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# Muscularity concerns in adolescent body dysmorphic disorder: evidence from clinical and community samples

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# Abstract

Muscle dysmorphia, a DSM-5 specifier for body dysmorphic disorder (BDD), is characterised by preoccupation with insufficient muscularity. It is described as primarily affecting males and having unique clinical correlates, risks, and treatment needs. However, evidence remains limited. We examined muscularity concerns in a clinical sample of adolescents with BDD (*N* = 311) and a community sample of adolescents with BDD (*n* = 50) and broader appearance preoccupation (*N* = 252). We additionally examined the association between muscularity concerns and BDD treatment outcomes in a subsample of 228 adolescents from the clinical group who received specialist cognitive behaviour therapy with or without medication. Muscularity concerns were reported in 14.8% of the clinical sample, 38.0% of the community BDD sample, and 31.7% of the community appearance preoccupation sample. The proportion of boys was greater in those with versus without muscularity concerns in both the clinical and community settings (clinical sample: 44.2% vs. 15.5%; community-based appearance preoccupation sample: 40.0% vs. 20.9%), although most adolescents with muscularity concerns were girls (clinical sample: 53.4%; community-based appearance preoccupation sample: 60.0%). Muscularity concerns were associated with more appearance concerns and excessive/rigid exercise, but not impairment, comorbidity, self-harm, suicidality or treatment outcome. Findings suggest that muscularity concerns are common in adolescent BDD, regardless of gender. However, muscularity concerns do not appear to define a distinct clinical subgroup, raising questions about the utility of the DSM-5 muscle dysmorphia specifier.


# Introduction

Muscle dysmorphia is a form of body dysmorphic disorder (BDD), which the Diagnostic and Statistical Manual of Mental Disorders, 5th edition (DSM-5) defines as occurring if an individual fulfils core diagnostic for BDD and, additionally, is preoccupied with the idea that his or her body build is too small or insufficiently muscular (American Psychiatric Association, 2013). According to the DSM-5, muscle dysmorphia can be specified even if the individual is preoccupied with additional appearance features beyond muscularity, which is often the case (Pope et al., 2005). It is estimated that approximately 10–20% of men with BDD fulfil criteria for muscle dysmorphia (Pope et al., 2005; Pope et al., 1997), and it is assumed to be less common among women (Cunningham et al., 2017).

Muscle dysmorphia is often differentiated from other forms of BDD as it is considered to have certain unique clinical features (e.g., excessive exercise, controlled dietary intake, greater severity) and risks (e.g., muscle damage, anabolic steroids, substance misuse, elevated suicidality) (Blashill et al., 2020; Pope et al., 2005), and may require different treatment strategies (Cunningham et al., 2017). However, empirical evidence for muscle dysmorphia being a distinct subtype is relatively weak (Blashill et al., 2020; Pope et al., 2005), and it is notable that the International Classification of Diseases, 11th revision (ICD-11) does not include muscle dysmorphia as a formal specifier. Importantly, there have been no studies to date examining treatment outcomes for individuals with BDD with versus without muscle dysmorphia and, therefore, it remains unclear whether standard treatment strategies, namely cognitive

behaviour therapy (CBT) and selective serotonin reuptake inhibitors (SSRIs), are equally effective when muscularity concerns are present.

Furthermore, little empirical attention has been given to muscle dysmorphia in girls and women and among adolescents. Muscle dysmorphia was first reported in body building communities, and it was originally thought that this phenomenon occurred almost exclusively in men (Pope et al., 1993). Consequently, research on muscle dysmorphia to date is largely confined to male-only samples of adults, even though BDD typically has an adolescent-onset and female preponderance (Bjornsson et al., 2013; Krebs et al., 2025; Veale et al., 2016). In recent years, a few studies have examined muscle dysmorphia in unselected community-based samples of adolescents and young adults (Ganson et al., 2023; Mitchison et al., 2022). A survey-based study in Australia (*N* = 3,618) found the prevalence of self-reported muscle dysmorphia to be 2.2% among adolescent boys and 1.4% among girls (Mitchison et al., 2022). Another survey-based study in Canada (*N* = 2,256) found muscle dysmorphia symptoms to be prevalent among young adults, with clinically significant symptoms occurring in 25.7% of men versus 11.2% of women (Ganson et al., 2023). While these studies indicate that muscle dysmorphia symptoms may be relatively common across genders, they rely on self-report measures and do not include diagnostic assessment of BDD. Consequently, it remains unclear whether muscularity concerns reported in these studies were associated with BDD or with other forms of psychopathology, such as eating disorders. Further research is therefore needed to establish the frequency of muscularity concerns and understand the associated clinical presentation in youth who meet diagnostic criteria for BDD.

The current study addressed two key questions relating to muscularity concerns in adolescent BDD. First, we aimed to determine the prevalence and clinical correlates of muscularity concerns in a clinical sample of young people with a confirmed diagnosis of BDD attending specialist clinics. Furthermore, we sought to replicate our findings in a large, nationally representative community sample of adolescents who had completed diagnostic assessments of BDD. Within the community sample, we examined muscularity concerns among those who a) fulfilled DSM-5 diagnostic criteria for BDD, and b) reported appearance preoccupations but did not necessarily fulfil diagnostic criteria for BDD, to maximise statistical power. Second, we aimed to test whether the presence of muscularity concerns was associated with differential response to specialist BDD multimodal treatment within a subsample of individuals in the clinical group.

## Methods

# Settings and procedures

**Clinical cohort.** All participants had been referred between January 2015 and November 2024 to one of two specialist clinics, namely the OCD and Related Disorders Clinic for Children and Adolescents in Stockholm, Sweden (*n* = 165), or the National and Specialist OCD, BDD, and Related Disorders Clinic for Young People at the Maudsley Hospital in London, England (*n* = 146), and had a diagnosis of BDD. In both clinics, intake assessments consisted of an approximately 3-hour session, described in detail

elsewhere (Rautio et al., 2020). Briefly, in Stockholm, the assessment included the administration of a diagnostic interview module for OCD and related disorders based on the Structured Clinical Interview for DSM-IV (SCID-I) (American Psychiatric Association, 2018) adapted to match the DSM-5 criteria and, additionally, most patients completed the Mini International Neuropsychiatric Interview for Children (MINI-KID) (Sheehan et al., 1998) to evaluate comorbidities. The London site used the Development and Well-Being Assessment (DAWBA) (Goodman et al., 2000) as a screening tool prior to the assessment. The diagnosis of BDD and psychiatric comorbidities were confirmed by a clinician during the assessment. In both sites, the Yale-Brown Obsessive-Compulsive Scale Modified for BDD – Adolescent version (BDD-YBOCS-A) (Monzani et al., 2022) was used to evaluate BDD symptom severity. Interviews were conducted by experienced clinical psychologists and assessments were discussed in a multidisciplinary team meeting also including a child and adolescent psychiatrist.

