Are body dysmorphic symptoms dimensional or categorical in nature? A taxometric investigation in adolescents

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A B S T R A C T

Body dysmorphic disorder (BDD) is a debilitating mental health condition which usually emerges during adolescence and is characterised by distressing and impairing appearance concerns. It is unclear whether body dysmorphic concerns represent an extreme manifestation of normal appearance concerns (a dimensional conceptualisation), or whether they are qualitatively distinct (a categorical conceptualisation). This study aimed to determine whether body dysmorphic symptoms are dimensional or categorical in nature by investigating the latent structure using taxometric procedures. Body dysmorphic symptoms were assessed using validated measures among 11-16-year-old school pupils (N=707). Items of the Body Image Questionnaire Child and Adolescent version were used to construct four indicators that broadly corresponded to the DSM-5 diagnostic criteria for BDD (appearance concerns, repetitive behaviours, impairment, and insight). Indicators were submitted to three non-redundant taxometric procedures (MAMBAC, MAXEIG and L-MODE). Overall, results of all three taxometric procedures indicated a dimensional latent structure of body dysmorphic symptoms. The current study provides preliminary evidence that body dysmorphic symptoms are continuously distributed among adolescents, with no evidence of qualitative differences between mild and severe symptoms. Implications for clinical practice and research are discussed.

1. Introduction

Body Dysmorphic Disorder (BDD) is characterised by an excessive preoccupation with perceived flaws in physical appearance, which appear minimal or completely unobservable to others (American Psychiatric Association, 2013; World Health Organization, 2018). Sufferers typically engage in a range of compulsive and repetitive behaviours, such as extreme grooming rituals, in an attempt to conceal or correct perceived appearance defects. The disorder has a prevalence of approximately 2% among adults, and is estimated to affect between 1.9% and 2.2% of adolescents (Veale et al., 2016; Schneider et al., 2017b). Higher prevalence rates have been observed in certain groups, such as students (prevalence of 3.6%) (Möllmann et al., 2017) and older adolescent girls (prevalence of 5.6%) (Vizard et al., 2018). BDD is associated with marked reduction in psychosocial functioning, poorer quality of life, and strikingly high rates of suicidality (Phillips et al., 2006, 2005; Angelakis et al., 2016). Approximately 65% of adults with BDD report onset during adolescence (Björnsson et al., 2013a). The clinical presentation of BDD in youth is broadly similar to that in adults, although adolescent-onset BDD has been reported to be associated with more severe symptoms, higher rate of substance use and greater risk of suicide attempts (Björnsson et al., 2013a; Phillips et al., 2006). Despite its high prevalence and morbidity, BDD is under-researched and remains poorly understood (Krebs et al., 2017).

A theoretically and clinically important question is: are body dysmorphic symptoms dimensional or categorical in nature? If body dysmorphic symptoms are dimensional, it would suggest that they occur relatively commonly throughout the general population, at varying levels of severity. It would also suggest that individuals who have elevated levels of body dysmorphic symptoms but fail to meet the diagnostic threshold, nevertheless experience some degree of associated distress and/or impairment. In support of this, appearance concerns are known to be highly prevalent in the general population, with approximately 15% of women and 5% of men reporting that they worry about...
Conducted in adult undergraduate samples (mean age of 22 years). Moreover, subthreshold body dysmorphic symptoms have been shown to be associated with diminished quality of life and elevated rates of psychiatric comorbidity (Schneider et al., 2017a). In contrast, if body dysmorphic symptoms were categorical in nature, it would suggest that they are qualitatively different to ‘normal’ appearance worries, and therefore likely have distinct risk factors, as well as different demographic and clinical correlates. This view is supported by the finding that normal appearance concerns are more prevalent in females compared to males (Quittkat et al., 2019), whereas BDD appears to be only slightly more common among women (2.1%) compared to men (1.6%) in the general population (Veale et al., 2016). Furthermore, the quality and content of dysmorphic concerns among individuals with BDD can appear distinct to normal appearance concerns. Individuals with BDD can express concerns such as ‘I look like a monster’ or ‘I look inhuman’, which gives the clinical impression of being distinct to normal appearance concerns.

