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DOI:
10.1136/bmjgast-2018-000255

Document Version
Peer reviewed version

Citation for published version (Harvard):
Beese, S, Harris, I, Dretzke, J & Moore, D 2019, 'Body image dissatisfaction in patients with inflammatory bowel disease: a systematic review', *BMJ Open Gastroenterology*, vol. 6, no. 1, e000255. https://doi.org/10.1136/bmjgast-2018-000255

BMJ Open Gastroenterology

Body Image Dissatisfaction in Patients with Inflammatory Bowel Disease: A Systematic Review

Journal:	*BMJ Open Gastroenterology*
Manuscript ID	bmjgast-2018-000255.R1
Article Type:	Systematic review
Date Submitted by the Author:	19-Nov-2018
Complete List of Authors:	Beese, Sophie; University of Birmingham, Institute of Applied Health Research Harris, Isobel; University of Birmingham, Institute of Applied Health Research Dretzke, Janine; University of Birmingham, Institute of Applied Health Research Moore, David; University of Birmingham, Institute of Applied Health Research
Keywords:	INFLAMMATORY BOWEL DISEASE, QUALITY OF LIFE, ULCERATIVE COLITIS, CROHN'S DISEASE
Abstract:	Background and Aims: Little is known about the relationship between inflammatory bowel disease and body image. The aim of this systematic review was to summarise the evidence on body image dissatisfaction in inflammatory bowel disease patients across four areas: body image tools (i), prevalence (ii), factors associated with body image dissatisfaction in inflammatory bowel disease (iii) and association between inflammatory bowel disease and quality of life (iv). Methods: Two reviewers screened, selected, quality assessed and extracted data from studies in duplicate. EMBASE, MEDLINE, PsycINFO and Cochrane CENTRAL were searched to April 2018. Study design specific critical appraisal tools were used to assess risk of bias. Narrative analysis was undertaken due to heterogeneity. Results: Fifty-seven studies using a body image tool were included; 31 for prevalence and 16 and 8 for associated factors and association with quality of life respectively. Studies reported mainly mean or median scores. Evidence suggested female gender, age, fatigue, disease activity, and steroid use were associated with increased body image dissatisfaction, which was also associated with decreased quality of life. Conclusion: This is the first systematic review on body image in inflammatory bowel disease patients. The evidence suggests that body image dissatisfaction can negatively impact patients, and certain factors are associated with increased body image dissatisfaction. Greater body image dissatisfaction was also associated with poorer quality of life. However, the methodological and reporting quality of studies was in some cases poor with considerable heterogeneity. Future IBD research should incorporate measurement of body image dissatisfaction using validated tools.

Body Image Dissatisfaction in Patients with Inflammatory Bowel Disease: A Systematic Review

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Word Count: 3694

ABSTRACT

Background and Aims: Little is known about the relationship between inflammatory bowel disease and body image. The aim of this systematic review was to summarise the evidence on body image dissatisfaction in inflammatory bowel disease patients across four areas: body image tools (i), prevalence (ii), factors associated with body image dissatisfaction in inflammatory bowel disease (iii) and association between inflammatory bowel disease and quality of life (iv).

Methods: Two reviewers screened, selected, quality assessed and extracted data from studies in duplicate. EMBASE, MEDLINE, PsycINFO and Cochrane CENTRAL were searched to April 2018. Study design specific critical appraisal tools were used to assess risk of bias. Narrative analysis was undertaken due to heterogeneity.

Results: Fifty-seven studies using a body image tool were included; 31 for prevalence and 16 and 8 for associated factors and association with quality of life respectively. Studies reported mainly mean or median scores. Evidence suggested female gender, age, fatigue, disease activity, and steroid use were associated with increased body image dissatisfaction, which was also associated with decreased quality of life.

Conclusion: This is the first systematic review on body image in inflammatory bowel disease patients. The evidence suggests that body image dissatisfaction can negatively impact patients, and certain factors are associated with increased body image dissatisfaction. Greater body image dissatisfaction was

also associated with poorer quality of life. However, the methodological and reporting quality of studies was in some cases poor with considerable heterogeneity. Future IBD research should incorporate measurement of body image dissatisfaction using validated tools.

Keywords: Systematic review – inflammatory bowel disease – body image – quality of life

What is already known about this subject?

Body image in inflammatory bowel disease (IBD) patients is relatively unexplored. However, it may potentially be an issue as symptoms and other factors associated with IBD could lead to body image dissatisfaction. Both of these conditions may lead to an increased risk of developing mental health disorders such as depression and self-harm, warranting research into the area.

What are the new findings?

This review highlights associations between certain factors in IBD and body image dissatisfaction, as well as suggesting that increased body image dissatisfaction is related to reduced quality of life. The review also highlights the need for a validated, reliable tool to measure body image in IBD patients as well as clearer reporting of studies.

How might it impact on clinical practice in the foreseeable future?

Body image can be considered when making clinical decisions regarding IBD patients with the potential for interventions to improve body image in patients at risk.

INTRODUCTION

Inflammatory bowel disease (IBD) is associated with a range of debilitating symptoms[1] and affects around 300,000 people in the UK[2], over 1 million in the USA and 2.5 million across Europe[3]. A potentially overlooked issue for IBD patients is body image dissatisfaction (BID). Body image (BI) is how an individual perceives themselves physically[4] and sufferers have a distorted and negative view of themselves, feeling anxious and uncomfortable about their body. Additionally, negative BI can have a serious impact on health and well-being[5].

Social media and celebrity attention contribute to pressure to adhere to an "ideal" body and an obsession with appearance[6, 7]. Discontentment with aspects such as body weight, shape, appearance and skin may contribute toward an individual having BID[8]. Studies have shown patients with negative BI are more likely to suffer with depression, anxiety and feel suicidal and BID can impact negatively upon relationships[9] and quality of life (QoL)[10].

Various tools have been utilised in healthcare to measure BI including the Body Image Ideals Questionnaire, the Body Image Scale and the Cash Body Image Disturbance Questionnaire (BIDQ)[11]. There are also condition-specific BI tools such as the Body Image Scale (BIS) for IBD[12].

Both condition-specific symptoms and treatments may contribute to BID in IBD patients, particularly during periods of active disease rather than remission. Symptoms can include urgent bowel movements, bloating, excess wind, fatigue,

skin problems and ulcers. Treatment with steroids can be associated with weight gain, acne and mood swings[13]. Surgeries may also impact upon BI due to scarring and implementation of a stoma[14] [15]. Those suffering with IBD or BID are at an increased risk of mental health issues[16, 17] ; this could be worse for patients living with both conditions. Furthermore, most IBD patients are diagnosed at adolescence[18], when BI is important. Body image is currently not routinely considered in the management of IBD.

No existing or ongoing systematic reviews on BI in IBD have been identified. However multiple primary studies, mainly cross-sectional in nature assess BI as an outcome in IBD patients, with disparate results. A systematic review is therefore warranted to synthesise and clarify the evidence base.

The following four questions will be addressed:

1. What tools are used to measure body image in IBD patients and what are their components?

2. What is the prevalence and severity of body image dissatisfaction in IBD patients?

3. What factors are associated with body image dissatisfaction in IBD patients?

4. Is there an association between body image dissatisfaction in IBD patients and quality of life?

METHODS

This systematic review has been reported according to the Preferred Reporting Items of Systematic Reviews and Meta-Analysis (PRISMA) guidelines[19]. A protocol was previously registered (PROSPERO (CRD42018060999)) and submitted for publication and is currently in process[20]. A summary of the methods is reported below. Selection, data extraction and quality assessment were carried out by two independent reviewers with disagreements resolved through discussion or third reviewer.

