



Body image disturbance in children and adolescents with anorexia nervosa and bulimia nervosa: a systematic review

Frank A. Sattler¹ · Sarah Eickmeyer² · Julia Eisenkolb²

Received: 18 December 2018 / Accepted: 31 May 2019 / Published online: 8 June 2019
© Springer Nature Switzerland AG 2019

Abstract

Purpose While several meta-analyses and reviews revealed a worse body image disturbance (BID) in adults with anorexia nervosa (AN) or bulimia nervosa (BN) than in controls, no systematic evidence is available on BID in children and adolescents. Since the usual onset of AN and BN is before the age of 21 years, being aware of BID in children and adolescents is crucial for preventing and treating eating disorders. This systematic review aims to provide an initial overview of differences in the BID components perception, global subjective satisfaction, affect/cognition, and behavior between children and adolescents with AN and BN and healthy controls.

Methods We conducted a systematic data search in PubMed and PsycINFO based on a priori eligibility criteria (AN or BN group; gender-matched healthy control group; each group $n \geq 20$; maximum age 19 years; BID outcome compared between groups; published in English or German).

Results We were able to include $k=8$ records. Compared to healthy controls, children and adolescents with AN and BN scored higher in the BID components perception, global subjective satisfaction, affect/cognition, and behavior.

Conclusions As previously found in adults, BID in children and adolescents is associated with AN and BN. Interventions and treatments are needed to alleviate BID in children and adolescents with BN and AN. We also noted that we need more investigations on BID differences in children and adolescents to improve the database.

Level of evidence Level I, Systematic review.

Keywords Body image disturbance · Anorexia nervosa · Bulimia nervosa · Children and adolescents · Healthy controls · Systematic review

Introduction

The term body image was first defined by Schilder [1] as “the picture of our own body which we form in our mind, that is to say the way in which the body appears to ourselves”. Slade [2] later extended the definition to “the picture we have in our minds of the size, shape, and form of our bodies; and to our feelings concerning these characteristics and our constituent body parts”, while Stice [3] defined body image simply as “cognitive and emotional perceptions of one’s body”. In accordance with Stice [3], Grogan

[4] proposed that body image encompasses perceptive and attitudinal evaluations of one’s body. While the perceptive body image is measured by evaluating the accuracy of body estimation, attitudinal body image is assessed by four components: global subjective satisfaction (evaluations of the body), affect (feelings towards the body), cognitions (investment in the body), and behaviors (e.g., checking behavior or avoiding situations in which the body is exposed) [4].

As early as 1962, Bruch [5] described a distorted body image – usually referred to as body image disturbance (BID) – as a core symptom of anorexia nervosa (AN). Today, BID is part of the Diagnostic and Statistical Manual of Mental Disorders, Fifth Edition’s (DSM-5) [6] diagnostic criteria for AN and bulimia nervosa (BN). BID is reflected in AN diagnostic criteria B (“intense fear of gaining weight or of becoming fat, or persistent behavior that interferes with weight gain, even though at a significantly low weight”) and C (“disturbance in the way in which one’s body weight

✉ Frank A. Sattler
frank.sattler@mediclin.de

¹ Clinic for Acute Psychosomatics, MediClin Clinics Bad Wildungen, Bad Wildungen-Reinhardshausen, Germany

² Department of Psychology, Philipps University Marburg, Marburg, Germany

or shape is experienced, undue influence of body weight or shape on self-evaluation, or persistent lack of recognition of the seriousness of the current low body weight”) and the BN criterion D (“self-evaluation is unduly influenced by body shape and weight”).

Consistent with these criteria, meta-analytic and review findings suggest that patients with AN and BN from primarily adult samples exhibit a stronger body-size distortion as well as greater body dissatisfaction than controls [7–9]. Moreover, BID is known to be a precursor of eating disorder pathology [10], and to predict more persistent eating disorders through being associated with worse treatment outcomes in females with AN [11] and with more relapses in women with AN and BN [12]. BID can thus be conceptualized as a precipitating and perpetuating component of AN and BN.

For children and adolescents, factors influencing body image will likely differ between developmental stages. A predecessor to BID may be body-size stigmatization, as there is evidence that girls of age 3.5–5.5 years attributed positive characteristics more often to thinner and average-looking dolls and negative characteristics more often to bigger dolls [13]. While exposure to underweight dolls increased thin-ideal internalization in girls aged 5–8 years, this did not translate into an increase in body dissatisfaction [14]. In adolescents, however, internalized body ideals and appearance-related conversations did predict BID [15, 16]. Furthermore, peer appearance criticism predicted body image dissatisfaction in children and adolescents, as did appearance magazine exposure (including magazines focusing on glamour, entertainment, or sports) in girls and female adolescents [17]. As puberty leads to rapid changes in body size and shape [18–20] that must be integrated within one’s body image [21], it has been suggested that adolescence is associated with particular vulnerability for BID [22]. Retrospective studies with adults reported that the usual onset of AN and BN is before the age of 21 years [23, 24] with the mean age at onset of AN at 18.0 years ($SD = 5.4$) and the mean age at onset of BN at 18.2 years ($SD = 5.2$), according to Volpe and colleagues [24]. Taking into account the standard deviations, 68% of cases with AN developed AN between the age of 12.6 and 23.4 years, while 68% of cases with BN developed BN between the age of 13.0 and 23.4 years.

However, since all meta-analyses or reviews that included children and adolescents with AN and BN either merged them with adult patients [7, 8, 25, 26] or were not done systematically [27, 28], no systematic evidence is available on BID characteristics in children and adolescents with AN or BN. We thus need a systematic synthesis of primary studies conducted on BID in children and adolescents. The present study intends to achieve this by conducting the first systematic review on children and adolescents with AN or BN, examining whether they deliver

higher scores in the BID dimensions perception, global subjective satisfaction, affect/cognition, and behavior than healthy controls.