Determining the latent structure of body dysmorphic symptoms has important theoretical and clinical implications. A true categorical structure suggests that the aetiology of a disorder can be explained by a single causal factor or mechanism (e.g. a single gene or environmental exposure gives rise to the disorder), an interaction effect (e.g. a genetic predisposition combined with a specific environmental exposure gives rise to the disorder), or threshold effects (e.g. exposure to an environmental trigger exceeding a certain threshold giving rise to the disorder). In contrast, a disorder with a dimensional latent structure is likely to have a more complex aetiology, and arises from the aggregate effects of various factors including genetic and environmental (Ruscio et al., 2011). Currently, diagnostic systems take a categorical approach to defining BDD (American Psychiatric Association, 2013; World Health Organization, 2018), but this is largely for clinically-oriented pragmatic reasons, and does not necessarily mean that BDD is truly categorical in nature. Categorical diagnostic classification often involves dichotomising dimensional constructs, and identifying individuals who fall above a clinically-established boundary (Ruscio and Ruscio, 2000). Currently, clinical research into BDD often takes a categorical approach by comparing individuals with the diagnosis and healthy controls (or other psychiatric groups). However, for disorders that are dimensional, it is arguably important to investigate symptoms at varying levels of severity along the continuum, including subthreshold symptoms. Moreover, a dimensional structure implies that research in non-clinical populations can inform understanding of the disorder of interest (often referred to as analogue studies). This is especially of importance for a disorder like BDD, where detection and diagnostic rates are poor (Schulte et al., 2020), thus making recruitment of clinical samples challenging.

To our knowledge, only two previous studies have directly examined the latent structure of body dysmorphic symptoms. The first analysed three BDD-related symptom factors using factor mixture modelling: perception, avoidance, and behaviour (Longley et al., 2019). The results of this study supported a hybrid categorical-dimensional solution, whereby three distinct participant categories were identified (non-BDD, elevated BDD-related avoidance, and elevated BDD), within which symptom severity varied quantitatively (i.e. dimensionally). The second study also utilised factor mixture modelling, and also found support for a hybrid categorical-dimensional solution of body dysmorphic concerns (Samad et al., 2019). Specifically, this study found evidence for individuals clustering into distinct low- and high-symptom severity groups, with symptoms being normally distributed within each group. Together, both of these studies suggest that body dysmorphic symptoms may be dimensionally distributed with possible categorical separation of groups. It should be noted that both of the studies were conducted in adult undergraduate samples (mean age of 22 years). Therefore, the results of these studies do not necessarily generalise to younger populations. It is crucial to explore the latent structure of BDD in an adolescent sample, given that body dysmorphic symptoms typically emerge during adolescence (Bjørnsson et al., 2013b), but can be difficult to differentiate from “normal” appearance concerns which are strikingly prevalent at this stage of development (Voelker et al., 2015). Also of note, both previous studies examined the latent structure of BDD symptoms using factor mixture modelling. An alternative, well-established and widely utilised method used to determine latent structure is taxometric analysis (Haslam et al., 2020; Ruscio et al., 2011). Factor mixture modelling and taxometric analyses are both statistical methods used to identify the latent structure of a trait or construct. Factor mixture modelling uses a hybrid of categorical and continuous latent variables to identify classes of individuals and heterogeneity within these classes. In contrast, taxometric analyses focus on examining the underlying latent structure (i.e. dimensional or categorical) of a construct within a given sample (Tueller and Lubke, 2008). Both methods have unique strengths and weaknesses (Lubke and Miller, 2015), highlighting the potential benefit triangulating findings across these methods.

In summary, the latent structure of body dysmorphic symptoms, particularly during adolescence, remains unclear. Thus, the current study used taxometric analyses to examine whether body dysmorphic symptoms have categorical or dimensional latent structure in a non-clinical sample of adolescents.

2. Methods

2.1. Participants and procedure

The sample comprised of 714 students aged 11-16 years old recruited from a government-funded secondary school in London for a study on body dysmorphic symptoms and perfectionism (Krebs et al., 2019). A total of seven participants were excluded from the final analysis, due to having missing data for questionnaire items of interest, therefore making the final sample size 707 (50.2% Male, 49.4% Female, 0.4% unknown).