Search Strategy

Bibliographic databases (EMBASE, MEDLINE, PsycINFO, Cochrane CENTRAL) were searched to April 2018 using combinations of index and text terms for IBD and BI (see Supplementary table 1 for MEDLINE strategy) Strategies were adapted for each database and run without date or language restrictions. Trial registries (Clinicaltrials.gov, EU Clinical Trial Register) were searched for ongoing trials and reference lists of included studies were checked.

Screening and Selection Criteria

Study eligibility was based on the following criteria:

Study design: Any primary study reporting quantitative data.

Population: Patients of any age diagnosed with IBD. At least 50% of population must have IBD unless results are reported separately for sub-groups of individuals with IBD.

Tools: Any tool measuring any aspect of BI (including QoL tools that had at least one BI related domain or question).

Studies were also eligible (for question 2-4) where they reported: any measure of prevalence/frequency and severity of BID in IBD patients; data on associations between any factor in IBD patients and BID; or any association between BI and QoL measures in IBD patients, including associations between two separate domain measures of the same tool.

Exclusion criteria: Case reports, qualitative research and conference abstracts published three years before the date of the searches.

Reasons for exclusion were recorded.

Data Extraction

A piloted data extraction form was used. Examples of the type of data extracted are shown below:

Study characteristics:

Study design, aim and setting, inclusion/exclusion criteria, recruitment methods, follow-up period.

Participant characteristics:

Number of patients, age, gender, type of IBD, disease severity and activity, BMI, comorbidities, therapy/surgery.

Data for synthesis/analysis:

BI measurement tool, components of tools/scales, data on BID (e.g. body image scores, prevalence, thresholds for determining BID), factors associated with BI dissatisfaction and strength of association, QoL measures, strength of association between BID and QoL.

Quality Assessment

Quality assessment was based on critical appraisal checklists for both prevalence and cross-sectional analytical studies from the Joanna Briggs Institute[21]. Studies solely included for question one were not quality assessed as the objective of this question was to compile a list of body image tools.

Important quality items included sample selection, response rate during enrolment in the study, clear inclusion criteria and measurement of outcomes in a valid and reliable way.

Analysis

A narrative synthesis was carried out separately for each question, with key findings tabulated. Substantial heterogeneity relating to populations, tools and settings was apparent in the included studies meaning that meta-analysis was

not appropriate. Consistencies and discrepancies in findings between studies were noted and discussed in the context of any likely sources of heterogeneity. Quality assessment findings were used when considering the strength of evidence for the latter three questions.

RESULTS

Database searches identified 587 records and 57[14, 22-77] studies were included, with some studies eligible for multiple questions (see Figure 1 for selection process and reasons for exclusion). All 57 papers reported using BI tools, 31[14, 22-26, 30, 31, 33-39, 42, 47, 50, 51, 53, 54, 59, 61, 62, 64-66, 68, 70, 72, 73] reported prevalence or mean/median BI scores, 16[14, 23, 24, 30, 34-36, 47, 54, 59, 61, 62, 64, 66, 68, 72] studies presented factors associated with BID and 8[14, 22-24, 34, 62, 66, 72] studies reported correlations between QoL and body image.

Question 1: What tools are used to measure body image and what are their components?

Of the 57 studies measuring BI, 51 were cross-sectional whilst the others varied (case-control[25],prospective cohort[51, 66],case series[39], randomised controlled trial[65] and non-randomised intervention study[42]). Study populations included adults and children in settings including outpatients, pre/post-surgery, summer camps and online registries, from countries across the world. Twenty studies focused on BI as one of the main outcomes but only six of these studies were non-surgery based.

Fifteen tools were identified (Table 1). Seven tools were specifically for BI and eight were QoL tools which included a BI domain or question(s). The most frequently applied tool specific to BI was the Body Image Questionnaire (BIQ) which was used in 14 studies. The Body Image Scale (BIS) was used in 5 studies and is the only tool validated in an IBD population. IMPACT-III (or earlier IMPACT-II) is a validated QoL questionnaire aimed at adolescents and children with IBD and includes a BI domain. It was used across 18 studies. The remaining 12 tools were used in only 1-3 studies respectively.

None of the tools included had a clear cut-off point for defining BID but offered an indication of increasing or decreasing likelihood of dissatisfaction. In some tools, a higher score indicated better BI (BIQ, EORTC, DUX-25). In others, a higher score indicated increased BID (IMPACT, BIS, RFIPC, IBDSI, Body Image Self-Consciousness during Intimacy Scale, BIDQ and ASWAP).

Tools where items had similar themes were grouped to show general focus of BI questions and are shown in Table 2.

Table 1. Tools identified and used across included studies

Measurement Tool	Type of Tool	Intended target population	Is tool Validated?	Scoring	No. of Studies Tool Used In
Body Image Tools					
ASWAP	Body image	Initially used in scleroderma patients	Yes but not in IBD patients	15 items rated on 7-point scale. Questions corresponding to items 4–11 were reverse scored such that higher scores reflect greater dissatisfaction	1
Askevold's Body Image Test	Body image	Unclear	Unclear	Unclear	2
Body Image and Self-Consciousness During Intimacy Scale	Body image and sexual self-consciousness	Women	No	0-75, higher scores poorer body image	1
BIA/BIA-P	Body image	Adults, no specific clinical population	Unclear	Based on body image silhouettes ranging in size. Score=difference between current body size and ideal body size.	1
BIQ	Body image	Originally caesarean or appendectomy patients, now IBD	No	5-20, higher score better body image	14

		patients			
BIS	Body image	Cancer patients	Yes	0-30, lower score better body image	5
Cash Body Image Disturbance Questionnaire	Body image	Range of clinical groups	Yes but not in IBD patients	7-35, higher score poorer body image	2
Quality of Life Tools with a Body Image Component					
DUX-25	Quality of daily functioning. (1 of 4 domains relate to body image)	School age children	No	Higher scores, better QoL	1
EORTC-QLQ-CR38	Quality of Life questionnaire. (3 of 38 items relate to body image)	Cancer patients	Yes but not in IBD patients	38 items with 4 category responses. Functional scales: higher score higher functioning. Symptoms scales: higher score higher level of symptoms.	1
EORTC-QLQ-CR29	Quality of Life questionnaire. (3 of 29 items relate to body image)	Cancer patients	Yes but not in IBD patients	29 items with 4 category responses. Functional scales: higher score higher functioning. Symptoms scales: higher score higher level of symptoms.	1
IMPACT-III or IMPACT II	Health-related quality of life. (3 of 35 items relate to body image)	Children and adolescents with IBD	Yes	35-175, higher scores better QoL	18
Inflammatory Bowel Disease Stress Index	Assessing the extent to which IBD has caused alterations in lifestyle. (1 of 10 items relate to body	IBD patients	Unclear	8 scales with a score of 0-3 (no impact-a great deal of impact).	1

	image)				
RFIPC	Quality of life questionnaire. (1 item of 25 relate to body image)	IBD patients	Yes	0-100, higher score poorer QoL	3
Stoma Quality of Life Scale	Stoma-related. (5 items of 19 relate to body image and sexuality).	Stoma patients	Yes (in ostomy patients)	5 scales, 19 questions. Each scored 1-5 (Never-always). Average scores for each scale calculated.	3
The Karolinska Psychodynamic Profile	Assessment of stable modes of mental functioning and character traits (1 subscale and 3 of 18 items relate to body image.)	No specific clinical population	Yes	Each subscale is graded from 1-3 (Most normal-least normal).	2

Abbreviations: ASWAP: Adapted Satisfaction with Appearance scale; BI/BIA-P: Body Image Assessment/Body Image Assessment-Preadolescent; BIQ: Body Image Questionnaire; BIS: Body Image Scale; DUX-25: Dutch Children's AZL/TNO Quality of Life Questionnaire; EORT-QLQ-CR38/EORT-QLQ-CR29: European Organisation for Research and Treatment of Cancer (EORTC) Quality of Life questionnaire for Colorectal Cancer; IMPACT-II/IMPACT-III:A measure of health-related quality of life in paediatric inflammatory bowel disease; RFIPC: Rating Form of IBD Patient Concerns.