Methods

For this systematic review, we applied the following study inclusion criteria: (1) the studies had to include a clinical group with either AN—including the restricting (AN-R) and binge-eating/purging subtypes (AN-BP)—, BN, or a combined AN/BN group with diagnoses based on DSM-5 [6] or ICD-10 [29]; (2) a gender-matched control group was assessed; (3) each group had to include $n \geq 20$ individuals to minimize statistical errors; (4) the maximum age of the groups was 19 years, since the World Health Organization [30] defines children and adolescents as individuals under 19 years; (5) the clinical and healthy control group was compared in reference to a BID dimension (perception, global subjective satisfaction, affect/cognition, and behavior); and (6) the study was published in English or German.

To enhance objectivity, two of the researchers conducted full-text searches, screening, exclusion, and data extraction on their own, resulting in two independent processes. We compared the results of each step and resolved discrepancies through discussion.

We searched the electronic databases PubMed and PsycINFO in April 2017 using keyword sets for: (1) body image (body image, body image distortion, body image disturbance, and body distortion disorder); (2) eating disorders (anorexia nervosa and bulimia nervosa), and (3) age (children and adolescents) combining them with AND operators. We separated the keywords in each set by OR operators. In PubMed, we searched for the keywords in title or abstract. Since this option was not available in PsycINFO, we searched for the keywords anywhere in the PsycINFO articles.

Statistical analyses

We conducted our statistical analyses in IBM SPSS Statistics 25 by computing the effect size Cohen’s d and its 95% confidence interval for each BID comparison between a clinical and a healthy control group as outlined by Hedges and Olkin [31]. If possible, we did our own calculations on a subscale level and omitted total scale data due to the more specific information provided by subscales. If results differed between a record’s text and its tables, we used results displayed in tables. We interpreted Cohen’s $d \geq .2$ as small, $d \geq .5$ as medium, and $d \geq .8$ as large [32].

Results

In PubMed, we identified $k = 374$ records; all of these persisted after using an age filter (preschool child, child, adolescent). In PsycINFO, we identified $k = 809$ records of which $k = 426$ persisted after using an age filter (childhood, school age, adolescence). Furthermore, we identified $k = 2$ records while screening the identified records' reference lists. In the next step, we examined the records based on their titles and abstracts, and excluded duplicates as well as studies that did not cover the research topic, resulting in the exclusion of $k = 677$ records. Then, we ruled out studies based on their full texts, leading to the exclusion of $k = 117$ records. The reasons for exclusion are displayed in Fig. 1. The final record set included in this systematic review was $k = 8$ (Table 1) deriving mainly from European samples, with $k = 4$ (50%) from Germany, $k = 1$ (12.5%) from Austria, and $k = 2$ (25%) from Spain. In addition, $k = 1$ (12.5%) record was from Canada. The records reported on ten samples of children and adolescents with AN or BN and eight samples of healthy controls. The participants' age range was 10–18 years. All studies applied $\alpha = .05$ as their significance level. Detailed results on the primary records are displayed in Table 1. Of the $k = 8$ records included, $k = 4$ reported on perceptible BID, $k = 5$ on global subjective satisfaction, $k = 5$ on affective/cognitive BID, and $k = 3$ on behavioral BID. Note that most studies reported data on several BID components.

Results by BID component

Perception

A Canadian study used the Quantification of Body Image Distortion (Q-BID), a computerized test for females in

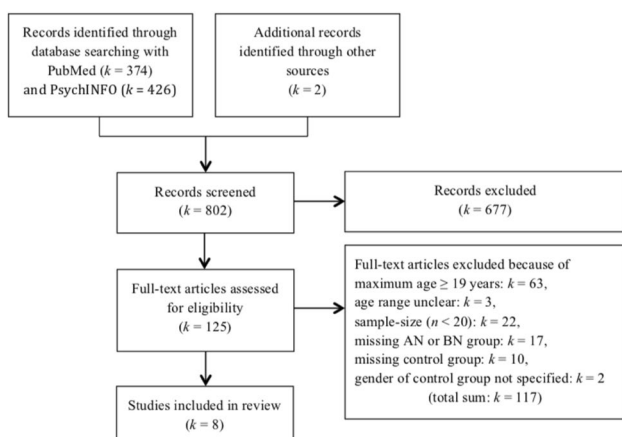


Fig. 1 Flowchart illustrating the reasons for record exclusion and inclusion

which participants modify a morphological body silhouette and its weight until it resembles their own body's characteristics as much as possible [33]. The result is then compared with their real weight and body mass index (BMI) [33]. The study reports that out-patient females with AN-R ($n = 22$) overestimated their body weight more than controls ($n = 200$) with a medium effect size, $d = .56$ [33].

Two Spanish studies assessed BID with the Subjective Body Dimensions Apparatus (SBDA) consisting of a 190 cm high cylindrical bar with several sticks attached representing the position of certain body parts (shoulders, thorax, waist, hips, thighs, and calves) [34]. Moveable rings are connected on both sides of the sticks with a string passing through them, representing a body silhouette [34]. The participants move the rings to resemble their body silhouette as well as possible and the result is then compared to the actual body silhouette [34]. Compared to healthy controls ($n = 427$), females with AN ($n = 85$) overestimated their shoulders, $d = 1.46$, thorax, $d = 1.11$, and hips, $d = .86$, with large effect sizes and their waist, $d = .66$, thighs, $d = .51$, and calves, $d = .67$, with moderate ones [34]. Males with AN ($n = 30$) overestimated their thighs, $d = 1.31$, and hips, $d = .86$, with high effect sizes and their shoulders, $d = .50$, with a medium effect size compared to healthy controls ($n = 421$) [35]. In males, no significant overestimation was found in thorax, $d = .09$, waist, $d = -.13$, and calves, $d = .21$ [35].

