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Review

The role of body image disturbance in the onset, maintenance, and relapse of anorexia nervosa: A systematic review

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HIGHLIGHTS

- Anorexia nervosa (AN) is characterized by body image disturbance.
- Body image disturbance seems related to the course of AN.
- Available evidence does not allow to conclude if body image disturbance is a causal risk factor.

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ABSTRACT

Body image disturbance is an important feature of Anorexia Nervosa (AN). Some researchers have argued that body image disturbance is not just a symptom of AN, but plays a causal role in the development, persistence, and relapse of AN. Our aim was to systematically review the existing empirical evidence concerning the role of the cognitive-affective, perceptual, and behavioral components of body image disturbance in AN. 46 studies fulfilled eligibility criteria reporting about 4928 participants with AN. There is some evidence suggesting that body image disturbance is related to the course of AN. However, experimental studies were missing and operationalizations of body image constructs and AN outcome measures varied greatly across studies. Therefore, on the basis of the available empirical data, it remained unclear whether body image disturbance is indeed a causal risk factor for AN. For future studies, it is crucial to use more consistent terminology and more specific and precise definitions of body image constructs as well as experimental designs, adequately powered samples, and well-validated measures. Altogether, this would set the stage to generate the high-quality data that are necessary to clarify the role of body image disturbance in the onset, maintenance and relapse of AN.

1. Introduction

Anorexia nervosa (AN) is a severe and persistent mental disorder with the highest mortality rate of all mental disorders (Arcelus, Mitchell, Wales, & Nielsen, 2011). Although AN can occur in all individuals, adolescent girls and young adult women are particularly at risk for developing AN (Smink, Van Hoeken, & Hoek, 2012). Treatments for patients with AN are limited in their effectiveness, and relapse after treatment is common (Berends, Boonstra, & van Elburg, 2018; Brockmeyer, Friederich, & Schmidt, 2018; Khalsa, Portnoff, McCurdy-McKinnon, & Feusner, 2017; Murray, Quintana, Loeb, Griffiths, & Le Grange, 2018; Zipfel, Giel, Bulik, Hay, & Schmidt, 2015). Genetic, neurobiological, cognitive, and sociocultural factors all are thought to be involved in the etiology of AN (e.g., Fairburn, Cooper, & Shafran, 2003; Kaye, Fudge, & Paulus, 2009; Munro, Randell, & Lawrie, 2017; Shih & Woodside, 2016). However, there is still much unknown about the processes that underlie the onset and maintenance of AN, and a better understanding of why the core symptoms of AN are so persistent seems important in the development of more effective treatments (Jansen, 2016; Zeeck et al., 2018).

A prominent characteristic of AN is a disturbance in body image. In the 5th edition of the Diagnostic and Statistical Manual of Mental disorders (DSM-5; American Psychiatric Association, 2013), two aspects of body image disturbance are defined as part of the diagnostic criteria for

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AN. The first aspect is "a disturbance in the way one's body weight or shape is experienced". The second DSM-5 aspect is an "undue influence of body shape and weight on self-evaluation". Some researchers consider body image disturbance more as a symptom than a driving force of AN (e.g., Munro et al., 2017; Schmidt & Treasure, 2006; Steinglass & Walsh, 2016; Treasure & Schmidt, 2013; Walsh, 2013). However, others emphasize body image disturbance as a causal factor in the development, persistence, and relapse of AN and consider body image disturbance therefore as an important target in the treatment of AN (e.g., Fairburn et al., 2003; Garner & Bemis, 1982; Phillipou, Castle, & Rossell, 2018; Stice, 2001; Williamson, White, York-Crowe, & Stewart, 2004). To clarify the role of body image in AN and its relevance as treatment target, this study was designed to review the empirical evidence for body image disturbance as a causal agent in AN. Body image has been defined as a multifaceted construct encompassing body-related cognitions and emotions, perceptions as well as behaviors (Cash, 2002, 2011; Cash & Pruzinsky, 1990). The term *body image disturbance* (also referred to as *negative body image*) is used primarily for negative experiences related to body weight and shape (Grogan, 2006) and is thought to manifest itself across the cognitive-affective, perceptual, and behavioral components of body image. All three body image components have been associated with AN.

1.1. Cognitive-affective component

The DSM-5 aspect "an undue influence of body shape and weight on self-evaluation" is part of the cognitive-affective component of body image which involves attitudes and feelings with respect to one's own body. An *overvaluation of weight and shape* means that someone judges his or her self-worth largely in terms of shape or weight, and the ability to control them. In cognitive-behavioral models of eating disorders, this is seen as the core pathology in eating disorders, leading to and maintaining dietary restriction and other weight-control behaviors (Fairburn et al., 2003; Williamson et al., 2004). The importance of weight and shape for one's self-esteem is distinguished from *body dissatisfaction* which can be defined as negative evaluations of one's body shape or weight (Cash, 2011; Fairburn et al., 2003). According to the dual-pathway model of eating pathology, body dissatisfaction promotes unhealthy dieting behaviors and may therefore play an important role in the onset of AN (Stice, 2001; Stice, Marti, & Durant, 2011). Empirical studies showed that individuals with AN indeed assign an excessive importance to their body weight and/or shape in evaluating their self-worth (e.g., Cooper & Turner, 2000) and show higher levels of body dissatisfaction than controls without AN (e.g., Cash & Deagle, 1997; Hagman et al., 2015). Although body dissatisfaction and overvaluation of weight and shape are typically related, there are also indications that it is important to distinguish between these constructs since both have shown distinctive patterns of association with disordered eating behaviors both concurrently and longitudinally (e.g., Mitchison et al., 2017; Sharpe et al., 2018).

1.2. Perceptual component

The DSM-5 aspect "disturbance in the way one's body weight or shape is experienced" is most often interpreted and operationalized as a disturbance in the *visual perception* of the own body (i.e., in most of the cases overestimation of body size). Meta-analyses and reviews generally indicate that individuals with AN indeed show an overestimation of their body size in comparison to healthy controls (Cash & Deagle, 1997; Farrell, Lee, & Shafran, 2005; Gardner & Brown, 2014; Mölbert et al., 2017; Smeets, 1997). In further support of the view that patients with AN overestimate their body size, there is evidence that patients with AN also move as if their bodies are larger than they actually are (Guardia et al., 2010; Guardia et al., 2012; Keizer et al., 2013; Metral et al., 2014). Furthermore, there are indications that patients with AN show a distortion in their tactile processing (Keizer et al., 2011; Keizer, Smeets, Dijkerman, Van Elburg, & Postma, 2012; Spitoni et al., 2015). However, research on the latter two kinds of distorted body representations is still limited compared to research on body size misperception. Several accounts have been given to explain the nature of body size overestimation in AN (see e.g. Cornelissen, Johns, & Tovée, 2013; Gadsby, 2017; Mölbert, Klein, et al., 2017). Overestimation of body size could be a perceptual distortion due to abnormalities in body-processing brain areas (Suchan, Vocks, & Waldorf, 2015). In addition, body size overestimation has been proposed to be a cognitive bias fueled by the activation of negative body self-schemas (Williamson et al., 2004). However, it could also be that the body schema of AN patients does not become "updated" after losing weight, which would imply that distorted body image representations in patients with AN develop as the result of AN symptoms (e.g., Guardia et al., 2012). Finally, the overestimation might be the result of negative body attitudes due to demand characteristics of the task, and/or due to negative affect elicited by exposure to self-images which may lead to reduced perceptual processing (Gadsby, 2017; Sachdev, Mondraty, Wen, & Gulliford, 2008). In all cases, body size overestimation could foster body dissatisfaction and thereby drive other eating disorder symptoms such as dietary restriction.

1.3. Behavioral component

Body checking and body avoidance are seen as behavioral indices of body image disturbance. *Body checking* refers to the hypervigilant monitoring of shape and weight by repeated checking and scrutinizing, for example through excessive weighing oneself, mirror gazing or measuring the circumference of various body parts. The term *body avoidance* is used for avoidance of a confrontation with one's weight and shape, for example refusal to be weighed or to look in the mirror (Rosen, Srebnik, Saltzberg, & Wendt, 1991). Both terms are also used for body-related safety behaviors such as wearing oversized clothes, taking a shower with the lights turned off or repeated checking of one's body parts in social situations. In cognitive-behavioral models (Williamson et al., 2004), body checking and body avoidance are assumed to lead to a temporary relief of distress which negatively reinforces these behaviors (Reas & Grilo, 2004). However, in the long-term, body avoidance prevents gathering of new information, which hampers the correction of distorted body image beliefs (Fairburn, Shafran, & Cooper, 1999). In addition, body avoidance might lead to body-size misperception resulting in overestimation of body size (Vossbeck-Elsebusch et al., 2015). With respect to body checking, some empirical studies suggest that this negative reinforcement does not take place and instead, distress increases in response to checking behavior (Kraus, Lindenberg, Zeeck, Kosfelder, & Vocks, 2015; Shafran, Lee, Payne, & Fairburn, 2007). Therefore, it could also be that the function of body checking is not so much the reduction of body-related distress, but instead the behavior acts as a form of self-motivation in order to further restrict food intake (Kraus et al., 2015; Bauer et al., 2017). Either way, repeated body checking seems to magnify perceived bodily imperfections, leading to a sense of failure of control over weight, shape, and eating, which in turn leads to continued food restriction and strengthening of distorted body image beliefs (Fairburn et al., 1999). Two recent meta-analyses showed that body checking and body avoidance are strongly related to eating disorder symptoms (Walker, White, & Srinivasan, 2018) and that individuals with AN report significantly higher body checking and body avoidance relative to healthy controls, with large effect sizes (Nikodijevic, Buck, Fuller-Tyszkiewicz, de Paoli, & Krug, 2018).

1.4. Current systematic review

All three components of body image disturbance were shown to be related to AN, and targeting body image disturbance is a core element of enhanced cognitive behavioral therapy (CBT-E; Fairburn, 2008), one of the dominant treatment approaches of AN. However, so far the CBT-E approach has not shown clear superiority over other treatment

approaches for AN in which body image disturbance is not explicitly addressed as a treatment target, such as family-based therapy, focal psychodynamic therapy, or the Maudsley model of anorexia treatment for adults (e.g., Zeeck et al., 2018; Zipfel et al., 2015). The latter raises the question whether body image disturbance plays a causal role in AN. Given that the effectiveness of current treatments is still rather limited, it seems crucial to increase our understanding of the processes that underlie the onset and persistence of AN. Therefore, the main aim of the present paper was to systematically review the existing empirical evidence concerning the role of body image disturbance in the onset, maintenance, and relapse of AN. Our goal was to summarize the empirical evidence for the cognitive-affective, perceptual, and behavioral components of body image disturbances described above. We distinguished between different body image components and between onset, maintenance and relapse of AN, because we reasoned that not all components are necessarily equally present from the start of AN. Potentially, the development of AN starts with a specific component which gradually spreads to the other components over time, and leads to eating-related behavioral changes. In future research, distinctions between components and a better understanding of how components are related to symptoms of AN, could help determine 'when to address what', e.g., which aspects should be treated to prevent the onset of AN and which aspects should be addressed once AN has developed.

In this systematic review, we use the term *risk factor* for correlates (factors associated with an outcome) that precede the outcome and the term *causal risk factor* for variable risk factors that change the outcome when manipulated (cf. Jacobi, Hayward, de Zwaan, Kraemer, & Agras, 2004; Kraemer et al., 1997). These definitions imply that aspects of body image can be considered a risk factor for AN if longitudinal (prospective) studies show that it predicts onset, maintenance or relapse of AN later in time. Aspects of body image can be considered a *causal* risk factor if experimental studies show that a manipulation of body image is associated with a change in the onset, maintenance, or relapse of AN symptoms.

