:** 15<br>**HC:** 15 | 23.6(3.5)<br>24.9(5.2)<br>22.1(3.9) | 86.7<br>86.7<br>86.7 | | |
| Li et al. (2015b) | **wr-AN:** 20 | 23.4(3.2) | 90 | EEG during viewing of unaltered, high and low spatial frequency images of faces and houses during a matching task | • P100 = no difference in amplitude between groups<br>• N170 amplitude = lower amplitude in AN than HC; trend for lower amplitude in BDD than HC; lower amplitude in AN compared to HC for high spatial frequency images than unaltered images; lower amplitude in BDD than HC for unaltered spatial frequency images<br>• N170 latency = increased latencies in AN relative to HC; trend for increased latencies in BDD; AN and BDD groups did not statistically differ in latencies |
| | **BDD:** 20<br>**HC:** 20 | 24.6(5.1)<br>22.6(4.0) | 90<br>90 | | |
| Moody et al. (2015) | **wr-AN:** 20<br>**BDD:** 20<br>**HC:** 20 | 22.3(4.4)<br>21.5(3.5)<br>23.3(4.6) | 90<br>75<br>85 | fMRI during viewing of high and low spatial frequency images of faces during a matching task | • R FFA connectivity with whole brain = low spatial frequency images associated with decreased connectivity with right insula, putamen, thalamus and central opercular cortex, and increased connectivity with right and left precuneus, right posterior cingulate and left lingual gyrus in BDD compared to HC; no difference in connectivity between AN and HC, but with lower statistical thresholding, increased connectivity with left precuneus, left posterior cingulate and right thalamus, and decreased connectivity with right insula and central opercular cortex in AN compared to HC<br>• R FFA connectivity with occipital temporal face network = increased connectivity between R FFA and left anterior occipital face area in BDD compared to AN and HC to low spatial frequency images; no difference in connectivity with right anterior occipital face area; no group difference of high spatial frequency images<br>• R FFA connectivity with salience network = increased connectivity between R FFA and right insula and orbitofrontal cortex in AN compared to BDD for high spatial frequency images; no group differences in AN or BDD compared to HC for high spatial frequency images; no group differences for low spatial frequency images |
| Rangaprakash et al. (2018) | **wr-AN:** 25 | 22.1(4.5) | 92 | fMRI while rating own degree of fearfulness when viewing fearful faces | • Subjective fear rating = higher in AN than HC, but no difference to BDD; no difference between BDD and HC<br>• Effective connectivity = weaker medial prefrontal cortex to amygdala connectivity in AN compared to BDD and HC |
| | **BDD:** 32<br>**HC:** 37 | 23.5(4.8)<br>21.7(4.5) | 84.4<br>86.5 | | |
| Zhang et al. (2016) | **wr-AN:** 24<br>**BDD:** 29<br>**HC:** 31 | 21.3(4.5)<br>23.2(5.0)<br>20.9(3.9) | 95.8<br>86.2<br>80.6 | Diffusion-weighted imaging | • Modular structure = HC included right caudate, pallidum, accumbens, rostral anterior cingulate, posterior cingulate, caudal anterior cingulate; AN included right caudate, accumbens, rostral anterior cingulate, lateral and medial orbitofrontal, frontal pole; BDD included right caudate, pallidum, rostral anterior cingulate, posterior cingulate, medial orbitofrontal; AN significantly differed to HC; trend for a difference between BDD and HC; no difference between BDD and AN<br>• Path length = longer in AN than BDD and HC who did not differ |

Note: AN and BDD group differences in the outcomes column are italicised; AN = anorexia nervosa; wr-AN = weight-restored AN; BDD = body dysmorphic disorder; HC = healthy control; R FFA = right fusiform face area.

a face matching task in which high and low spatial frequency face images were presented. The investigators were specifically interested in examining the functional connectivity of the right fusiform face area given its role in face processing as well as in both high and low spatial frequency processing. There were similarities in connectivity between the BDD and AN groups, both displaying increased connectivity relative to controls between the right fusiform face area and the precuneus and posterior cingulate gyrus for low spatial frequency images, as well as decreased connectivity with the insula. Increased connectivity with the left anterior occipital face area was also found in BDD participants, relative to both AN and healthy controls to low spatial frequency images; and increased connectivity for the AN group compared to BDD with the right insula and orbitofrontal cortex for high spatial frequency face images. These findings suggest similarities between AN and BDD patients in terms of atypical functional connectivity of higher-order systems for face processing, but differences in occipito-temporal visual network connectivity between the disorders.