A German study used the *Test for Body Image Distortion in Children and Adolescents* (BID-CA) that assesses BID by having participants estimate the circumference of their upper arms, thighs, and abdomen with a string [36]. Those results are then compared with the genuine circumferences measured with a tape measure [36]. The authors reported a greater overestimation of waist, $d = .85$, and thigh, $d = 1.27$, in German females with AN ($n = 58$) than in healthy controls ($n = 56$) at high levels [36]. In addition, they observed an upper arm overestimation, $d = .76$, with a medium effect size [36].

In summary, three (75%) of the four clinical samples reported overall higher perceptible BID compared to healthy controls [33, 34, 36]. The participants within these samples were female children and adolescents with AN of an age ranging from 12 to 18 years. The remaining sample (25%) of male adolescents with AN and an age ranging from 11 to 18 years revealed perceptible BID differences in half of the measures [35].

Global subjective satisfaction

Five records applied the “body-dissatisfaction” scale from the Eating Disorder Inventory-2 (EDI-2) [37] or Eating Disorder Inventory (EDI) [38]. The body-dissatisfaction scale

Table 1 Description and results of the included records

Included study	Age range and gender	Country	Groups	Assessment tools	Results on dimensions of body image disturbance
Bauer et al. [40]	13–18, female	Germany	AN-R (<i>n</i> = 30), AN-BP (<i>n</i> = 26), BN (<i>n</i> = 22), HC (<i>n</i> = 43)	EDI-2, EDE-Q, fixation on unattractive and attractive parts of the own body	<p>Satisfaction: AN-R (<i>d</i> = 1.35, CI [1.84, 1.86]), AN-BP (<i>d</i> = 1.48, CI [1.95, 2.01]), BN (<i>d</i> = 1.63, CI [1.07, 2.20]) > HC in EDI-2 body dissatisfaction</p> <p>Affect/Cognition: AN-R (<i>d</i> = 1.84, CI [1.29, 2.38]), AN-BP (<i>d</i> = 1.94, CI [1.36, 2.51]), BN (<i>d</i> = 1.98, CI [1.39, 2.57]) > HC in EDE-Q shape concern; AN-R (<i>d</i> = 1.51, CI [1.99, 2.03]), AN-BP (<i>d</i> = 1.69, CI [1.14, 2.24]), BN (<i>d</i> = 1.84, CI [1.04, 2.16]) > HC in EDE-Q weight concern; AN-R (<i>d</i> = 1.84, CI [1.30, 2.39]), AN-BP (<i>d</i> = 1.73, CI [1.18, 2.28]), BN > HC (<i>d</i> = 1.97, CI [1.38, 2.57]) in EDI-2 drive for thinness</p> <p>Behavior: AN-R > HC in fixation of unattractive parts of the own body (<i>d</i> = .73, CI [.25, 1.21]); AN-BP (<i>d</i> = .42, CI [-.08, .91]), BN (<i>d</i> = .37, CI [-.14, .89]) = HC in fixation of unattractive parts of the own body; AN-R (<i>d</i> = -.55, CI [-1.02, -.07]), AN-BP^a (<i>d</i> = -.56, CI [-1.05, -.06]), BN^a (<i>d</i> = -.53, CI [-1.05, -.01]) < HC in fixation of attractive parts of the own body^b</p> <p>Satisfaction: AN = HC in EDI body dissatisfaction (<i>d</i> = -.25, CI [-.77, .26])</p> <p>Affect/Cognition: AN = HC in FBeK insecurity/unpleasant feelings (<i>d</i> = .24, CI [-.27, .76]) and attractiveness/self-confidence^b (<i>d</i> = -.47, CI [-.99, .06]); AN = HC in EDI drive for thinness (<i>d</i> = .12, CI [-.39, .64])</p> <p>Behavior: AN = HC in FBeK body accentuation/sensitivity^b (<i>d</i> = -.42, CI [-.95, .10])</p> <p>Perception: AN > HC in SBDA overestimation of shoulders (<i>d</i> = 1.46, CI [1.99, 1.93]), thorax (<i>d</i> = 1.11, CI [1.65, 1.56]), waist (<i>d</i> = .66, CI [.22, 1.10]), hips (<i>d</i> = .86, CI [.41, 1.30]), thighs (<i>d</i> = .51, CI [.07, .95]), calves (<i>d</i> = .67, CI [.24, 1.11])</p> <p>Perception: AN > HC in SBDA overestimation of shoulders (<i>d</i> = .50, CI [.13, .87]), hips (<i>d</i> = .86, CI [.49, 1.23]), thighs (<i>d</i> = 1.31, CI [1.93, 1.69]); AN = HC in overestimation of thorax (<i>d</i> = .09, CI [-.29, .46]), waist (<i>d</i> = -.13, CI [-.50, .24]), calves (<i>d</i> = .21, CI [-.16, .58])</p> <p>Perception: AN-R > HC in Q-BID overestimation of body weight (<i>d</i> = .56, CI [1.11, 1.00])</p> <p>Perception: AN > HC in BID-CA overestimation of upper arm (<i>d</i> = .76, CI [1.38, 1.14]), abdomen [waist] (<i>d</i> = .85, CI [.47, 1.23]), thigh (<i>d</i> = 1.27, CI [1.86, 1.67])</p> <p>Satisfaction: AN > HC in EDI-2 body dissatisfaction (<i>d</i> = .56, CI [1.19, .93])</p> <p>Affect/cognition: AN > HC in EDI-2 drive for thinness (<i>d</i> = .99, CI [1.60, 1.37])</p>
Bönsch et al. [39]	10–17, female	Austria	AN (<i>n</i> = 29), HC (<i>n</i> = 29)	EDI, FBeK	
Gila et al. [34]	12–18, female	Spain	AN (<i>n</i> = 85), HC (<i>n</i> = 427)	SBDA	
Gila et al. [35]	11–18, male	Spain	AN (<i>n</i> = 30), HC (<i>n</i> = 421)	SBDA	
Roy and Forest [33]	13–18, female	Canada	AN-R, out-patients (<i>n</i> = 22), HC (<i>n</i> = 200)	Q-BID	
Salbach et al. [36]	12–18, female	Germany	AN (<i>n</i> = 58), HC (<i>n</i> = 56)	BID-CA, EDI-2	