Ethical approval for this study was given by the Psychiatry, Nursing and Midwifery Research Ethics Subcommittee of King’s college London (HR-16/17-3877). Parents received a written information sheet and an opt-out form, which they were asked to complete if they wished to have opt out their child from the study. Following this, a researcher provided both verbal and written information to participants. Participants were informed that confidentiality would be maintained except if their results raised risk concerns. Participants were then asked to complete the Appearance Anxiety Inventory and Body Image Questionnaire Child and Adolescent Version in classrooms under the supervision of a member from the research team or a teacher. The questionnaires were completed online, but paper copies were given in the event a computer was unavailable.

2.2. Measures

2.2.1. The appearance anxiety inventory (AAI; Veale et al., 2014)

The AAI is a self-report measure that assesses cognitive and behavioural processes that are characteristic of BDD, such as threat monitoring (e.g. checking appearance and brooding on past events related to appearance) and avoidance (e.g. avoiding reflective surfaces, avoiding people). The questionnaire consists of 10 items that are rated on a frequency Likert scale ranging from 0-4, where a higher score indicates greater frequency of BDD-related cognitive processes and behaviours. Mastro et al. (2016) identified a cut-off score of 20 as indicating high risk of BDD. The AAI has been found to have good test-retest reliability and convergent validity (Veale et al., 2014). The measure has been shown to have a moderate correlation (r = .55) with the BDD version of the Yale-Brown Obsessive-Compulsive Scale, which is a clinician-administered measure of BDD symptom severity (Veale et al., 2014). Furthermore, it had excellent internal consistency in the current sample (Cronbach’s Alpha = 0.91). In the current study, the AAI was used to determine the size of the putative taxon; that is, a discrete latent
class that can be distinguished from the mutually exclusive complement class (Ruscio et al., 2011).

2.2.2. The body image questionnaire child and adolescent version (BIQ-C; Veale, 2009)

The BIQ-C is a self-report measure of BDD symptom severity. It has been modified from the original BIQ by slightly rewording certain items to be more appropriate for children and adolescents, and by replacing the item on sexual relationships with one on family relationships. Participants are first asked a screening question regarding whether they wish to amend any aspect of their appearance and, if so, list up to five areas of concern. In order to avoid measurement of eating disorder psychopathology, participants were given explicit instructions to only report appearance concerns that were not related to weight and fitness. Those who reported having appearance concerns then answered 12 additional items. Each item was rated on a Likert scale of 0-8. Higher total scores indicated greater symptom severity. The BIQ-C has good convergent validity. For example, the adult version has been shown to be highly correlated with the Body Image Quality of Life Inventory (r = 0.68) (Veale et al., 2012). The measure also has good internal consistency, test-retest reliability, and has been found to have a sensitivity of 88.9% and specificity of 80.6% in detecting BDD among adults (Veale et al., 2012). Further the BIQ-C had excellent internal consistency in this study (Cronbach’s Alpha = 0.90). In the current study, single items from the BIQ-C were used as “indicators”.

2.3. Data analysis

2.3.1. Selecting indicators

A taxometric analysis uses “indicators” that assess distinct aspects of the phenotype of interest as input variables. They need to be theoretically relevant and fulfill certain statistical criteria (see Table 1). In order to determine indicator validity, it is necessary to classify cases into taxon and complement groups. This was done using the AAI cut-off score of 20. Based on the resulting putative taxon size, cases were then re-classified using the base-rate classification method. This involves classifying cases into taxon and complement groups based on indicator scores rather than total AAI scores. Indicators should distinguish taxon and complement groups with sufficient validity (d ≥ 1.25). Within-group correlations must be such that r ≤ 0.3 to reduce nuisance covariance. However, this requirement does not extend to the full sample, as it is expected for elements that represent a specific construct to relate to greater extents.

In the current study, indicators were constructed by selecting single-items of the BIQ-C that broadly corresponded to each of the DSM-5 criterion for BDD (appearance concerns, repetitive behaviours, impairment and insight; see Table 2) and displayed the best properties for running taxometric procedures (see Table 3). Items from the BIQ-C, as opposed to the AAI, were utilised because they have a higher number of ordered categories (nine) than the AAI (five). Further, single-item indicators were used due to data checks of summed indicators failing to meet the data requirements. The impairment indicator had a large positive skew (2.27), which can affect the shape of curves generated in the taxometric procedures (Ruscio et al., 2004). Therefore, a square-root transformation was performed, where the post-transformation skew was