Table 2. Body image tools with similar questions grouped into overarching themes

Body Image Tool	Components								
	Satisfaction with appearance	Attractiveness	Socialising/Work	Avoidance of people or tasks	Feeling feminine/ masculine	Effect of disease on body	Scar satisfaction	Satisfaction with body both naked and dressed	Distressing thoughts
BIS	✓	✓	✓		✓	✓		✓	
BIQ	✓	✓			✓	✓	✓	✓	
CBIDQ	✓	✓	✓	✓					✓
ASWAP	✓	✓	✓	✓				✓	

N.B. Similar components of tools were grouped into themes shown above. BIS=Body Image Scale. BIQ=Body Image Questionnaire.

CBDIQ=Cash Body Image Disturbance Questionnaire. ASWAP=Adapted Satisfaction with Appearance Scale. Askevold's Body Image Test (no information in paper or online), Body Image and Self-consciousness during Intimacy Scale (too specific) and the Body Image Assessment (based on figural drawing scales) were not included.

What is the prevalence of body image dissatisfaction in IBD patients?

Thirty-one studies including a total of 3,634 patients reported on prevalence or severity of BID (see Table 3 for study characteristics). Seventeen studies[14, 22, 23, 25, 30, 31, 38, 42, 53, 54, 59, 61, 62, 66, 70, 72, 73] included both ulcerative colitis (UC) and Crohn's disease (CD) patients. Ages ranged from 2-71 and eighteen studies[22, 30, 38, 40-42, 51-53, 58, 60-63, 70, 71, 73, 76] included only children/adolescents. Fourteen studies[24-26, 33-37, 39, 47, 50, 64, 65, 68] included surgery patients and one study included only females[72].

Only three studies reported prevalence. Brown (2015)[26] found that 21-34% UC patients reported negative impacts on BI using BIQ. McDermott (2015)[14] found that 87% patients reported some form of concern about an aspect of their BI using the Cash Body Image Disturbance Questionnaire. Muller (2010)[59] reported that 66.8% IBD patients stated they had impaired BI based on a researcher devised questionnaire. The other 28 studies reported mean/median BI scores based on a range of tools.

In studies with populations undergoing surgery it was found that there was no significant difference in BI scores (using the BIQ) after laparoscopic or open/conventional surgery in IBD patients[33-35, 64, 78]. Only one study found BI scores to be significantly improved after laparoscopic surgery compared to conventional surgery in CD[36].

BI was included as an outcome across 31 studies. All but one study compared results within the included IBD population e.g. UC vs CD, surgery vs no surgery, males vs females. Bel (2015) found that women with IBD with disease in

remission scored comparably to women in a healthy population. One longitudinal study by Saha (2015)[66] measured scores over two years and found that BI did not change despite improvements in symptoms.

Table 3. Study characteristics of papers included for questions two, three and four.

Study	Design	Population	Country	No. patients	No. UC/CD/Other	Body Image Tool	Outcomes	Body Image Prevalence/Score
Beld et al (2010)	Cross sectional	UC or FAP undergone restorative proctocolectomy IPAA Jan 92 to Oct 08	Netherlands	26	UC (16) FAP (10)	BIQ	Mean body image scores (SD)	Males 16.3 (3.1) Females 13.5 (4.1)
Brown et al (2015)	Cross sectional	Patients with UC who had colectomy within the past 10 years, data collected from Nov 2010 to July 2011.	Canada, Australia, UK	351	All UC	BIQ	Median body image scores (IQR) Prevalence of "quite a bit" or "extreme" negative impacts on body image as a result of colectomy.	Males 8 (IQR 6-11) Females 11 (IQR 8-14) Age group >50 years 8 (IQR 6-11) Age group <50 years 10 (IQR 7-13). 21-34% reported negative impacts on body image.
Dunker et al (1998)	Cross sectional	CD patients undergoing open or laparoscopic resection at Leiden university medical centre	Netherlands	34	All CD	BIQ	Mean body image scores	Open 16.4 (10-20) Laparoscopic 18 (13-20) (SD not reported)

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Study	Design	Population	Country	No. patients	No. UC/CD/Other	Body Image Tool	Outcomes	Body Image Prevalence/Score
Dunker et al (2001)	Cross sectional matched comparison	UC patients who underwent laparoscopic assisted IPAA and matched conventional IPAA patients.	Netherlands	32	UC (28) FAP (4)	BIQ	Mean body image scores (SD)	Laparoscopic 19 (1.3) Conventional 17.9 (SD not reported)
Eshuis et al (2008)	Repeated cross sectional	Patients who underwent ileocolic resection for Crohn's disease from 1995 until 1998 two centres.	Netherlands	71 (*medical file analysis*) 61 (*returned questionnaires*)	All CD	BIQ	Mean body image scores (range)	Open 15.63 (6-20) Laparoscopic 16.3 (7-20) (SD not reported)
Eshuis et al (2010)	Repeated cross sectional	CD patients who had ileocolic resections between September 1999 and November 2003.	Netherlands	55	All CD	BIQ	Median body image scores (IQR)	Open 18.0 (IQR 16-19) Laparoscopic 19.0 (IQR 17-20)

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Study	Design	Population	Country	No. patients	No. UC/CD/Other	Body Image Tool	Outcomes	Body Image Prevalence/Score
Giudici et al (2017)	Case series (Abstract only)	December 2014-December 2015. Consecutive patients undergoing laparoscopic proctectomy for ulcerative colitis.	Italy	10	All UC	Self-designed body image questionnaire	Mean body image score	59 (SD not reported)
Kjaer et al (2014)	Cross sectional	Adult patients treated with laparoscopy-assisted or open IPAA at Odense University Hospital during the period between October 2008 and March 2012.	Denmark	50	UC (44) FAP (4) Other (2)	BIQ	Median body image scores (range)	Laparoscopic 8 (5-18) Open 9.5 (5-20)
Polle et al (2007)	Repeated cross sectional	Patients eligible for an elective proctocolectomy with IPAA for UC or FAP were included in a randomized trial	Netherlands	53	UC (34) FAP (19)	BIQ	Mean body image scores (limited data)	Women open group 15 Laparoscopic group: 18 (SD not reported)

Table 3. Study characteristics of papers included for questions two, three and four.