Table 1 (continued)

Included study	Age range and gender	Country	Groups	Assessment tools	Results on dimensions of body image disturbance
Salbach-Andrae et al. [43]	13–18, female	Germany	AN or BN ($n = 71$); of these $n = 48$ AN and $n = 23$ BN), HC ($n = 150$)	EDI-2	Satisfaction: AN or BN > HC EDI-2 in body dissatisfaction ($d = .99$, CI [.70, 1.29]) Affect/cognition: AN or BN > HC in EDI-2 drive for thinness ($d = 1.41$, CI [1.10, 1.73])
Steinfeld et al. [44]	14–18, female	Germany	AN or BN ($n = 81$); of these $n = 57$ with AN and $n = 24$ with BN), HC ($n = 48$)	EDI-2, EDE-Q, BCQ	Satisfaction: AN or BN > HC in EDI-2 body dissatisfaction ^c ($d = 1.28$, CI [.88, 1.67]) Affect/cognition: AN or BN > HC in EDE-Q shape concern ^c ($d = 1.93$, CI [1.50, 2.36]), weight concern ^c ($d = 1.62$, CI [1.20, 2.03]); AN or BN > HC in EDI-2 drive for thinness ($d = 1.88$, CI [1.45, 2.31]) Behavior: AN or BN > HC in BCQ overall appearance ($d = 1.19$, CI [.80, 1.57]), checking of specific body parts ($d = 1.17$, CI [.78, 1.55]), idiosyncratic checking rituals ($d = 1.22$, CI [.83, 1.61])

AN anorexia nervosa, AN-R AN, restricting type, AN-BP AN, binge-eating/purging type, BN bulimia nervosa, HC healthy controls, d Cohen's d (if the scale's scores are higher in the clinical group than in HC, the effect size is positive and v.v.), CI 95% confidence interval. EDI-2 eating disorder inventory-2, EDE-Q Eating Disorder Examination-Questionnaire, EDI eating disorder inventory, FBek Questionnaire for Appraisal of the own Body, SBDA Subjective Body Dimensions Apparatus, Q-BID quantification of body image distortion, BID-CA test for body image distortion in children and adolescents, BCQ Body Checking Questionnaire

^aThese results differed in the original article's text and its table

^bInverted scale; negative values suggest higher BID in clinical group

^cIn this analysis, $n = 46$ HC were included

assesses global subjective body dissatisfaction via nine items (sample item “I think that my stomach is too big”) [38]. While Austrian females with AN ($n=29$) did not differ from controls ($n=29$), $d=-.25$ [39], four German studies reported stronger body dissatisfaction in female patients with AN ($k=1$; [36]), AN-R ($k=1$; [40]), AN-BP ($k=1$; [40]), BN ($k=1$; [40]), and AN or BN ($k=2$; [43, 44]) than in healthy controls. These differences were medium to large.

In summary, six (85.71%) out of seven samples of female children and adolescents with AN or BN exhibited greater body dissatisfaction than controls [36, 40, 43, 44]. Their age ranged from 12 to 18 years. In contrast, one (14.29%) sample of female children and adolescents with AN (age range 10–17 years) did not differ from controls in global subjective satisfaction [39].

Affect and cognition

An Austrian study used the Questionnaire for Appraisal of the Own Body (FBeK) assessing subjective views of one’s body [41]. This questionnaire includes the 19-item scale “insecurity/unpleasant feelings” assessing negative body appraisal (sample item “I often think I could hurt myself”) and the 13-item scale “attractiveness/self-confidence” assessing positive body appraisal (sample item “I am satisfied with my physique”) [41]. Females with AN ($n=29$) did not differ from healthy controls ($n=29$) in insecurity/unpleasant feelings, $d=.24$, and attractiveness/self-confidence, $d=-.47$ (inverted) [39].

Two independent German studies used the 8-item scale “shape concern” (sample item “Have you had a definite desire to have a totally flat stomach?”) and the 5-item scale “weight concern” [sample item “Has your weight influenced how you think about (judge) yourself as a person?”] of the *Eating Disorder Examination-Questionnaire* (EDE-Q) [42] as BID outcomes. In shape concern, females with AN-R ($n=30$), $d=1.84$, AN-BP ($n=26$), $d=1.94$, BN ($n=22$), $d=1.98$ [40], and AN or BN ($n=81$), $d=1.93$ [44], scored higher than healthy controls ($n=43$ and $n=48$, respectively) with large effect sizes. Similarly, females with AN-R, $d=1.51$, AN-BP, $d=1.69$, BN, $d=1.84$ [40], and AN or BN, $d=1.62$ [44], reported greater weight concern than healthy controls with large effect sizes.