2. Method

The systematic review was conducted in accordance with the Preferred Reporting Items for Systematic Review and Meta-Analyses (PRISMA) checklist (Moher, Liberati, Tetzlaff, Altman, & Group, 2009). The protocol of the systematic review was registered in the International Prospective Register of Systematic Review (PROSPERO) and may be accessed under the registration number CRD42018088768 (Glashouwer, van der Veer, Adipatria, de Jong, & Vocks, 2018).

2.1. Eligibility criteria

Studies were included when: (1) the study was published in a scientific journal or an online equivalent, (2) a full-text of the study was available in English, (3) the study was published before 21st June 2018, (4) the study concerned body image as a predictor for symptoms of AN (e.g., change in Body Mass Index (BMI), fulfilling DSM-criteria for AN, severity of eating disorder symptoms), (5) participants of the study were individuals diagnosed with AN according to the ICD-10, DSM-III, DSM-IV, or DSM-5, (6) the study reported data specifically concerning individuals with AN, recovered from AN, or samples of various eating disorder diagnoses, but only when at least 50% of the clinical sample was diagnosed with AN, and (7) the design of the study was either experimental or longitudinal, i.e., studies with at least two measurement points. Treatment studies in which body image indices were only included as outcome measures were excluded from the review.

2.2. Study selection

A systematic search of databases PsycINFO and PubMed was conducted (by RV and FA) in June 2018 utilising key search terms derived from most used terms associated with body image within scientific publications. The search terms were amalgamated to formulate a search syntax: (((disturbance[Title/Abstract] OR dissatisfaction[Title/Abstract] OR satisfaction[Title/Abstract] OR distortion[Title/Abstract] OR perception[Title/Abstract] OR negative[Title/Abstract] OR preoccupation [Title/Abstract] OR overevaluation[Title/Abstract] OR overvaluation [Title/Abstract] OR overinvestment[Title/Abstract] OR concern[Title/Abstract] OR worry[Title/Abstract])) AND (body[Title/Abstract] OR weight[Title/Abstract] OR shape[Title/Abstract] OR appearance[Title/Abstract] OR size[Title/Abstract])) AND ((anorexia nervosa)[Title/Abstract] OR (eating disorder*)[Title/Abstract] OR anorexia[Title/Abstract]) Filters: Publication date to 2018/06/21; English.

The citations generated from the database search were exported into Covidence (Veritas Health Innovation, 2014), an online software program designed to assist systematic reviews. Duplicates were automatically eliminated by the program; albeit, the list of duplicates was also manually rechecked to ensure that non-duplicates were not erroneously excluded from the subsequent stages of the systematic review. Two reviewers (RV and FA) independently screened the title and abstract of the studies, and subsequently, the full-text of the studies initially considered to meet the eligibility criteria. Throughout the screening process, in the case of disagreements between the two reviewers regarding the eligibility of the study, a third reviewer (KG) was consulted for consensus on whether to include the study in the next stages of the review. Studies that ultimately were assessed as meeting the eligibility criteria following the screening process were included in the systematic review. Finally, the reference lists of the included studies were manually screened for potentially relevant studies that were previously unidentified through the database search. See Fig. 1 for the PRISMA flow diagram.

2.3. Data extraction

Data extraction was performed by two independent reviewers (RV and FA). The variables extracted concerned information on the authors, publication year, and study characteristics, such as the study's: design, sample size, participant characteristics, outcome measures, and findings.

2.4. Outcomes assessed

In the Results section, the outcomes were subdivided in studies regarding onset, maintenance, and relapse and within each category, grouped according to the cognitive-affective, perceptual, and behavioral components of body image disturbances. In the present review the heterogeneity between studies was too large to make a meta-analytical approach meaningful. The most important problem with respect to heterogeneity is that the studies varied greatly in the choice of outcome measures of AN. Outcome measures could for example vary between the use of structured clinical interviews for DSM criteria, the assessment of BMI only, self-reported eating disorder symptoms, time to remission or treatment drop-out. In addition, the study designs differed on many other aspects, such as time between assessments, number of assessment points, age of the samples, treatment setting of the samples, and analytical approaches. This means that conducting a meta-analysis would lead to so many subgroup comparisons/meta-regressions that the results would not be reliable.

2.5. Quality assessment

The United States National Institutes of Health's Study Quality Assessment Tools (National Heart, Lung, and Blood Institute (NHLBI), 2014) were utilized to assess the risk of bias of individual studies. First, applicable items from the assessment tool for observational cohort and cross-sectional studies were selected to assess the risk of bias of individual studies at outcome and study levels. Items 1, 2, 3, 4, 5, 6, 11, and 13 were included in our quality assessment. The remaining items of the tool were excluded, because these were not applicable or less

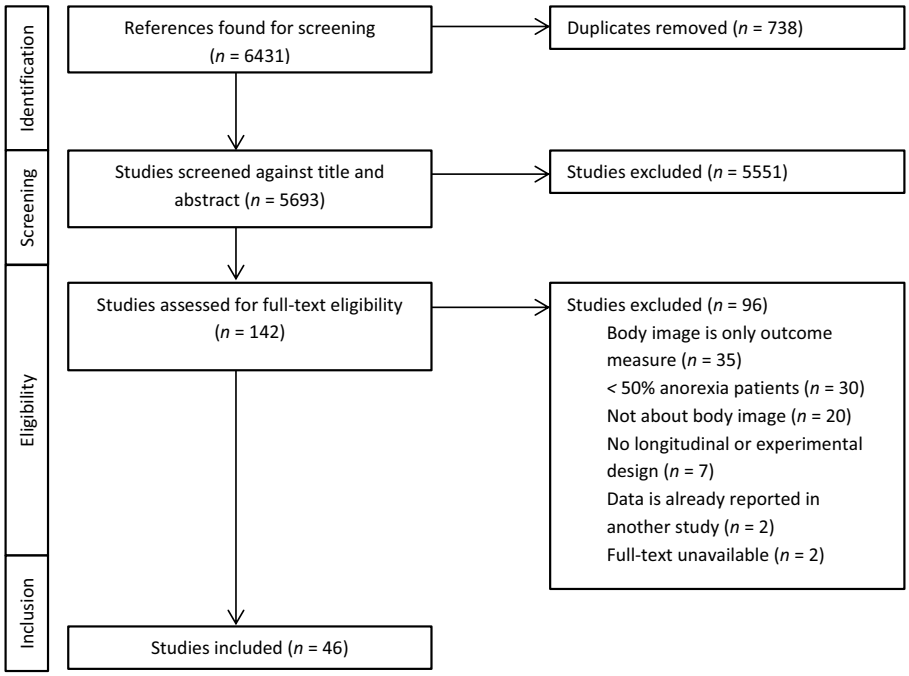

Fig. 1. PRISMA flow-chart for study selection.

suitable for assessing the quality of the articles in our review. In addition, we compared these items with the framework by Downs and Black (1998) and decided to add item 6 and 17 from Downs and Black. Two reviewers (RV and FA) rated each study independently for each of the ten items. Reviewers could respond with a "+", "−", or "not applicable". Inconsistencies in ratings were solved by consultation of a third reviewer (KG). The NHLBI assessment tools are not designed to generate a final quantitative score, but to assist reviewers in focusing on concepts that are key for critical appraisal of the internal validity of a study. Therefore, there are no cut-off points that can be used to decide whether a study is of poor, moderate or high quality. However, studies with many positive ratings can be generally considered to be less susceptible to bias and show relatively high quality of evidence, whereas many negative ratings indicate significant risk of bias and lower quality of evidence. The results of the quality assessment are shown in Table 1.

Risk of bias across studies was assessed utilising the Grading of Recommendations Assessment, Development, and Evaluation (GRADE; Guyatt et al., 2008) and the strength of the cumulative evidence was determined.

3. Results

In total, 46 studies fulfilled the inclusion criteria; all studies used a longitudinal design and no studies with an experimental design could be included (see Table 1 for an overview of the study characteristics and main findings). Most studies reported data specifically concerning individuals with AN or recovered from AN. Only two studies reported data of mixed samples of various eating disorder diagnoses (60% AN: Danielsen & Rø, 2012; 55% AN: Tabri et al., 2015). One study was about maintenance as well as relapse, and therefore included twice in Table 1 (Castellini et al., 2011). Studies that investigated two components were also included twice in Table 1. In three cases, two studies were performed on data of exactly the same sample (Calugi et al., 2017; Calugi et al., 2018 – Deter et al., 2005; Löwe et al., 2001 – Stice et al., 2017; Stice & Desjardins, 2018). When possible, results of these studies were presented together. In addition, data of several studies seemed to (partially) overlap, but this was often not sufficiently specified in the text (see notes of Table 1 for the studies of which we suspect overlap in data). In total, 38 studies investigated the cognitive-affective component of body-image disturbance; six studies the perceptual component; and two studies the behavioral component. In Table 2 we describe the measures that were used to assess body image as well as the reliability of these measures as indexed with estimates of internal consistency and test-retest reliability.

3.1. Onset

3.1.1. Cognitive-affective component

In three studies conducted in adolescents and young adults, the cognitive-affective component of body image disturbance was examined in the onset of AN. Body dissatisfaction did not directly predict AN onset (Stice et al., 2017; Striegel-Moore et al., 2004). However, body dissatisfaction amplified the relation between low BMI and AN onset indicating that individuals low in BMI showed an increased risk to develop (subthreshold) AN, and body dissatisfaction further increased this risk (Stice & Desjardins, 2018). AN symptoms were operationalized as a combination of eating disorder symptoms and weight and assessed via semi-structured interviews. The number of individuals that developed AN was small (Stice et al., 2017, 2018: AN: $N = 9$, subthreshold AN: $N = 25$; Striegel-Moore et al., 2004: $N = 10$). No studies regarding the perceptual and the behavioral component of body image disturbances in the onset of AN fulfilled the eligibility criteria.

3.2. Maintenance

3.2.1. Cognitive-affective component

In 14 studies, overvaluation and concerns regarding weight and shape were investigated as a factor in the maintenance of AN. Seven studies found a positive association between overvaluation of weight and shape and maintenance of AN (Amianto et al., 2017; Ben-Tovim et al., 2001; Calugi et al., 2018; Castellini et al., 2011; Ricca et al., 2010; Tabri et al., 2015; Woodside et al., 2004). In four of these studies, AN was operationalized as a combination of eating disorder symptoms and weight, and in two studies as eating disorder symptoms only. Eating disorder symptoms in these studies were assessed with semi-structured interviews. Two studies focused on weight only and one study investigated premature termination of inpatient treatment.[1] Five

[1] Some studies included more than one index of AN symptoms.

Table 1
Longitudinal studies investigating the role of body image disturbance in the onset, maintenance and relapse of anorexia nervosa.