Study	Design	Population	Country	No. patients	No. UC/CD/Other	Body Image Tool	Outcomes	Body Image Prevalence/Score
Ponsioen et al (2017)	Randomised controlled trial	Eligible patients aged 18–80 years, had active Crohn's disease of the terminal ileum, and had not responded to at least 3 months of conventional therapy with glucocorticosteroids, thiopurines, or methotrexate. Patients with diseased terminal ileum longer than 40 cm or abdominal abscesses were excluded.	Netherlands and UK	70 Infliximab group 73 Laparoscopic ileocaecal resection	All CD	BIQ	Mean body image scores (only given for resection group)	Resection group: Baseline 16. Endpoint 17.8. (SD not reported)
Scarpa et al (2009)	Prospective case series	Patients admitted for intestinal surgery for CD May 06 - July 08	Italy	47	All CD	BIQ	Median body image score (IQR)	5 (5-8)
Voermans et al (2010)	Prospective case series	A consecutive series of patients who had an indication for a laparoscopic ileocolic resection were invited to participate. CD patients.	Netherlands	10	All CD	BIQ	Median body image scores	Before surgery 17.0 After surgery 19.0
Bengtsson et al (2011)	Case-control	Patients with preoperative diagnosis of UC or CD who underwent IPAA	Sweden	101 *(72 controls,*	Controls; UC (60) CD (0) Study group;	BIS	Median body image scores.	Study group: Males 6.5 Females 10. Control group Males

Table 3. Study characteristics of papers included for questions two, three and four.

Study	Design	Population	Country	No. patients	No. UC/CD/Other	Body Image Tool	Outcomes	Body Image Prevalence/Score
				29 study group)	UC (25) CD (4)			1 Females 3
Trindade et al (2017)	Cross sectional	Female participants with ages between 18 and 40 years old who had not undergone IBD-related surgery	Portugal	96	UC (58) CD (38)	BIS	Mean body image score (SD)	10.10 (7.73) (SD not reported)
Vlahou et al (2008)	Cross sectional	Adolescents with IBD who attended clinics at two separate hospitals and a camp for children with IBD	USA	44	Breakdown not reported	BSQ (modified version of BIQ) and BIA-P	Mean body image scores (SD)	BSQ: Males 36.45 (4.88) Females 33.52 (7.77). BIA-P: Males 0.41 (0.85) Females 0.77 (0.92)
Grootenhuis (2009)	Non-randomised controlled	Adolescents with IBD who were under medical care at Emma Children's Hospital AMC and members of Crohn's and colitis association Netherlands	Netherlands	18 controls; 22 interventi	Controls CD (11) UC (4) IBDU (3). Intervention	DUX-25	Mean body image domain scores (SD)	Intervention: baseline 55.4 (18.6) post intervention 68.9 (17.7) Control:

Table 3. Study characteristics of papers included for questions two, three and four.

Study	Design	Population	Country	No. patients	No. UC/CD/Other	Body Image Tool	Outcomes	Body Image Prevalence/Score
	study			on	CD (17) UC (5) IBDU (0)			baseline 60.0 (17.4) post intervention 59.0 (20.1)
Bel et al (2015)	Cross sectional with controls	18-70 UC or CD	Netherlands	287 *(197 healthy controls)*	UC (132) CD (155)	EORTC-QLQ-CR38	Mean body image domain scores (SD)	Active: Males 5.61 (2.31) Females 6.2 (2.78). Remission: Males 3.82 (1.33) Females 4.58 (1.68)
Shepanksi (2009)	Before and after study	Children attending Camp Guts and Glory in Pennsylvania	USA	61	CD:UC (2:1)	IMPACT II	Mean body image domain scores (SD, for before and after camp)	By age; Age 9-10: pre 14.6 (4.1). Post 16.4 (3.7). Age 11-12: Pre 11.4 (4.9). Post 13.2 (5.0). Age 13-14:Pre 12.9 (5.2). Post 13.8 (5.9). Age 15-16: Pre 12.3

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Study	Design	Population	Country	No. patients	No. UC/CD/Other	Body Image Tool	Outcomes	Body Image Prevalence/Score
								(5.0). Post 11.2 (5.4)
Abdovic et al (2013)	Cross sectional validation study	Children aged nine years or older with confirmed diagnosis of IBD for more than six months from inpatient and outpatient clinics at particular centres.	Croatia	104	UC (30) CD (74)	IMPACT III	Mean body image domain score (SD).	12.03 (1.96)
Chouliaras et al (2017)	Cross sectional	UC and CD patients hospitalized or followed in outpatient clinic in Athens	Greece	99	UC (37) CD (62)	IMPACT III	Mean body image domain scores (SD)	Overall 71.5 (17.9) UC 67.3 (22.4) CD 72.6 (19.3) No significant relationship between body image and assessed disease characteristics or

Table 3. Study characteristics of papers included for questions two, three and four.

Study	Design	Population	Country	No. patients	No. UC/CD/Other	Body Image Tool	Outcomes	Body Image Prevalence/Score
								prescribed medications.
Gallo et al (2014)	Cross sectional	Children between the ages of 8 and 18 years, who had been diagnosed with IBD at least 6 months before, and were being followed at the Pediatric Gastroenterology Service of the Hospital Italiano de Buenos Aires, Argentina, or at the private office of one of the co-authors (M.O.) and one of their parents.	Argentina	27	UC (17) CD (9)	IMPACT III	Mean body image domain score (SD)	76.54 (16.06)
Lee et al (2015)	Prospective observational study	Children and young adults less than 22 years of age started on EN or anti-TNF therapy for active CD at Hospital for Sick Children Toronto and Children's Hospital Philadelphia.	Canada and USA	90	All CD	IMPACT III	Median body image domain scores (range)	Baseline PEN 71 (54-75) EEN 58 (58-75) TNf 67 (50-83)

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Study	Design	Population	Country	No. patients	No. UC/CD/Other	Body Image Tool	Outcomes	Body Image Prevalence/Score
Mason et al (2015)	Prospective observational study	Adolescents >10 years old with confirmed diagnosis of IBD attending gastroenterology clinic at Royal Hospital for Sick Children, Glasgow	Scotland	63	UC/IBDU (18) CD (45)	IMPACT III	Mean body image domain score	7 (SD not reported)
Ogden et al (2011)	Cross sectional validation study	Unclear - children with IBD	UK	97	UC (12) CD (64) IBDU (21)	IMPACT III	Mean body image domain score	63.5 (95% CI 56.5 - 70.6) (SD not reported)
Perrin et al (2008)	Cross sectional	Children aged 8-17 years diagnosed with UC or CD 6 mnths before the study followed at 1 of 6 paediatric gastroenterology centres. No other chronic conditions.	USA	220	UC (59) CD (161)	IMPACT III	Mean body image domain scores (SD)	68.1 (19.6) UC 68.6 (20.8) CD 67.9 (19.2)

Table 3. Study characteristics of papers included for questions two, three and four.

Study	Design	Population	Country	No. patients	No. UC/CD/Other	Body Image Tool	Outcomes	Body Image Prevalence/Score
McDermott et al (2015)	Cross sectional	Patients with histologically confirmed IBD attending ambulatory clinics in 1 of 2 medical centres between July 2011 and November 2012	Ireland	330	UC (145) CD (194)	Modified BIS and Cash Body Image Scale (qualitative only)	Median body image score (range) Prevalence	6 (0-27) 13% patients reported no concerns about any aspect of body image
Saha et al (2015)	Prospective observational study	Patients with UC, CD or IBDU aged 18 and above enrolled in the Ocean State Crohn's and Colitis Area Registry (OSCCAR) with a minimum of 2 years of follow-up	USA	274	CD (145) UC/IBDU (129)	ASWAP	Mean body image scores (SD)	Baseline: Females 30.1 (14.4) Males 21.2 (8.4) Year 1: Females 28.2 (14.1) Males 24.5 (12.5) Year 2: Females 28.8 (13.2) Males 24.1 (13.5)

Table 3. Study characteristics of papers included for questions two, three and four.