| Table 1 Indicator requirements for taxometric analyses. |
|----------------|----------------------|
| Criterion | Value obtained in current study |
| Number of indicators (k ≥ 3) | k = 4 |
| Number of Ordered Categories (C ≥ 4) | C = 9 |
| Size of the putative taxon (P > 0.1) | P = 0.13 |
| Inter-Indicator Correlation (r ≥ 0.3) | r = 0.33 (0.268 – 0.433) |
| Within Taxon Correlation (ρwgc ≤ 0.3) | ρwgc = −0.07 (-0.21 – 0.1) |
| Within Complement Correlation (ρwgt ≤ 0.3) | ρwgt = 0.15 (0.09 – 0.29) |

1.67. All four indicators met indicator validity criteria (average d = 1.67; see Table 3), as well as all other indicator requirements (see Table 2).

2.3.2. Taxometric procedures

Taxometric analysis involves viewing the graphical output of multiple taxometric procedures and judging whether the graphical output of observed data is more resemblant of curves generated from simulated taxonic or dimensional comparison datasets. The simulated categorical and dimensional datasets generated reproduce both correlational and distributional features of empirical data (Ruscio et al., 2007). In the current study, three non-redundant taxometric procedures were carried out: Mean Above Minus Below A Cut (MAMBAC; Meehl and Yonce, 1994), Maximum Eigenvalue (MAXEIG; Waller and Meebel, 1998), and Latent Mode (L-Mode; Waller and Meebel, 1998). The MAMBAC procedure calculates the mean differences of an output indicator for cases scoring above and below a series of cut-off scores of an input indicator. Fifty equally spaced cuts were created starting and ending ten cases from each end. The MAXEIG procedure looks at the association of output indicators in subsamples formed along an input indicator, where the output indicator consists of the remaining indicators. Subsamples were created along the input indicator by creating 25 windows with 90% overlap. The first (largest) eigenvalue of the covariance matrix (the variance-covariance matrix, where variances along the diagonal are replaced with 0) is calculated and plotted against the x-axis. Ten internal replications were carried out for both the MAMBAC and MAXEIG to mitigate cuts and windows being made between cases with tied scores along the input indicator. MAMBAC and MAXEIG curves with a clear peak are indicative of taxonicity, whereas flat or concave curves are indicative of dimensionality. In the L-mode procedure, indicators are submitted to a factor analysis. The distribution of factor score estimates on the first factor is graphed. Categorical data results in a bimodal curve, and dimensional data in a unimodal curve.

One hundred simulated taxonic and dimensional datasets were created and submitted to the three taxometric procedures. The graphical output of the simulated datasets were superimposed onto the output of observed data to aid visual interpretation of whether the observed data has taxonic or dimensional solution. Additionally, Comparison Curve Fit Index (CCFI) scores were calculated for each procedure. This is an objective way of determining whether observed data better fits the simulated comparison categorical or dimensional data. CCFI values range from 0-1, where values closer to 0 are indicative of the dataset.
being dimensional, and the values closer to one being indicative of the dataset being taxonic (Ruscio et al., 2010). The solution is considered ambiguous if CCFI values range from 0.45-0.55, with a more stringent range being from 0.4-0.6 (Ruscio et al., 2010).

2.3.3. Sensitivity analyses

Given the AAI score is not diagnostic, but rather detects high-risk of BDD, two sensitivity analyses were carried out. The first involved running the analysis at the minimum possible taxon base-rate recommended for detecting taxonicity (P = 0.1; Meehl, 1999) All data requirements were met for this analysis (see Tables S1 and S2 in supplementary material). For the second sensitivity analysis, a CCFI profile was generated, whereby scores for all three taxometric procedures were calculated across 40 different base-rates ranging from 0.025 – 0.975. All analysis were executed on R using the ‘RTaxometrics’ package (Ruscio and Wang, 2017).

3. Results

3.1. Descriptives

The Appearance Anxiety Inventory identified 13% of the sample to score in the range of high-risk for BDD with a mean score of 9.07 (SD = 8.37). The Body Image Questionnaire Child and Adolescent Version identified 5.9% of the sample to have high body dysmorphic symptom severity, with a mean score of 27.1 (SD = 17.2).