Authors	Assessment points	Sample	Body image measures	AN symptoms (outcome)	Key findings	Quality assessment
Onset - cognitive/affective component						
Stice, Gau, Rohde, and Shaw (2017), 2018)	Baseline, 1 m FU, 6 m FU, 12 m FU, 24 m FU, 36 m FU	N = 1272; AN: N = 9; subthreshold AN: N = 25; DSM-5 High-risk students; females; mean age = 18.5, SD = 4.2; mean BMI = 24.1; SD = 5.1	Body dissatisfaction (BDS)	(Subthreshold[a]) AN (EDDI)	Body image measures do not directly predict onset of AN. However, body dissatisfaction interacted with low BMI in the prediction of AN onset. Individuals low in BMI who were dissatisfied with their body had an increased risk for AN onset.	2017: + + + + − + + + + + 2018: + + + + − + + + + −
Striegel-Moore et al. (2004)	2 y and 1 y before onset; y of onset; 1 y and 2 y after onset	AN: N = 10; No ED controls: N = 659; DSM-IV Community sample; females; mean age AN onset = 14.9, SD = 3.7; mean BMI AN onset = 18.5, SD = 2.5	Pictograms; Body dissatisfaction = difference between current and ideal body size silhouette[b]	AN (EDE)	AN group shows tendency for greater weight dissatisfaction before onset of AN than controls. However, weight dissatisfaction in AN group decreases over time and no dissatisfaction is shown at onset and 1 y after onset.	+ + + + − + − + − −
Maintenance – cognitive/affective component						
Amianto, Spalatro, Ottone, Abbate Daga, and Fassino (2017)	Admission, 8 y FU	N = 59; AN-R: N = 19; AN-BP: N = 40; DSM-IV(-TR) Outpatients; Females; Mean age = 30.2, SD = 8.9; mean BMI = 16.1, SD = 0.9	Body shape concern (BSQ-34); Body dissatisfaction (EDI-2)	Outcome classified as healed, improved, stable, worsened according to DSM-IV and BMI criteria	The worsened group scored higher than the non-worsened group on all body image measures at baseline.	+ + − + − + + − + −
Ben-Tovim et al. (2001)	Admission, 6 m FU, 5 y FU	N = 95; AN-R: N = 56; AN-BP: N = 42; DSM-III-R Mean age = 22.5, SD = 6.9; mean BMI = 16.5, SD = 1.9; mean duration = 7.4 y, SD = 7.0	Body attitudes (BAQ)	Eating disorder symptoms (Mean score MROAS)	Self-rated attractiveness after 6 m and change in salience of weight and shape over the first 6 m were related to outcome in AN symptoms at 5 y FU. Other subscales of the BAQ at admission, 6 m FU or change over time were no significant predictors of outcome after 5 y.	+ − + − − + + + + −
Bizeul, Sadowsky, and Rigaud (2001)	Admission, every 6 m for at least 5 y	N = 26; AN-R: N = 20; AN-BP: N = 6; ICD-10 Inpatients; mean age = 22.2, SD = 5.2	Body dissatisfaction (EDI)	Recovery vs. poor outcome based on MROAS	The recovered group did not differ on body dissatisfaction from the group with a poor outcome.	+ + − − − + + − − −
Byrne et al. (2015)[c]	Admission, EOT	N = 108; Primary weight concerned N = 36; primary shape concerned N = 72; DSM- IV Outpatients; 89.8% female; mean age = 14.5, SD = 1.6; mean duration = 11.9 m, SD = 12.0	Weight concern compared with shape concern (EDE)	Achieving remission (normal weight and global EDE score within 1 SD of published norms) or achieving normal weight	There were no significant differences between the AN group with primary weight concern and the AN group with primary shape concern assessed at start of treatment across treatments in the proportion of participants achieving full remission or normal weight.	+ + + + − + + − + −
Calugi, El Ghoch, Conti, and Dalle Grave (2018)[d]	Admission, EOT, 6 m FU, 12 m FU	N = 66; DSM-IV Inpatients, females, mean age = 26.1, SD = 5.9; mean BMI = 14.7, SD = 2.1; mean duration = 7.7 y, SD = 5.7	Preoccupation with weight or shape, feeling fat (EDE)	Eating disorder symptoms (EDE global score and subscales), BMI, general psychopathology (BSI)	Higher preoccupation with shape or weight at admission predicted slower improvement in eating concern and general psychopathology symptoms. Lower scores on both body image measures at EOT predicted higher chance of achievement of BMI ≥ 18.5 at 6 m FU.	+ + + + − + + + − −
Castellini et al. (2011)[e]	Admission, EOT, 3 y FU, 6 y FU	N = 165; AN-R: N = 76; AN-BP: N = 89; DSM-IV Outpatients; 96.4% female; mean age = 27.2, SD = 9.1; mean BMI = 16.5, SD = 3.5; mean duration = 4.7	Shape and weight concern (EDE-Q)	Recovery using DSM-IV and DSM-5[f]	Lower shape and weight concern at admission were associated with higher chance of recovery at 6 y FU. Only shape concern remained a significant predictor in a multiple predictor model.	+ + + + − + + + + −

(*continued on next page*)

Table 1 (*continued*)

Authors	Assessment points	Sample	Body image measures	AN symptoms (outcome)	Key findings	Quality assessment
Clausen (2008)[g]	Admission, EOT, 1 y FU, 2.5 y FU	*N* = 35; AN-R: *N* = 21; AN-BP: *N* = 14; DSM-IV Mean age = 19.8, *SD* = 5.8; mean BMI = 16.0, *SD* = 1.6; mean duration = 3.7 y, *SD* = 5.2	Shape and weight concern (EDE-Q); Body dissatisfaction (EDI)	Time to remission, i.e. without symptoms > 3 m (based on EDE and LIFE-EAT-II)	Body image measures at admission did not predict time to remission.	+ − + + − + + − − +
Collin et al. (2016)	Admission, EOT; Mean treatment duration = 140 days, *SD* = 64.2	*N* = 60; AN-R: *N* = 33; AN-BP: *N* = 27; DSM-IV Inpatients; females; mean age = 25.6; *SD* = 7.0; mean BMI = 14.9; *SD* = 2.4; mean duration = 8.6 y, *SD* = 7.8	Impact of physical appearance on self-esteem (Body Appearance subscale of MSEI)	Change in BMI and eating disorder symptoms (EDE subscales)	Body appearance at admission or mean change in body appearance did not predict change in BMI or EDE subscales from admission to EOT.	+ + + − − + + − − −
Danielsen and Rø (2012)	Admission, discharge; Mean time between assessments = 166d	*N* = 50; AN-R: *N* = 26; AN-BP: *N* = 4; BN: *N* = 9; EDNOS: *N* = 11; DSM-IV Inpatients; 96% females; mean age = 19.8; *SD* = 3.3; mean BMI = 15.1; *SD* = 1.6; mean duration = 4.8 y, *SD* = 3.5	Body attitudes (BAT)	Eating disorder symptoms (EDI-2 total score), BMI	Improvement in body attitudes from admission to discharge significantly predicted improvement in eating disorder symptoms, but not BMI at discharge.	+ + + − − + + − + −
Deter, Schellberg, Köpp, Friederich, and Herzog (2005)[h]	Admission, 3.6 y FU (*SD* = 2.7), 11.8 y FU (*SD* = 2.43); and annual assessments	*N* = 84; DSM-III-R Inpatients; females; mean age = 20.7; *SD* = 4.1; mean BMI = 13.3; *SD* = 2.0; mean duration = 2.7 y, *SD* = 3.9	Disturbed body image (single item of ANSS)	Good vs. poor somatic outcome (weight & menstruation), Overall condition[i]	Body image disturbance at admission was significantly related to a good somatic condition at 8 y, but not at 4 y or 12 y, and not to the global outcome score at 12 y.	+ + + − − + + + − −
Löwe et al. (2001)	Admission, 12 y FU, 21 y FU	*N* = 84; AN-R: *N* = 48; AN-BP: *N* = 36; DSM-IV	Body dissatisfaction (EDI-2)	21 y FU: Good vs. intermediate vs. poor outcome (LIFE-EAT II)	Body dissatisfaction at 12 y FU did not significantly predict outcome at 21 y FU	+ + − − − + + − − −
Fassino, Abbate Daga, Amianto, Leombruni, Fornas, et al., (2001)[j] PAP	Admission, 6 m FU	*N* = 42 AN-R; DSM-IV Outpatients; females; mean age = 21.9; *SD* = 4.6; mean BMI = 15.5; *SD* = 1.8; mean duration = 4.1 y, *SD* = 3.6	Body dissatisfaction (EDI-2)	Improved vs. not-improved (based on BMI and MROAS)	Groups did not significantly differ in body dissatisfaction at admission.	+ + + + − + + − + −
Fassino, Abbate Daga, Amianto, Leombruni, Garzaro, et al. (2001) EP	Admission, 6 m FU	*N* = 40 AN-R; DSM-IV Outpatients; Improved group: mean age = 21.6; *SD* = 3.7; mean BMI = 14.6; *SD* = 1.6; mean duration = 3.8 y, *SD* = 2.2; Not-improved group: mean age = 22.1; *SD* = 3.7; mean BMI = 15.3; *SD* = 1.4; mean duration = 3.9 y, *SD* = 3.9	Body dissatisfaction (EDI-2)	Improved vs. not-improved (based on BMI and MROAS)	Groups did not significantly differ in body dissatisfaction at admission.	+ + − + − + + − + −
Fichter, Quadflieg, Crosby, and Koch (2017)	Admission, FU; Mean time between assessments = 9.8 y; *SD* = 5.6	*N* = 1138; DSM-IV Inpatients; 98.3% female; mean age = 24.9, *SD* = 7.2; mean BMI = 14.7, *SD* = 1.8; mean duration = 7.1 y, *SD* = 5.9	Body dissatisfaction (EDI)	(Partial) remission vs. poor outcome (i.e. having an ED for 3 m according to SIAB-S)	Individuals with a poor outcome did not differ in body dissatisfaction at admission from individuals who partially or fully remitted.	+ + + + − + + − +
Helverskov et al. (2010)[g]	Admission, 32 m FU	*N* = 58; DSM-IV Mean age = 22, *SD* = 6.5; mean BMI = 15, *SD* = 1.4; mean duration = 4.2 y, *SD* = 5.6	Weight and shape concern (EDE)	Time to full/partial remission (No symptoms > 12 w; EDE, LIFE-EAT-II)	Weight and shape concern were not related to remission.	+ − − + − + − − + +
Howard, Evans, Quintero-Howard, Bowers, and Andersen (1999)	Admission, discharge	*N* = 59; AN-R: *N* = 30; AN-BP: *N* = 19; AN-S: *N* = 10; DSM-IV Inpatients; females; mean age = 24.8, *SD* = 8.7; mean BMI = 16.0, *SD* = 2.0; mean duration = 5.0 y, *SD* = 6.1	Body dissatisfaction (EDI-2)	Success vs. failure in transferal from inpatient to day treatment	There were no significant differences between groups in body dissatisfaction at admission.	+ − − − − + + − − −

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Table 1 (*continued*)