Six records used the EDI-2’s or EDI’s scale “drive for thinness”. The scale consists of seven items (sample item “I eat sweets and carbohydrates without feeling nervous”) assessing cognitions and affects towards being thin. Austrian females with AN ($n=29$) did not differ from healthy controls ($n=29$) in drive for thinness, $d=.12$ [39]. In contrast, four German studies report higher drive for thinness in female patients with AN ($k=1$; [36]), AN-R ($k=1$; [40]), AN-BP ($k=1$; [40]), BN ($k=1$; [40]), AN or BN ($k=2$; [43, 44]) than in healthy controls, with large effect sizes.

In summary, six (85.71%) out of seven samples of females with AN or BN reported higher affective or cognitive BID than healthy controls [36, 40, 43, 44]. Their age ranged from 12 to 18 years. The remaining (14.29%) sample of females with AN (age range 10–17 years) reported no difference in affective or cognitive BID compared to controls [39].

Behavior

A German study used the *Body Checking Questionnaire* (BCQ) [45]. The BCQ consists of the 10-item scale “overall appearance” assessing checking behaviors related to general appearance (sample item “I look at others to see how my body size compares to their body size”), the 8-item scale “checking of specific body parts” assessing checking behaviors related to specific body parts (sample item “I pinch my stomach to measure fatness”), and the 5-item scale “idiosyncratic checking rituals” assessing checking behaviors considered unusual (sample item “I pinch my cheeks to measure fatness”) [45]. Females with AN or BN ($n=81$) yielded higher scores in overall appearance, $d=1.19$, checking of specific body parts, $d=1.17$, and idiosyncratic checking rituals, $d=1.22$, than healthy controls ($n=48$) [44]. All effect sizes were large [44].

Another German study compared fixation duration on attractive and unattractive parts of one’s own body that can be considered an objective assessment of body checking [40]. The original authors did not report significant results between AN-BP, BN, and healthy controls, although this contrasts with the data in their study’s table: using that data, we found that females with AN-R ($n=30$), $d=-.55$ (inverted), AN-BP ($n=26$), $d=-.56$ (inverted), and BN ($n=22$), $d=-.53$ (inverted), gazed for less time at their attractive body parts than controls ($n=43$) with medium effect sizes [40], indicating body avoidance. In addition, females with AN-R, $d=.73$, looked longer at their unattractive body parts than healthy controls with an intermediate effect size. This indicates body checking. However, females with AN-BP, $d=.42$, and BN, $d=.37$, did not differ from healthy controls in body checking [40].

In a German study using the FBeK, females with AN ($n=29$) did not differ from healthy controls ($n=29$), $d=-.42$ (inverted), in its 20-item scale “body accentuation/sensitivity” assessing positive behavior towards the body (sample item “I look at myself often and with pleasure”) [39].

In summary, we found that two (40%) clinical samples (age range 13–18 years) reported behavioral BID throughout, while two (40%) samples (age range 13–18 years) showed behavioral BID in half of the measures, and one (20%) sample (age range 10–17 years) reported no behavioral BID at all. All clinical samples consisted of female children and adolescents with AN or BN.

Discussion

This systematic reviews reports on findings from primary reports on BID differences between children and adolescents with AN or BN and gender-matched controls. In total $k = 8$ records fulfilled inclusion criteria. These investigations reported on ten samples of individuals aged 10.5–18 years from Austria, Canada, Germany, and Spain published between 1993 and 2017. We were able to include reports on all BID components, namely, perception, global subjective satisfaction, affect/cognition, and behavior [4].

In perception, three (75%) samples of female children and adolescents out of four AN samples reported worse perceptible BID than healthy controls in all subscales. In contrast, one (25%) sample of male children and adolescents with AN differed in half of the measures. In global subjective satisfaction, six (85.71%) out of seven samples of female children and adolescents with AN or BN exhibited stronger body dissatisfaction than healthy controls, while one (14.29%) sample did not differ from healthy controls. In affect/cognition, we found that out of seven independent samples of female children and adolescents with AN or BN, six (85.71%) reported a stronger BID, and one (14.29%) reported no BID differences compared to healthy controls. In behavior, we found that two (40%) samples reported a worse behavioral BID than healthy controls throughout, while two (40%) samples revealed an increased BID in half of the measures, and one (20%) sample reported no behavioral BID differences compared to healthy controls. Overall, most studies detected BID differences in the components perception, global subjective satisfaction, affect/cognition, and behavior.

Our findings are consistent with studies indicating stronger perceptible, subjective satisfactory, affective/cognitive, and behavioral BID in adults with eating disorders or eating disorder symptoms than in controls [7–9, 46–49]. Since having a BID is a precipitating as well as a perpetuating factor in AN and BN pathology [10–12] and since the mean ages of onset of AN and BN are between 18.0 and 18.2 years [24], strategies are needed to prevent their development as well as BID-focused treatments of children and adolescents already affected by AN and BN.

According to the German guidelines of eating disorder treatment, children and adolescents with AN and BN should primarily receive an out-patient psychotherapy, which should be family-based therapy for children and adolescents with AN and cognitive behavioral therapy that includes family members for those with BN [50]. In more severe cases of AN or BN, a day-care or in-patient treatment is indicated [50]. As such, an in-patient treatment is recommended if children and adolescents with AN or BN possess risk factors such as: a rapid, continuous body weight loss (> 20% in six months), severe underweight (BMI < 3rd age percentile),

suicidality or severe self-injury, social, or family factors hinder improvement [50]. In-patient hospitals should hold specific concepts for eating disorder treatment and employ a multiprofessional team providing individual psychotherapy (≥ 50 min per week), group psychotherapy (≥ 200 min per week), nutritional therapy, complementary therapy (such as body therapy, creative therapy, and occupational therapy), social therapy, including the patient's family, regular body monitoring, a weekly medical round, and bodily exercise that corresponds with the physical condition [50].