3.2. Taxometric analyses

The graphical output of the three taxometric procedures are shown in Fig. 1. Across all three taxometric procedures, the observed data curves more closely resembled the shape of the simulated dimensional comparison dataset than the categorical comparison dataset. There was no visible taxonic peak in both the MAMBAC and the MAXEIG observed data curves, thereby demonstrating a dimensional solution. The curve for observed data in the L-mode was unimodal, which is a feature of a dimensional solution.

A Comparison Curve Fit Index (CCFI) score was calculated for each taxometric procedure. The CCFI scores for the MAMBAC, MAXEIG and L-Mode were 0.38, 0.36 and 0.34 respectively. The mean CCFI score across procedures was 0.36. Since, these CCFI scores are closer to 0 than 1 and do not lie in the ambiguous range (i.e. 0.4 – 0.6; Ruscio et al., 2010) they provide clear support for dimensionality of the observed data.

Fig. 1. Graphical output of the MAMBAC, MAXEIG, and L-MODE procedures.

Note: The average curve from each taxometric procedure (bold dark line) is superimposed on curves generated from simulated comparison datasets. The grey band denotes the middle 50% of data points from the comparison datasets. The two thin dark lines show the output for the largest and smallest values of the comparison datasets.
Sensitivity analyses, in which a base-rate of 0.1 was specified, resulted in a similar pattern of results (see Table S3 and Figure S1 in supplementary material). The mean CCFI score across procedures was 0.38. Further, overall the CCFI profile supported dimensionality across the 40 different base-rates ranging from 0.025 – 0.975, indicating that findings were generally stable regardless of the size of the putative taxon group (see Table S4 and Figure S2 in supplementary material). However, it is of note that at the lowest taxon base rate of 2.5%, the mean CCFI fell in the ambiguous range and only the MAMBAC procedure provided support for dimensionality at this base rate.

4. Discussion

The current study represents the first taxometric investigation of body dysmorphic symptoms, and is also the first study to examine the latent structure of body dysmorphic symptoms in adolescents. The results, across both main and sensitivity analyses, were generally in support of body dysmorphic symptoms having a dimensional latent structure. These findings provide preliminary support for the notion that dysmorphic concerns and related behaviours in BDD are likely to represent an extreme manifestation of normal appearance concerns and related behaviours, as opposed to being a qualitatively distinct phenomenon. This is broadly consistent with two previous studies that examined the latent structure of body dysmorphic symptoms using factor mixture modelling, and found body dysmorphic symptoms varied quantitatively within groups (Longley et al., 2019; Samad et al., 2019). Furthermore, findings from this study are consistent with a large body of research showing that the majority of psychiatric traits are dimensional constructs (Caspi et al., 2014; Haslam et al., 2020).

The current study has several important implications for theory, clinical practice and future research. At a theoretical level, dimensionality of body dysmorphic symptoms implies that the aetiology is multifactorial, as opposed to symptoms being attributable to a single factor (i.e. a single gene or environmental experience) (Ruscio et al., 2011). This is consistent with findings of previous studies that have suggested BDD arises from the aggregate effects of multiple factors, including additive genetic influence and non-shared environmental experiences, such as peer victimisation (Monzani et al., 2011, 2012; Webb et al., 2015; Krebs et al., 2017). Although not directly examined, our findings also imply that the same aetiological factors underpin mild, subthreshold and extreme body dysmorphic symptoms. Future research should seek to directly test this, for example using twin methods (Zavos et al., 2014; Dinkler et al., 2019) to examine the consistency of genetic and environmental influences on “normal” versus extreme body dysmorphic symptoms.

At a clinical level, the current findings have implications for the assessment and diagnosis of BDD. Current diagnostic systems (American Psychiatric Association, 2013; World Health Organization, 2018) adopt a categorical approach to classifying BDD, which has important clinical utility but may produce a false dichotomy and overlook individuals with elevated symptoms who fail to meet threshold for a BDD diagnosis. Indeed, the majority of healthcare systems are set up to only provide treatment to those who reach diagnostic thresholds (Pauker and Kasirer, 1980), yet sub-threshold BDD symptoms have been associated with poorer quality of life and elevated comorbid psychopathology (Schneider et al., 2017), and may therefore warrant treatment. Further research is needed to explore whether construct-related correlates are similar in clinical and non-clinical ranges of body dysmorphic symptoms. However, the current data suggest potential value in developing a diagnostic system that is based on identifying where an individual lies on a continuum of body dysmorphic symptom severity, rather than whether they fall above or below an arbitrary cut-off point. Furthermore, a dimensional structure suggests that sub-threshold body dysmorphic symptoms may be a risk factor for the latter development of diagnosable BDD, as has been shown in related disorders (Fullana et al., 2009). Although longitudinal studies are needed to test this hypothesis, it raises the possibility that treating subthreshold body dysmorphic symptoms could ameliorate risk for BDD and therefore be an effective prevention strategy.