Authors	Assessment points	Sample	Body image measures	AN symptoms (outcome)	Key findings	Quality assessment
Kahn and Pike (2001)	Admission, EOT	*N* = 81; AN-R: *N* = 30; AN-BP: *N* = 51; DSM-IV Inpatients; females; mean age = 26.3, *SD* = 7.4; mean BMI = 15.1, *SD* = 1.8; mean duration = 7.8 y, *SD* = 6.1	Body shape concern (BSQ-34)	Treatment drop-out, i.e. discharge prior to reaching target weight	Patients who dropped out of treatment did not differ from completers on body shape concern at admission.	+ + − + + + − na − −
Kaplan et al. (2009)[k]	Discharge, 6 m FU, 12 m FU	*N* = 93; AN-R: *N* = 48; AN-BP: *N* = 45; DSM-IV Inpatients; females; mean age = 23.3, *SD* = 4.6; mean BMI = 20.3, *SD* = 0.5; mean duration = 4.5 y, *SD* = 3.6	Weight and shape concern (EDE)	(Time to) unsuccessful vs. successful weight maintenance (maintaining a BMI ≥ 18.5)	Weight and shape concern were not related to (time) to unsuccessful weight maintenance.	+ + + + − + + − + +
Karlsson, Clinton, and Nevonen (2013)	Admission, 6 m, 36 m	*N* = 89; DSM-IV Females; mean age = 23.9, *SD* = 6.0; mean BMI = 15.7, *SD* = 1.6; mean duration = 6.7 y, *SD* = 5.9	Body dissatisfaction (EDI-2)	Change in weight	Body dissatisfaction was not significantly related to weight increase from baseline to 6 m or weight increase from baseline to 36 m.	+ + + + − + + + +
Kästner et al. (2015)	Admission, discharge	*N* = 153; DSM-IV Inpatients; females; mean age = 26.9, *SD* = 8.6; mean BMI = 15.0, *SD* = 1.6; mean duration = 9.1	Body dissatisfaction (EDI-2)	Change in BMI	Body dissatisfaction was not related to change in BMI during inpatient treatment.	+ + − + − + + − − +
Misra et al. (2013)	Baseline, 18 m FU	*N* = 72; AN-E+ *N* = 38; AN-E−: *N* = 24; DSM-IV Females; AN-E+: mean age = 16.9; mean BMI = 17.2; mean duration = 14.5 m, *SD* = 2.8; AN-E−: mean age = 16.6; mean BMI = 17.5; mean duration = 13.6 m, *SD* = 2.6	Body dissatisfaction (EDI-2); Body shape concern (BSQ-34)	Change in BMI	In the placebo group, changes in body dissatisfaction were related to changes in BMI: decrease in body dissatisfaction was related to a decrease in BMI. The latter might indicate that individuals who gained more weight, became more dissatisfied with their bodies. No relations were found in the experimental group (receiving estrogen) or for the body shape concern.	+ + + + − + − − + +
Ricca et al. (2010)[e]	Admission, EOT, 3 y FU	*N* = 103; Full AN: *N* = 53; AN-S: *N* = 50 [j]; DSM-IV Outpatients; females; Full AN: mean age = 27.5, *SD* = 10.3; mean BMI = 15.6, *SD* = 1.7; mean duration = 6.2 y, *SD* = 4.5; AN-S: mean age = 29.9, *SD* = 8.9; mean BMI = 19.2, *SD* = 1.9; mean duration = 8.1 y, *SD* = 5.6	Weight and shape concern (EDE-Q); Body uneasiness (BUT-GSI)	Change in BMI; Treatment resistance (absence of diagnostic change at EOT); Recovery at EOT and 3 y FU (DSM-IV criteria were not met)	Reduction in shape concern and in body uneasiness from admission to EOT were related to increase in BMI over the same period. Reduction in shape concern and in weight concern from EOT to 3 y FU were related to increase in BMI over the same period. Higher shape concern at admission was related to higher treatment resistance at EOT. Lower shape concern and body uneasiness at admission were related to higher chance of recovery at EOT and 3 y FU. Subjects with shape concern higher than the median value of the sample had a lower probability of remission across time.	+ + + + − + + − + +
Schlegl, Quadflieg, Löwe, Cuntz, and Voderholzer (2014)	Admission, discharge; mean days of admission = 91.8, *SD* = 44.3	*N* = 435; AN-R: *N* = 316; AN-BP: *N* = 111; ICD-10 Inpatients; females; mean age = 26.4; *SD* = 9.0; mean BMI = 14.6; *SD* = 1.7; mean duration = 8.8 y, *SD* = 7.8	Body dissatisfaction (EDI-2)	Clinically significant change in eating disorder symptoms (EDI-2 global score)	Lower body dissatisfaction at admission was related to a higher chance of clinically significant change in eating disorder symptoms.	+ + + + − + + + +

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Table 1 (*continued*)

Authors	Assessment points	Sample	Body image measures	AN symptoms (outcome)	Key findings	Quality assessment
Schlegl et al. (2016)	Admission, discharge; mean days of admission = 81.9, *SD* = 32.0	*N* = 238; AN-R: *N* = 188; AN-BP: *N* = 42 atypical AN: *N* = 8; ICD-10 Inpatients; females; mean age = 15.7; *SD* = 1.11; mean BMI = 14.8; *SD* = 1.2; mean duration = 2.1 y, *SD* = 1.4	Body dissatisfaction (EDI-2)	Clinically significant change in eating disorder symptoms (EDI-2 global score); change in BMI; pre-mature discharge	Lower body dissatisfaction at admission was related to a higher chance of clinically significant change in eating disorder symptoms. Body dissatisfaction at admission did not predict change in BMI or pre-mature discharge.	+ + + + − + + + + +
Tabri et al. (2015)[l]	Weekly ratings retrospectively assessed every 6-12 m during 2 y	*N* = 246; AN-R: *N* = 51; AN-BP: *N* = 85; BN: *N* = 110; DSM-IV Outpatients; females	Overvaluation of shape/weight; feelings of fatness (LIFE-EAT II)	Restrictive eating and non-compensatory weight-control behaviors (LIFE-EAT II)	Overvaluation was reciprocally related to restrictive eating and non-compensatory weight-control behaviors, i.e. participants who overvalued their shape/weight in a given week were more likely to engage in restrictive eating and compulsive exercise during the following week and vice versa. Feelings of fatness/fat phobia were similarly reciprocally related to restrictive eating during the following week.	+ − − − − + − + + +
Treat, McCabe, Gaskill, and Marcus (2008)	Admission, EOT, 6 m FU	*N* = 71; AN-R: *N* = 45; AN-BP: *N* = 26; DSM-IV Inpatients; 93% females; mean age = 18.4; *SD* = 5.9; mean BMI = 15.2; *SD* = 1.5; mean duration = 3.4 y, *SD* = 4.1	Body dissatisfaction (EDI-2)	Outcome of day hospital program delivered after inpatient program and at 6 m FU [m]	Body dissatisfaction did not differ significantly between individuals with a poor and an excellent outcome and was not significantly related to higher chance of a satisfactory outcome 6 m after discharge.	+ − + − − + + − +
Van der Ham, Van Strien, and Van Engeland (1998)	Admission, 4 y FU	*N* = 35; AN-R: *N* = 23; AN-BP: *N* = 12; DSM-IV Outpatients; 92% females; mean age = 17.3; mean duration = 1.5 y	Body dissatisfaction (EDI)	Eating disorder symptoms (Average Score MROAS)	Body dissatisfaction at admission was not related AN symptoms 4 years later.	+ + − − − + + − − −
Vansteelandt, Pieters, Vanderlinden, and Probst (2010)	Admission, EOT; mean treatment duration = 23.4w; *SD* = 4.4	*N* = 92; AN-R: *N* = 65; AN-BP: *N* = 27; DSM-IV Inpatients; females; mean age = 20.5; *SD* = 6.6; mean BMI = 14.2; *SD* = 1.6; mean duration = 4 y, *SD* = 4.7	Body dissatisfaction (EDI-2)	BMI curve over course of treatment	Patients with higher body dissatisfaction at admission gained weight more slowly over the course of treatment than patients with lower body dissatisfaction.	+ + − − − + + − − +
Woodside, Carter, and Blackmore (2004)[k]	Admission, EOT	*N* = 166; AN-R: *N* = 75; AN-BP: *N* = 91; DSM-IV Inpatients; 98% females; mean age = 27.1; *SD* = 9.0; mean BMI = 14.9; *SD* = 1.8; mean duration = 6.7 y, *SD* = 7.6	Shape and weight concern (EDE); Body dissatisfaction (EDI)	Time to premature termination inpatient treatment (discharge before achieving BMI ≥ 20)	Higher weight concern during admission significantly predicted higher likelihood of premature termination of treatment.	+ − − − − + − na − +
Zeeck, Hartmann, Buchholz, and Herzog (2005)	Admission, EOT	*N* = 133; DSM-IV or ICD-10 Inpatients; 93% females; mean age = 24.8; *SD* = 6.8; mean BMI = 14.9; *SD* = 1.7;; mean duration = 5.2 y–7.4 y	Body dissatisfaction (EDI)	Drop-out from inpatient treatment	Patients who drop-out from treatment did not differ from completers on body dissatisfaction at admission.	+ + + + − + + na + na

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Table 1 (*continued*)

Authors	Assessment points	Sample	Body image measures	AN symptoms (outcome)	Key findings	Quality assessment
Maintenance – perceptual component						
Boehm et al. (2016)	Admission, 3 y FU; Mean time between assessments: 3.72 y, *SD* = 1.63	*N* = 76; AN-R: *N* = 48; AN-BP: *N* = 20; Atypical AN: 10%, *N* = 8; ICD-10 Inpatient sample; females; mean age = 15.8, *SD* = 2.0; mean BMI = 15.2, *SD* = 1.9; Mean BMI-SDS = −2.8, *SD* = 1.4; mean duration = 1.5 y	Body size estimation (BPI-1)	Eating disorder symptoms: (MROAS; global & physical: BMI & menstruation)	Lower body size overestimation at admission was related to a better global outcome after three years, to BMI-SDS at FU and BMI-SDS increase in between admission and FU, but was not related to BMI-SDS increase during first 28 days.	+ + + − − + + − +
Button (1986)	Admission, 1 w FU, near maximum weight, post discharge	*N* at admission = 43, *N* at FU = 21; AN criteria of Russel (1970) Inpatients; females; mean age = 23.5, *SD* = 7.3; mean % standard weight = 70.6, *SD* = 8.5; mean duration = 4.5 y, *SD* = 4.8	Body size estimation (BPI-2)	% of standard weight post discharge	Greater overestimation of size at admission (but not after 1 w; or near maximum weight; or change between admission and near maximum weight) was related to lower weight 6 m post discharge.	+ − − − − + − − +
Casper, Halmi, Goldberg, Eckert, and Davis (1979)	Baseline, 5 w FU	*N* = 81; Females	Body size estimation[o]	Change in weight over 5 weeks of treatment	Overestimation of body size is related to smaller weight gain over 5 w.	+ − − − − + + − − −
Roy and Meilleur (2010)	Admission, discharge	AN-R: *N* = 10 Inpatients; females; mean age = 14.9; *SD* = 1.5; mean BMI = 16.7; *SD* = 1.0	Body size estimation (Q-BID)	Change in eating disorder symptoms (EDE-Q; EAT-26)	Change in body size estimation significantly related to change in eating disorder symptoms from admission to discharge.	+ + − − − + + − − −
Slade and Russell (1973)	Admission, weekly testing until discharge, FU after discharge varying from 26 d to 213 d	*N* = 10; Inpatients	Body size estimation (visual size-estimation apparatus)	Change in weight during and after inpatient treatment	Higher body size estimation during hospitalization related to more weight loss after discharge.	+ − − − − + + − − −
Strober, Bowen, and Preble (1985)	Admission, 90 d FU	*N* = 65; AN criteria of Feighner et al. (1972) Inpatients; females; mean age = 15.1; mean expected weight = 73%; mean duration = 6.9 m	Body image disturbance (no instrument given)	Change in weight in first 90 d of treatment	Higher body image disturbance at admission was related to less weight gain over time.	+ − − − − + + − − −
Maintenance – behavioral component						
Calugi, El Ghoch, and Dalle Grave (2017)[d]	Admission, EOT, 6 m FU, 12 m FU	*N* = 66; DSM-IV Inpatients, females, mean age = 26.1, *SD* = 5.9; mean BMI = 14.7, *SD* = 2.1; mean duration = 7.7 y, *SD* = 5.7	Self-reported body checking (BCQ)	Eating disorder symptoms (EDE global score and subscales), BMI, general psychopathology (BSI)	Body checking at admission was not related to eating disorder symptom change, BMI and general psychopathology. Change in body checking from admission to EOT was not related to change in BMI or EDE restraint or eating concern subscale scores. However, change in body checking from admission to EOT was related to change in EDE weight concern, shape concern and global scores as well as general psychopathology.	+ + − + − + + − − −