The Stockholm Regional Ethical Review Board and the South London and Maudsley Child and Adolescent Mental Health Service Audit Committee approved the study. In the Stockholm site, informed consent was provided by all participants and their parents/legal guardians. In the London site, the study was part of an audit of routinely collected clinical data, hence informed consent was not required.

**Community-based cohort.** The Mental Health of Children and Young People in England (MHCYP) survey (Vizard et al., 2020) is an epidemiological study which used stratified probability sampling to identify a nationally-representative sample of 9,117 children and adolescents aged 2–19 years living in England who were surveyed in 2017. In the current study, we included participants who were aged between 11 and 19 years who had been assessed for BDD and who had available data on self-reported appearance concerns. This age range was selected for consistency with the clinical sample and because BDD is rare in children (Krebs et al., 2025).

The MHCYP (2017) survey was reviewed and approved by the West London & GTAC Research Ethics Committee (16/LO/0155) and the Health Research Authority Confidentiality Advisory Group (16/CAG/0016). Parents of children 2 to 16 years of age provided consent, children and adolescents 11 to 16 years provided assent to be interviewed, and adolescents aged 17–19 provided their own consent.

## Measures

**Clinical cohort.** The following measures were administered at both clinical sites before and at the end of treatment, unless otherwise specified.

**Clinician-rated measures.** The BDD-YBOCS-A is a widely-used 12-item clinician-administered, semi-structured interview that measures BDD symptom severity over the past week (Monzani et al., 2022). The BDD-YBOCS-A contains 12 Likert-type items ranging from 0 to 4: five questions on obsessions, five on compulsions, one about insight, and one to measure avoidance behaviour. The total score ranges from 0 to 48, higher scores denoting higher symptom severity. BDD-YBOCS-A scores of 24–29 correspond to moderate BDD, scores from 30–36 to severe BDD, and scores from 37–48 points to extreme BDD

(Mataix-Cols et al., 2025). Treatment response was defined as a reduction ≥ 30% on the BDD-YBOCS-A from baseline, while remission was defined as a total score < 12 on the BDD-YBOCS-A (Fernández de la Cruz et al., 2026).

As part of the BDD-YBOCS-A, clinicians asked participants about their main body areas of concern including muscularity, either using a body drawing to aid a head-to-toe scan of appearance concerns or using a standardised checklist of 28 body parts. Clinicians also asked about current desire for and/or whether they had undergone any cosmetic/surgical procedure related to their BDD concerns. Additionally, clinicians collected detailed data on school attendance and asked about past or current self-harm, suicidal thoughts, and/or suicide attempts.

Additionally, participants were administered the Clinical Global Impairment (CGI) and the Children's Global Assessment Scale (CGAS). The CGI – Severity (CGI-S) is a single-item, clinician rating of global symptom severity, in this case focused on BDD. Scores range from 1 ('not ill at all') to 7 ('among the most extremely ill') (Guy, 1976). The CGI – Improvement (CGI-I) is a single-item, clinician rating of symptom improvement. Improvement scores, in relation to baseline, range from 1 ('very much improved') to 7 ('very much worse') (Guy, 1976). The CGI-I is not administered at baseline. The CGAS is a single-item, clinician-rated measure of global functioning (ranging from 1 to 100; higher scores indicate better functioning) across all domains. The CGAS is a commonly used instrument with good psychometric properties (Shaffer et al., 1983).

**Self- and parent-reported measures.** The Appearance Anxiety Inventory (AAI) is a self-reported measure that assesses BDD-related cognitive processes and behaviours. It consists of 10 items scored on a 0–4 Likert scale, yielding a total score ranging from 0 to 40, higher scores denoting higher symptom severity. It includes two subscales: avoidance and threat monitoring. It has good convergent validity and high internal consistency (Gumpert et al., 2024).

Self-reported depressive symptoms were assessed using different measures. In Stockholm, the Children's Depression Inventory–Short Version (CDI–S), a 10-item instrument, was first used and then replaced by the Short Mood and Feelings Questionnaire, child version (SMFQ-C), a 13-item measure. During the whole period, the Stockholm site also used the 13-item parent-reported version of the SMFQ (SMFQ-P). In the London site, the Mood and Feeling Questionnaire, child version (MFQ-C), a 33-item measure, was used throughout the whole inclusion period and no parent-reported measures were applied. A *z*-transformation was done to standardise scores from the different depression measures for analyses. All three measures of depressive symptoms have good psychometric properties (Allgaier et al., 2012; Rhew et al., 2010; Thabrew et al., 2018).

The self-reported Work and Social Adjustment Scale–Youth (WSAS-Y) and Parent (WSAS-P) versions were used to assess BDD-related functional impairment in five areas (i.e., school/work, daily situations, social activities, leisure activities, and relationships). The instruments have excellent psychometric properties (Jassi et al., 2020). The WSAS was used at baseline at both sites, but only the Stockholm site administered it after treatment.

**Community-based cohort.** In the MCHYP, BDD and appearance preoccupations were measured using the DAWBA. The DAWBA is a structured diagnostic interview tool for children and adolescents assessing common psychiatric and neurodevelopmental disorders (Goodman et al., 2000), which was administered by a researcher as a face-to-face interview to parents and to adolescents. The BDD module begins with the following screening item: *"Most people are concerned about how they look. This typically varies from time to time, e.g., being worse if they develop a bad spot or are about to star in the school play. Some people have worries about their appearance that go beyond this, filling their thoughts, taking up a lot of their time and really upsetting them. Does this happen to [you / your child]?"* The question has three response options: "no," "a little," and "a lot". Those endorsing "a little" or "a lot" completed further items about appearance concerns and appearance-related behaviours, distress, and impairment. Areas of appearance preoccupation were captured by questions asking about eight aspects of appearance, including muscularity, using the same response options ("no," "a little," or "a lot"). A BDD diagnosis required that all DSM-5 criteria were met. Final diagnoses were assigned by trained clinical raters (who were child and adolescent psychiatrists) by reviewing all closed and open responses across all diagnostic categories and across informants, as previously described (Krebs et al., 2025).

In the current study, we examined muscularity concerns among adolescents with a confirmed BDD diagnosis and also among those with more broadly defined appearance preoccupation, operationalised as those who self-reported "a lot" of appearance concerns on the initial screening question described above. Adolescents with appearance preoccupation were divided into a "muscularity concerns" group, defined as those who reported "a little" or "a lot" of concerns about muscularity, and a "no muscularity concerns" group, consisting of those who did not report any muscularity concerns.