We argue that psychotherapy with children and adolescents with AN or BN in any setting should include a module treating BID explicitly, due to the findings that BID is a stabilizing factor for AN and BN [10–12]. Such modules are already available for adults [51] and could be adapted for treating children and adolescents with AN and BN. Since the preferred psychotherapy for children and adolescents with AN is family-based therapy, while for children and adolescents with BN, it is cognitive behavioral therapy that includes family members [50], specific BID treatments for children and adolescents modules should be incorporated within both forms of psychotherapy.

Findings on eating disorder prevention indicate that interventions enhancing media literacy were the most effective in reducing eating disorder risk factors (such as shape and weight concern and media internalization) for up to 30 months in female and male adolescents in universal prevention [52]. In selective prevention, increasing cognitive dissonance was the most effective intervention in reducing eating disorder symptoms and behaviors for up to 3 years in adolescents and young adults, while there was insufficient data to allow recommendations in the field of indicative prevention [52]. We argue that interventions for indicative prevention that target children and adolescents with BID, before AN or BN has developed, should be conducted and evaluated, since this group is the one most in need of prevention. Furthermore, evaluations of prevention programs must include pre-adolescent children, since none are available so far and it is thus unclear if AN and BN prevention in children is effective [52, 53].

A limitation of this review is that we did not conduct a meta-analysis. In addition, we combined the review steps removal of duplicates and record screening and thus did not precisely follow the Preferred Reporting Items for Systematic Review and Meta-Analyses (PRISMA). A drawback in the research field we reviewed is that all the primary studies we included relied on non-representative data, failed to examine non-Western populations, and seldom involved males. In general, the number of studies testing for BID differences between children and adolescents with AN and BN and healthy controls is still far too small. Representative studies and those on seldom-examined populations are urgently needed. Another limitation is that only

two included studies compared BID levels of prepubescent children younger than 12 years with healthy controls [35, 39] and none included children under 10 years. Influences of puberty and age can hence not be conclusively addressed. Finally, insignificant findings are less likely to have been published resulting in a publication bias for our systematic review, as is the case in similar research [54]. It is, therefore, possible that we overrated BID in children and adolescents with AN and BN.

Strengths of this systematic review are that it provides the first systematic overview of different BID components in children and adolescents with AN or BN compared to healthy controls. Another strength is that we developed our detailed plan and search strategy a priori, to reduce bias.

Conclusions

This systematic review provides an overview of studies on BID in children and adolescents with AN or BN compared to healthy controls. We could include $k=8$ records. Most samples of children and adolescents with AN and BN scored higher in the BID components perception, global subjective satisfaction, affect/cognition, and behavior than samples of healthy controls. BID prevention and treatments are needed to reduce the number of children affected by BN and AN. In addition, more empirical, and especially representative studies and those on seldom-examined populations (e.g., males and non-Western children and adolescents) are needed in the research field of BID in children and adolescents.

Compliance with ethical standards

Conflict of interest The authors have no competing interest to declare.

Ethics approval This article does not refer to any studies with human participants carried out by any of the authors.

Informed consent Informed consent is not required for this type of study (systematic review).

References

References marked with an asterisk indicate studies included in the systematic review.

- Schilder P (1935) *The image and appearance of the human body*. Kegan Paul, London
- Slade PD (1988) Body image in anorexia nervosa. *Br J Psychiatry* 153(Suppl 2):20–22. <https://doi.org/10.1192/S0007125000298930>
- Stice E (2003) Puberty and body image. In: Hayward C (ed) *Gender differences at puberty*. Cambridge University Press, Cambridge, pp 61–76
- Grogan S (2017) *Body image: understanding body dissatisfaction in men, women and children*, 3rd edn. Routledge, London
- Bruch H (1962) Perceptual and conceptual disturbances in anorexia nervosa. *Psychosom Med* 24:187–194
- American Psychiatric Association (2013) *Diagnostic and statistical manual of mental disorders*, 5th edn. American Psychiatric Association, Arlington
- Cash TF, Deagle EA III (1997) The nature and extent of body-image disturbances in anorexia nervosa and bulimia nervosa: a meta-analysis. *Int J Eat Disord* 22:107–125. [https://doi.org/10.1002/\(SICI\)1098-108X\(199709\)22:2%3c107::AID-EAT1%3e3.0.CO;2-J](https://doi.org/10.1002/(SICI)1098-108X(199709)22:2%3c107::AID-EAT1%3e3.0.CO;2-J)
- Gardner RM, Brown DL (2014) Body size estimation in anorexia nervosa: a brief review of findings from 2003 through 2013. *Psychiatry Res* 219:407–410. <https://doi.org/10.1016/j.psychres.2014.06.029>
- Mölbart SC, Klein L, Thaler A, Mohler BJ, Brozzo C, Martus P, Giel KE (2017) Depictive and metric body size estimation in anorexia nervosa and bulimia nervosa: a systematic review and meta-analysis. *Clin Psychol Rev* 57:21–31. <https://doi.org/10.1016/j.cpr.2017.08.005>
- Stice E, Shaw HE (2002) Role of body dissatisfaction in the onset and maintenance of eating pathology: a synthesis of research findings. *J Psychosom Res* 53:985–993. [https://doi.org/10.1016/S0022-3999\(02\)00488-9](https://doi.org/10.1016/S0022-3999(02)00488-9)
- Boehm I, Finke B, Tam FI, Fittig E, Scholz M, Gantchev K, Ehrlich S (2016) Effects of perceptual body image distortion and early weight gain on long-term outcome of adolescent anorexia nervosa. *Eur Child Adolesc Psychiatry* 25:1319–1326. <https://doi.org/10.1007/s00787-016-0854-1>
- Keel PK, Dorer DJ, Franko DL, Jackson SC, Herzog DB (2005) Postremission predictors of relapse in women with eating disorders. *Am J Psychiatry* 162:2263–2268. <https://doi.org/10.1176/appi.ajp.162.12.2263>
- Worobey J, Worobey HS (2014) Body-size stigmatization by preschool girls: in a doll's world, it is good to be "Barbie". *Body Image* 11:171–174. <https://doi.org/10.1016/j.bodyim.2013.12.001>
- Rice K, Prichard I, Tiggemann M, Slater A (2016) Exposure to Barbie: effects on thin-ideal internalisation, body esteem, and body dissatisfaction among young girls. *Body Image* 19:142–149. <https://doi.org/10.1016/j.bodyim.2016.09.005>
- Carlson Jones D (2004) Body image among adolescent girls and boys: a longitudinal study. *Dev Psychol* 40:823–835. <https://doi.org/10.1037/0012-1649.40.5.823>
- Knauss C, Paxton SJ, Alsaker FD (2007) Relationships amongst body dissatisfaction, internalisation of the media body ideal and perceived pressure from media in adolescent girls and boys. *Body Image* 4:353–360. <https://doi.org/10.1016/j.bodyim.2007.06.007>
- Carlson Jones D, Vigfusdottir TH, Lee Y (2004) Body image and the appearance culture among adolescent girls and boys: an examination of friend conversations, peer criticism, appearance magazines, and the internalization of appearance ideals. *J Adolesc Res* 19:323–339. <https://doi.org/10.1177/0743558403258847>
- Loomba-Albrecht LA, Styne DM (2009) Effect of puberty on body composition. *Curr Opin Endocrinol Diabetes Obes* 16:10–15. <https://doi.org/10.1097/MED.0b013e328320d54c>
- Petersen AC, Crockett L, Richards M, Boxer A (1988) A self-report measure of pubertal status: reliability, validity, and initial norms. *J Youth Adolesc* 17:117–133. <https://doi.org/10.1007/BF01537962>
- Watzlawik M (2009) Die Erfassung des Pubertätsstatus anhand der Pubertal Development Scale: Erste Schritte zur Evaluation

