San Jose State University

SJSU ScholarWorks

Faculty Research, Scholarly, and Creative Activity

12-1-2022

Psychometric evaluation of the muscle dysmorphic disorder inventory (MDDI) among gender-expansive people

Emilio J. Compte
Universidad Adolfo Ibáñez

Chloe J. Cattle
University of California, San Francisco

Jason M. Lavender
Uniformed Services University of the Health Sciences

Tiffany A. Brown
Auburn University

Stuart B. Murray
University of Southern California

See next page for additional authors

Recommended Citation

Emilio J. Compte, Chloe J. Cattle, Jason M. Lavender, Tiffany A. Brown, Stuart B. Murray, Matthew R. Capriotti, Annesa Flentje, Micah E. Lubensky, Juno Obedin-Maliver, Mitchell R. Lunn, and Jason M. Nagata. "Psychometric evaluation of the muscle dysmorphic disorder inventory (MDDI) among gender-expansive people" *Journal of Eating Disorders* (2022). https://doi.org/10.1186/s40337-022-00618-6

Authors

Emilio J. Compte, Chloe J. Cattle, Jason M. Lavender, Tiffany A. Brown, Stuart B. Murray, Matthew R. Capriotti, Annesa Flentje, Micah E. Lubensky, Juno Obedin-Maliver, Mitchell R. Lunn, and Jason M. Nagata

Psychometric evaluation of the muscle dysmorphic disorder inventory (MDDI) among gender-expansive people

Emilio J. Compte[1,2], Chloe J. Cattle[3], Jason M. Lavender[4,5], Tiffany A. Brown[6], Stuart B. Murray[7], Matthew R. Capriotti[8,9], Annesa Flentje[9,10,11], Micah E. Lubensky[9,10], Juno Obedin-Maliver[9,12,13], Mitchell R. Lunn[9,13,14†] and Jason M. Nagata[3*†]

Abstract

Purpose: Muscle dysmorphia is generally classified as a specific form of body dysmorphic disorder characterized by a pathological drive for muscularity and the preoccupation that one is too small or not sufficiently muscular. The majority of research on the condition has been conducted in cisgender men with a paucity of literature on gender minority people, a population that is at risk for muscle dysmorphia. One of the most widely used measures of muscle dysmorphia symptoms, the Muscle Dysmorphic Disorder Inventory (MDDI), has not been psychometrically validated for use in gender minority samples, the aim of the present study.

Methods: We evaluated the psychometric properties of the MDDI in a sample of 1031 gender-expansive individuals (gender minority people whose gender identity differs from that assumed for their sex assigned at birth and is not exclusively binary man or woman) aged 18–74 who were part of The PRIDE Study, a large-scale, U.S., longitudinal cohort study.

Results: Using a two-step, split-sample exploratory and confirmatory factor analytic approach, we found support for the original three-factor structure of the measure. The subscales showed adequate internal consistency, and convergent validity was supported based on significant associations of the MDDI subscale scores with theoretically related scores on a widely used measure of disordered eating.

Conclusions: These findings provided novel support for adequate psychometric properties of the MDDI in a sample of gender-expansive individuals, facilitating the use of this measure in future research on muscle dysmorphia in this understudied and at-risk population.

Keywords: Gender-expansive, Non-binary, Transgender persons, Genderqueer, Muscle dysmorphia, MDDI

†Mitchell R. Lunn and Jason M. Nagata contributed equally to the work

*Correspondence: jason.nagata@ucsf.edu

[3] Department of Pediatrics, University of California, San Francisco, 550 16th Street, 4th Floor, Box 0110, San Francisco, CA 94158, USA
Full list of author information is available at the end of the article

Compte *et al. Journal of Eating Disorders*   (2022) 10:95

Page 2 of 11

Plain English Summary

Gender-expansive describes gender identities that do not fit within the binary gender identity system, such as man or woman. We asked gender-expansive participants in The PRIDE Study to fill out a widely used survey about muscle dysmorphia (when someone is worried about not being muscular enough). We found that this issue about muscularity has three parts for gender-expansive people: (1) a desire to be bigger and more muscular, (2) dissatisfaction with the way their body looks, and (3) problems with normal life functions. We find that this survey is appropriate for use in gender-expansive people. These results can help providers and researchers understand the muscle-related problems that gender-expansive people face.

Introduction

Muscle dysmorphia is generally classified as a specific form of body dysmorphic disorder characterized by an extreme drive for muscularity and preoccupation with the idea that one is too small or not sufficiently muscular [1, 2]. Muscle dysmorphia is associated with significant distress and psychosocial impairment as well as a myriad of pathological behaviors including excessive exercise, disordered eating, and the use of appearance- and performance-enhancing substances such as anabolic androgenic steroids [1–7]. Comorbidity with other forms of psychopathology is also common, and those with muscle dysmorphia have been found to have an increased risk for eating disorders, anxiety, and depression [3, 8, 9] as well as elevated rates of substance use and suicide [4]. Prevalence estimates vary dramatically across specific populations, including 1.4% of Australian adolescent girls [10], 6–7% of college men, and nearly 50% of bodybuilding men [7].

Although most research on muscle dysmorphia has been conducted using samples of cisgender men (i.e., individuals who identify as a man and were assigned male at birth), accumulating evidence suggests that gender minority people (i.e., those whose gender(s) differs from that assumed for their sex assigned at birth) are also at risk. Gender minority people face substantial mental health disparities, including elevated rates of overall psychological distress, mood and anxiety disorders, suicidality, and self-injurious behavior [11–13]. The term gender-expansive has been used to describe a spectrum of gender identities that fall outside of the binary structure (i.e., man and woman); this includes various non-binary and genderqueer identities and those who describe multiple or no gender identities. Research suggests that, compared to their exclusively cisgender and binary transgender peers, gender-expansive individuals have the lowest degree of social support and the highest risk of bullying [11]. Moreover, in the United States (U.S.) and United Kingdom, gender-expansive people reported a lower quality of life and increased psychological distress compared to binary transgender and cisgender people [14]. These findings emphasize the importance of characterizing the nature and severity of psychopathology experienced by gender minorities generally, as well as identifying potentially heightened disparities among certain subgroups such as gender-expansive people.

Importantly, with regards to muscle dysmorphia specifically, gender minority people experience greater dissatisfaction with their bodies, increased rates of diagnosed eating disorders, and more restrictive eating behaviors and excessive exercise [15–17]. Indeed, the differences in muscle dysmorphia symptomatology among various gender groups (e.g., cisgender, transgender, and gender-expansive) emphasize the importance of studying the drive for muscularity and the manifestations of muscle dysmorphia in these subgroups [18, 19]. Nagata et al. (2021) found that transgender men reported higher scores on a muscle dysmorphia measure compared to transgender women and non-binary individuals. Similarly, Amodeo et al. (2020) compared cisgender, transgender, and gender non-binary individuals and found that transgender men score higher on appearance anxiety/avoidance.