We also used data on DSM-5 psychiatric comorbidities derived from the DAWBA. Additionally, lifetime self-harm or suicide attempts were assessed via a single item ("*Have you ever tried to harm or kill yourself*?") with a yes/no response format. Emotional and behavioural symptoms were measured using the 25-item Strengths and Difficulties Questionnaire (SDQ) (Goodman, 2001), completed by both parents and young people. The SDQ provides five subscale scores (emotional, conduct, hyperactivity/inattention, peer problems, prosocial behaviour; each 0–15) and an impact score reflecting psychosocial impairment. Psychometric properties of the SDQ are well established (Bourdon et al., 2005; Goodman, 2001).

## Treatment

A subset of individuals in the clinical cohort received multimodal treatment at one of the two specialist clinics. The cognitive behaviour therapy (CBT) protocol used in both clinical settings was an updated version of the manual developed for a previous randomised controlled trial (2015). The protocol primarily focuses on exposure with response prevention, as previously described (Rautio et al., 2022). Standard treatment involves around 20 weekly, one-hour sessions. However, given the naturalistic nature of the study, the format of delivery was matched to the patients' needs and, in some cases longer or more frequent therapy sessions were offered. Similarly, the total number of sessions varied according to need

and treatment response. At both sites, CBT was delivered by clinical psychologists with experience in the treatment of BDD or by clinical psychology trainees under supervision. Patients could also receive concurrent pharmacological treatment for their BDD and other comorbid symptoms/disorders, which was prescribed by child and adolescent psychiatrists at the respective clinics, according to treatment guidelines (BUP Stockholm, 2021; NICE, 2005) and clinical judgement.

## Statistical analyses

In both cohorts, baseline demographic and clinical characteristics were examined descriptively using means and standard deviations for continuous variables, and frequencies and percentages for categorical variables. Between-group differences were explored using Student's t-tests and Chi-squared tests, respectively.

Linear mixed-effect (LME) models for repeated measures with maximum likelihood estimation of parameters were implemented to examine treatment outcomes in the clinical cohort. All models included fixed effects of time (baseline and post-treatment), muscularity concerns (present or not present), and the interaction time by presence of muscularity concerns. A random intercept was included to account for the meaningful variance between participants at baseline. In addition to the LME models, we calculated the proportion of treatment responders and remitters in both the muscularity concerns and no muscularity concerns groups using empirically derived definitions, as described above (Fernández de la Cruz et al., 2026). Between-group differences were explored using Chi-squared tests, respectively.

A series of sensitivity analyses were conducted to assess the robustness of findings in the community cohort. All descriptive analyses were repeated using a more stringent definition of muscularity concerns, whereby only those who reported "a lot" of concern about muscularity were classified as having muscularity concerns ($n$ = 22). Those who reported "a little" muscularity concerns ($n$ = 58) were excluded from these analyses (rather than reallocated to the "no muscularity concern" group).

Alpha levels (two-tailed) were set to $p < 0.05$. All analyses were performed using Stata 19.5 (StataCorp LLC).

## Results

# Prevalence and correlates of muscularity concerns

**Clinical cohort.** A total of 332 individuals were assessed at one of the two clinics who had BDD as the main diagnosis requiring treatment. Of these, 21 were excluded due to being returning patients (i.e., they had done at least another initial assessment in the past), because they had missing information on BDD-YBOCS-A at baseline or missing information on areas of preoccupation. Hence, the final sample consisted of 311 participants (53.5% girls) (Fig. 1, **Panel A**).

Forty-six adolescents (14.8%; 95% CI: 11.0-19.2%) reported muscularity concerns, and all of them had additional areas of appearance preoccupation. Demographic and clinical characteristics of those with and without muscularity concerns are shown in Table 1 and Table 2. There was a significantly higher percentage of boys in those with versus without muscularity concerns (44.2% *vs.* 15.5%; $\chi^2$ = 22.03, *p*<.001), although most adolescents with muscularity concerns were girls (53.5%). Individuals with muscularity concerns were more likely to be receiving attention-deficit/hyperactivity disorder medication (13.3% *vs.* 0%; $\chi^2$ = 4.34, *p*=.037) and less likely to be prescribed psychotropic medications under the "other" group (e.g., antihistamine and melatonin) (10.3% *vs.* 30.4%; $\chi^2$ = 4.88, *p*=.027). Individuals with muscularity concerns also reported a higher number of areas of appearance concern (12.7 *vs.* 8.2; *t*=-5.24, *p*<.001) and were more likely to report excessive exercise when asked about BDD-related repetitive behaviours (44.4% *vs.* 12.8%; $\chi^2$ = 8.56, *p*=.003) (**Supplementary Figs. 1 and 2)**. There were no other significant group differences in other demographic or clinical characteristics, including BDD symptom severity, psychiatric comorbidity, self-harm, suicidality, school attendance, and psychosocial impairment, as rated by clinicians, parents and adolescents.

Table 1
Demographic and clinical characteristics of a clinical sample of adolescents with body dysmorphic disorder, with and without muscularity concerns (*N* = 311).

| **Ages *(n)*** | **Muscularity concerns (*n* = 46)** | | **No muscularity concerns (*n* = 265)** | | **Statistics** | |
|---|---|---|---|---|---|---|
| | **M** | **SD** | **M** | **SD** | **t** | **p** |
| **Age at assessment** (308) | 15.7 | 1.3 | 15.6 | 1.3 | -0.68 | 0.499 |
| **Age of BDD onset** (233) | 13.4 | 1.5 | 12.5 | 2.2 | -2.29 | 0.023* |
| **Clinical characteristics**[a] *(n)* | **N** | **%** | **N** | **%** | **$\chi^2$** | **p** |
| **Gender** (307) | | | | | 22.03 | < 0.001*** |
| Girls | 23 | 53.5 | 222 | 84.1 | | |
| Boys | 19 | 44.2 | 41 | 15.5 | | |
| Other[b] | 1 | 2.3 | 1 | 0.4 | | |
| **Any comorbid mental disorder** (303) | 33 | 75.0 | 205 | 79.2 | 0.38 | 0.535 |
| Mood disorders[c] | 20 | 45.5 | 104 | 40.2 | 0.44 | 0.509 |
| Anxiety disorders[d] | 5 | 11.4 | 55 | 21.2 | 2.31 | 0.129 |
| Obsessive-compulsive disorder | 6 | 13.6 | 54 | 20.9 | 1.23 | 0.267 |
| Attention-deficit/hyperactivity disorder | 6 | 13.6 | 36 | 13.9 | 0.00 | 9.963 |
| Autism spectrum disorder | 10 | 22.7 | 53 | 20.5 | 0.12 | 0.732 |
| Eating disorders | 6 | 13.6 | 35 | 13.5 | 0.00 | 0.982 |
| **Family history (1st and 2nd degree relatives) of OCRD** (295) | 11 | 25.0 | 52 | 20.7 | 0.41 | 0.523 |
| **Previous CBT for BDD** (296) | 20 | 45.5 | 100 | 39.7 | 0.52 | 0.472 |
| **Pharmacological treatment** | | | | | | |
| Selective serotonin reuptake inhibitors (305) | 17 | 37.0 | 129 | 49.8 | 2.58 | 0.108 |
| Antipsychotics[e] (164) | 0 | 0.0 | 6 | 4.4 | 1.34 | 0.247 |
| ADHD medication[e] (164) | 0 | 0.0 | 18 | 13.3 | 4.34 | 0.037* |
| Other medication[e, f] (164) | 3 | 10.3 | 41 | 30.4 | 4.88 | 0.027* |