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Table 1 (*continued*)

Authors	Assessment points	Sample	Body image measures	AN symptoms (outcome)	Key findings	Quality assessment
Lavender et al. (2013)	Baseline, daily for 2 w	N = 118; full AN: N = 59; AN-S: N = 59; DSM-IV Females; mean age = 25.3, SD = 8.4; mean BMI = 17.1, SD = 1.0	Self-reported frequency of body checking[p]	Dietary restriction (8 waking hours without eating; consuming < 1200 cal per day)	Daily body checking frequency was associated with dietary restriction on the same day, as well as the following day. Dietary restriction did not significantly predict body checking frequency during the next day.	+ − + + − + + + − +
Relapse – cognitive/affective component						
Carter, Blackmore, Sutandar-Pinnock, and Woodside (2004)[k]	Admission, discharge, FU (mean length of 15.6 m post-discharge)	N = 51; DSM-IV (weight restored) Inpatients; females; mean age = 26.9, SD = 9.0; mean BMI at admission = 15.1, SD = 2.1; mean duration = 6.2 y, SD = 6.8	Shape and weight concern (EDE-Q); Body dissatisfaction (EDI)	Relapse (BMI < 17.5 for 3 m)	Higher decrease in weight and shape concern from admission to discharge was related to lower risk of relapse at FU.	+ + + − − + − + + +
Carter et al. (2012)[k]	Admission, discharge, every 3 m FU during 1 y post-discharge	N = 100; AN-R: N = 67; AN-BP: N = 33; DSM-IV In/day patients; 95% females; mean age = 25.4 SD = 7.7; mean BMI = 15.1, SD = 1.9; mean duration = 6.3 y, SD = 7.2	Shape and weight concerns (EDE; EDE-Q)	Relapse (BMI ≤ 17.5 for 3 m or ≥1 binge/purge episode per week for 3 m)	Shape and weight concern at discharge and increase in shape and weight concern from admission to discharge significantly predicted relapse in univariate analyses (not in multivariate analyses).	+ + − − − + + + + +
Castellini et al. (2011)	Admission, EOT, 3 y FU, 6 y FU	N = 165; AN-R: N = 76; AN-BP: N = 89; DSM-IV Outpatient; 96.4% female; mean age = 27.2, SD = 9.1; mean BMI = 16.5, SD = 3.5; mean duration = 4.7 y	Shape and weight concerns (EDE-Q)	Relapse using DSM-IV and DSM-5[q]	Weight and shape concerns at admission were not related to relapse in patients who initially had recovered.	+ + + + − + + + +
Keel, Dorer, Franko, Jackson, and Herzog (2005)[l]	Baseline, each 6 m FU for first 5 y, then annually; mean FU = 8.6 y	N = 42; N relapse = 15; DSM-IV Outpatients; females; mean age = 20.7; median duration = 3.7 y	Overvaluation of shape/weight (LIFE-EAT II)	Relapse; MacArthur guidelines	Concern about shape/weight after remission was a significant predictor of relapse in an univariate model, but not in a multivariate model.	+ + + + − + + + +
Lock et al. (2013)[c]	EOT, 12 m FU	N = 111; adults: N = 28; adolescents: N = 83 Females; Mean age adolescents = 14.5, SD = 1.6; mean age adults = 26.0, SD = 6.3; mean BMI adolescents = 16.1, SD = 1.1; mean BMI adults = 18.0, SD = 2.1	Shape concern, weight concern (EDE)	Recovery (weight > 95%; global EDE score within 1 SD of published norms; no binge/compensatory behaviors)	Shape and weight concern or their change from EOT to FU were no clinically significant predictors of recovery in adolescents with AN. Few adults with AN met full criteria for recovery. However, in adults, weight concerns at EOT were predictive of global EDE scores at FU, but change in weight concern or shape concern were not.	+ + − + − + + − +
Relapse – perceptual component						
Castro, Gila, Puig, Rodriguez, and Toro (2004)	Admission, 12 m FU	N = 101; AN-R: N = 80; AN-BP: N = 21; DSM-IV; Body image only investigated for N = 75 Inpatients; Females; mean age = 15, SD = 1.8; mean BMI = 15.9, SD = 1.3; mean duration = 14.9 m, SD = 10.3	Body size estimation (SBDA)	Readmission after initial weight recovery	Global body overestimation at admission did not differ between individuals that were and were not readmitted after initial weight recovery. However, overestimation of hips was higher at admission in individuals who readmitted than individuals who were not.	+ + − − − + − − +

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Table 1 (*continued*)

Authors	Assessment points	Sample	Body image measures	AN symptoms (outcome)	Key findings	Quality assessment
Keel et al. (2005)[l]	Baseline, each 6 m FU for first 5 y, then annually; mean FU = 8.6 y	*N* = 42; *N* relapse = 15; DSM-IV Outpatients; females; mean age = 20.7; median duration = 3.7 y	Misperception of body (LIFE-EAT II)	Relapse; MacArthur guidelines	Misperception of body was significant predictor of relapse in univariate model and showed independent predictive validity for relapse in multivariate model.	+ + + + − + + + +

Note. AN = anorexia nervosa; AN-BP = anorexia nervosa of the binge/purging subtype; AN-E+ = anorexia patients receiving estradiol; AN-E− = anorexia patients receiving placebo; AN-R = anorexia nervosa of the restrictive subtype; AN-S = subthreshold anorexia nervosa; Lavender et al.: DSM-IV AN, except BMI was between 17.6 and 18.5, or absence of amenorrhea or cognitive features of AN. Ricca et al.: DSM-IV AN, except amenorrhea or underweight; ANSS = Anorexia Nervosa Symptom Score (Deter, 1992); BAT = Body Attitude Test (Probst, Van Coppenolle, & Vandereycken, 1997; Probst, Pieters, & Vanderlinden, 2008); BAQ = Body Attitudes Questionnaire (Ben-Tovim & Walker, 1991); BCQ = Body Checking Questionnaire, italian version (Bamford, Attoe, Mountford, Morgan, & Sly, 2014); BDS = Body Dissatisfaction Scale (Stice et al., 2011); BMI = body mass index; BMI-SDS = body mass index standard deviation score (Kromeyer-Hauschild et al., 2001); BPI-1 = Body Perception Index: BPI width = estimated/real width - abdomen, BPI length = estimated/real length - thigh, BPI Quotient = BPI width/BPI length (Smeets, Smit, Panhuysen, & Ingleby, 1998); BPI-2 = Body Perception Index: Perceived body size by means of Slade and Russell's (1973) Visual Size Estimation Apparatus (Face, chest, waist, hips, stomach depth, overall). BSI = Brief Symptom Inventory (De Leo, Frisoni, Rozzini, & Trabucchi, 1993); BSQ-34 = Body Shape Questionnaire (Cooper, Taylor, Cooper, & Fairbum, 1987); BUT-GSI = Body Uneasiness Test Global Severity Index (Cuzzolaro, Vetrone, Marano, & Battacchi, 1999); d = days; DSM-III, DSM-IV, DSM-5 = Diagnostic and Statistical Manual of Mental disorders 3rd, 4rd, 5th edition; EAT-26 = Eating Attitudes Test (Garner & Garfinkel, 1979); ED = eating disorder; EDDI = Eating Disorder Diagnostic Interview (Stice, Marti, & Rohde, 2013); EDE = Eating Disorder Examination (Fairburn & Cooper, 1993); EDE-Q = Eating Disorder Examination-questionnaire (Fairburn & Beglin, 1994); EDI = Eating Disorders Inventory (Garner, Olmstead, & Polivy, 1983); EDI-2 = Eating Disorders Inventory-2 (Garner, 1991); EDNOS = eating disorder not otherwise specified; EOT = end of treatment; FU = follow-up; ICD-10 = 10th revision of the International Statistical Classification of Diseases and Related Health Problems; LIFE-EAT II = Longitudinal Interval Follow-Up Evaluation Eating Disorders Version 2 (Herzog et al., 1999); m = months; MROAS = Morgan-Russel Outcome Assessment Schedule (Morgan & Hayward, 1988); MSEI = Multidimensional self-esteem inventory (O'Brien & Epstein, 1988); na = not applicable; Q-BID = Quantification of Body Image Distortion (Roy & Forest, 2007); SBDA = Subjective Body Dimensions Apparatus (Gila, Castro, Toro, & Salamero, 1998); SIAB-S = Structured Inventory for Anorexic and Bulimic Eating Disorders Self-rating form (Fichter & Quadflieg, 2000); w = weeks; y = years.

Criteria of quality assessment were: 1) research question/aim specified; 2) description study population provided; 3) participation rate at least 50%; 4) inclusion and exclusion criteria specified; 5) sample size justification; 6) reasonable timeframe for outcome to change; 7) valid and reliable outcome measure; 8) simple outcomes reported for main findings; 10) adjustment for differences in length of follow-up. Studies were scored with "+", "−", or "na = not applicable".

[a] Criteria subthreshold AN: BMI between 90% and 85% of that expected for age and gender. Definite fear of weight gain > 25% of the days for at least 3 months. Weight and shape were one of the main aspects of self-evaluation.

[b] Stunkard, Sorensen, & Schulsinger, 1983.

[c] Partial overlap in samples of Byrne et al. (2015) and Lock et al. (2013).

[d] Data of Calugi et al. (2017) and Calugi et al. (2018) concern exactly the same sample.

[e] Unclear whether samples of Castellini et al. (2011) and Ricca et al. (2010) overlap.

[f] Patients were considered recovered when at 6 y FU they did not fulfill the DSM-IV or DSM-V criteria for any ED (including EDNOS).

[g] There seems to be a partial overlap in sample between Clausen (2008) and Helverskov et al. (2010).

[h] The samples of Löwe et al. (2001) and Deter et al. (2005) are identical. However, since they present different data, we decided to include both studies.

[i] According to the Deter-Herzog criteria (1994).

[j] There seems to be partial overlap in the samples of Fassino, Abbate Daga, Amianto, Leombruni, Fornas, et al. (2001) and Fassino, Abbate Daga, Amianto, Leombruni, Garzaro, et al. (2001).

[k] The sample of Woodside et al. (2004) overlaps partially with Carter et al. (2012) and Kaplan et al. (2009). The sample of Carter et al. (2004) seems unique.

[l] Overlap in data between Tabri et al. (2015) and Keel et al. (2005), but different statistical approach.

[m] To be classified as exhibiting either an excellent or good outcome, patients could not be losing more than one-third a pound per week, should have reached > 90% of their BMI and show no use of regular compensatory measures in the last week of the program. Patient outcomes were classified as unsatisfactory 6 months after discharge if patients had been referred by their individual clinician in the eating-disorders program to a higher level of care (i.e., an intensive outpatient, day hospital, residential, or inpatient program).

[o] Adapted from Slade and Russell (1973).

[p] Engel et al. (2005).

[q] According to Keel et al., relapse was defined as the return to a full syndromal or EDNOS criteria after a period of remission.

Table 2
Body image assessments.