The Muscle Dysmorphic Disorder Inventory (MDDI) [20] is one of the most used instruments to evaluate symptoms of muscle dysmorphia in clinical and research settings [21]. The measure is comprised of 13 items with three subscales assessing Drive for Size, Appearance Intolerance, and Functional Impairment. In addition to its relative brevity and focus on core symptoms, a particular benefit of the MDDI is its inclusion of the subscale assessing functional impairment, which is a key diagnostic criterion for muscle dysmorphia. Support for the original three-factor structure has been highly consistent across multiple studies [22–29] with only one exception [30]. Santarnecchi and Dèttore found a four-factor structure in a small sample of 60 non-competing presumably cisgender male bodybuilders. Moreover, support has been found for the psychometric properties of the MDDI in samples from numerous countries, including Argentina, Turkey, Spain, Brazil, Norway, and Germany [22–28]. To date, however, most studies have been conducted in samples of cisgender, or presumed cisgender, men; furthermore, most of these are reported to be weightlifters,

Compte *et al. Journal of Eating Disorders* (2022) 10:95

Page 3 of 11

bodybuilders, or highly physically active. A recent study did report normative data for the MDDI among a community sample of gender-expansive individuals; however, there is no thorough psychometric evaluation of the MDDI to examine its factor structure and psychometric properties in gender-expansive individuals [19].

To address these gaps in the existing literature, this study aimed to psychometrically validate the MDDI in a large sample of adults from the U.S. with a gender group that is not exclusively cisgender or binary transgender—a population we refer to as gender-expansive. Specifically, exploratory and confirmatory factor analyses were conducted to evaluate the factor structure in this sample. Furthermore, the internal consistency of the MDDI subscales was evaluated, and convergent validity based on associations with theoretically relevant measures of disordered eating was examined. Consistent with numerous replications across other samples, we hypothesized that the original three-factor structure of the MDDI proposed by Hildebrandt et al. (2004) would be supported in the current sample and that the subscales would show adequate internal consistency. In support of convergent validity, and consistent with conceptual associations between the constructs of muscle dysmorphia and disordered eating symptoms, we expected to find significant (positive or negative) associations between scores on the MDDI subscales and scores on relevant subscales from the Eating Disorder Examination-Questionnaire (EDE-Q). Specifically, the MDDI Appearance Intolerance subscale would be positively associated with the EDE-Q Shape Concern and Weight Concern subscales, given their overlapping nature (i.e., body image concerns). The MDDI Functional Impairment subscale would be significantly, positively correlated with the EDE-Q Global Score, given the impairment-related content (e.g., social avoidance, difficulties with concentration) reflected in items from several subscales comprising the Global Score. In contrast, The MDDI Drive for Size subscale would be negatively associated with the EDE-Q Restraint and Weight Concern subscales, given the differential focus on specific behaviors and concerns (i.e., those related to desires to be larger versus those focused predominantly on desires for a lower weight).

Methods
Study population, data collection, and recruitment
Procedure
The (Population Research in Identity and Disparities for Equality) PRIDE Study [31] is a national (U.S.), longitudinal cohort study of sexual and gender minority adults. Inclusion criteria were: age ≥ 18, identification as a sexual and/or gender minority, living in the U.S. or its territories, and the ability to respond to questionnaires written in English. Recruitment efforts, led by PRIDEnet (a national network of individuals and organizations formed to engage sexual and gender minorities), included online advertising via social media and newsletters, word-of-mouth, event outreach, and distribution of branded promotional materials. The study was approved by the Institutional Review Boards of the University of California, San Francisco and Stanford University. All participants provided written informed consent and compensation was not provided. Further details of the study, including design, population demographics, and description of the digital platform, have been described elsewhere [31]. Participants in The PRIDE Study were invited to complete an online questionnaire, the Eating and Body Image Survey, from April to August 2018.

Participants
Participants were asked about their gender identity ("What is your current gender identity?") and were able to choose more than one option and write in their identity if it was not provided in the preset categorical answer choices. They were asked to identify the sex assigned to them at birth ("What sex were you assigned at birth on your original birth certificate?"). For this study, we excluded those participants who were classified exclusively as a cisgender man (gender identity: man, assigned sex at birth: male), cisgender woman (gender identity: woman, assigned sex at birth: female), transgender man (gender identity: man, assigned sex at birth: female), and/or transgender woman (gender identity: woman, assigned sex: male). Participants who selected "genderqueer," multiple gender identities, "another gender identity," and/or provided a write-in (e.g., non-binary, nonconforming, genderfluid, agender, and bigender) were considered gender-expansive and included in the present study. Of the 4672 participants from The PRIDE Study who completed the Eating and Body Image Survey, 1120 were classified as gender-expansive people. In addition to data on gender identity and sex assigned at birth, participants self-reported sociodemographic data including age, race/ethnicity, educational status, weight, and height (the latter two of which were used to calculate body mass index [BMI; kg/m^2]).

Of the total sample, 89 participants had more than 50% of their values missing and were excluded from the analyses. The final sample was comprised of 1031 gender-expansive participants with a mean age of 29.9 years ($SD = 9.8$, range = 18–74.3) and a mean BMI of 28.7 kg/m^2 ($SD = 8.53$, range = 12.9–70.8). Furthermore, 72.3% of the participants identified as White, 2.6% as Asian, 1.0% as Black, 0.3% as Native American/American Indian, 11.0% as another race, 2.4% as multi-race (e.g., reported two or more racial identities), and 10.4% did not report

Compte *et al. Journal of Eating Disorders*   (2022) 10:95

Page 4 of 11

their race. Additionally, 5.4% of participants identified as Hispanic, Latino, or Spanish in origin. From the total sample, 82.8% were assigned female sex at birth, 13.1% were assigned male sex at birth, and 4.1% did not report sex assigned at birth. Finally, 58.1% of participants reported having a college degree or higher, and 87.6% were born in the U.S.

Measures

Muscle Dysmorphic Disorder Inventory (MDDI) [20]. The MDDI is a 13-item measure that assesses symptoms of muscle dysmorphia. Items are rated on a five-point Likert-type scale (1 = *never*; 5 = *always*), and higher scores indicate greater symptom severity. The MDDI is comprised of three subscales: *Drive for Size* (DFS), *Appearance Intolerance* (AI), and *Functional Impairment* (FI). In this study, item 5 *("I think my chest is too small")* was modified to specify "chest (muscle)", so as to not confuse "chest" with breast size [29]. Previous studies across diverse populations have supported the original three-factor structure, including a recent publication that found good psychometric properties among cisgender gay men and lesbian women [29]. Norms for the MDDI have been published in a variety of populations [32] including among gender-expansive individuals [19]. Internal consistency values for the MDDI subscales in the current sample are presented in Table 2.