| **Ages *(n)*** | **Muscularity concerns (*n* = 46)** | | **No muscularity concerns (*n* = 265)** | | **Statistics** | |
|---|---|---|---|---|---|---|
| | **M** | **SD** | **M** | **SD** | **t** | **p** |
| **Poor or absent insight/delusional beliefs**[g] (308) | 22 | 48.9 | 162 | 52.6 | 0.29 | 0.590 |
| **Desire for cosmetic procedure** (225) | 14 | 37.8 | 80 | 42.6 | 0.28 | 0.595 |
| **Conducted a cosmetic procedure** (225) | 2 | 5.4 | 10 | 5.3 | 0.00 | 0.983 |
| **Self-harm and suicidality** (245) | 29 | 74.4 | 145 | 70.4 | 0.25 | 0.616 |
| Past or current self-harm (241) | 25 | 67.6 | 115 | 56.4 | 1.61 | 0.204 |
| Past or current suicide thoughts (237) | 25 | 67.6 | 127 | 63.5 | 0.22 | 0.636 |
| History of suicide attempts (245) | 8 | 20.5 | 39 | 15.9 | 0.73 | 0.392 |
| **School attendance** (254) | | | | | 0.28 | 0.870 |
| Full attendance | 17 | 42.5 | 93 | 43.5 | | |
| Partial attendance | 15 | 37.5 | 72 | 33.6 | | |
| No attendance | 8 | 20.0 | 49 | 22.9 | | |

* $p < 0.05$; ** $p < 0.01$; *** $p < 0.001$.

*Note*: [a] Current, unless otherwise specified; [b] For example transgender or non-binary; [c] Includes major depressive disorder and dysthymia; [d] Includes specific phobia, social anxiety disorder, panic disorder or anxiety disorders not otherwise specified; [e] Only data from the Stockholm site; [f] For example melatonin and antihistamine; [g] Defined as 3 or 4 on the insight item of the BDD-YBOCS-A.

*Abbreviations*: ADHD, attention-deficit/hyperactivity disorder; BBD, body dysmorphic disorder; CBT, cognitive behaviour therapy; OCRD, obsessive-compulsive and related disorder; SD, standard deviation.

Table 2
Clinician-, self-, and parent-reported measures in a clinical sample of adolescents with body dysmorphic disorder, with and without excessive muscularity concerns (*N* = 311).

| **Variable *(n)*** | **Muscularity concerns (*n* = 46)** | | **No muscularity concerns (*n* = 265)** | | **Statistics** | |
|---|---|---|---|---|---|---|
| | **M** | **SD** | **M** | **SD** | **t** | **p** |
| **BDD measures** | | | | | | |
| **BDD-YBOCS-A** (311) | 31.3 | 5.2 | 31.7 | 5.7 | 0.50 | 0.617 |
| Obsessions (297) | 13.0 | 2.4 | 13.4 | 2.6 | 0.95 | 0.345 |
| Compulsions (297) | 13.2 | 2.5 | 13.3 | 2.5 | 0.34 | 0.734 |
| Insight (308) | 2.4 | 0.8 | 2.5 | 0.8 | 0.72 | 0.472 |
| Avoidance (306) | 2.2 | 0.7 | 2.3 | 0.9 | 0.98 | 0.327 |
| Number of preoccupations (311) | 12.7 | 7.0 | 8.2 | 5.1 | -5.24 | < 0.001*** |
| **AAI** (252) | 27.2 | 7.2 | 28.1 | 7.3 | 0.65 | 0.517 |
| **Other clinical measures** | | | | | | |
| **CGI-S** (228) | 4.8 | 0.8 | 4.8 | 0.8 | -0.43 | 0.665 |
| **CGAS** (306) | 46.3 | 6.8 | 44.1 | 9.1 | -1.54 | 0.124 |
| **CDI-S**[a] (56) | 11.5 | 6.2 | 11.3 | 4.1 | -0.12 | 0.902 |
| **SMFQ-C**[a] (93) | 15.6 | 6.1 | 15.7 | 5.8 | 0.02 | 0.981 |
| **SMFQ-P**[a] (89) | 14.8 | 5.7 | 14.6 | 6.0 | -0.10 | 0.918 |
| **MFQ-C**[b] (78) | 40.3 | 16.1 | 41.3 | 13.9 | 0.22 | 0.829 |
| **WSAS-Y** (218) | 21.7 | 8.6 | 22.2 | 7.6 | 0.40 | 0.690 |
| School or work (216) | 5.6 | 2.4 | 5.9 | 2.0 | 0.92 | 0.361 |
| Everyday functioning (216) | 3.4 | 2.8 | 3.6 | 2.4 | 0.51 | 0.610 |
| Social activities (216) | 5.5 | 2.1 | 5.6 | 2.1 | 0.31 | 0.756 |
| Spare time (216) | 3.0 | 2.3 | 2.5 | 2.3 | -1.21 | 0.227 |
| Family activities (216) | 4.2 | 2.4 | 4.6 | 2.2 | 1.04 | 0.299 |
| **WSAS-P**[a] (156) | 21.5 | 7.7 | 21.8 | 7.1 | 0.18 | 0.860 |
| School or work (156) | 6.1 | 2.0 | 6.1 | 1.9 | -0.06 | 0.949 |

| Variable *(n)* | Muscularity concerns (*n* = 46) | | No muscularity concerns (*n* = 265) | | Statistics | |
|---|---|---|---|---|---|---|
| | **M** | **SD** | **M** | **SD** | **t** | **p** |
| Everyday functioning (156) | 3.4 | 2.1 | 3.6 | 2.3 | 0.37 | 0.714 |
| Social activities (156) | 5.1 | 2.3 | 5.5 | 2.0 | 1.02 | 0.311 |
| Spare time (156) | 2.5 | 2.4 | 2.1 | 2.2 | -0.77 | 0.442 |
| Family activities (156) | 4.4 | 2.4 | 4.4 | 2.2 | 0.12 | 0.907 |

* $p < 0.05$; ** $p < 0.01$; *** $p < 0.001$.