A recent study by Rangaprakash et al. (2018) investigated effective connectivity (a type of 'casual' functional connectivity) in weight-restored AN, BDD and healthy control participants when viewing images of fearful faces during fMRI. Participants were also asked to rate the degree of their own fearfulness while viewing the images in the scanner. Subjective fear responses were higher in AN compared to HCs, but did not differ from the BDD group who also did not significantly differ from HCs. The investigators were particularly interested in fronto-limbic connectivity across diagnostic groups, focussing on effective connectivity between the medial prefrontal cortex and amygdala. The AN group showed weaker effective connectivity compared to both BDD and healthy control participants. The degree of connectivity was also found to correlate positively with eating disorder symptomatology and anxiety in the AN group, but no relationship with BDD symptomatology was found (Yale-Brown Obsessive-Compulsive Scale Modified for Body Dysmorphic Disorder; BDD-YBOCS).

BDD, weight-restored AN patients and healthy controls have also been compared in terms of white matter connectivity of the brain using diffusion-weighted imaging (Zhang et al., 2016). Through the construction of white matter connectivity matrices, modular structures were compared between groups. There was only a trend for BDD patients to show similar abnormalities relative to healthy individuals, and the BDD and AN groups did not significantly differ from each other. The AN group showed increased path lengths relative to both BDD patients and healthy controls, who did not differ from each other. The AN group also showed atypical modularity compared to healthy controls (encompassing inclusion of the caudate, accumbens and rostral anterior cingulate cortex, in addition to the inclusion of the lateral and medial orbitofrontal cortices and frontal pole; and exclusion of the palidum, posterior cingulare and caudal anterior cingulate cortices in AN relative to healthy controls).

In summary, neurophysiology and neuroimaging findings suggest similarities between BDD and AN patients in terms of abnormalities in visuospatial processing, which may contribute to the distorted perception of body image experienced in these conditions. Similarities in the atypical white matter organisation of basal ganglia and frontal regions may also contribute to deficits in reward processing reported in these conditions. However, a number of differences are apparent in terms of structural and functional connectivity between AN and BDD groups. It must be stated that only a small number of studies have been undertaken to date, each of which used a different imaging technique and all with modest sample sizes, therefore making comparisons across studies difficult. Research in larger samples is therefore required to draw firmer conclusions on the neurobiological similarities and differences between AN and BDD.

## 4. Discussion

The aim of this study was to undertake a comprehensive review of

the literature comparing individuals with AN and BDD directly, to identify similarities and differences. In particular, we sought to identify whether the two conditions share overlapping features which may suggest that they may be more appropriately reclassified as 'body image disorders'. The findings suggest that AN and BDD share a number of commonalities including similarities in sociodemographic characteristics, severity of body image concerns, level of body dissatisfaction and preoccupation, degree of perfectionism, altered experience of emotion, degree of obsessive-compulsive disorder comorbidity and deficits in body size estimation. In addition, AN and BDD groups were found to show similar disturbances in low-level visual processing and structural connectivity of the brain. Differences between groups were restricted to the predominant physical concerns with their appearance (i.e. body weight/shape in AN, and the face in BDD); increased delusionality and poorer quality of life regarding body image in BDD; and lower self-esteem and increased levels of depression in AN. AN and BDD groups also differed in functional connectivity of the fusiform face area of the brain, with increased insula-orbitofrontal cortex connectivity in AN, and increased occipital cortex connectivity in BDD. Effective connectivity was also found to be weaker in individuals with AN between the medial prefrontal cortex and amygdala, relative to people with BDD.

The findings of the studies reported in this review are constrained due to several factors. Firstly, the sociodemographic characteristics reported in studies is likely to reflect sampling bias as a result of investigators attempting to match groups, so they may not be representative of sociodemographic commonalities and differences between AN and BDD patients. The review also included samples of AN patients who were in current and weight-restored states and the different studies may therefore be reflective of different physical states in AN patients and different levels of recovery. The review also identified only fifteen studies comparing AN and BDD participants directly, with relatively small sample sizes and few similarities between the measures administered across studies. This represents a significant limitation of the literature and limits the conclusions that can be drawn from this review. In addition to the need for greater research directly comparing these illnesses, replication studies in large samples is required.

Overall, although only a relatively small number ($n = 15$) of studies have been undertaken contrasting AN and BDD groups, this review suggests that AN and BDD may share a number of similarities, particularly in relation to their experience and dissatisfaction of their body image. This has important implications for the diagnostic classification of these illnesses. Although AN and BDD are classified as feeding/eating and obsessive compulsive disorders, respectively, the findings provide preliminary support for the proposal that AN and BDD may be more appropriately classified as 'body image disorders' (Phillipou et al., 2016, 2018), and may benefit from similar therapeutic interventions that target body image disturbances. More research in larger samples is, however, required to determine the nosology of these conditions and the potential for the development of similar therapeutic interventions targeting body image in both conditions.

## Supplementary materials

Supplementary material associated with this article can be found, in the online version, at doi:10.1016/j.psychres.2019.01.106.

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