With respect to research implications, finding evidence for dimensionality of body dysmorphic symptoms indicates the potential benefit of analogue research in non-clinical samples, which may have various practical and ethical advantages (Abramowitz et al., 2014). This is particularly relevant given that BDD is strikingly under-detected and under-diagnosed, and therefore recruitment of individuals with BDD for research studies can be challenging. Furthermore, some research methods, such as genomic research, rely on large samples and therefore recruiting a sufficient number of BDD patients may not be feasible. Our findings provide preliminary support for the validity of assessing BDD symptoms in population-based samples using dimensional measures. Altogether, whilst in need of replication, the current findings encourage further work into proposing and validating strategies to incorporate dimensional aspects of BDD into our clinical and research practice.

There are several limitations in this study that should be considered. First, the AAI cut-off score is based on a single study (Mastro et al., 2016), and could have resulted in an inflated putative taxon size in the current study (i.e. overestimated the number of people with the latent “BDD” group). We found that 13% of our sample scored above cut-off on the AAI, which is higher than population-based prevalence rates of BDD (Veale et al., 2016). This is consistent with several other studies showing that high levels of body dysmorphic symptoms are self-reported by approximately 10% of high school students (Mastro et al., 2016), but is likely to be an overestimate of the prevalence of diagnosable BDD. In our sensitivity analyses, only one of the three taxometric procedures demonstrated dimensionality when the base-rate was set at 0.025 (equivalent to a prevalence of 2.5%), and overall the latent structure was ambiguous with this base rate. This indicates that our data were not capable of making an informative structural distinction with a base rate that corresponds to the likely population prevalence of diagnosable BDD. For this reason, our findings should be taken as preliminary and replication is required, for example using a sample with a significantly higher BDD base rate (e.g. a psychiatric clinical sample) or by using measures that yield better properties for taxometric analyses (e.g. more favourable between-group validity and within-group correlation estimates). A second limitation is that the current analyses utilised single-item indicators, which may be less reliable than multi-item measures (Haslam et al., 2012). Although indicator validity criterion was met, future studies could usefully extend the current research by including multi-item measures of BDD as separate indicators, as well as measures from multiple informants (e.g. parents, clinicians). A challenge with this may be identifying multiple measures that assess different facets of BDD in order to minimise “nuisance correlation”, given that a limited range of validated BDD measures are currently available. Similarly, construct validity variables could usefully be included in future taxometric studies. Third, the sample of this study was only obtained from a single school and it is not clear the extent to which these results can be generalised across demographic characteristics, such as sex and ethnicity. Additionally, our sample size was not large enough to conduct sex-stratified analyses, which would have shed light on whether the latent structure of body dysmorphic symptoms is consistent across males and females. This is particularly relevant given that some qualitative sex differences in body dysmorphic symptoms have been reported, perhaps most notably with males being more likely to experience muscle dysmorphia (Tedd et al., 2016). Thus, it is plausible that the latent structure of body dysmorphic symptoms differs in boys and girls. Similarly, it remains possible that the latent structure of body dysmorphic symptoms changes across development, whereby taxons can be formed consequent to distinct learning trajectories or specific biological aetiologies linked to a particular stage of development (Beauchaine, 2003; Haslam et al., 2020). Future studies should address this question, ideally using a longitudinal design.

In conclusion, this is the first study to examine the latent structure of
body dysmorphic symptoms in an adolescent sample using taxometric procedures. A dimensional solution for body dysmorphic symptoms was indicated across most analyses, thereby providing preliminary evidence to support the notion that BDD represents one end of a continuum of body dysmorphic symptoms. Future studies should seek to replicate and extend this finding, by testing whether the current results are consistent across different age and sex groups.