*Note*: [a] Only data from the Stockholm site; [b] Only data from the London site.

*Abbreviations*: AAI, Appearance Anxiety Inventory; BDD, body dysmorphic disorder; BDD-YBOCS-A, Yale-Brown Obsessive-Compulsive Scale, modified for BDD–Adolescent version; CDI-S, Children's Depression Inventory – Short Version; CGAS, Children´s Global Assessment Scale; CGI-S, Clinical Global Impression – Severity; MFQ-C, Mood and Feelings Questionnaire, Child Version; SD, standard deviation; SMFQ-C, Short Mood and Feelings Questionnaire, Child Version; SMFQ-P, Short Mood and Feelings Questionnaire, Parent Version; WSAS-Y, Work, Social and Adjustment Scale – Youth Version; WSAS-P, Work, Social and Adjustment Scale – Parent Version.

**Community cohort.** A total of 60 participants fulfilled DSM-5 diagnostic criteria for BDD. Of those, 10 did not have data available on self-reported muscularity concerns and were therefore excluded. Hence, the final sample comprised 50 adolescents (88.0% girls) (Fig. 1, **Panel B**). Nineteen (38.0%; 95% CI: 25.4–52.4%) adolescents reported muscularity concerns. Of these, 11 (22.0%) reported "a little" and 8 (16.0%) reported "a lot" of muscularity concerns. Due to the small number of cases, no statistical comparisons of those with versus without muscularity concerns were conducted.

A total of 252 adolescents (73.0% girls) reported experiencing appearance preoccupation, and all had self-reported muscularity concern data available. The prevalence of muscularity concerns among those with appearance preoccupation was 31.7% (95% CI: 26.0-37.9%). Of the 80 participants in the muscularity group, 58 (23.0%) reported "a little" and 22 (8.7%) reported "a lot" of muscularity concerns. Only two participants (2.5%) reported muscularity as their sole appearance concern.

Demographic and clinical characteristics of those with and without muscularity concerns are shown in Table 3. Similarly to the clinical sample, the majority of those who reported muscularity concerns were girls (60.0%) but there was a significantly higher proportion of boys in the group with muscularity concerns compared to the non-muscularity concerns group (40.0% *vs.* 20.9%; $\chi^2 = 10.08$, $p$=.002). Youth in the muscularity group reported a significantly higher number of areas of appearance concern (5.0 vs 3.1; $t$=-9.30, $p$<.001). There was also a higher proportion of individuals in the muscularity group that reported excessive exercising (40.9% *vs.* 23.5%; $\chi^2 = 6.73$, $p$=.009) and checking their appearance (71.8% *vs.* 54.4%; $\chi^2 = 5.92$, $p$=.015) (Table 3, **Supplementary Figs. 3 and 4**). However, there were no significant group differences in other demographic or clinical characteristics including psychiatric comorbidity, self-

and parent-reported psychosocial impairment, and self-reported experience of self-harm or suicide attempts.

Table 3
Demographic and clinical characteristics of a community sample of adolescents who self-reported excessive appearance concerns, with (*n* = 80) and without muscularity concerns (*n* = 172).

| **Variable (*n*)** | **Appearance concerns (*N* = 252)** | | | | | |
|---|---|---|---|---|---|---|
| | **Muscularity concerns (*n* = 80)** | | **No muscularity concerns (*n* = 172)** | | **Statistics** | |
| | **M** | **SD** | **M** | **SD** | **t** | **p** |
| **Age** (252) | 15.6 | 2.2 | 15.3 | 2.2 | -0.92 | 0.361 |
| **Clinical characteristics** (*n*) | **N** | **%** | **N** | **%** | **$\chi^2$** | **p** |
| **Sex** (252) | | | | | | |
| Females | 48 | 60.0 | 136 | 79.1 | 10.08 | 0.002** |
| Males | 32 | 40.0 | 36 | 20.9 | | |
| **Any comorbid mental disorder** (252) | | | | | | |
| Mood disorders | 17 | 21.3 | 29 | 16.9 | 0.71 | 0.401 |
| Anxiety disorders | 35 | 43.8 | 67 | 39.0 | 0.52 | 0.470 |
| Obsessive-compulsive disorder | 3 | 3.8 | 4 | 2.3 | 0.41 | 0.522 |
| Attention-deficit/hyperactivity disorder | 3 | 3.8 | 4 | 2.3 | 0.41 | 0.522 |
| Autism spectrum disorder | 10 | 12.5 | 15 | 8.7 | 0.872 | 0.350 |
| Eating disorders | 4 | 5.0 | 6 | 3.5 | 0.33 | 0.567 |
| **Area of concern** (252) | | | | | | |
| Face | 55 | 68.8 | 105 | 61.1 | 1.40 | 0.237 |
| Skin condition | 58 | 72.5 | 102 | 59.3 | 4.10 | 0.043* |
| Hair | 43 | 53.8 | 59 | 34.3 | 8.57 | 0.003** |
| Skin colour | 31 | 38.8 | 49 | 28.5 | 2.65 | 0.103 |
| Face or body asymmetry | 32 | 40.0 | 30 | 17.4 | 14.98 | < 0.001*** |
| Body shape | 74 | 92.5 | 142 | 82.6 | 4.41 | 0.036* |
| Other concern | 28 | 35.0 | 39 | 22.7 | 4.25 | 0.039* |
| | **M** | **SD** | **M** | **SD** | **t** | **p** |

* $p < 0.05$; ** $p < 0.01$; *** $p < 0.001$.