Eating Disorders Examination-Questionnaire (EDE-Q) [33]. The EDE-Q is a self-report measure of eating disorder attitudes and behaviors experienced over the previous 28 days. The EDE-Q provides four subscale scores: *Restraint* (five items), *Eating Concern* (five items), *Weight Concern* (five items), and *Shape Concern* (eight items). The Global Score is calculated as the average of the four subscales. Attitudinal items are rated on a seven-point ordered scale with higher scores reflecting greater eating disorder symptom severity. Norms for the EDE-Q have been published in a variety of populations [34, 35] including among gender-expansive individuals [36]. Internal consistency values for the EDE-Q subscales and Global Score are presented in Table 2.

Data analysis

Among those included in the analysis, 0.07% of missing values were observed, and the nonparametric test of homoscedasticity suggested that the mechanism was consistent with data missing completely at random ($p = 0.29$); consequently, data imputation was performed using multivariate imputation by chained equations. Descriptive statistics were reported as means and standard deviations (SD) for continuous variables and as percentages for categorical variables. Following recent guidelines in scale validation [37, 38], the full sample of

gender-expansive participants was randomly divided in a 1:1 ratio into split-half subsamples. An exploratory factor analysis (EFA) was conducted to determine the underlying factor structure of the MDDI using data from the first split-half subsample, after which confirmatory factor analysis (CFA) was conducted to assess the retained EFA model using data from the second split-half subsample. Because accurate sample adequacy for EFA is best determined after data analyses (communalities ≥ 0.50), guidelines to recruit as large a sample as possible were followed [38]; however, a minimum sample size of 260 participants was considered suitable, offering a 20:1 ratio per item [39]. To determine sample size requirements for the CFAs, a power analysis based on an RMSEA value consistent with a good model fit [40] was conducted for the original 13-item, three-factor model. A minimum sample size of 209 participants was required for a power of 0.80, an RMSEA value of 0.05, and an alpha level of 0.05.

Given that the assumption of multivariate normality was not fulfilled for the first split-half subsample (Mardia's Skewness 4419.11, $p < 0.001$), EFA was based on the principal-axis factoring estimation method [41]. Factors were assumed to be correlated, and the non-orthogonal Oblimin rotation was used. The Kaiser–Meyer–Olkin (KMO) measure of sampling adequacy and Bartlett's test of sphericity were used to determine if the data met the assumptions for an EFA; values of KMO > 0.60 and significant results in Bartlett's test were considered acceptable [42]. A parallel analysis [43] was conducted to provide empirical guidance for the number of factors to retain. Parallel analysis creates a random dataset with the same number of cases and variables as the actual dataset with support to retain the factors for which eigenvalues (λ) from the actual data are greater than those from the randomly generated data [44]. Extracted components in the EFA were judged to be adequate when their eigenvalues exceeded 1.0 (Kaiser's criterion) and after visual examination of the scree plot. In addition, items were retained if they had an item-factor loading of at least 0.40 on a primary factor and cross-loadings < 0.25 on other factors [45].

For the second split-half sample, due to the lack of multivariate normality (Mardia's Skewness 4138.08, $p < 0.001$), CFAs were based on a robust maximum likelihood estimation method with the Satorra-Bentler χ^2 scaled correction [46]. To ensure an identified model, items were set to load freely except for one item per factor, which was set to 1. Model fit was assessed using the following robust indices: comparative fit index (CFI), Tucker–Lewis index (TLI), root mean square error of approximation (RMSEA) and its 90% confidence interval (CI), and standardized root mean square residual

(SRMR). Following Gana and Broc, (2019), values of CFI and TLI between 0.90 and 0.95, RMSEA values between 0.06 and 0.08, and SRMR values < 0.08 were indicative of adequate fit [47].

Additionally, modification indices (M.I.) were considered for model improvement and to identify potential misspecifications; M.I. values > 5.0 were assumed to have a significant effect on the model. In addition to M.I., items residuals from the same factor were allowed to correlate also based on theoretical and substantive meaning [38]. A scaled Chi-square difference test ($\Delta\chi^2$) was used to compare the original and re-specified models [48]. Given the Likert-type nature of the data, the Omega coefficient and its 95% CI [49] were calculated to determine internal consistency; according to Najera Catalan (2019), values close to 0.80 were considered acceptable [50]. Due to the lack of multivariate normality among measures, the Spearman correlation coefficient was used for evaluating associations across variables. Values of > 0.10–0.29 were considered small, > 0.30–49 were considered moderate, and > 0.50 were considered large correlations [51]. Across the first and second split-half subsamples, all items were subjected to item analysis; no values < 0.20 were expected between latent variables and each of their correspondent items [52].

As sensitivity analyses, *Mann–Whitney U* Rank tests for group comparisons were conducted between participants from the first split-half and second split-half subsamples, in key sociodemographic variables (age and BMI) and across MDDI subscales, to determine if randomization produced equivalent groups. The coefficient r ($r = z$/square root of N) was used to report the effect size for continuous variables [53]. Cohen's r values ≥ 0.10 were considered a "weak" effect, $r \geq 0.30$ a "moderate" effect, and $r \geq 0.50$ a "strong" effect. Finally, a two-tailed $p < 0.05$ was considered significant.

R software (version 3.4.4) and the following packages were used: *Psych* [54], *MissMech* [55], *Mice* [56], *MVN* [57], *hornpa* [58], *GPArotation* [59], *MBESS* [60], *Hmisc* [61], *WebPower* [62], *Lavaan* [63], and *semPlot* [64].

Results

Exploratory factor analysis

An EFA for the first split-half subsample of gender-expansive participants ($n = 515$) was conducted. The KMO index was 0.75; the Bartlett's test of sphericity was significant ($\chi^2(78) = 2856.86$, $p < 0.001$); and the mean item communality of 0.53 was > 0.50, suggesting that data and sample size were adequate for the analysis. Results from parallel analysis suggested the presence of three factors; only the first three eigenvalues from the observed data presented λ greater than the criterion λ ($\lambda_1 = 3.33 > 1.34$; $\lambda_2 = 1.93 > 1.90$; $\lambda_3 = 3.00 > 1.25$); the fourth factor derived

Table 1 Factor loadings for the exploratory factor analysis in the first split-half subsample of gender-expansive participants (n = 515) from The PRIDE Study