Study	Design	Population	Country	No. patients	No. UC/CD/Other	Body Image Tool	Outcomes	Body Image Prevalence/Score
Muller et al (2010)	Cross sectional	IBD patients aged 18-50 from a database of IBD patients maintained by the Southern Adelaide IBD Service	Australia	217	UC (85) CD (127) IBDU (5)	No specific tool – range of questions regarding body image and impact of IBD on this	Prevalence (%) of body image dissatisfaction	66.8% of patients reported impaired body image
de Rooy et al (2001)	Cross sectional	Outpatients of the Inflammatory Bowel Disease Center, Mount Sinai Hospital. Subjects were a convenience sample waiting for a regularly scheduled physician appointment.	USA	241	UC (121) CD (120)	RFIPC	"Feelings about body" question mean score (SD)	42.84 (33.97)
Maunder et al (1999)	Retrospective analysis	Patients with IBD who had completed the RFIPC and a survey of demographic and disease-related variables in one of three previous studies	Unclear	343	UC (186) CD (157)	RFIPC	"Feelings about body" question mean scores	Female 52.13 (34.8) Male 38.16 (33.83)
Kuruvilla et al	Cross-sectional	Consecutive patients who had undergone IPAA or a permanent ileostomy for ulcerative colitis by a	USA	59	All UC. IPAA (35); TPC (24).	Stoma Quality of Life Scale	Mean (SD) and median (range) body	IPAA; Mean 93.1 (9.7). Median 100.

Table 3. Study characteristics of papers included for questions two, three and four.

Study	Design	Population	Country	No. patients	No. UC/CD/Other	Body Image Tool	Outcomes	Body Image Prevalence/Score
(2012)	(Abstract only)	single surgeon, presenting for their annual follow-up visit from July through September 2011, were offered participation in the study. A randomly chosen group of subjects who did not have scheduled appointments during the study period were sent a letter inviting them to participate in the study.					image/sexuality domain scores.	(65-100). TPC: Mean 76.4 (14.6) Median 80 (50-100).

Abbreviations: *UC: Ulcerative Colitis; CD: Crohn's disease; IBD: Inflammatory bowel disease; IBDU: Inflammatory bowel disease unclassified; FAP: Familial adenomatous polyposis; IPAA: ileal pouch-anal anastomosis; TPC: Total proctocolectomy; PEN: Partial Enteral Nutrition; EEN: Exclusive Enteral Nutrition; TNF; Tumour Necrosis Factor; TNF: Tumour necrosis factor; IQR: Interquartile range; SD; Standard deviation; ASWAP: Adapted Satisfaction with Appearance scale; BI/BIA-P: Body Image Assessment/Body Image Assessment-Preadolescent; BIQ: Body Image Questionnaire; BIS: Body Image Scale; DUX-25: Dutch Children's AZL/TNO Quality of Life Questionnaire; EORT-QLQ-CR38/EORT-QLQ-CR29: European Organisation for Research and Treatment of Cancer (EORTC) Quality of Life questionnaire for Colorectal Cancer; IMPACT-II/IMPACT-III:A measure of health-related quality of life in paediatric inflammatory bowel disease; RFIPC: Rating Form of IBD Patient Concerns; BSQ: Body Satisfaction Questionnaire.*

What factors are associated with body image dissatisfaction in IBD patients?

Sixteen studies[14, 23, 24, 30, 34-36, 47, 54, 59, 61, 62, 64, 66, 68, 72] totalling 2333 IBD patients reported the association between various factors and BID (see Table 4). Factors included those related to demographics as well as disease and treatment-related characteristics. Ten studies[14, 24, 34-36, 47, 64, 66, 68, 72] utilised a specific BI tool and six[34-36, 47, 64, 68] focused on comparative surgery techniques. Three studies[30, 61, 62] included a paediatric population; the remaining studies included adults. BI was one of the main outcomes in most of these studies and the study by Saha (2015)[66] was the first longitudinal follow up of BID in IBD according to the authors.

In 6/10 studies[14, 23, 54, 59, 64, 66] female gender was found to be significantly associated with increased BID. One study[59] reported the odds of BID was over 3 times more in females than males (p=0.001), with strong associations reported in the other five studies. Increased disease activity was found to have a significant but moderate positive association in 7/9 studies[14, 23, 34, 62, 66, 68, 72]

Other factors found to be significantly associated with increased BID included steroid use[14, 61, 66, 72], age[14, 23], increased BMI[14, 72], smoking[14] and fatigue[23](Table 4). Saha (2015)[66] also found a significant association between extraintestinal manifestations (EIM) and increased BID, but were the only study to assess this. Laparoscopic surgery was found to be associated with improved body image in 2/6 studies[36, 68]. Ileal pouch-anal anastomosis (IPAA) seemed to result in patients being satisfied with their body image in two studies[24, 26] but

they lacked a comparative surgery group. One study[50] compared IPAA and ileostomy and found better body image scores in the IPAA group. No significant associations were found between disease sub-type and increased BID.

Is there an association between body image dissatisfaction and quality of life in IBD patients?

Eight studies[14, 22-24, 34, 62, 66, 72] explored a potential association between BID and QoL across a total of 1371 patients, with seven presenting a significant association. Three studies[22, 24, 62] (Table 4) focused on younger populations with the rest including adults only. The majority of studies included populations with both UC and CD whilst two [24, 34] included only one subtype.

Statistically significant weak to moderately strong correlations were present in five studies[22, 23, 34, 62, 72] ranging from r = 0.34 to r = 0.67. Furthermore, McDermott(2015)[14] found that when using the BI scale there was a significant difference in scores between those with good or poor QoL. Trindade(2017)[72] found that BI was positively correlated with psychological and physical QoL. Saha(2015)[66] found that a one unit increase in the total ASWAP score (indicating poorer body image) was associated with a 0.62 decrease in QoL score ($p<0.0001$).

Various QoL tools (See Table 1) were used across studies with some using more than one. Four of these questionnaires used (IMPACT II and III, GIQLI and WHOQOL-BREF) contain a question or domain on BI, potentially making them more likely to correlate with BI questionnaires.

Table 4. Most common factors found to be significantly associated with impaired body image in IBD as reported in each study, including associations between reduced body image and reduced QoL.

	Abdovic	Bel 2015	Beld 2010	2017	Chouliaras	1998	Dunker	2008	Eshuis	2010	Eshuis	Kjaer 2014	1999	Maunder	2015	McDermott	2010	Muller	Ogden	Perrin	Polle 2007	Saha 2015	2009	Scarpa	2017	Trindade
Female gender		r= -0.18*	Difference in means p=0.08		Difference in means p>0.10		Difference in scores p=0.18		No significant association				Females significantly worse scores*			p<0.001*	Difference in proportions p=0.0007				Significantly worse scores in open surgery group p=0.004*	p<0.0001*				

Factor	Study																							
	Abdovic	Bel 2015	Beld 2010	2017	Chouliaras	1998	Dunker	2008	Eshuis	2010	Eshuis	Kjaer 2014	1999	Maunder	2015	McDermott	2010	Muller	Ogden	Perrin	Polle 2007	Saha 2015	2009	Scarpa	2017	Trindade
Higher disease/ symptom activity		r= 0.38*			No significant association		r=0.5*									p<0.001*				p= 0.50	p= 0.003*		In UC p=0.006* In CD p=0.003*	Multiple regression β=0.426 p=0.006*		Active disease r=0.18 Symptoms r=0.40*
Fatigue		r= 0.55*																								

Factor	Study																							
	Abdovic	Bel 2015	Beld 2010	Chouliaras 2017	Dunker 1998	Eshuis 2008	Eshuis 2010	Kjaer 2014	Maunder 1999	McDermott 2015	Muller 2010	Ogden [illegible]	Perrin [illegible]	Polle 2007	Saha 2015	Scarpa 2009	Trindade 2017
Disease Subtype				No significant association						p=0.63	Difference in proportions p=0.094		p=0.05		No association found		
Age		r= -0.18*			No significant association					Younger age p<0.001*							r= -0.06
Steroids				No significant association	No significant association					p=0.03*		p=0.05*			p=0.02*		r=0.22*