- einer deutschen Übersetzung. *Diagn* 55:55–65. <https://doi.org/10.1026/0012-1924.55.1.55>
21. Boeger A (2010) Entwicklungspsychologie: Körper und Geschlecht im Jugendalter: Schlaglichter auf eine Entwicklungsaufgabe für beide Geschlechter. In: Steins G (1st ed) *Handb Psychol Geschlechterforschung* VS Verlag für Sozialwissenschaften, Wiesbaden, pp 133–151
 22. Dähne A, Aßmann B, Ettrich C, Hinz A (2004) Normwerte für den Fragebogen zur Beurteilung des eigenen Körpers (FBek) für Kinder und Jugendliche. *Prax Kinderpsychol Kinderpsychiatr* 53:483–496
 23. Favaro A, Caregario L, Tenconi E, Bosello R, Santonastaso P (2009) Time trends in age at onset of anorexia nervosa and bulimia nervosa. *J Clin Psychiatry* 70:1715–1721. <https://doi.org/10.4088/JCP.09m05176blu>
 24. Volpe U, Tortorella A, Manchia M, Monteleone AM, Albert U, Monteleone P (2016) Eating disorders: what age at onset? *Psychiatry Res* 238:225–227. <https://doi.org/10.1016/j.psychres.2016.02.048>
 25. Cash TF, Brown TA (1987) Body image in anorexia nervosa and bulimia nervosa: a review of the literature. *Behav Modif* 11:487–521. <https://doi.org/10.1177/01454455870114005>
 26. Sarrar L, Schneider N (2010) Body image distortion in female adolescents with anorexia nervosa. *Minerva Psichiatr* 51:145–159
 27. Legenbauer T, Thiemann P, Vocks S (2014) Body image disturbance in children and adolescents with eating disorders: current evidence and future directions. *Z Kinder- Jugendpsychiatrie Psychother* 42:51–59. <https://doi.org/10.1024/1422-4917/a000269>
 28. Ricciardelli LA, McCabe MP (2001) Children's body image concerns and eating disturbance: a review of the literature. *Clin Psychol Rev* 21:325–344. [https://doi.org/10.1016/S0272-7358\(99\)00051-3](https://doi.org/10.1016/S0272-7358(99)00051-3)
 29. World Health Organization (1992) The ICD-10 classification of mental and behavioral disorders: clinical descriptions and diagnostic guidelines. World Health Organization, Geneva
 30. World Health Organization (2013) Definition of key terms. <https://www.who.int/hiv/pub/guidelines/arv2013/intro/keyterms/en/>
 31. Hedges L, Olkin I (1985) *Statistical methods for meta-analysis*. Academic Press, New York
 32. Cohen J (1992) A power primer. *Psychol Bull* 112:155–159. <https://doi.org/10.1037/0033-2909.112.1.155>
 - *33. Roy M, Forest F (2007) Assessment of body image distortion in eating and weight disorders: the validation of a computer-based tool (Q-BID). *Eat Weight Disord* 12:1–11. <https://doi.org/10.1007/BF03327766>
 - *34. Gila A, Castro J, Toro J, Salamero M (1998) Subjective body-image dimensions in normal and anorexic adolescents. *Br J Med Psychol* 71:175–184. <https://doi.org/10.1111/j.2044-8341.1998.tb01378.x>
 - *35. Gila A, Castro J, Cesena J, Toro J (2005) Anorexia nervosa in male adolescents: body image, eating attitudes and psychological traits. *J Adolesc Health* 36:221–226. <https://doi.org/10.1016/j.jadohealth.2004.02.039>
 - *36. Salbach H, Klinkowski N, Pfeiffer E, Lehmkuhl U, Korte A (2007) Body image and attitudinal aspects of eating disorders in rhythmic gymnasts. *Psychopathol* 40:388–393. <https://doi.org/10.1159/000106469>
 37. Garner DM (1991) *Eating disorder inventory-2: professional manual*. Psychological Assessment Resources, Odessa
 38. Garner DM, Olmstead MP, Polivy J (1983) Development and validation of a multidimensional eating disorder inventory for anorexia nervosa and bulimia. *Int J Eat Disord* 2:15–34. [https://doi.org/10.1002/1098-108X\(198321\)2:2%3c15:AID-EAT2260020203%3e3.0.CO;2-6](https://doi.org/10.1002/1098-108X(198321)2:2%3c15:AID-EAT2260020203%3e3.0.CO;2-6)