Name of instrument	Reference	Description	Number of items	Reliability[a]	Sample[b]
Cognitive/affective component					
Anorexia Nervosa Symptom Score scale (ANSS); body image disturbance	Deter (1992)	Multidimensional clinical rating scale	1	n/a	n/a
Body Attitude Test (BAT)	Probst, Vandereycken, Coppenolle, & Vanderlinden (1995)	Questionnaire for female patients with eating disorders	20	Total: $\alpha = 0.89$ 1-Week test-retest: $r = 0.92$	$N = 50$ ♀ AN, BN, EDNOS; Age: $M = 20.8$, $SD = 4.2$ (Danielsen & Rø, 2012) $N = 35$ ♀ AN, BN, EDNOS; Age: not reported (Probst et al., 1995)
Body Attitudes Questionnaire (BAQ)	Ben-Tovim and Walker (1991)	Questionnaire whose subscales encompass 6 distinct aspects of body experience	44	$\alpha = 0.87$ 4-Week test-retest: $r = 0.83$	$N = 504$ ♀ NC; Age: $M = 38$, $SD = 14.5$ (Ben-Tovim & Walker, 1991) $N = 41$ ♀ NC; Age: not reported (Ben-Tovim & Walker, 1991)
Body Dissatisfaction Scale (BDS)	Stice (2001)	Questionnaire, satisfaction ratings of 9 body parts	9	$\alpha = 0.91$ 3-Week test–retest: $r = 0.90$	$N = 1272$ ♀ NC; Age: $M = 18.5$, $SD = 4.2$ (Stice & Desjardins, 2018) Sample not reported (Stice & Desjardins, 2018)
Body Shape Questionnaire (BSQ-34)	Cooper et al. (1987)	Questionnaire of concerns about body shape	34	$\alpha = 0.94$ 2-Week test-retest: $r = 0.90$	$N = 90$ ♀ BN, EDNOS; Age: $M = 28.5$, $SD = 9.6$ (Ghaderi & Scott, 2004) $N = 124$ ♀ NC; Age: $M = 28.8$ $SD = 6.3$ (Ghaderi & Scott, 2004)
Body Uneasiness Test, Global Severity Index (BUT-GSI)	Cuzzolaro et al. (1999)	Questionnaire which explores various areas (13 subscales) of body-related psychopathology	71	Subscales: $\alpha = 0.69–0.90$ 1-Week test-retest: $r = 0.90$	$N = 2417$ ♀♂ AN, BN, EDNOS, NC; Age: Range 13–80 (Cuzzolaro, Vetrone, Marano, & Garfinkel, 2006) $N = 38$ ♀♂ AN, BN, EDNOS; Age: $M = 24.5$, $SD = 6.1$ (Cuzzolaro et al., 2006)
Eating Disorder Examination;(EDE); Weight Concern (WC) and Shape Concern (SC) subscales	Fairburn, Cooper & O'Connor (1993)	Semi-structured investigator-based Interview of eating disorder symptoms	WC = 5 SC = 8	WC: $\alpha = 0.51–0.76$ SC: $\alpha = 0.68–0.85$ WC: $\alpha = 0.67$ SC: $\alpha = 0.79$ 2 to 7-day test-retest: WC: $r = 0.71$ SC: $r = 0.76$	4 samples: $N = 116$ to 688 ♀♂ BN, NC; Different ages (Berg, Peterson, Frazier, & Crow, 2012) $N = 142$ ♀ AN, BN, NC; Age: $M = 20.5–22.1$ (Cooper, Cooper & Fairburn, 1989) $N = 20$ ♀ AN, BN, BED; Age: $M = 4.0$, $SD = 6.9$ (Rizvi, Peterson, Crow & Agras, 2000)
Eating Disorder Examination Questionnaire; (EDE-Q); Weight Concern (WC) and Shape Concern (SC) subscales	Fairburn and Beglin (1994)	Self-report version of the EDE of eating disorder symptoms	WC = 5 SC = 8	WC: $\alpha = 0.87$ SC: $\alpha = 0.94$ 2-Week test-retest: WC: $r = 0.92$ SC: $r = 0.94$	$N = 570$ ♀ AN, BN, EDNOS, BED; Age: $M = 13.5$, $SD = 0.7$ (Mantilla, Birgegård & Clinton, 2017) $N = 139$ ♀ NC; Age: $M = 18.5$, $SD = 2.0$ (Luce & Crowther, 1999)

(*continued on next page*)

Table 2 (*continued*)

Name of instrument	Reference	Description	Number of items	Reliability[a]	Sample[b]
Eating Disorder Inventory (EDI); Body Dissatisfaction subscale	Garner et al. (1983) Garner (1991)	Questionnaire of eating disorder symptoms	9	$\alpha = 0.85$ 1-Week test-retest: $r = 0.89$	$N = 1139$ ♀ AN; Age: $M = 24.9$, $SD = 7.2$ (Fichter et al., 2017) $N = 327$ ♀ AN, BN, EDNOS; Age: $M = 33$, $SD = 13.5$ (Thiel & Paul, 2006)
Longitudinal Interval Follow-Up Evaluation Eating Disorders Version (LIFE-EAT II); overvaluation of shape and weight	Herzog, Keller, Lavori, Kenny, & Sacks (1992)	Semi-structured interview designed for collecting longitudinal data on eating disorder symptoms	1	n/a	n/a
Multi-dimensional self-esteem inventory (MSEI); Body Appearance subscale	O'Brien and Epstein (1988)	Questionnaire about areas of life which impact self-esteem	Not reported	$\alpha > 0.80$ Test-retest (period not reported): $r \geq 0.85$	Sample not reported (Collin et al., 2016)
Pictograms	Stunkard et al. (1983)	Select a pictogram out of 9 pictograms ranging from very lean to obese, to reflect current and ideal body size	1	n/a	n/a
Perceptual component					
Body Perception Index (BPI-1)	Boehm et al. (2016) (adaption of Slade & Russell, 1973)	Instruction is to indicate with outstretched hands and closed eyes the width of the abdomen	1	n/a	n/a
Body Perception Index (BPI-2)	Button (1986) (adaption of Slade & Russell, 1973)	Adaptation of Slade and Russell (1973) Visual Size Estimation Apparatus	5	Test-retest over 3 time points (admission, 1 week, close to weight restoration): For Chest, Waist, Hips, Stomach depth and Bust depth: $r \geq 0.60$ Face width: $r \leq 0.60$	$N = 21$ ♀ AN; Age: not reported (Button, 1986)
Quantification of Body Image Distortion (Q-BID)	Roy and Forest (2007)	Modify computerized silhouettes (shoulders/hips, breast, weight) by clicking on "+" and "−" buttons until they seem the most like own body size	3	4 to 7-day test-retest: $r = 0.71$	$N = 78$ ♀ NC; Age: Range 13–18 (Roy et al., 2007)
Subjective Body Dimensions Apparatus (SBDA)	Gila et al. (1998)	Participants have to move a string through movable rings until it forms a human silhouette that represents the subjective silhouette of the participant	6	2-Week test-retest: Shoulders $r = 0.55$, Thorax $r = 0.57$, Waist $r = 0.66$, Hips $r = 0.71$, Thighs $r = 0.71$, Calves $r = 0.33$	$N = 26$ ♀ AN; Age: Range 12–18 (Gila et al., 1998)
Visual size-estimation apparatus	Slade and Russell (1973)	Subjects estimate the width of body parts (face, chest, waist, hips) by means of two markers on a horizontal bar	4	n/a	n/a
Visual-size estimation apparatus	Casper et al. (1979) (adaption of Slade & Russell, 1973)	Subjects estimate the width of 8 body parts by means of two markers on a horizontal bar	8	2-Week test-retest: $r = 0.79$–0.95	$N = 11$ ♀ NC; Age: not reported (Ben-Tovim & Crisp, 1984)
Behavioral component					
Body Checking Questionnaire (BCQ)	Reas, Whisenhunt, Netemeyer & Williamson (2002)	Questionnaire with 3 subscales: overall appearance, specific body parts and idiosyncratic checking	23	Subscales: $\alpha = 0.84$–0.92 2-Week test-retest: $r = 0.90$	$N = 573$ ♀ AN, BN, EDNOS, NC; Age: $M = 24.1$, $SD = 5.9$ $N = 69$ ♀ NC (Calugi et al., 2006)
Self-reported body checking	Engel et al. (2005)	Two self-report items: "I made sure my thighs didn't touch" and "I checked my joints and bones for fat"	2	n/a	n/a

Note. AN = anorexia nervosa, BED = binge eating disorder, BN = bulimia nervosa, EDNOS = eating disorder not otherwise specified, n/a = not available, NC = non-clinical.

[a] Of most instrument different versions and translations exist. Therefore, the overview below does not cover all reliability indices available, but generally gives a good indication of the reliability of the different measures.

[b] Where possible, we report reliability indices of AN samples. If not available, we report indices of other eating disorder samples and/or NC groups.

studies examined an adult sample, one study a mixed sample, and for one study the age was not specified. Four studies concerned outpatient samples, two studies inpatient samples and one was conducted in mixed settings. For all seven studies, the sample size seemed sufficient.

Six studies found no association between overvaluation of weight and shape and maintenance of AN (Clausen, 2008; Collin et al., 2016; Helverskov et al., 2010; Kahn & Pike, 2001; Kaplan et al., 2009; Misra et al., 2013). In two of these studies, AN was operationalized as a combination of eating disorder symptoms and weight, and in one study as eating disorder symptoms only. Eating disorder symptoms in these studies were assessed with semi-structured interviews. Three studies focused on weight only and one study investigated drop-out of inpatient treatment. Three studies examined an adult sample, one study an adolescent sample, and two studies a mixed age group. Three studies concerned inpatient samples; two studies were conducted in mixed settings and for one study, the setting was unknown. For five of the six studies, the sample size seemed sufficient.

Finally, one study investigated whether treatment outcomes differed between individuals with AN with relatively high shape concern and relatively high weight concern assessed at start of treatment. Full remission or weight recovery did not significantly differ between both groups (Byrne et al., 2015). This study was conducted in adolescent outpatients. Both weight only as well as a combination of weight and eating disorder symptoms was used as index of AN outcome, assessed with a semi-structured interview.

In 23 studies, body dissatisfaction was investigated as a factor in the maintenance of AN. Ten studies found a positive association between body dissatisfaction and maintenance of AN (Amianto et al., 2017; Ben-Tovim et al., 2001; Calugi et al., 2018; Danielsen & Rø, 2012; Deter et al., 2005; Misra et al., 2013; Schlegl et al., 2016; Tabri et al., 2015; Vansteelandt et al., 2010; Schlegl et al., 2014). In three of these studies, AN was operationalized as a combination of eating disorder symptoms and weight and in five studies as eating disorder symptoms only. In these studies, eating disorder symptoms were mainly assessed with semi-structured interviews, except for three studies that used self-report. Six studies focused on weight only and one study investigated premature discharge of inpatient treatment. Three studies examined an adult sample, two studies an adolescent sample, and four studies a mixed age group. For one study, the age was not specified. Six studies concerned inpatient samples; two studies were conducted in an outpatient setting, one study in mixed settings and for one study, the setting was unknown. For nine of the ten studies the sample size seemed sufficient.