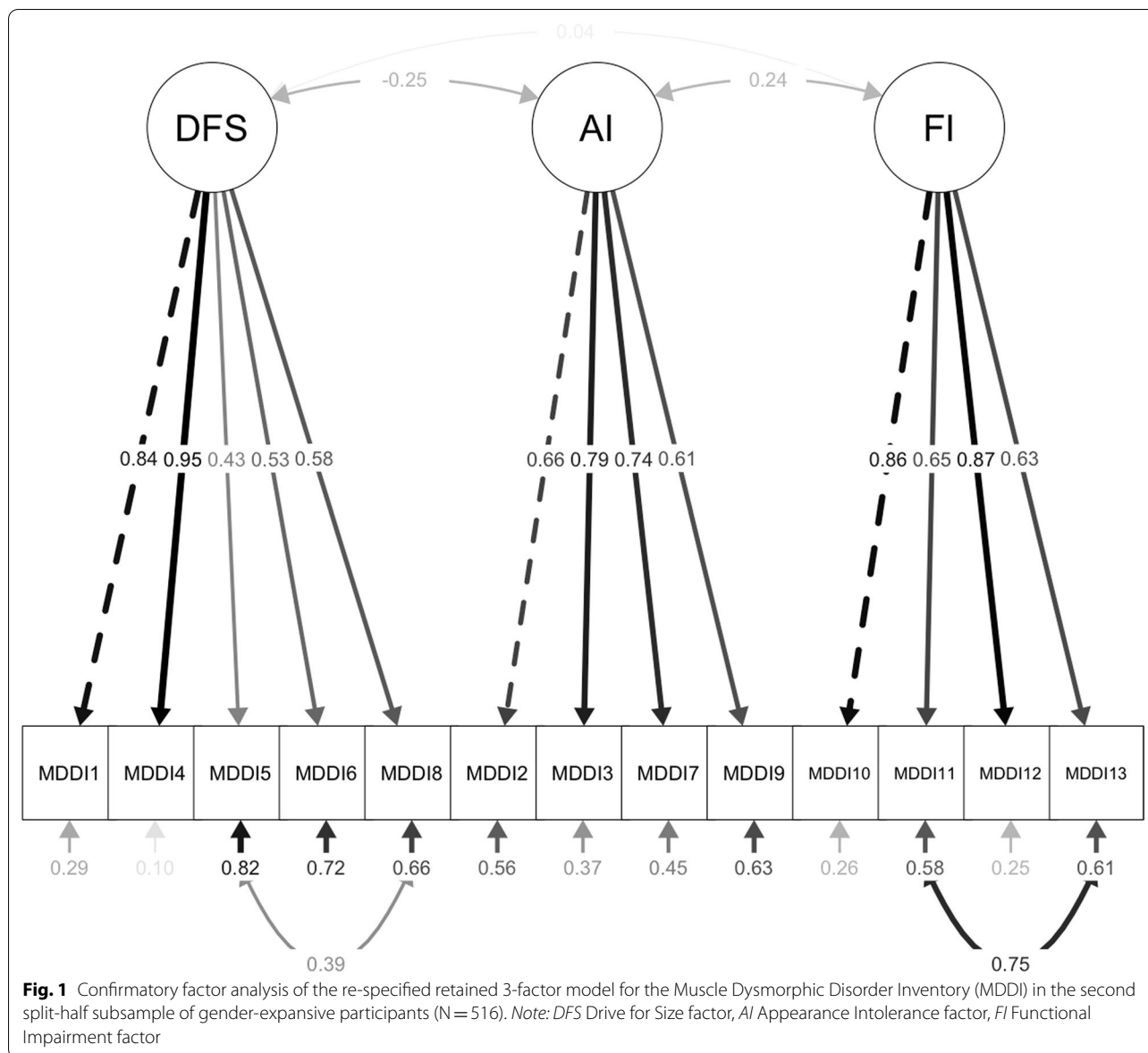| Item/factor	Gender-expansive participants (*n* = 515)			h2
	Factor loadings			
	1	**2**	**3**	
Drive for size				
1	**0.79**	− 0.01	− 0.01	0.65
4	**0.89**	0.01	− 0.02	0.78
5	**0.48**	0.21	0.09	0.27
6	**0.60**	0.01	− 0.05	0.35
8	**0.67**	0.03	15	0.49
Appearance intolerance				
2	0.01	**0.62**	0.02	0.39
3	0.07	**0.79**	− 0.04	0.60
7	− 0.20	**0.69**	0.09	0.63
9	0.09	**0.60**	− 0.05	0.34
Functional impairment				
10	0.10	0.15	**0.69**	0.55
11	− 0.08	− 0.12	**0.79**	0.59
12	0.12	0.09	**0.77**	0.66
13	− 0.06	− 0.05	**0.80**	0.62
Eigenvalue	3.33	1.93	3.00	–
Explained variance	.19.88	15.06	18.44	–
Mean item communalities	–	–	–	0.53

Table 2 Robust fit indices values for the tested models in the second split-half sample of gender-expansive participants (n = 516) from The PRIDE Study

Models	CFI	TLI	RMSEA [CI 90%]	SRMR
1. MDDI	0.81	0.76	0.13 (0.12, 0.14)	0.09
2. MDDI Re-specified	0.94	0.92	0.08 (0.07, 0.09)	0.07

from the actual data had a λ that was lower than the corresponding criterion λ generated by the parallel analysis ($\lambda_4 = 0.82 < 1.42$). A three-factor solution for the EFA that accounted for the 53.38% of the variance was observed. Table 1 shows factor loadings, communalities, eigenvalues, and explained variance. Primary factor item-factor loadings ranged from 0.48 to 0.89 across factors (above the 0.40 suggested threshold) with cross-loadings < 0.25 on other factors. Item communalities ranged from 0.27 to 0.78.

Confirmatory factor analysis

A CFA using the EFA model derived from the first split-half subsample was then conducted using data from the

Compte *et al. Journal of Eating Disorders*   (2022) 10:95

Page 6 of 11

Fig. 1 Confirmatory factor analysis of the re-specified retained 3-factor model for the Muscle Dysmorphic Disorder Inventory (MDDI) in the second split-half subsample of gender-expansive participants (N = 516). *Note: DFS* Drive for Size factor, *AI* Appearance Intolerance factor, *FI* Functional Impairment factor

second split-half subsample of gender-expansive participants ($n=516$). Fit indices were marginally below the suggested threshold (see Table 2); however, an inspection of the M.I. revealed high correlations between items 11 ("I pass up social activities with friends because of my workout schedule") and 13 ("I pass up chances to meet new people because of my workout schedule") (M.I.: 209.73) from the MDDI FI subscale, and between items 5 ("I think my chest (muscle) is too small") and 8 ("I wish my arms were bigger") (M.I.: 75.86) from the MDDI DFS subscale. Therefore, the model was re-specified allowing for residuals to correlate (see Table 2). The respecified model showed adequate fit and significantly improved the model fit ($\Delta\chi^2(2,\ n=516)=160.47,\ p<0.001$).

Figure 1 shows standardized parameters (factor loadings and factor correlations) for the respecified model. All factor loadings were statistically significant ($ps<0.001$) and >0.30 (standardized parameters).