Factor	Study																							
	Abdovic	Bel 2015	Beld 2010	2017	Chouliaras	1998	Dunker	2008	Eshuis	2010	Eshuis	Kjaer 2014	1999	Maunder	2015	McDermott	2010	Muller	Ogden	Perrin	Polle 2007	Saha 2015	2009	Scarpa	2017	Trindade
Smoking																p=0.001*										
Open/ conventional surgery						Difference in scores p=0.2		Difference in means p=0.51		Difference in median p=0.03*		Difference in median p=0.17									No significant differences		Multiple regression (for laparoscopic approach) β=0.331 p=0.036*			

Factor	Study																													
	Abdovic	Bel 2015	Beld 2010	2017	Chouliaras	1998	Dunker	2008	Eshuis	2010	Eshuis	Kjaer 2014	1999	Maunder	2015	McDermott	2010	Muller	Ogden	Perrin	Polle 2007	Saha 2015	2009	Scarpa	2017	Trindade
Increased BMI																Females only p<0.001*						No significant association				r= 0.25*

Factor	Study																						
	Abdovic 2017	Bel 2015	Beld 2010	Chouliaras 1998	Dunker 2008	Eshuis 2010	Eshuis 2010	Kjaer 2014	Maunder 1999	McDermott 2015	Muller 2010	Ogden [illegible]	Perrin [illegible]	Polle 2007	Saha 2015	Scarpa 2009	Trindade 2017
Impaired QoL	r=0.52*	r=0.67*	r<0.41	r=0.5*						p<0.001*			r=0.51*		One unit increase ASWAP score associated with a 0.62 decrease in IBDQ (p<0.001).*		Psychol. QoL r=0.56* Physical QoL r=0.50*

Significant association found.

Factor	Study															
	Abdovic	Bel 2015	Beld 2010	Chouliaras 2017	Dunker 1998	Eshuis 2008	Eshuis 2010	Kjaer 2014	Maunder 1999	McDermott 2015	Muller 2010	Ogden	Perrin	Polle 2007	Saha 2015	Scarpa 2009	Trindade 2017

N.B: With some tools, higher scores indicate better body image/QoL and in others higher scores indicate worse body image/QoL. This may result in both positive and negative correlation coefficients. Where applicable, signs have been flipped for ease of interpretation to clearly show the positive correlation between body image and quality of life.

Risk of Bias

The 31 studies relevant for questions 2-4 were assessed using criteria from the Joanna Briggs Institute critical appraisal tools for analytical cross-sectional and prevalence designs (Supplementary Table 2). Only cross-sectional data was relevant for the review. Poor reporting of quality criteria in many studies made quality assessment difficult. Where criteria were reported, the overall quality was variable. Most studies had some areas of low and higher quality. Only one study, McDermott (2015)[14], was able to demonstrate adequate response rates, validated outcome measurement tools and adjustment for confounders. However, Chouliaras (2017)[30], Trindade (2017)[72], Lee (2015)[51] and Bel (2015)[23] adjusted for confounders and used validated outcome measurement tools but lacked adequate response rates.

Twenty studies (64.5%) used an appropriate sample frame with acquisition of patients from outpatient settings, IBD registries or healthcare records. Eighteen studies (58.1%) clearly reported inclusion criteria applied when recruiting participants. Only twelve studies (38.7%) had response rates >75%. Fifteen studies (48.4%) used a tool which had been validated using factor analysis and internal consistency analysis to measure BI. The others used non-validated tools. Twelve studies[14, 35, 50, 51, 59, 65, 66, 73] adjusted for potential confounders such as age, gender, BMI and previous surgery often using multiple regression models. Several studies reported limited demographic data. It should also be noted that sample sizes of many of the studies were small and confidence intervals were mostly not presented.

DISCUSSION

Summary of Findings

Overall, fifteen different tools were used across 57 studies to measure BI in IBD patients. These included QoL tools incorporating BI questions or domains, BI tools and other adapted questionnaires. None offer a defining threshold for presence or absence of BID, which is not commonly considered as a specific psychological disorder unlike body dysmorphia.

It remains unclear whether IBD patients suffer with BID more so than the general population as most studies reported mean values with no reference to healthy population values. Three studies estimated a prevalence of a negative BI based on one question and this varied between 21 and 81%. This wide variation likely reflects the differences in tools and study characteristics. All three studies were based on self-report questionnaires with a wide age range and registry or hospital-based population.

Certain factors including female gender, disease activity and steroid use were consistently found to be significantly associated with increased BID in IBD patients. There was also a significant association between increasing BID and decreasing QoL reported in eight studies. These findings are consistent with a previous narrative review[79] assessing BID and sexual functioning in IBD patients.

Strengths and Weaknesses of the Review

This is the first systematic review assessing BID in an IBD population, and a robust methodology was employed to ensure that bias and errors were minimised. A sensitive search strategy means that it is unlikely that relevant studies were missed and over 50 studies have contributed to the evidence base in an area previously unexplored by a systematic review.

The review has some limitations. Some of the extracted data is based on abstracts only where full texts could not be obtained from the authors. This will have resulted in some missing information.

Furthermore, qualitative studies were not included as this was considered beyond the scope of this review. It's likely that there are qualitative studies which could offer a deeper insight into perception of BI in IBD patients.

Strengths and Weaknesses of the Evidence

There are some weaknesses within the included evidence. All studies had some areas of high risk of bias or had poorly reported methodological criteria thus hampering quality assessment. Some studies had very low response rates leading to possible under-representation of certain groups. Few studies adjusted for confounders which could have resulted in overestimates of associations.

A further issue is the lack of healthy control groups. Although it appears that IBD patients are concerned about BI, it is difficult to determine whether they are

affected more than the general population. However, it has been found that children and adolescents with chronic illnesses such as asthma, cystic fibrosis and diabetes do have increased BID compared to healthy peers[80].

Non-validated tools were often used for measuring BI and the reliability and validity of findings based on these is therefore unknown. There is also still little known about potential changes in BI perception over time.

Findings in Context

This review is consistent with findings from the narrative review by Jedel (2015)[79]which found that BI could potentially be a problem in IBD patients. Whilst surgery has been found to be an important contributing factor in BID in other research [81], it is unclear how it impacts upon IBD patients. An association between BID and poorer QoL has been highlighted in both.

Females and adolescents are more likely to be concerned with BI and to suffer with BID compared with males and older people[82-87]. Whilst we found inconsistent results surrounding age, IBD is often diagnosed in adolescence when BID could be more of a concern.

In oncology, BI is more widely researched. One study suggested gynaecologic cancer patients suffered with BID which predicted emotional well-being[88]. Another study with advanced cancer patients suggested BID was associated with depression, anxiety and fatigue[89]. Qualitative research in pregnancy[90] and systematic lupus[91] suggests BI can affect medication compliance and that

patients would like more support around dealing with BI issues. This could also be true for IBD patients.

Finally, a previous systematic review found that children with chronic conditions were more likely to be dissatisfied with their body than healthy peers[92]. Although IBD patients were not included, patients with similar chronic diseases like diabetes, cancer, asthma and scoliosis were, suggesting IBD patients could be similarly affected.

Implications

This evidence identified in this review suggests an association between BID and poorer QoL as well as finding factors influencing BI in IBD patients. There were however limitations to the evidence in terms of methodological quality and/or reporting. Also, results were difficult to compare across studies. More promisingly, BI is becoming an increasingly assessed outcome, highlighting the need for continued research in this area.