Thirteen studies did not find an association between body dissatisfaction and maintenance of AN (Bizeul et al., 2001; Clausen, 2008; Fichter et al., 2017; Howard et al., 1999; Karlsson et al., 2013; Kästner et al., 2015; Löwe et al., 2001; Treat et al., 2008; Van der Ham et al., 1998; Woodside et al., 2004; Zeeck et al., 2005; Fassino, Abbate Daga, Amianto, Leombruni, Fornas, et al., 2001; Fassino, Abbate Daga, Amianto, Leombruni, Garzaro, et al., 2001). In seven of these studies, AN was operationalized as a combination of eating disorder symptoms and weight. Eating disorder symptoms in these studies were assessed with semi-structured interviews, except for one study that used self-report. Two studies focused on weight only and four studies investigated other outcomes, such as drop-out of inpatient treatment. Eight studies examined an adult sample, one study an adolescent sample, and four studies a mixed age group. Eight studies concerned inpatient samples; three studies were conducted in an outpatient setting, two studies in mixed settings. For eight of the thirteen studies, the sample size seemed sufficient.

3.2.2. Perceptual component

In six studies, the perceptual component of body image disturbance was investigated as a factor in the maintenance of AN. All studies found a positive association between body size overestimation and maintenance of AN (Boehm et al., 2016; Button, 1986; Casper et al., 1979; Roy & Meilleur, 2010; Slade & Russell, 1973; Strober et al., 1985). In one study, AN was operationalized as a combination of eating disorder symptoms and weight and in one study as eating disorder symptoms only both assessed via self-report. Five studies focused on weight only. One study examined an adult sample, three studies an adolescent sample, and two studies a mixed age group. Five studies concerned inpatient samples and for one study, the treatment setting was not specified. For three of the six studies, the sample size seemed sufficient.

3.2.3. Behavioral component

In two studies self-reported body checking behavior was investigated in relation to maintenance of AN and both report positive associations (Calugi et al., 2017; Lavender et al., 2013). Both studies focused on eating disorder symptoms only assessed with a semi-structured interview or self-report. One study additionally investigated weight only. Both studies had a sufficient sample size and were conducted in adult samples in an inpatient setting or in mixed settings. No studies could be included regarding body avoidance behavior.

3.3. Relapse

3.3.1. Cognitive-affective component

In five studies, overvaluation of weight and shape was investigated as a factor in relapse of AN. Three studies found a positive association (Carter et al., 2004; Carter et al., 2012; Keel et al., 2005). In one study AN was operationalized as a combination of eating disorder symptoms and weight assessed via a semi-structured interview. Two studies focused on weight only. All three studies were conducted in adult samples. Two studies concerned inpatient samples and one study concerned an outpatient sample. For two of the three studies, the sample size seemed sufficient. In two other studies, overvaluation of weight and shape did not predict relapse (Castellini et al., 2011; Lock et al., 2013). In both studies AN was operationalized as a combination of eating disorder symptoms and weight assessed via semi-structured interviews. The studies were conducted in outpatient samples of adolescents as well as adults. Sample sizes seemed sufficient. Body dissatisfaction was investigated in one study in adult inpatients which did not show a relation between body dissatisfaction and relapse of AN (Carter et al., 2004).

3.3.2. Perceptual component

In two studies, the perceptual component of body image disturbance was investigated as a factor in relapse of AN. One study in a small adult outpatient sample found a positive association between misperception of the body and relapse (Keel et al., 2005). The other study in an adolescent inpatient sample did not show a relationship between general body overestimation and readmission (Castro et al., 2004). No studies could be included regarding the behavioral component of body image disturbances in the relapse of AN.

4. Discussion

The main aim of the present paper was to systematically review the existing empirical evidence concerning the role of the cognitive-affective, perceptual, and behavioral components of body image disturbance in the onset, maintenance, and relapse of AN. From the 5693 studies that were screened, 46 studies with a longitudinal design were included in the review. No studies with experimental designs could be included. Altogether, the studies in this review reported on data of 4928 participants with AN.[2]

[2] We corrected this number for studies performed on exactly the same samples, but not for studies of which we were uncertain whether there was (partial) overlap in samples, since in the latter case, overlap was not sufficiently specified in the text to do so.

4.1. Onset

Only very few studies investigated the cognitive-affective component of body image disturbance as a predictor for the onset of AN. No studies could be included regarding the perceptual and behavioral components of body image disturbance. Body dissatisfaction did not directly predict AN onset (Stice et al., 2017; Striegel-Moore et al., 2004). However, body dissatisfaction amplified the relation between low BMI and onset of AN, indicating that individuals low in BMI who were dissatisfied with their body had an increased risk to develop (subthreshold) AN (Stice & Desjardins, 2018). The findings of Stice et al. (2017) and Stice, Marti, Spoor, Presnell, and Shaw (2018) are in line with the dual-pathway model of eating pathology in which body dissatisfaction is assumed to promote unhealthy dieting behaviors which then may lead to the onset of AN (Stice, 2001; Stice et al., 2011). Specifically, in individuals who are already successful in controlling their food intake (considering their relatively low BMI), body dissatisfaction might further fuel restrictive eating behaviors. If future studies confirm the robustness of these findings, this would enable the possibility to target a specific subgroup for the prevention of AN, such as high school students with both a relatively low BMI and high body dissatisfaction (e.g., through an internet program: Beintner, Jacobi, & Taylor, 2012). The identification of such a subgroup is also important, because negative body image is a common phenomenon (i.e., normative discontent), particularly in Western societies (e.g., Fallon, Harris, & Johnson, 2014; Tiggemann, 2004). Considering that only a small proportion of individuals with a negative body image develops AN, factors other than negative body image are likely necessary for the development of AN. The latter might also explain why the available findings provide no straightforward support for a direct relationship between body dissatisfaction and AN onset.

That we did not find many studies investigating body image disturbance in the onset of AN is not surprising considering the challenges that come with this type of research design, most importantly being the low prevalence of AN. For example, in one of the largest prospective studies in an unselected sample of schoolgirls, not one participant had developed AN during follow-up (n = 1103; McKnight & the McKnight Investigators, 2003). One solution to this problem is to study high-risk groups as was done in the work of Stice et al. (2017), 2018), but even in this sample, the proportion of individuals who developed AN was low (N = 9 out of total N = 1272). Taking into account the high costs of good quality onset studies, future studies in this domain should utilize study designs as much as possible by simultaneously testing all three components of body image disturbance. That way, we can determine whether body image disturbance indeed is a risk factor for the onset of AN, and if so, which component shows the highest predictive validity. In addition, it seems important to investigate which factors influence whether at risk individuals develop AN, no eating disorder, or a different eating disorder such as bulimia nervosa (BN), although a diagnostic crossover between eating disorder classifications also frequently occurs (e.g., from AN to BN; Castellini et al., 2011). Stice and Desjardins (2018) found that overeating was the strongest predictor of BN onset, and that body dissatisfaction amplified this relationship. The latter findings might indicate that naturally occurring eating styles can develop into disordered eating under the influence of body dissatisfaction (and perhaps also other body image components). One of the factors determining whether someone initially may develop AN or BN could be the pre-morbid habitual eating style (restricting vs. overeating).

4.2. Maintenance

Most studies included in this review investigated the role of body image disturbance in the maintenance of AN, particularly of the cognitive-affective component. Findings were mixed with 18 studies suggesting that overvaluation of weight and shape and/or body dissatisfaction are risk factors for the maintenance of AN symptoms, and 19 studies showing no support in this regard. Taken together, these results do not provide straightforward support nor falsification of existing cognitive-behavioral models of eating disorders (Fairburn et al., 2003; Williamson et al., 2004). It could be that overvaluation of weight and shape and/or body dissatisfaction are indeed risk factors for the maintenance of AN, and that the null findings can be explained by power problems. The latter is plausible since the quality assessment showed that none of the studies included in this review reported a sample size justification. The differences in outcomes between studies might also be the results of many methodological differences across studies, such as the use of various samples (e.g., different age groups; inpatients vs. outpatients), and different operationalizations of body image and AN symptoms. However, we could not detect systematic links between the results and age of the participants, treatment setting, or AN symptoms. It was striking to notice that most of the studies have been conducted in adult samples with a mean duration of illness indicating chronicity (duration until 3 years is considered early stage of illness; Hay, Touyz, & Sud, 2012). Since maintaining factors might differ between individuals in early and later stages of the illness (e.g., Treasure, Stein, & Maguire, 2015), future studies concerning body image disturbance as a risk factor for maintenance of AN should distinguish between patients with early stages of AN and patients with chronic AN.

Six studies suggest that the perceptual component of body image disturbance is a risk factor for maintenance of AN symptoms. Greater overestimation of body size was related to a more negative course of AN symptoms, particularly in terms of weight recovery. However, it is important to mention that according to the quality assessment, the quality of the studies on this component was low, except for one of the studies (Boehm et al., 2016). In addition, it should be noted that the operationalizations of AN symptoms were not well validated. The same yields for the assessments of body size estimation which were used. As more valid and reliable instruments are now available (e.g., Farrell et al., 2005; Gardner & Brown, 2014;Mölbert, Klein, et al., 2017; Mölbert, Thaler, et al., 2017), it seems important to supplement these findings with more recently developed indices of body size overestimation, as for example digital photo distortion techniques (Vocks, Legenbauer, Rüddel, & Troje, 2007) or 3D variants, based on scans of one's own body which were recently also developed in virtual environments (Mölbert, Klein, et al., 2017; Mölbert, Thaler, et al., 2017). In addition, it is important to study the role of other aspects of the perceptual component, such as movement in space (e.g., Keizer et al., 2013) and attentional biases for negatively evaluated body parts (e.g., Bauer et al., 2017).

Finally, there is some preliminary evidence from two studies showing that body checking is associated with the maintenance of AN symptoms. Both studies used self-report measures of body checking (Calugi et al., 2017; Lavender et al., 2013). Although such measures might give a global indication of the level of body checking, they could lead to an underestimation of the actual body image-related behaviors and might be biased by the level of self-insight. For a more fine-grained assessment of body image-related behaviors, other measures might need to be used that can circumvent the problems of self-report. For example, (spontaneous) body image-related behaviors could be assessed by observing individuals' checking and avoidance behaviors while passing mirrors in real life using ecological momentary assessment (EMA; e.g., Kraus et al., 2015) or in virtual reality (cf. Purvis, Jones, Bailey, Bailenson, & Taylor, 2015). Such a measure would also make it feasible to examine whether body checking or avoidance increase under influence of certain conditions (e.g., as a result of body dissatisfaction or negative mood). However, it should be noted that body image-related behaviors differ between individuals which makes the latter approach less suitable for interpretations on an individual level. Future studies should further investigate the role of body checking, but also of body avoidance, which has not been studied so far regarding its role in the maintenance of AN. When indeed the

behavioral component of body image disturbance plays a prominent role in the maintenance of AN, as implied by the cognitive-behavioral models (Fairburn et al., 1999; Williamson et al., 2004), this would corroborate these behaviors as important points of action in treatment.

4.3. Relapse

Five studies investigated the predictive validity of the cognitive-affective component for AN relapse and two studies looked at the perceptual component. However, findings were mixed with four studies showing a relation between body image disturbance and relapse, whereas three other studies did not. Problematic for the interpretation of findings again is the great variability in study designs. For example, the assessment points of body image indices differed between studies from measured at admission, measured at end of treatment, to difference scores over time. In addition, the operationalizations of relapse greatly differed across studies, with definitions varying from 'fulfilling DSM criteria', or 'not reaching weight recovery' to 'being re-admitted'. Finally, length of follow-up differed from one year up to several years. Therefore, future studies could profit from the use of validated criteria for relapse, remission and recovery as well as standardized assessment points, being every three months for the first year and every six months thereafter for longer studies (see e.g., Khalsa et al., 2017).