Internal consistency, convergent validity, and item analyses

Table 3 reports descriptive statistics, Omega values with 95% CI, and Spearman correlations among variables within both the first and second split-half subsamples. The Omega coefficient for the MDDI subscales ranged between 0.77 and 0.86 across the two samples, providing support for the internal consistency of the subscales. With regard to convergent validity, the MDDI

Table 3 Internal consistency, descriptive statistics, and Spearman correlations in the first and second split-half subsamples of gender expansive participants (N = 1031) from The PRIDE Study

	First split-half sample of gender expansive participants (n = 515)		Second split-half sample of gender expansive participants (n = 516)		1	2	3	4	5	6	7	8
	Omega (95% CI)	M (SD)	Omega (95% CI)	M (SD)								
1 MDDI DFS	0.80 (0.76, 0.83)	8.27 (3.83)	0.81 (0.76, 0.86)	8.31 (3.87)		− 0.18**	0.13**	− 0.09*	− 0.08*	− 0.24**	− 0.16**	− 0.18**
2 MDDI AI	0.77 (0.73, 0.80)	12.92 (3.95)	0.80 (0.77, 0.82)	12.71 (4.13)	− 0.11*		0.17**	0.48**	0.63**	0.75**	0.80**	0.78**
3 MDDI FI	0.86 (0.78, 0.90)	6.10 (3.08)	0.81 (0.76, 0.86)	6.20 (3.10)	0.21**	0.18**		0.37**	0.28**	0.30**	0.29**	0.33**
4 EDE-Q R	0.85 (0.83, 0.86)	1.28 (1.49)	0.86 (0.83, 0.88)	1.24 (1.49))	− 0.07	0.41**	0.36**		0.57**	0.65**	0.64**	0.77**
5 EDE-Q EC	0.85 (0.82, 0.87)	1.03 (1.26)	0.86 (0.82, 0.88)	1.02 (1.28)	− 0.09*	0.55**	0.34**	0.55**		0.73**	0.75**	0.81**
6 EDE-Q WC	0.85 (0.83, 0.87)	2.24 (1.57)	0.87 (0.85, 0.88)	2.15 (1.69)	− 0.20**	0.73**	0.27**	0.58**	0.69**		0.91**	0.95**
7 EDE-Q SC	0.90 (0.88, 0.91)	2.64 (1.61)	0.91 (0.90, 0.92)	2.55 (1.69)	− 0.08*	0.79**	0.32**	0.56**	0.67**	0.86**		0.96**
8 EDE-Q G	0.94 (0.93, 0.95)	1.95 (1.32)	0.95 (0.94, 0.96)	1.89 (1.41)	− 0.12**	0.76**	0.36**	0.74**	0.78**	0.92**	0.94**	

MDDI DFS MDDI Drive for Size subscale, *MDDI AI* MDDI Appearance Intolerance subscale, *MDDI FI* MDDI Functional Impairment subscale, *EDE-Q R* EDE-Q Restraint subscale, *EDE-Q EC* EDE-Q Eating Concern subscale, *EDE-Q WC* EDE-Q Weight Concern subscale, *EDE-Q SC* EDE-Q Shape Concern subscale, *EDE-Q G* EDE-Q Global Score

Correlations for the first split-half sample are located below the diagonal. Correlations for the second split-half sample are located above the diagonal

*p < 0.05

**p < 0.01

AI subscale had significant, large positive correlations with the EDE-Q Shape Concern and Weight Concern subscales in both split-half subsamples as expected ($r_s = 0.63$–0.79, ps < 0.01). The MDDI AI subscale was further found to have significant, positive correlations (moderate to large) with the other EDE-Q subscales and the Global Score in both subsamples ($r_s = 0.41$–0.78, ps < 0.01). Also consistent with expectations, the MDDI FI subscale had significant, moderate positive correlations with the EDE-Q Global Score in both split-half subsamples ($r_s = 0.33$–0.36, ps < 0.01). The MDDI FI subscale additionally showed significant, positive correlations (small to moderate) with all of the EDE-Q subscales in both subsamples ($r_s = 0.27$–0.37, ps < 0.01). Finally, as anticipated, the MDDI DFS subscale showed significant, small negative correlations with the EDE-Q Weight Concern subscale in both split-half subsamples ($r_s = -0.20$–0.24, ps < 0.01) and with the EDE-Q Restraint subscale in the second split-half subsample ($r_s = -0.09$, $p < 0.05$); the correlation with EDE-Q Restraint in the second split-half subsample was similar in size but non-significant ($r_s = -0.07$, $p > 0.05$). The MDDI DFS subscale additionally showed significant, small negative correlations with all of the EDE-Q subscales and the Global Score in both subsamples ($r_s = -0.08$ to -0.24, ps < 0.05).

In both split-half subsamples, item analyses revealed strong significant positive correlations between items and their latent factor for the MDDI DFS ($r_s = 0.51$ to 0.82, ps < 0.001), MDDI AI ($r_s = 0.73$ to 0.83, ps < 0.001), and MDDI FI ($r_s = 0.60$ to 0.94, ps < 0.001) subscales.

Sensitivity analyses

The *Mann–Whitney U* test was used to assess differences in key sociodemographic variables (age and BMI) and across all subscales of the MDDI. No significant differences were observed between the first and second split-half samples of gender-expansive participants on age (*Mann Whitney U* test: $z = 0.74$, $p = 0.770$, Cohen's $r = 0.02$), BMI (*Mann Whitney U* test: $z = -0.88$, $p = 0.190$, Cohen's $r = 0.03$), or across MDDI subscales (DFS: *Mann Whitney U* test: $z = 1.64$, $p = 0.950$, Cohen's $r = 0.05$; AI: *Mann Whitney U* test: $z = -0.12$, $p = 0.451$, Cohen's $r = 0.01$; FI: *Mann Whitney U* test: $z = -0.2$, $p = 0.493$, Cohen's $r = 0.01$), suggesting that the randomization process was effective in balancing the groups.

Discussion

This study is one of only a few to focus on muscle dysmorphia symptoms in a sample of gender-expansive individuals, and further represents the first psychometric evaluation of the MDDI in this potentially at-risk, yet understudied population. Despite elevated body dissatisfaction [16] and eating disorder symptomatology [15]

among gender minorities, gender-expansive people have been largely underrepresented in muscle dysmorphia research. Our goal was to validate the MDDI in a sample of gender-expansive people to encourage future research on muscle dysmorphia in this population. Broadly, our analyses supported the original three-factor structure of the MDDI, and the subscales were found to show adequate internal consistency and convergent validity based on associations with a theoretically relevant measure of disordered eating.

Using an exploratory and confirmatory factor analytic approach, we found support for the original three-factor structure of the MDDI, suggesting the distinct nature of the three subscales that assess different dimensions of muscle dysmorphia symptomatology. This finding is consistent with previous MDDI validation studies in various samples from a broad array of countries (e.g., Argentina, Turkey, Germany, Brazil) that have confirmed the original three factors proposed by Hildebrandt et al. [22–28]. Although these studies have predominantly been conducted in men (cisgender or presumed cisgender) with very little attention to sexual or gender minority status, a recent study replicated the three-factor structure in cisgender gay men and lesbian women [29].