Contributions

Manya Bala conducted the final data analysis and wrote the original draft of the manuscript. Dr. Rachel Quinn collected the data and edited the manuscript. Dr. Amita Jassi contributed to the data collection and edited the manuscript. Dr. Georgina Krebs conceptualised the study, undertook the preliminary analyses, and wrote sections of the manuscript.

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Declaration of Competing Interest

None.

Supplementary materials

Supplementary material associated with this article can be found, in the online version, at doi:10.1016/j.jpsychres.2021.114201.

References

Abramowitz, J.S., Fabricant, L.E., Taylor, S., Deacon, B.J., McKay, D., Storch, E.A., 2014. Obsessions and compulsions in body dysmorphic symptoms. Future studies should seek to replicate and extend this finding, by testing whether the current results are consistent across different age and sex groups.

Beauchaine, T.P., 2003. Taxometrics and developmental psychopathology. Dev. Psychopathol. 15, 501–527. https://doi.org/10.1017/S0954579403000270.

Bjornsson, A.S., Didie, E.R., Grant, J.E., Menard, W., Stalker, E., Phillips, K.A., 2013b. Evidence for a genetic overlap between body dysmorphic concerns and obsessive-compulsive symptoms in an adult female Swedish twin sample. Am. J. Med. Genet. Part B Neuropsychiatr. Genet. 159B, 376–382. https://doi.org/10.1002/ajmg.b.32040.

Pauker, S.G., Kassirer, J.P., 1980. The threshold approach to clinical decision making. New Engl. J. Med. 302, 1109–1117. https://doi.org/10.1056/nejm198005153022003.

Veale, D., 2009. Body image questionnaire- child and adolescent version. [WWW Document]. URL https://cran.r-project.org/web/packages/RTaxometrics/index.html (accessed 12.29.20).

Ruscio, J., Wang, S., 2017. RTaxometrics: taxometric analysis. R package version 2.0 [WWW Document]. URL https://cran.r-project.org/web/packages/RTaxometrics/index.html (accessed 12.29.20).

Samad, M., Ralph-Nearman, C., Helleman, G., Khalsa, S.S., Shams, L., Feeney, J.D., 2019. Disturbed eating and body dysmorphic symptoms in a young adult sample are separable constructs that each show a mixture of distributions. Assessment 107391191189789241. https://doi.org/10.1177/107391191189789241.

Schneider, S.C., Mond, J., Turner, C.M., Hudson, J.L., 2017a. Subthreshold body dysmorphic disorder in adolescents: Prevalence and impact. Psychiatry Res. 251, 125–135. https://doi.org/10.1016/j.psychres.2017.04.063.

Schneider, S.C., Turner, C.M., Mond, J., Hudson, J.L., 2017b. Prevalence and correlates of body dysmorphic disorder in a community sample of adolescents. Aust. N. Z. J. Psychiatry 51, 595–603. https://doi.org/10.1177/0004864416658483.

Schulte, S., Schulz, C., Wilhelm, S., Buhlmann, U., 2020. Treatment utilization and treatment barriers in individuals with body dysmorphic disorder. BMC Psychiatry 20, 69. https://doi.org/10.1186/s12888-020-02489-0.

Tod, D., Edwards, C., Cranzwick, I., 2016. Muscle dysmorphia: current insights. Psychol. Behav. Manag. 9, 199–206. https://doi.org/10.2147/PRBM.S97494.

Fueller, S., Krebs, G., 2008. Abstract: a comparison of the factor model mixture and taxometric procedures. Multivariate Behav. Res. 43 https://doi.org/10.1080/10826720802200517. 660–660.

Veale, D., 2009. Body image questionnaire- child and adolescent version. Veale, D., Ellison, N., Wernher, T., Dodia, R., Serfaty, M., Clarke, A., 2012. Development of a cosmetic procedure screening questionnaire (COPS) for body dysmorphic disorder. J. Plast. Reconstr. Aesthetic Surg. 65, 530–532. https://doi.org/10.1016/j.bjps.2011.09.007.

Krebs, G., Quinn, R., Jansi, A., 2019. Is perfectionism a risk factor for adolescent body dysmorphic symptoms? Evidence for a prospective association. J. Obsessive Compulsive Disord. 22, 100445 https://doi.org/10.1016/j.jocdis.2019.100445.