4.4. Limitations

4.4.1. Perceptual and behavioral component understudied

It is striking that the studies in this review predominantly focused on the cognitive-affective component of body image disturbance, whereas the perceptual and behavioral components remained largely unstudied. This imbalance in research efforts might be related to the greater emphasis on the cognitive-affective and perceptual components of body image disturbance in the diagnostic criteria for AN (American Psychiatric Association, 2013). Many different measures of the cognitive-affective component have been developed during the last decades (Menzel, Krawczyk, & Thompson, 2011). However, research on the perceptual component of body image disturbance might have been hampered by technological restrictions. Yet, with the currently available technology such as computerized body scanners (see Mölbert, Klein, et al., 2017; Mölbert, Thaler, et al., 2017), it has become increasingly feasible to conduct studies on the perceptual component. Since body image is traditionally considered an intrapsychic phenomenon, the behavioral component of body image disturbance only caught the attention in the literature more recently, which is also reflected in the still limited (but growing) number of available measurement instruments for this component (Menzel et al., 2011; Nikodijevic et al., 2018).

4.4.2. Low quality of evidence

Furthermore, quality assessment indicated that the quality of the studies included in this review was varying greatly with many studies of only poor to moderate quality (Downs & Black, 1998; National Heart, Lung, and Blood Institute, NHLBI, 2014). Together with the lack of experimental studies and inconsistencies in findings, the overall quality of the evidence is relatively low which makes the cumulative evidence weak. As an important shortcoming, none of the studies provided a clear power calculation in the paper. Thus, it remained largely unclear whether the studies included in this review had sufficient power. Low power not only renders studies vulnerable to chance findings (which then may explain positive findings), but may also explain failures to find meaningful relationships between body image indices and the onset, maintenance, and relapse of AN. Also, for studies with relatively large sample sizes, statistical power was often lowered because of the many tests that were conducted. In addition, some studies selectively reported only the significant results without any justification how the authors dealt with the inflated chance of Type I error in these cases. In addition, some studies included in this review did not use well validated indices of body image disturbance (Deter et al., 2005; Keel et al., 2005; Strober et al., 1985; Tabri et al., 2015). Finally, another notable problem that became clear during the quality assessment was that almost no studies corrected for variable time to follow-up despite some very large differences within studies in this regard. General recommendations for future studies are to design studies in which clear pre-specified hypotheses are being tested, to pre-register analysis plans, to conduct power calculations, and to prevent variations between participants in time to follow-up, or at least to statistically correct for such variations if present (e.g., by including time to follow-up as a covariate in the statistical model).

4.4.3. Problems with terminology

A final important issue to note is that there are problems with regard to the terminology used in the body image field (Thompson, 2004; Stewart & Williamson, 2004; Mitchison et al., 2017). Different labels are used for the same constructs and not all labels are clearly defined. A striking example is that in the DSM-5 criteria of AN, no exact definition is given of what "a disturbance in the way one's body weight or shape is experienced" (American Psychiatric Association, 2013) exactly means. The lack of such a definition is problematic, since it leaves space for interpretational differences between clinicians and between researchers and thereby directly affects the basis of AN research. In addition, the classical categorization of body image into a cognitive-affective, perceptual and behavioral component is somewhat arbitrary given the interconnections that actually exist between these components (e.g., Fairburn et al., 1999; Vossbeck-Elsebusch et al., 2015). Moreover, it is difficult to include concepts like information processing biases (e.g., attentional bias, memory bias; Williamson et al., 2004) in this categorization.

4.5. Future directions

4.5.1. Need for theory-driven research designs

Many studies in this review examined body image disturbance in the onset, maintenance, and relapse of AN in a very broad and global sense and were not designed to test well-specified theory-derived predictions. In addition, barely any studies were conducted in which specific hypotheses were tested about how body image components are related to each other. To advance our understanding of body image disturbance in AN, future studies should be designed to test clear pre-specified theory-driven hypotheses about how body image components are linked to each other as well as to other eating disorder symptoms such as restrictive eating behavior. The cognitive-behavioral theory of eating disorders of Williamson et al. (2004) seems an excellent starting point for such enterprise. The core assumption of this model is that an overvaluation of weight and shape leads to the formation of a negative body self-schema (to be subsumed under the cognitive/affective component of body image). This body self-schema can become easily triggered in response to internal and external cues and is thought to activate cognitive biases such as a preferred attention to food and body-related stimuli and a negative interpretation of self-relevant events. In this model, overestimation of body size (i.e. the perceptual component of body image) is also classified as a cognitive bias. Cognitive biases, in turn, are thought to elicit negative emotions and body image behaviors such as body-related checking and avoidance (i.e. the behavioral component of body image), as well as eating disorder behaviors such as restrictive eating and purging. These behaviors are thought to lead to a reduction in negative emotions and a confirmation of body image concerns, thereby strengthening the body-related self-schema. Although it goes too far to describe the entire model in detail here, this brief description already illustrates that the dynamics between different body image components and other eating disorder symptoms might be more complex than can be tested in the type of designs that were used in most of the studies that were included in this review. For a better

Table 3
Recommendations for future studies in the field of body image disturbance in anorexia nervosa.

Theory

- Develop and use precise definitions and consistent labels of aspects of body image disturbance
- Formulate specific theory-driven hypotheses about how body image aspects are related to each other as well as to other eating disorder symptoms
- Distinguish between trait-like and state-like aspects of body image disturbance

Study design

- Design studies in which clear pre-specified hypotheses are being tested
- Pre-register analysis plans
- Conduct power calculations and avoid cumulative Type I errors
- Conduct experiments in anorexia nervosa patients in which (a single aspect of) body image disturbance is manipulated
- Conduct experiments in which the effect of adding a body image intervention to treatment as usual is investigated on recovery and relapse from anorexia nervosa

Method

- Use validated criteria for relapse of anorexia nervosa
- Use specific, reliable and validated state-of-the-art measures of body image and eating pathology
- Use standardized assessment points

Statistics

- Correct for great variations between participants in time to follow-up
- Consider network analysis as statistical approach

understanding of the onset and persistence of AN, it seems important to use designs that are equipped to test the contributions of single selected aspects of body image as well as the proposed interrelations between different body image components and eating disorder symptoms.

In this regard, it is also important to be aware that - so far - most studies used relatively stable trait-like body image indices in which the assessment of body image reflects a longer period of time. However, as the theoretical model just described indicates, it seems important to complement such trait measures with more variable, state-like aspects of body image disturbance (e.g., Cash, Fleming, Alindogan, Steadman, & Whitehead, 2002). The persistence of AN symptoms might be better understood looking at the interplay between longer existing vulnerabilities (e.g., overvaluation of weight and shape) and more variable processes (e.g., feeling fat) which together may guide body image behaviors (e.g., body checking) and other problematic behaviors (e.g., food restriction). Such a distinction between trait and state aspects of body image implies a careful choice of assessment instruments (e.g., Cash et al., 2002; Thompson, 2004) as well as a study design that allows to test the interplay between trait and state aspects, for example by using ecological momentary assessment (e.g., Lavender et al., 2013) or experimental designs as outlined below. Finally, network analysis could be a useful statistical approach for testing the relationships between specific body image components and other (eating disorder) symptoms (e.g., Levinson, Vanzhula, Brosof, & Forbusch, 2018).

4.5.2. Need for experimental studies

Theory-driven predictions should be tested more often in experimental studies, which are currently lacking in this field. A recent systematic review showed that - so far - 11 studies tested body image interventions in AN samples, but only few of these used a full experimental design in which AN patients were randomly allocated to an experimental or a control group[3] (Ziser et al., 2018). Experimental designs are crucial to be able to draw any conclusion with respect to body image disturbance as a causal risk factor for the onset, maintenance and relapse of AN (Jansen, 2016). A good way to start is the use of short experiments in which single aspects of body image disturbance are manipulated (cf. Bailey & Waller, 2017; Shafran et al., 2007; Smith & Rieger, 2009). Although it would be unethical to worsen body image disturbance in individuals with AN, it might be possible to improve certain aspects of body image disturbance and look at the (short-term) effects on other eating disorder symptoms. Series of such short experiments could be followed-up by more extensive experiments in which the effect of adding body image interventions to treatment as usual is investigated on recovery and relapse from AN.

[3] None of these experimental studies could be included in the present systematic review, since in these experimental studies, body image indices were only used as outcome measures and not as a predictor for AN symptoms.

4.6. Clinical implications

On basis of the current findings, it is not possible to determine whether or not the treatment of body image disturbance is crucial for successful prevention or recovery of AN. However, when individuals are heavily burdened by their negative body image, this can of course be an important reason for using interventions that are designed to address body image disturbances. Body image is an explicit treatment target in CBT-E (Fairburn, 2008). The aim of the body image intervention techniques in CBT-E is to decrease overvaluation of weight and shape as well as their control by heightening the saliency of other sources of self-evaluation, decreasing body checking behavior (including mirror use and comparison making with other people) and body-related avoidance behavior, and decreasing feelings of fatness. There are indications that the cognitive-affective and behavioral components of body image disturbance indeed decrease in patients with AN during the course of CBT-E treatment (e.g., Calugi et al., 2017; Dalle Grave, Calugi, Doll, & Fairburn, 2013; Fairburn, Cooper, Doll, Palmer, & Dalle Grave, 2013). Another intervention technique which is commonly used in the treatment of body image disturbance is mirror exposure (Griffin, Naumann & Hildebrandt, 2018). During mirror exposure therapy, individuals systematically and repeatedly look at themselves in a mirror in order to correct the distorted view of one's own body and decrease negative body-related emotions. Although mirror exposure therapy has not been investigated in patients with AN with low weight to avoid habituation to an underweight body, a few studies have investigated mirror exposure in patients with AN who recently became weight restored. Outcomes showed that mirror exposure indeed was related to improvements both in the cognitive-affective component of body image disturbance (Geissner, Bauer, & Fichter, 1997; Key et al., 2002; Morgan, Lazarova, Schelhase, & Saeidi, 2014) and the behavioral component of body image disturbance (Key et al., 2002; Morgan et al., 2014). Since cognitive abilities of patients with AN can be severely impacted by starvation (e.g., Zipfel et al., 2015), currently, AN treatment typically starts with addressing eating and weight restoration. Body image is usually addressed in a later phase of treatment, such as in CBT-E (Fairburn, 2008). Future studies could further investigate whether addressing body image disturbance more early on in treatment could help improve treatment effects, in particular in patients who show problems with gaining weight.

4.7. Conclusions

Our main goal was to systematically review the existing empirical evidence concerning the role of body image disturbance in the onset, maintenance, and relapse of AN. This review shows that there is some evidence suggesting that body image disturbance might be related to the course of AN. However, the available empirical data provide no basis to answer the question whether body image disturbance is a (causal) risk factor for AN. An important next step is to conduct theory-driven experimental studies as well as longitudinal studies in which different aspects of body image disturbance are investigated (see Table 3). Furthermore, it is important to distinguish between stable, trait-like aspects and variable, state-like aspects of body image disturbance and adapt the choice of assessments accordingly. Together, this would set the stage to generate the high-quality data that are

necessary to further refine our existing theoretical models, and clarify if and how the various aspects of body image disturbance are critical factors in the onset, maintenance and relapse of AN.

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Contributors

All authors contributed to the design of the study. RV and FA conducted the literature search, title and abstract screening, full-text assessment, data-extraction and quality assessment. This process was supervised by KG, who also was consulted in case of disagreements between reviewers. Final processing and summarizing of the data was conducted by KG. KG wrote the first draft of the manuscript and all authors contributed to and have approved the final manuscript.

Declaration of competing interest

All authors declare that they have no conflicts of interest.

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