Current research suggests that age, gender, medication and disease activity in IBD may impact upon BI. These could be taken into account by clinicians and patients by altering therapy or targeting comorbidities which could have a beneficial effect on BID. Interventions to improve BI could be incorporated into treatment strategies, which may in turn help to improve QoL. A recent systematic review[93] found that stress-management, mindfulness and talking therapies may offer small to moderate improvements in BI however there is a lack of evidence from good randomised controlled trials.

Future Research

Future research should focus on developing a consensus around which validated tool or tools are best suited to measuring BID in an IBD population. Whilst we describe validity of tools such as the Body Image Scale, we have not independently verified this, therefore we could not recommend a particular tool. Defining thresholds may allow estimation of the prevalence of BID in this population. Establishing reference values in a healthy population would allow for more meaningful interpretation of BID scores across different chronic diseases. Enrolling patients from diagnosis and following them over time would be useful to measure how BI changes with duration, activity of disease and treatment. Whilst more severe IBD symptoms or invasive treatment options may exacerbate BID, BID itself and any associated anxiety or depressive symptoms may in turn exacerbate IBD symptoms[94, 95], and future research should also address this association. If BID is recognised and treated early it may contribute to preventing worsening disease course. It may also be useful to encourage the use of BI as a patient reported outcome in future IBD studies. This would increase data on BID and lead to a greater understanding of the condition.

CONCLUSION

In conclusion, the evidence suggests a detrimental effect of IBD on BI, but uncertainty remains due a lack of comparison data from healthy populations. Associations of BID with disease-related factors such as steroid treatment, fatigue, disease activity and surgery are apparent and findings suggest a

correlation between impaired BI and poorer QoL. These results should be cautiously interpreted due to risk of bias and/or poor reporting of methodological criteria amongst included studies, and the wide variation between populations, BI tools, and scoring systems. Future studies should make use of validated measurement tools and include BI as a main outcome where appropriate.

Specific Author Contributions

SB identified the topic, undertook scoping, defined the question, developed the protocol and wrote the draft of the manuscript. IH contributed to the methods development and carried out second reviewer tasks as well as helping to draft, comment on and approve the final version of this paper. DM provided substantial methodological input to aid protocol development and assisted with drafting and reading, commenting on approving the final version. JD provided methodological input and read, commented on and edited the draft and approved the final version.

Financial Support

During this research Isobel Harris was funded by a National Institute for Health Research (NIHR) Research Methods - Systematic Review Fellowship and Sophie Beese was a locally funded trainee in systematic reviews at the University of Birmingham with agreement from the NIHR. This article presents independent research funded by the NIHR. The views expressed are those of the authors and not necessarily those of the NHS, the NIHR or the Department of Health.

Acknowledgements

Not applicable.

Conflicts of Interest

The authors have nothing to disclose.

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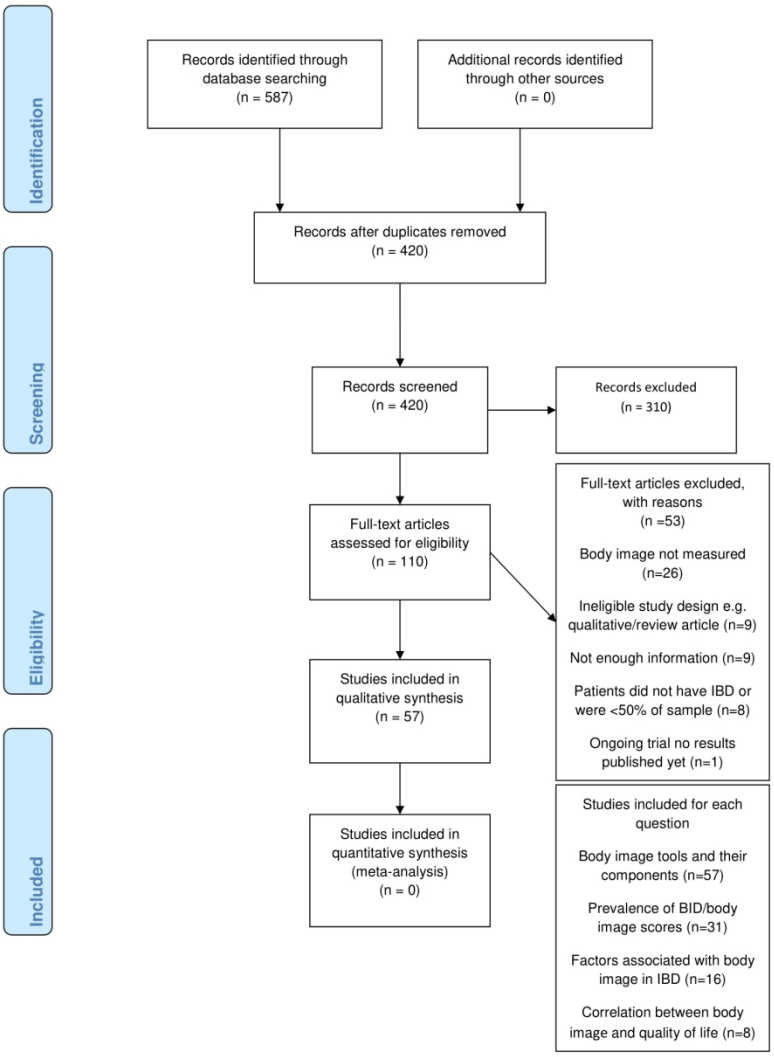
Figures

1. The selection process of records for inclusion/exclusion detailed in a PRISMA flowchart.



437x618mm (96 x 96 DPI)

Supplementary Data Content - Table 1

MEDLINE Search Strategy – OVID MEDLINE In process & other non-indexed citations and OVID MEDLINE.

Search	Query
#1	exp inflammatory bowel diseases/
#2	inflammatory bowel disease*.mp.
#3	exp Colitis, Ulcerative/
#4	ulcerative colitis.mp.
#5	exp Crohn disease/
#6	Crohn* disease.mp.
#7	Crohn*.mp.
#8	IBD.mp.
#9	CD.mp.
#10	UC.mp.
#11	1 OR 2 OR 3 OR 4 OR 5 OR 6 OR 7 OR 8 OR 9 OR 10
#12	exp body image/
#13	body image.mp.
#14	body dissatisfaction.mp.
#15	body awareness.mp.
#16	body concern*.mp.
#17	body attitude*.mp.
#18	body preoccupation.mp.