| **Variable** (*n*) | **Appearance concerns** (***N*** **= 252)** | | | | | |
|---|---|---|---|---|---|---|
| | **Muscularity concerns** (***n*** **= 80)** | | **No muscularity concerns** (***n*** **= 172)** | | **Statistics** | |
| **Number of preoccupations** | 5.0 | 1.6 | 3.1 | 1.5 | -9.30 | < 0.001*** |
| **Repetitive behaviours** (207) | **N** | **%** | **N** | **%** | **$\chi^2$** | **p** |
| Comparing | 29 | 59.2 | 83 | 61.0 | 0.07 | 0.794 |
| Checking | 51 | 71.8 | 74 | 54.4 | 5.92 | 0.015* |
| Camoflaging | 34 | 47.9 | 54 | 39.7 | 1.28 | 0.258 |
| Exercising | 29 | 40.9 | 32 | 23.5 | 6.73 | 0.009** |
| Reassurance seeking | 26 | 36.6 | 43 | 31.6 | 0.53 | 0.469 |
| **Other clinical variables** | **M** | **SD** | **M** | **SD** | **t** | **p** |
| **SDQ self-report** (246) | | | | | | |
| Total difficulty score | 15.0 | 5.2 | 14.5 | 5.6 | -0.66 | 0.501 |
| Emotional score | 5.0 | 2.1 | 5.0 | 2.3 | 0.09 | 0.930 |
| Impact score | 1.8 | 2.2 | 1.9 | 2.4 | 0.22 | 0.825 |
| **SDQ parent-report** (202) | | | | | | |
| Total difficulty score | 11.0 | 7.4 | 11.4 | 6.5 | 0.34 | 0.732 |
| Emotional score | 3.5 | 2.4 | 3.9 | 2.7 | 0.96 | 0.340 |
| Impact score | 1.4 | 2.2 | 1.7 | 2.4 | 1.07 | 0.285 |
| | **N** | **%** | **N** | **%** | **$\chi^2$** | **p** |
| **Self-harm or suicide attempts** (252) | 26 | 32.5 | 50 | 29.1 | 0.31 | 0.581 |

* $p < 0.05$; ** $p < 0.01$; *** $p < 0.001$.

*Abbreviations:* SD, standard deviation; SDQ, strength and difficulties questionnaire.

A series of sensitivity analyses were conducted in which we restricted 'muscularity concerns' to include only those who reported that they had "a lot" of muscularity concerns (*n* = 22/194; 11.3%). The pattern of results remained largely similar, although some group differences became non-significant due to the reduced statistical power. Specifically, there was no significant difference in the proportion of boys and girls in the muscularity concerns versus no muscularity concern group, and there were no significant group differences in preoccupation with skin conditions, 'other appearance concerns' or any appearance-

related behaviours. On the other hand, some group differences in psychiatric comorbidity emerged. Specifically, a higher proportion of individuals in the muscularity concern group met diagnostic criteria for anxiety and mood disorders, compared to the no muscularity concern group (anxiety disorders: $\chi^2$ = 9.09, $p$=.003; mood disorders: $\chi^2$ = 4.81; $p$=.03) (**Supplementary Table 1**).

## Association between muscularity concerns and treatment outcome

Within the clinical sample, 228 out of 311 (73.3%) adolescents received treatment for BDD and had post-treatment data available. It was equally common among individuals with and without muscularity concerns (30.4%; $n$ = 14 *vs.* 26.0%; $n$ = 69, $\chi^2$ = 0.39, $p$=.534) to not have received treatment and/or not have provided outcome data. Of those who received treatment, individuals with versus without muscularity concerns received a similar number of CBT sessions (19.6 *vs.* 17.5, respectively; $t$=-1.19, $p$=.236).

Raw means and standard deviations for all measures at pre- and post-treatment are shown in **Supplementary Table 2** and means and standard errors from the mixed-effect regression models are reported in Table 4. The results from the models showed a significant main effect of time on the BDD-YBOCS-A (coefficient [95% confidence interval]=-14.6 [-15.7, -13.4], $p$<.001), indicating a reduction in BDD symptom severity across both groups which corresponded to a within-group effect size of Cohen's $d$ = 2.39, (95% CI = 2.22 to 2.55). There was no significant main effect of group (0.5 [-2.8, 1.8], $p$=.696), confirming that there was no overall difference in BDD symptom severity in those with versus without muscularity concerns across timepoints. Importantly, there was no group by time interaction (-0.2 [-3.2, 2.9], $p$=.918), indicating that those with and without muscularity concerns responded similarly to multimodal treatment. Similarly, the proportion of treatment responders and partial or full remitters at post-treatment was comparable in both groups. In the muscularity group with muscularity concerns, 24 (75.0%) of the participants were classified as responders, compared to 142 (72.8%) in the non-muscularity group without muscularity concerns ($\chi^2$ = 0.07, $p$ = 0.797). Further, 10 individuals with muscularity concerns (31.3%) were classified as remitters, compared to 62 (31.6%) of the individuals without muscularity concerns ($\chi^2$ = 0.01, $p$ = 0.966).

Table 4
Results from the mixed-effect regression models in the subsample of individuals with body dysmorphic disorder with post-treatment data on the outcome measures (*N* = 311).

| **Variable** | **Muscularity concerns (*n* = 46)** | | **No muscularity concerns (*n* = 265)** | | **Main effect of time** | **Main effect of group** | **Time x group interaction effects** |
|---|---|---|---|---|---|---|---|
| **Measure** *(n)* | **M** | **SE** | **M** | **SE** | **Coefficient (CI)** | **Coefficient (CI)** | **Coefficient (CI)** |
| **BDD-YBOCS-A** | | | | | -14.6 (-15.7 – -13.4)*** | 0.5 (-2.8–1.8) | -0.2 (-3.2–2.9) |
| Baseline (311) | 31.3 | 1.1 | 31.7 | 0.5 | | | |
| Post-treatment (228) | 16.5 | 1.3 | 17.2 | 0.5 | | | |
| **CGI-S**[a] | | | | | -2.0 (-2.3 – -1.8)*** | 0.1 (-0.3–0.5) | -0.1 (-0.6–0.5) |
| Baseline (163) | 4.8 | 0.2 | 4.6 | 0.1 | | | |
| Post-treatment (146) | 2.7 | 0.2 | 2.6 | 0.1 | | | |
| **CGAS** | | | | | 12.5 (11.0–14.1)*** | 2.2 (-0.8–5.3) | -2.6 (-6.7–1.5) |
| Baseline (306) | 46.4 | 1.4 | 44.2 | 0.6 | | | |
| Post-treatment (210) | 56.3 | 1.7 | 56.7 | 0.7 | | | |
| **AAI** | | | | | -10.9 (-12.7 – -9.2)*** | -0.5 (-3.6–2.5) | 1.0 (-3.6–5.7) |
| Baseline (252) | 27.6 | 1.4 | 28.1 | 0.6 | | | |
| Post-treatment (139) | 17.6 | 1.9 | 17.2 | 1.4 | | | |
| **CDI-S / S/MFQ-C**[a,b] | | | | | -0.9 (-1.0 – -0.7)*** | -0.1 (-0.3–0.4) | 0.4 (-0.1–0.8) |
| Baseline (227) | 0.3 | 0.2 | 0.2 | 0.1 | | | |