Longley, S.L., Holm-Denoma, J., Allan, N.P., Calamari, J.E., Armstrong, K., Wainwright, A., Hasan, N., 2019. A quantitative study of body dysmorphic disorder: latent structure and correlates. J. Obsessive Compulsive. Disord. Relat. Disord. 21, 82–90. https://doi.org/10.1016/j.jocdis.2019.03.004.

Lukte, G.H., Miller, P.J., 2015. Does nature have jowts worth carving? A discussion of taxometrics, model-based clustering and latent variable mixture modeling. Psychol. Med. 45, 705–715. https://doi.org/10.1017/S0033291714001503.

Mastro, S., Zimmer-Gembeck, M.J., Webb, H.L., Farrell, L., Waters, A., 2016. Young adolescents’ anxiety about body dysmorphic symptoms: social problems, self-perceptions and comorbidities. J. Obsessive Compulsive. Disord. Relat. Disord. 8, 50–55. https://doi.org/10.1016/j.jocdis.2015.12.001.

Meeth, P., Vonce, L., 1994. Taxometric analysis: I. Detecting taxonomy with two quantitative indicators using means above and below a sliding cut (MAMBC procedure). Psychol. Rep. 74, 1059–1274.

Abramowitz, J.S., Fabricant, L.E., Taylor, S., Deacon, B.J., McKay, D., Storch, E.A., 2014. Obsessions and compulsions in body dysmorphic symptoms. Future studies should seek to replicate and extend this finding, by testing whether the current results are consistent across different age and sex groups.

Bjornsson, A.S., Didie, E.R., Grant, J.E., Menard, W., Stalker, E., Phillips, K.A., 2013a. Conceptualised the study, undertook the preliminary analyses, and wrote sections of the manuscript.

Declaration of Competing Interest

None.

 Supplementary materials

Supplementary material associated with this article can be found, in the online version, at doi:10.1016/j.jpsychres.2021.114201.
Veale, D., Eshkevari, E., Kanakam, N., Ellison, N., Costa, A., Werner, T., 2014. The appearance anxiety inventory: validation of a process measure in the treatment of body dysmorphic disorder. Behav. Cogn. Psychother. 42, 605–616. https://doi.org/10.1017/S1352465813000556.

Veale, D., Gledhill, L.J., Christodoulou, P., Hodoll, J., 2016. Body dysmorphic disorder in different settings: a systematic review and estimated weighted prevalence. Body Image 18, 168–186. https://doi.org/10.1016/j.bodyim.2016.07.003.

Vizard, T., Pearce, N., Davis, J., Sadler, K., Ford, T., Goodman, A., Goodman, R., McManus, S., 2018. Mental Health of Children and Young People in England, 2017: Emotional Disorders. NHS Digital, Leeds, England, pp. 1–33. https://files.digital.nhs.uk/14/0E2282/MHCYP%202017%20Emotional%20Disorders.pdf.

Voelker, D., Reel, J.K., Greenleaf, C., 2015. Weight status and body image perceptions in adolescents: current perspectives. Adolesc. Health. Med. Ther. 6, 158. https://doi.org/10.2147/ahmt.s65344.

Waller, N., Meehl, P., 1998. Multivariate Taxometric Procedures: Distinguishing Types from Continua. Sage Publications, Inc.

Webb, H.J., Zimmer-Gembeck, M.J., Mastro, S., Farrell, L.J., Waters, A.M., Lavell, C.H., 2015. Young adolescents’ body dysmorphic symptoms: associations with same- and cross-sex peer teasing via appearance-based rejection sensitivity. J. Abnorm. Child Psychol. 43, 1161–1173. https://doi.org/10.1007/s10802-014-9971-9.

World Health Organization, 2018. International Statistical Classification of Diseases and Health Related Problems, 11th ed. Geneva.

Zavos, H.M.S., Freeman, D., Haworth, C.M.A., McGuire, P., Plomin, R., Cardno, A.G., Ronald, A., 2014. Consistent etiology of severe, frequent psychotic experiences and milder, less frequent manifestations: a twin study of specific psychotic experiences in adolescence. JAMA Psychiatry 71, 1049–1057. https://doi.org/10.1001/jamapsychiatry.2014.994.