 - *39. Bönsch C, Raml E, Seiwald M, Rathner G (1993) Das Körpererleben magersüchtiger Mädchen, ihrer Mütter und Schwestern: eine kontrollierte Studie. *Psychother Psychosom Med Psychol* 43:420–427
 - *40. Bauer A, Schneider S, Waldorf M, Braks K, Huber TJ, Adolph D, Vocks S (2017) Selective visual attention towards oneself and associated state body satisfaction: an eye-tracking study in adolescents with different types of eating disorders. *J Abnorm Child Psychol* 45:1647–1661. <https://doi.org/10.1007/s10802-017-0263-z>
 41. Brähler E, Strauß B, Hessel A, Schumacher J (2000) Normierung des Fragebogens zur Beurteilung des eigenen Körpers (FBek) an einer repräsentativen Bevölkerungsstichprobe. *Diagn* 46:156–164. <https://doi.org/10.1026/0012-1924.46.3.156>
 42. Fairburn CG, Beglin SJ (1994) Assessment of eating disorders: interview or self-report questionnaire? *Int J Eat Disord* 16:363–370. [https://doi.org/10.1002/1098-108X\(199412\)16:4%3c363:AID-EAT2260160405%3e3.0.CO;2-](https://doi.org/10.1002/1098-108X(199412)16:4%3c363:AID-EAT2260160405%3e3.0.CO;2-)
 - *43. Salbach-Andrae H, Schneider N, Bürger A, Pfeiffer E, Lehmkuhl U, Holzhausen M (2010) Psychometrische Gütekriterien des Eating Disorder Inventory (EDI-2) bei Jugendlichen. *Z Kinder- Jugendpsychiatrie Psychother* 38:219–228. <https://doi.org/10.1024/1422-4917/a000035>
 - *44. Steinfeld B, Bauer A, Waldorf M, Engel N, Braks K, Huber TJ, Vocks S (2017) Validierung einer deutschsprachigen Fassung des Body Checking Questionnaire (BCQ) an Jugendlichen mit Anorexia und Bulimia Nervosa. *Psychother Psychosom Med Psychol* 67:38–46. <https://doi.org/10.1055/s-0042-110851>
 45. Reas DL, Whisenhunt BL, Netemeyer R, Williamson DA (2002) Development of the body checking questionnaire: a self-report measure of body checking behaviors. *Int J Eat Disord* 31:324–333. <https://doi.org/10.1002/eat.10012>
 46. Mond JM, Hay PJ, Rodgers B, Owen C, Beumont PJV (2004) Validity of the Eating Disorder Examination Questionnaire (EDE-Q) in screening for eating disorders in community samples. *Behav Res Ther* 42:551–567. [https://doi.org/10.1016/S0005-7967\(03\)00161-X](https://doi.org/10.1016/S0005-7967(03)00161-X)
 47. Shafran R, Fairburn CG, Robinson P, Lask B (2004) Body checking and its avoidance in eating disorders. *Int J Eat Disord* 35:93–101. <https://doi.org/10.1002/eat.10228>
 48. Tuschen-Caffier B, Vögele C, Bracht S, Hilbert A (2003) Psychological responses to body shape exposure in patients with bulimia nervosa. *Behav Res Ther* 41:573–586. [https://doi.org/10.1016/S0005-7967\(02\)00030-X](https://doi.org/10.1016/S0005-7967(02)00030-X)
 49. Vocks S, Legenbauer T, Wächter A, Wucherer M, Kosfelder J (2007) What happens in the course of body exposure? Emotional, cognitive, and physiological reactions to mirror confrontation in eating disorders. *J Psychosom Res* 62:231–239. <https://doi.org/10.1016/j.jpsychores.2006.08.007>
 50. Herpertz S, Herpertz-Dahlmann B, Fichter M, Tuschen-Caffier B, Zeck A (2011) S-3 Leitlinie. Diagnostik und Behandlung der Essstörungen. Springer, Berlin
 51. Vocks S, Bauer A, Legenbauer T (2018) *Körperbildtherapie bei Anorexia und Bulimia nervosa*, 3rd edn. Hogrefe, Göttingen
 52. Le KDL, Barendregt JJ, Hay P, Mihalopoulos C (2017) Prevention of eating disorders: a systematic review and meta-analysis. *Clin Psychol Rev* 53:46–58. <https://doi.org/10.1016/j.cpr.2017.02.001>
 53. Holt KE, Ricciardelli LA (2008) Weight concerns among elementary school children: a review of prevention programs. *Body Image* 5:233–243. <https://doi.org/10.1016/j.bodyim.2008.02.002>
 54. Easterbrook PJ, Berlin JA, Gopalan R, Matthews DR (1991) Publication bias in clinical research. *Lancet* 337:867–872. [https://doi.org/10.1016/0140-6736\(91\)90201-Y](https://doi.org/10.1016/0140-6736(91)90201-Y)