In terms of MDDI subscale intercorrelations, consistent with previous findings, we found that the Functional Impairment subscale was positively correlated with the Appearance Intolerance and Drive for Size subscales in both split-half subsamples [20, 22, 27, 29]. There were, however, significant negative correlations between the Drive for Size and Appearance Intolerance subscales in both subsamples. This latter finding diverges from previous validation studies conducted in cisgender or presumed cisgender men [20, 22, 28]. However, there were negative associations between these two subscales in one study of a sample of approximately half women (though gender identity was not specifically assessed) [26] and another conducted in cisgender sexual minority men and women [29]. This may suggest that, in cisgender women and sexual and gender minority people, the drive to be thin and lean is more central to concerns about appearance than increased body size. However, additional research is needed to confirm these findings and better understand the underlying mechanisms.

Consistent with our hypotheses, the MDDI subscales showed adequate internal consistency reliability in this sample of gender-expansive individuals. As part of the convergent validity evaluation, we found expected moderate to large positive correlations of the MDDI Appearance Intolerance and Functional Impairment subscales with all of the EDE-Q subscales and the global score in both split-half subsamples. In line with our hypotheses, the MDDI Drive for Size subscale was negatively

Compte *et al. Journal of Eating Disorders* (2022) 10:95

Page 9 of 11

correlated with EDE-Q subscale and global scores in both split-half subsamples with one exception (i.e., similar effect size, but non-significant correlation with the EDE-Q restraint in the first subsample). These findings are generally consistent with the patterns of associations between the MDDI and measures related to disordered eating that have been reported in previous studies including in cisgender gay men and lesbian women [29]. However, other studies, including one in Brazilian men and one in Argentinian men (though gender identity was not specifically assessed), found that MDDI Drive for Size and EDE-Q scores were positively associated [22, 28]. More research is needed to understand the nature of associations between muscle dysmorphia symptoms and disordered eating across diverse populations.

Strengths and limitations

Strengths of this study include a large sample size from a national cohort, the focus on an understudied population of gender minority people, and distinguishing gender-expansive from binary transgender people (i.e., transgender men [65] and transgender women), as these two groups have been found to differ in their body image concerns [15, 19]. However, future research should evaluate specific gender-expansive subpopulations (e.g., non-binary, agender, gender fluid) as our gender-expansive group was diverse and included combinations and write-ins, such that there were insufficient sample sizes for conducting specific gender-expansive subgroup analyses. Additional limitations should be addressed. First, the sample was comprised of English-speaking, predominantly White, and highly educated individuals, therefore limiting the generalizability of the findings. Given that nearly one-third of gender-expansive people are not White [66], gender-expansive people of color are underrepresented in the present study, and their experiences with body image and muscle dysmorphia symptoms may differ from those of most of our study participants. Future studies of these constructs will be needed in samples reflecting greater racial, ethnic, and socioeconomic diversity. Second, the MDDI is a measure of the severity of muscle dysmorphia symptoms, but it cannot provide a diagnosis for the disorder, which would require a full, structured interview. Third, data were not available to evaluate the test–retest reliability or the discriminant validity of the MDDI subscales since all constructs measured were likely to be correlated in this investigation; these important psychometric properties should be investigated in future research. Finally, the conceptually relevant overlap between the constructs of muscle dysmorphia symptoms and disordered eating supported using the EDE-Q for evaluating convergent

validity evaluation in this study; however, future studies should further examine convergent validity based on associations of the MDDI subscales with measures of other theoretically related constructs, including muscularity-oriented disordered eating (e.g., the Muscularity Oriented Eating Test) [67], body dysmorphic disorder symptoms (e.g., the Appearance Anxiety Inventory [68], the Body Dysmorphic Disorder Questionnaire) [69], and other key diagnostic features (e.g., body checking and avoidance).

Conclusions and future directions

In sum, this study supports the three-factor structure of the MDDI and the psychometric properties of the subscales in gender-expansive individuals. The support found for the MDDI in this study will facilitate its use in future research on muscle dysmorphia symptoms among gender-expansive individuals, who are at elevated risk for a variety of eating- and body image-related concerns. Future studies will be needed to further evaluate other psychometric properties of the MDDI in this population, including test-rest reliability and discriminant validity, as well as investigating predictive validity using longitudinal data. Further, building upon work that has established MDDI norms in gender-expansive people [19], additional studies will be needed to develop clinical cut-off scores for the MDDI and to establish comprehensive prevalence estimates for muscle dysmorphia in gender minority groups. Finally, it will be important to explore the specific nature and diversity of body image ideals in gender-expansive people, especially those related to the drive for size and muscularity, and to consider how these may influence the risk for muscle dysmorphia.

Compte *et al. Journal of Eating Disorders*   (2022) 10:95

Page 10 of 11

Declarations

Ethics approval and consent to participate
The University of California, San Francisco and Stanford University Institutional Review Boards approved this study (#16-21213). Written informed consent was obtained from all participants.

Consent for publication
Not applicable.

Competing interests
Dr. Obedin-Maliver has consulted for Sage Therapeutics (5/2017) in a one-day advisory board, Ibis Reproductive Health (a non-for-profit research group; 3/2017–5/2018, 2020-present), Folx, Inc. (2020—present), and Hims Inc. (2019—present). Dr. Lunn has consulted for Hims Inc. (2019—present) and Folx, Inc. (2020). Dr. Flentje has consulted for Hopelab (2020). None of these roles present a conflict of interest with this work as described here. The other authors have no conflicts of interest to report.

Author details
[1]Eating Behavior Research Center, School of Psychology, Universidad Adolfo Ibáñez, Santiago, Chile. [2]Research Department, Comenzar de Nuevo Treatment Center, Monterrey, Mexico. [3]Department of Pediatrics, University of California, San Francisco, 550 16th Street, 4th Floor, Box 0110, San Francisco, CA 94158, USA. [4]Military Cardiovascular Outcomes Research Program (MiCOR), Department of Medicine, Uniformed Services University of the Health Sciences, Bethesda, MD, USA. [5]The Metis Foundation, San Antonio, TX, USA. [6]Department of Psychological Sciences, Auburn University, Auburn, AL, USA. [7]Department of Psychiatry and Behavioral Sciences, University of Southern California, Los Angeles, CA, USA. [8]Department of Psychology, San José State University, San Jose, CA, USA. [9]The PRIDE Study/PRIDEnet, Stanford University School of Medicine, Stanford, CA, USA. [10]Department of Community Health Systems, University of California, San Francisco, San Francisco, CA, USA. [11]Alliance Health Project, Department of Psychiatry and Behavioral Sciences, University of California, San Francisco, San Francisco, CA, USA. [12]Department of Obstetrics and Gynecology, Stanford University School of Medicine, Stanford, CA, USA. [13]Department of Epidemiology and Population Health, Stanford University School of Medicine, Stanford, CA, USA. [14]Division of Nephrology, Department of Medicine, Stanford University School of Medicine, Stanford, CA, USA.