* $p < 0.05$; ** $p < 0.01$; *** $p < 0.001$.

| Variable | Muscularity concerns (*n* = 46) | | No muscularity concerns (*n* = 265) | | Main effect of time | Main effect of group | Time x group interaction effects |
|---|---|---|---|---|---|---|---|
| Post-treatment (115) | -0.2 | 0.2 | -0.6 | 0.1 | | | |
| **WSAS-Y**[a] | | | | | -10.1 (-11.8 – -8.4)*** | 0.0 (-2.9–2.8) | 1.6 (-2.6–5.8) |
| Baseline (218) | 21.3 | 1.3 | 21.3 | 0.6 | | | |
| Post-treatment (132) | 11.8 | 1.7 | 11.2 | 0.8 | | | |
| **WSAS-P**[a] | | | | | -8.2 (-9.9 – -6.5)*** | -0.3 (-3.3–2.7) | 1.4 (-2.9–5.6) |
| Baseline (156) | 21.4 | 1.4 | 21.8 | 0.6 | | | |
| Post-treatment (107) | 14.6 | 1.8 | 13.6 | 0.8 | | | |
| * $p < 0.05$; ** $p < 0.01$; *** $p < 0.001$. | | | | | | | |

*Abbreviations:* AAI, Appearance Anxiety Inventory; BDD, body dysmorphic disorder; BDD-YBOCS-A, Yale-Brown Obsessive-Compulsive Scale, modified for BDD–Adolescent version; CDI-S, Children's Depression Inventory – Short Version; CGAS, Children´s Global Assessment Scale; CGI-S, Clinical Global Impression – Severity; MFQ-C, Mood and Feelings Questionnaire, Child Version; SE, standard error; SMFQ-C, Short Mood and Feelings Questionnaire, Child Version; SMFQ-P, Short Mood and Feelings Questionnaire, Parent Version; WSAS-Y, Work, Social and Adjustment Scale – Youth Version; WSAS-P, Work, Social and Adjustment Scale – Parent Version.

In additional models, there was a significant main effect of time on all secondary measures, indicating improvements in both groups in self-reported BDD symptoms, depressive symptoms, self- and parent-reported functional impairment, and clinician-rated global functioning. As with the main outcome measure, there was no significant effect of group in any of the measures and no significant group by time interaction effect on any of the secondary outcomes, showing that both groups improved equally across all secondary measures (Table 4).

# Discussion

The current study represents the first investigation of muscularity concerns among adolescents with BDD. Four key findings emerged. First, muscularity concerns were relatively common. These concerns

were present in around 1 in 7 of adolescent BDD cases seeking help through specialist clinics, which aligns with the 10–20% estimates observed in adult studies (Pope et al., 2005; Pope et al., 1997). Importantly, our estimate is not likely to be inflated by help-seeking or referral bias since some level of muscularity concern were reported by an even higher proportion (38%) of adolescents with BDD in a representative, community-based sample, with 16% reporting more pronounced muscularity concerns. Similarly, among those who reported excessive appearance preoccupations in the community sample, around one third reported some level of muscularity concerns, with 9% reporting more severe concerns. Taken together, these findings suggest that muscularity is a common concern among adolescents with sub- and supra-threshold BDD. Notably, in both our clinical and community samples, muscularity concerns were rarely the sole appearance concern. In fact, those with muscularity concerns reported a higher number of areas of preoccupation compared to those without, potentially suggesting greater generalisation of appearance-related concerns. A similar finding was reported in one of the earliest studies on muscle dysmorphia, in which 12 out of 14 men with muscle dysmorphia had additional non-muscle-related appearance concerns, and those with muscle dysmorphia reported significantly more areas of concern than those with BDD who did not have muscularity concerns (Pope et al., 2005).

Second, we found that, in both our clinical and community samples, the proportion of boys was significantly larger within the group of adolescents with muscularity concerns than in the group without these concerns. However, it is also notable that across both samples, there were more girls than boys with muscularity concerns, challenging the historical perspective that preoccupation with muscularity is largely or exclusively a male phenomenon (Pope et al., 1997). Our results are consistent with the observation that appearance preoccupation and BDD are substantially more prevalent among adolescent girls than boys (Krebs et al., 2025). However, our novel finding also conflicts with previous studies indicating muscle dysmorphic symptoms to be more common among boys in community samples of youth (Ganson et al., 2023; Mitchison et al., 2022). This apparent discrepancy may be due to the fact that these previous studies used self-report items to assess muscle dysmorphia that placed a greater emphasis on concerns about muscle size (as opposed to leanness or tone) and may therefore have been biased towards detect muscularity concerns in boys.

Third, we observed a remarkably similar clinical presentation in young people with versus without muscularity concerns. Overall, the groups had comparable patterns of BDD symptom severity, impairment, psychiatric comorbidity, self-harm, and suicidality. This is in line with a previous study comparing adult men with muscle dysmorphia to men with other forms of BDD, which found no statistically significant differences in psychiatric comorbidities (Blashill et al., 2020). Our findings are, however, at odds with some previous findings suggesting certain unique correlates of muscle dysmorphia among adults, including increased risk of suicide, substance abuse, and functional impairment, than BDD alone (Phillips et al., 2010; Pope et al., 2005). Discrepant findings could partly be explained by genuine age effects but could also be an artefact of methodological differences including sampling and assessment approaches.

Fourth, in the current study, individuals with muscularity concerns had a similar response to multimodal treatment than those without these concerns. To our knowledge, this is the first investigation to test the effect of muscularity concerns on treatment outcomes in BDD. Our findings do not indicate that treatment of muscle dysmorphia requires additional treatment strategies beyond standard CBT for BDD, which is intrinsically flexible and person-centred. However, we cannot exclude the possibility that, in the current study, clinicians were adapting standard the protocol to address specific features of muscle dysmorphia, such as excessive exercise or unhealthy eating patterns, especially given that therapists were typically highly experienced in treating BDD. Nevertheless, large improvements were observed across all outcomes (e.g., BDD symptom severity, depressive symptoms, functioning), consistent with previous treatment studies of adolescent BDD (Mataix-Cols et al., 2015; Rautio et al., 2022) and muscle dysmorphia in adults (Çınaroğlu et al., 2025; Martenstyn et al., 2025). Overall, our results are encouraging and indicate that adolescents presenting with muscularity concerns in the context of BDD can benefit from the recommended treatment approaches.