#19	body perception.mp.
#20	body anxiety.mp.
#21	body conscious*.mp.
#22	12 OR 13 OR 14 OR 15 OR 16 OR 17 OR 18 OR 19 OR 20 OR 21
#23	11 AND 22

1 **Supplementary Data Content - Table 2** Results of risk of bias assessment using Joanna Briggs Institute Tools

Study	Was the sample frame appropriate to address the target population?	Were the criteria for inclusion in the sample clearly defined?	Were the study subjects and the setting described in detail?	Was the exposure measured in a valid and reliable way?	Were objective, standard criteria used for measurement of the condition?	Were confounding factors identified?	Were strategies to deal with confounding factors stated?	Were the outcomes measured in a valid and reliable way?	Was appropriate statistical analysis used?	Was the response rate adequate, and if not, was the low response rate managed appropriately? (>75%)
Abdovic et al (2013)	Yes	Yes	Yes	Yes	N/A	No	No	Yes	Yes	Yes
Bel et al (2015)	Yes	Yes	Yes	Yes	N/A	Yes	Yes	Yes	Yes	No
Beld et al (2010)	Yes	Yes	No	Yes	Yes	No	No	No	Yes	Yes

Study	Was the sample frame appropriate to address the target population?	Were the criteria for inclusion in the sample clearly defined?	Were the study subjects and the setting described in detail?	Was the exposure measured in a valid and reliable way?	Were objective, standard criteria used for measurement of the condition?	Were confounding factors identified?	Were strategies to deal with confounding factors stated?	Were the outcomes measured in a valid and reliable way?	Was appropriate statistical analysis used?	Was the response rate adequate, and if not, was the low response rate managed appropriately? (>75%)
Bengtsson et al (2011)	Yes	No	No	Yes	Yes	Unclear	No	Yes	Yes	No
Brown et al (2015)	Yes	Yes	Yes	Yes	Yes	Unclear	No	No	Yes	No
Chouliaras et al (2017)	Yes	Yes	Yes	Yes	N/A	Yes	Yes	Yes	Yes	Unclear
de Rooy et al (2001)	Unclear	No	Yes	No	N/A	Yes	Yes	Yes	Yes	Unclear

Study	Was the sample frame appropriate to address the target population?	Were the criteria for inclusion in the sample clearly defined?	Were the study subjects and the setting described in detail?	Was the exposure measured in a valid and reliable way?	Were objective, standard criteria used for measurement of the condition?	Were confounding factors identified?	Were strategies to deal with confounding factors stated?	Were the outcomes measured in a valid and reliable way?	Was appropriate statistical analysis used?	Was the response rate adequate, and if not, was the low response rate managed appropriately? (>75%)
Dunker et al (1998)	No	No	Yes	Unclear	Unclear	No	No	No	Yes	Yes
Dunker et al (2001)	Unclear	No	Unclear	Yes	Unclear	Unclear	Unclear	No	Yes	Yes
Eshuis et al (2008)	Yes	Unclear	Yes	Yes	Yes	Yes	Yes	No	Yes	Yes
Eshuis et al	Unclear	Yes	Unclear	Yes	Yes	No	No	No	Yes	Yes

Study	Was the sample frame appropriate to address the target population?	Were the criteria for inclusion in the sample clearly defined?	Were the study subjects and the setting described in detail?	Was the exposure measured in a valid and reliable way?	Were objective, standard criteria used for measurement of the condition?	Were confounding factors identified?	Were strategies to deal with confounding factors stated?	Were the outcomes measured in a valid and reliable way?	Was appropriate statistical analysis used?	Was the response rate adequate, and if not, was the low response rate managed appropriately? (>75%)
(2010)										
Gallo et al (2014)	Yes	Yes	Yes	Yes	N/A	No	No	Yes	Yes	Yes
Giudici et al (2017)	No	Unclear	Unclear	Unclear	Unclear	Unclear	Unclear	Unclear	Unclear	Unclear
Grootenhuis (2009)	Yes	Yes	Yes	N/A	Unclear	Yes	Yes	No	Yes	No

Study	Was the sample frame appropriate to address the target population?	Were the criteria for inclusion in the sample clearly defined?	Were the study subjects and the setting described in detail?	Was the exposure measured in a valid and reliable way?	Were objective, standard criteria used for measurement of the condition?	Were confounding factors identified?	Were strategies to deal with confounding factors stated?	Were the outcomes measured in a valid and reliable way?	Was appropriate statistical analysis used?	Was the response rate adequate, and if not, was the low response rate managed appropriately? (>75%)
Kjaer et al (2014)	Unclear	Unclear	Yes	Yes	Unclear	No	No	No	Yes	No
Kuruvilla et al (2012)	Yes	Unclear	Unclear	Unclear	Unclear	Unclear	Unclear	Unclear	Unclear	Unclear
Lee et al (2015)	Yes	Yes	Yes	Unclear	Yes	Yes	Yes	Yes	Yes	Unclear
Mason et al (2015)	Yes	Yes	Yes	Yes	N/A	No	No	Yes	Yes	Unclear

Study	Was the sample frame appropriate to address the target population?	Were the criteria for inclusion in the sample clearly defined?	Were the study subjects and the setting described in detail?	Was the exposure measured in a valid and reliable way?	Were objective, standard criteria used for measurement of the condition?	Were confounding factors identified?	Were strategies to deal with confounding factors stated?	Were the outcomes measured in a valid and reliable way?	Was appropriate statistical analysis used?	Was the response rate adequate, and if not, was the low response rate managed appropriately? (>75%)
Maunder et al (1999)	Unclear	Unclear	Yes	Yes	N/A	No	No	Yes	Yes	Unclear
McDermott et al (2015)	Yes	Yes	Unclear	Unclear	N/A	Yes	Yes	Yes	Yes	Yes
Muller et al (2010)	Yes	Yes	Unclear	Unclear	N/A	Yes	Yes	No	Yes	Unclear
Ogden et al	Unclear	Unclear	Unclear	Unclear	N/A	N/A	N/A	Yes	Yes	Yes

Study	Was the sample frame appropriate to address the target population?	Were the criteria for inclusion in the sample clearly defined?	Were the study subjects and the setting described in detail?	Was the exposure measured in a valid and reliable way?	Were objective, standard criteria used for measurement of the condition?	Were confounding factors identified?	Were strategies to deal with confounding factors stated?	Were the outcomes measured in a valid and reliable way?	Was appropriate statistical analysis used?	Was the response rate adequate, and if not, was the low response rate managed appropriately? (>75%)
(2011)										
Perrin et al (2008)	Yes	Yes	Yes	Unclear	N/A	N/A	N/A	Yes	Yes	No
Polle et al (2007)	Unclear	Unclear	Unclear	Yes	Unclear	Yes	No	No	Yes	Yes
Ponsioen et al (2017)	Yes	Yes	Yes	Yes	Unclear	Unclear	Unclear	Yes	Unclear	No

Study	Was the sample frame appropriate to address the target population?	Were the criteria for inclusion in the sample clearly defined?	Were the study subjects and the setting described in detail?	Was the exposure measured in a valid and reliable way?	Were objective, standard criteria used for measurement of the condition?	Were confounding factors identified?	Were strategies to deal with confounding factors stated?	Were the outcomes measured in a valid and reliable way?	Was appropriate statistical analysis used?	Was the response rate adequate, and if not, was the low response rate managed appropriately? (>75%)
Saha et al (2015)	Yes	Yes	Yes	Yes	N/A	Yes	Yes	Unclear	Yes	No
Scarpa et al (2009)	Unclear	Yes	Unclear	Yes	Yes	Yes	Yes	No	Yes	Yes
Shepanksi (2005)	Yes	Unclear	Unclear	Yes	Unclear	Unclear	No	Yes	Yes	No
Trindade et al (2017)	Yes	Yes	Yes	Unclear	N/A	Yes	Yes	Yes	Yes	Unclear

Study	Was the sample frame appropriate to address the target population?	Were the criteria for inclusion in the sample clearly defined?	Were the study subjects and the setting described in detail?	Was the exposure measured in a valid and reliable way?	Were objective, standard criteria used for measurement of the condition?	Were confounding factors identified?	Were strategies to deal with confounding factors stated?	Were the outcomes measured in a valid and reliable way?	Was appropriate statistical analysis used?	Was the response rate adequate, and if not, was the low response rate managed appropriately? (>75%)
Vlahou et al (2008)	Yes	Unclear	No	Unclear	N/A	Yes	Yes	No	Yes	Unclear
Voermans et al (2010)	Unclear	Yes	Unclear	Yes	N/A	No	No	No	Yes	Yes