References
1. Pope HG, Gruber AJ, Choi P, Olivardia R, Phillips KA. Muscle dysmorphia: an underrecognized form of body dysmorphic disorder. Psychosomatics. 1997;38:548–57.
2. American Psychiatric Association. Diagnostic and statistical manual of mental disorders. 5th ed. Arlington: American Psychiatric Publishing; 2013.
3. Cunningham ML, Griffiths S, Mitchison D, Mond JM, Castle D, Murray SB. Muscle dysmorphia: an overview of clinical features and treatment options. J Cogn Psychother. 2017;31:255–71.
4. Pope CG, Pope HG, Menard W, Fay C, Olivardia R, Phillips KA. Clinical features of muscle dysmorphia among males with body dysmorphic disorder. Body Image. 2005;2:395–400.
5. Hildebrandt T, Alfano L, Langenbucher JW. Body image disturbance in 1000 male appearance and performance enhancing drug users. J Psychiatr Res Pergamon. 2010;44:841–6.
6. Tod D, Edwards C. Relationships among muscle dysmorphia characteristics, body image quality of life, and coping in males. J Sci Med Sport. 2015;18:585–9.
7. Tod D, Edwards C, Cranswick I. Muscle dysmorphia: current insights. Psychol Res Behav Manag. 2016;9:179–88.
8. Olivardia R, Pope H, Hudson J. Muscle dysmorphia in male weightlifters: a case-control study. Am J Psychiatry. 2000;157:1291–6.
9. Cafri G, Olivardia R, Thompson JKK. Symptom characteristics and psychiatric comorbidity among males with muscle dysmorphia. Compr Psychiatry Compr Psychiatry. 2008;49:374–9.
10. Mitchison D, Mond J, Griffiths S, Hay P, Nagata JM, Bussey K, et al. Prevalence of muscle dysmorphia in adolescents: findings from the EveryBODY study. Psychol Med. 2021.
11. Aparicio-García ME, Díaz-Ramiro EM, Rubio-Valdehita S, López-Núñez MI, García-Nieto I. Health and well-being of cisgender, transgender and non-binary young people. Int J Environ Res Public Health. 2018;15:2133.
12. James S, Herman J, Rankin S, Keisling M, Mottet L, Anafi M. The Report of the 2015 US Transgender Survey. The Report of the 2015 US Transgender Survey. 2016.
13. Thorne N, Witcomb GL, Nieder T, Nixon E, Yip A, Arcelus J. A comparison of mental health symptomatology and levels of social support in young treatment seeking transgender individuals who identify as binary and non-binary. Int J Transgenderism. 2019;20:241.
14. Scandurra C, Mezza F, Maldonato NM, Bottone M, Bochicchio V, Valerio P, et al. Health of non-binary and genderqueer people: a systematic review. Front Psychol. 2019;10:1453.
15. Diemer EW, Hughto JMW, Gordon AR, Guss C, Austin SB, Reisner SL. Beyond the binary: differences in eating disorder prevalence by gender identity in a transgender sample. Transgender Health. 2018;3:17.
16. Ålgars M, Santtila P, Sandnabba NK. Conflicted gender identity, body dissatisfaction, and disordered eating in adult men and women. Sex Roles. 2010;63:118–25.
17. Roberts SR, Salk RH, Thoma BC, Romito M, Levine MD, Choukas-Bradley S. Disparities in disordered eating between gender minority and cisgender adolescents. Int J Eat Disord. 2021;54:1135–46.
18. Amodeo AL, Esposito C, Antuoni S, Saracco G, Bacchini D. Muscle dysmorphia: what about transgender people? Cult Health Sex. 2020;24:63–78.
19. Nagata J, Compte EJ, McGuire FH, Lavender JM, Brown TA, Murray SB, et al. Community norms of the Muscle Dysmorphic Disorder Inventory (MDDI) among gender minority populations. J Eat Disord. 2021;9:1.
20. Hildebrandt T, Langenbucher J, Schlundt DG. Muscularity concerns among men: development of attitudinal and perceptual measures. Body Image. 2004;1:169–81.
21. Mitchell L, Murray SB, Cobley S, Hackett D, Gifford J, Capling L, et al. Muscle dysmorphia symptomatology and associated psychological features in bodybuilders and non-bodybuilder resistance trainers: a systematic review and meta-analysis. Sports Med. 2017;47:233–59.

Compte *et al. Journal of Eating Disorders*　　　(2022) 10:95

Page 11 of 11

22. Compte EJ, Nagata JM, Sepúlveda AR, Rivas A, Sbdar LS, Menga S, et al. Assessment and validation of a Spanish version of the Muscle Dysmorphia Disorder Inventory in Argentinian men who exercise: Inventario de Dismorfia Muscular. Body Image. 2019;31:24–34.

23. Sandgren SS, Giske R, Shalfawi SAI. Muscle dysmorphia in norwegian gym-going men: an initial investigation. Kinesiology. 2019;51:12–21.

24. Galiana-Linares L, Badenes-Rivera L, Fuentes-Durán MC, et al. Validación de la versión espãnola del Inventario del Trastorno por Dismorfia Muscular en una muestra de estudiantes universitarios. In: Nunez JC, Molero MM, Gázquez JJ, Pérez-Fuentes MC, Simón MM, Martos A, et al., editors. Atención a las necesidades comunitarias para la salud. Almería: Scinfoper; 2017. p. 41–5.

25. Subaşı B, Okray Z, Çakıcı M. Validity and reliability of Turkish Form of Muscle Dysmorphia Disorder Inventory among elite bodybuilder men. Anatolian J Psychiatry. 2018;19:47–54.

26. Zeeck A, Welter V, Alatas H, Hildebrandt T, Lahmann C, Hartmann A. Muscle Dysmorphic Disorder Inventory (MDDI): Validation of a German version with a focus on gender. PLoS ONE. 2018;13: e0207535.

27. Devrim A, Bilgic P. Validity and reliability study of turkish version of "muscle dysmorphic disorder inventory" and "bodybuilder image grid" scales. Curr Nutr Food Sci. 2018;15:517–24.

28. Gomes VMGM, Compte EJ, Almeida M, Campos PF, Queiroz ACC, Pereira LF, et al. Psychometric properties of the muscle dysmorphic disorder inventory among physically active Brazilian college men. Psychol Men Mascul. 2020;21:622.

29. Compte EJ, Cattle CJ, Lavender JM, Murray SB, Brown TA, Capriotti MR, et al. Psychometric evaluation of the Muscle Dysmorphic Disorder Inventory (MDDI) among cisgender gay men and cisgender lesbian women. Body Image. 2021;38:241–50.

30. Santarnecchi E, Dèttore D. Muscle dysmorphia in different degrees of bodybuilding activities: Validation of the Italian version of Muscle Dysmorphia Disorder Inventory and Bodybuilder Image Grid. Body Image. 2012;9:396–403.

31. Lunn MR, Lubensky M, Hunt C, Flentje A, Capriotti MR, Sooksaman C, et al. A digital health research platform for community engagement, recruitment, and retention of sexual and gender minority adults in a national longitudinal cohort study: The PRIDE Study. J Am Med Inform Assoc. 2019;26:737–48.