The main strength of this study was the large and diverse clinical sample of youth with BDD from two different European countries. Furthermore, we used an epidemiological cohort for replication in an unbiased, nationally-representative population of youth. However, some limitations should be considered. First, we did not have information regarding the nature of the muscularity concerns. Future studies should seek to determine whether concerns primarily relate to muscle size, as is often assumed, or other aspects of muscularity such as definition and tone, and whether this differs by sex. Second, since we did not have detailed information about the content of CBT sessions, it is not possible to determine to what extent clinicians adapted the treatment protocol to address specific features of muscle dysmorphia, which could have enhanced outcomes in the muscularity concerns group. Third, only 50 adolescents had muscularity concern data available in the community sample, and therefore we did not have sufficient power for inferential statistical tests.

In summary, the current findings indicate that muscularity concerns are relatively common among adolescents with BDD, both girls and boys, and should be routinely asked about at assessment. However, muscularity concerns do not appear to be associated with substantial differences in the broader clinical presentation of BDD or treatment outcomes, indicating that a unified approach to BDD treatment and management, regardless of specific appearance concerns, should be adopted. Overall, our findings do not provide evidence for muscle dysmorphia being a distinct subtype of BDD. The clinical utility of the muscle dysmorphia specifier for BDD in DSM-5 should be reviewed as evidence accumulates.

## Declarations

# Competing Interests

Georgina Krebs receives honoraria for editorial work from Elsevier, outside the submitted work. Lorena Fernández de la Cruz receives royalties for contributing articles to UpToDate, Wolters Kluwer Health and

for editorial work from Elsevier, all outside the submitted work. David Mataix-Cols receives royalties for contributing articles to UpToDate, Wolters Kluwer Health, and is co-owner of Scandinavian E-Health AB, all outside the submitted work. Amita Jassi and Daniel Rautio report no conflicts of interest.

# Author Contribution

G.K. conceptualised the study and wrote the original manuscript.A.J. contributed to study methodology, data collection and curation, and reviewed and edited the manuscript.L.F.C. contributed to data collection, and reviewed and edited the manuscript.D.M.C. contributed to data collection, and reviewed and edited the manuscript.D.R. contributed to the conceptualistion of the study, undertook data curation and statistical analyses, wrote sections of the original manuscript, and reviewed and edited the manuscript.

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# Data Availability

Access to anonymised clinical cohort data may be made available upon request, subject to data sharing agreements. Access to the Mental Health of Children and Young People 2017 dataset can be requested via the UK Data Service.

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# Figures

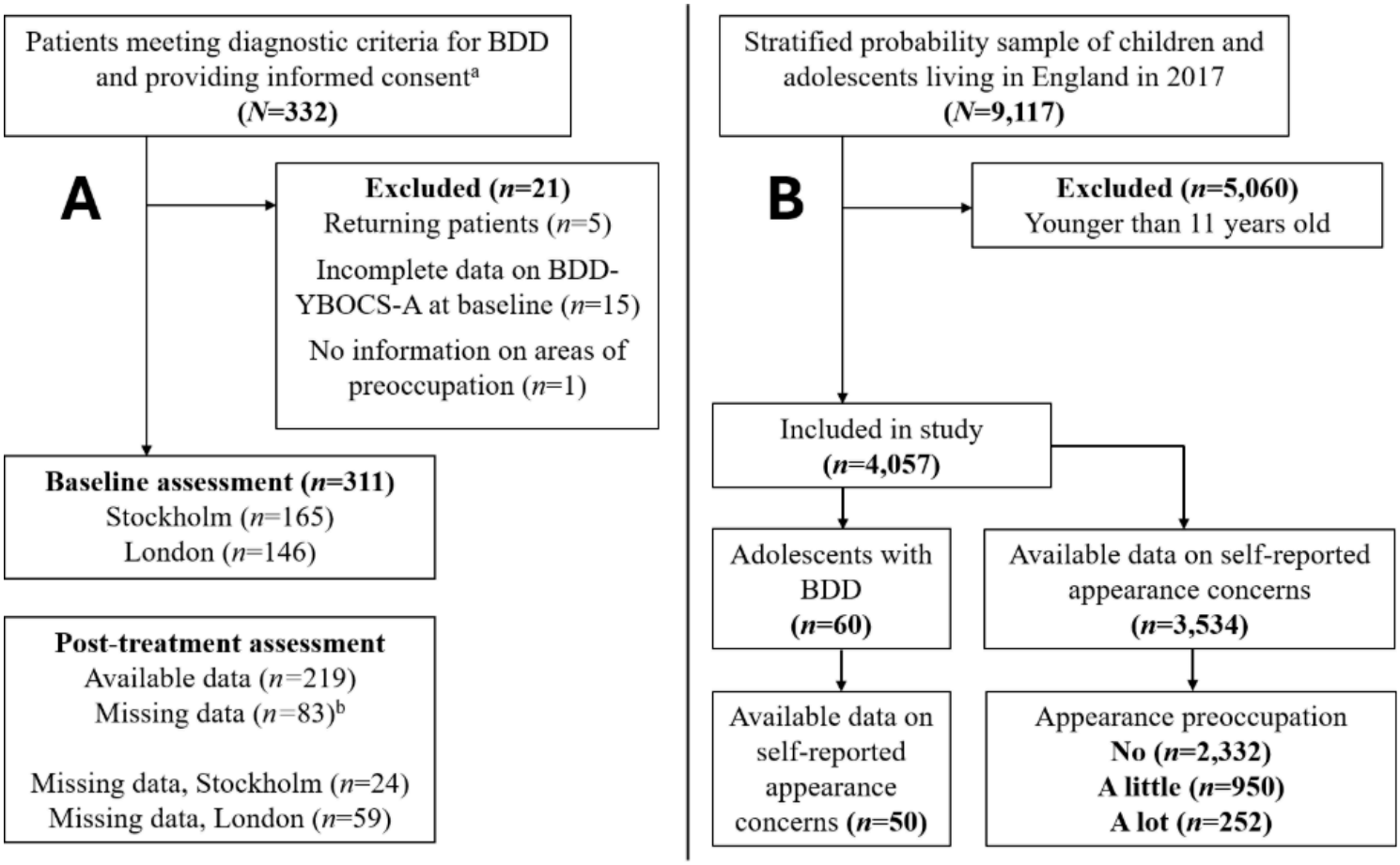



**Figure 1**

Study participants' flow. **Panel A**, clinical cohort; **Panel B**, community-based cohort.

*Note:* [a] Informed consent was only required at the Stockholm site; [b] Data were listed as missing if the BDD-YBOCS-A was missing at the specified time point.

*Abbreviations:* BDD, body dysmorphic disorder; CBT, cognitive behaviour therapy; BDD-YBOCS-A, Yale-Brown Obsessive-Compulsive Scale, modified for BDD – Adolescent version.

## Supplementary Files

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