32. Nagata JM, Compte EJ, Cattle CJ, Lavender JM, Brown TA, Murray SB, Flentje A, Capriotti MR, Lubensky ME, Obedin-Maliver J, Lunn MR. Community norms of the Muscle Dysmorphic Disorder Inventory (MDDI) among cisgender sexual minority men and women. BMC Psychiatry. 2021;21:297.

33. Fairburn CG, Beglin SJ. Eating disorder examination questionnaire (6.0). In: Fairburn CG, editor. Cognitive behaviour therapy for eating disorders. New York: Guilford Press; 2008. p. 309–13.

34. Nagata JM, Capriotti MR, Murray SB, Compte EJ, Griffiths S, Bibbins-Domingo K, Obedin-Maliver J, Flentje A, Lubensky ME, Lunn MR. Community norms for the Eating Disorder Examination Questionnaire among cisgender gay men. Eur Eat Disord Rev. 2020;28:92–101.

35. Nagata JM, Murray SB, Compte EJ, Pak EH, Schauer R, Flentje A, Capriotti MR, Lubensky ME, Lunn MR, Obedin-Maliver J. Community norms for the Eating Disorder Examination Questionnaire (EDE-Q) among transgender men and women. Eat Behav. 2020;37:101381.

36. Nagata JM, Compte EJ, Cattle CJ, Flentje A, Capriotti MR, Lubensky ME, et al. Community norms for the Eating Disorder Examination Questionnaire (EDE-Q) among gender-expansive populations. J Eat Disord. 2020;8:74.

37. Boateng GO, Neilands TB, Frongillo EA, Melgar-Quiñonez HR, Young SL. Best practices for developing and validating scales for health, social, and behavioral research: a primer. Front Public Health. 2018;6:149.

38. Swami V, Barron D. Translation and validation of body image instruments: Challenges, good practice guidelines, and reporting recommendations for test adaptation. Body Image. 2019;31:204–20.

39. Hair JF, Black WC, Babin B, Anderson R. Multivariate data analysis. 7th ed. Upper Saddle River: Prentice Hall; 2010.

40. MacCallum RC, Browne MW, Sugawara HM, Wegener D. Power analysis and determination of sample size for covariance structure modeling. Psychol Methods. 1996;1:130–49.

41. Fabrigar LR, MacCallum RC, Wegener DT, Strahan EJ. Evaluating the use of exploratory factor analysis in psychological research. Psychol Methods. 1999;4:272–99.

42. Worthington RL, Whittaker TA. Scale development research: a content analysis and recommendations for best practices. Counsel Psychol. 2016;34(806):838. https://doi.org/10.1177/0011000006288127.

43. Horn JL. A rationale and test for the number of factors in factor analysis. Psychometrika. 1965;30:179–85.

44. Hayton JC, Allen DG, Scarpello V. Factor retention decisions in exploratory factor analysis: a tutorial on parallel analysis. Organ Res Methods. 2004;7:191–205.

45. Tabachnick B, Fidell L, Ullman J. Using multivariate statistics. Pearson; 2007.

46. Satorra A, Bentler PM. Corrections to test statistics and standard errors in covariance structure analysis. Latent variables analysis: applications for developmental research. Thousand Oaks: Sage Publications Inc; 1994. p. 399–419.

47. Gana K, Broc G. Structural equation modeling with lavaan. Structural Equation Modeling with lavaan. Wiley; 2019. p. 1–273.

48. Satorra A, Bentler PM. A scaled difference chi-square test statistic for moment structure analysis. Psychometrika. 2001;66:507–14.

49. Dunn TJ, Baguley T, Brunsden V. From alpha to omega: a practical solution to the pervasive problem of internal consistency estimation. Br J Psychol. 2014;105:399–412.

50. Nájera Catalán HE. Reliability, population classification and weighting in multidimensional poverty measurement: a monte carlo study. Soc Indic Res. 2019;142:887–910.

51. Cohen J. A power primer. Psychol Bull Psychol Bull. 1992;112:155–9.

52. Nunnally J. Psychometric theory. 2nd ed. New York: McGraw-Hill; 1978.

53. Cohen J. Statistical power analysis for the behavioral sciences. 2nd ed. Hillsdale: Lawrence Erlbaum Associates; 1988.

54. Revelle W. psych: procedures for personality and psychological research. J Res Person. 2018;72:64–72.

55. Jamshidian M, Jalal S, Jansen C. Missmech: an R package for testing homoscedasticity, multivariate normality, and missing completely at random (MCAR). J Stat Softw. 2014;56:1–31.

56. van Buuren S, Groothuis-Oudshoorn K. mice: multivariate imputation by chained equations in R. J Stat Softw. 2011;45:1–67.

57. Korkmaz S, Goksuluk D, Zararsiz G. MVN: an R package for assessing multivariate normality. R J. 2014;6:151–62.

58. Huang F. Horn's (1965) Test to determine the number of components/factors. 2015

59. Bernaards CA, Jennrich RI. Gradient projection algorithms and software for aribtrary rotation. Educ Psychol Measur. 2005;65:676–96.

60. Kelley K, Lai K. MBESS: MBESS. R package version 3.3.2.. 2012.

61. Harrell F. Hmisc: Harrell miscellaneous. 2008.

62. Zhang Z, Yuan K-H. Practical statistical power analysis using webpower and R. 2018.

63. Rosseel Y. Lavaan: an r package for structural equation modeling. J Stat Softw. 2012;48:1–36.

64. Epskamp S. semPlot: unified visualizations of structural equation models. Struct Equ Model. 2015;22:474–83.

65. Nagata JM, Compte EJ, McGuire FH, Lavender JM, Murray SB, Brown TA, Capriotti MR, Flentje A, Lubensky ME, Obedin-Maliver J, Lunn MR. Psychometric validation of the Muscle Dysmorphic Disorder Inventory (MDDI) among US transgender men. Body Image. 2022;42:43–9.

66. Todd K, Peitzmeier SM, Kattari SK, Miller-Perusse M, Sharma A, Stephenson R. Demographic and behavioral profiles of nonbinary and binary transgender youth. Transgend Health. 2019;4(1):254–61.

67. Murray SB, Brown TA, Blashill AJ, Compte EJ, Lavender JM, Mitchison D, et al. The development and validation of the muscularity-oriented eating test: a novel measure of muscularity-oriented disordered eating. Int J Eat Disord. 2019;52:1389–98.

68. Veale D, Eshkevari E, Kanakam N, Ellison N, Costa A, Werner T. The Appearance Anxiety Inventory: validation of a process measure in the treatment of body dysmorphic disorder. Behav Cogn Psychother. 2014;42:605–16.

69. Phillips K. The broken mirror: understanding and treating body dysmorphic disorder. Oxford: Oxford University Press; 1998.

Publisher's Note