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Muscle dysmorphia in different degrees of bodybuilding activities: Validation of the Italian version of Muscle Dysmorphia Disorder Inventory and Bodybuilder Image Grid

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ABSTRACT

The purpose of the study was to validate two measures of muscle dysmorphia (MD) into the Italian language. The sample included three participant groups: (1) competing bodybuilders, (2) non-competing bodybuilders, and (3) non-bodybuilding controls. In general the Italian versions of the scales showed psychometric utility that is consistent with the original instruments. The severity of MD was greater for competing bodybuilders than non-competing bodybuilders and controls.

Introduction

Body dysmorphic disorder (BDD) is characterized by the excessive concern and preoccupation of an imaginary body defect or a slight physical anomaly (Pope, Katz, & Hudson, 1993). BDD has been included for the first time in nosography in the DSM-III and ICD-10 (Phillips, McElroy, Keck, Pope, & Hudson, 1993). In the last 20 years, several authors have reported evidence of body image disturbance in males and male weightlifters (Andersen, Bartlett, Morgan, & Brownell, 1995; Drewnowski, Kurth, & Krahn, 1995; Schwerin et al., 1996). Several studies have investigated the preoccupation with muscularity, in terms of its prevalence and correlates (Frederick, Fessler, & Haselton, 2005; McCreary & Sasse, 2000), suggesting that body image disturbance in men relates to two factors: desire for increased muscularity and reduced body fat. Pope, Olivardia, Gruber, and Borowiecki (1999) found that men idealized a body size on average 28 pounds more muscular than their current weight, suggesting that obtaining lean muscle mass is the most desired form of weight change in men. This is most probably due to the modification in cultural ideals, reflected in the increasingly lean and muscular action figures of movie, magazine and television stars (Frederick et al., 2005).

In the early 1990s, Pope et al. (1993) described an extreme form of body image disturbance called 'reverse anorexia', now known as muscle dysmorphia (MD) (Pope, Gruber, Choi, Olivardia, & Phillips, 1997; Vandereycken, 2011). Pope et al. (1993) described a pathological desire to become more lean and muscular in both men and women. When MD was first included in the DSM-III it was described as a subtype of body dysmorphic disorder (BDD), as the two conditions had several aspects in common. Three main criteria define the MD subtype: a preoccupation with being lean and muscular; a negative belief about one's own body and subsequent body avoidance or anxiety; and the interference of these two aspects in social and/or occupational areas of functioning.

Recently many studies have been conducted with the purpose of enlarging knowledge about muscle dysmorphia along with the necessity of a review of BDD in the DSM-5 (Phillips, Wilhelm, Koran, Didie, Fallon, & Feusner, 2010). A recent contribution (Murray, Rieger, Touyz, & De la Garza Garcia Lic, 2010) supported the necessity of a reassignment of muscle dysmorphia from BDD to the eating disorders field, due to the analogies between their symptomatology: the pathological search of weight loss (anorexia nervosa) and weight gain (muscle dysmorphia), along with the focus on quality and amount of food consumed. They also cited evidence from research that demonstrated the similar epidemiological characteristics of the two disorders, such as diagnostic crossover time and the finding that 29% of men with MD had previously suffered from an eating disorder (Olivardia, Pope, & Hudson, 2000); common etiological factors such as similar responses to psychological or pharmacological therapies (Lamanna, Grieve, Derryberry,

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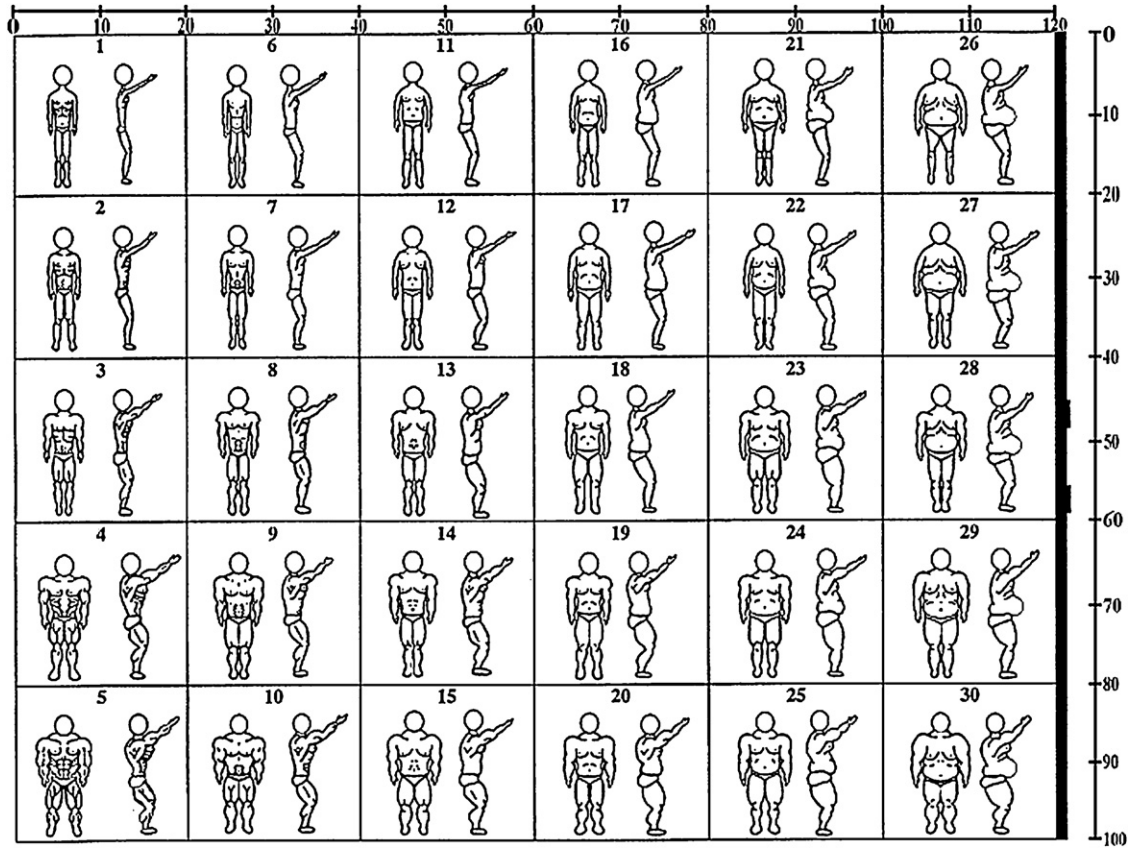

Fig. 1. The Bodybuilder Image Grid (BIG). Figure grid is composed by individual figures that represent a distance of 6.5% body fat from figure to figure, and a progressive increase from left to right starting with 3.5% and ending with 36% across the columns. The muscularity dimension includes figures that have a degree of muscularity and body fat percentage that is unattainable without the use of ergogenic drugs such as steroids. Derived from the original paper by Hildebrandt et al. (2004).

Hakman, & McClure, 2010); and familial disturbance transmission supported by studies on twin siblings (Raevuori, Keski-Rahkonen, Hoek, Sihvola, Rissanen, & Kaprio, 2008). However there is also evidence to suggest that obsessive–compulsive disorder, anorexia and MD could constitute alternative manifestations of obsessive thoughts (focus about the germs, thinness and muscle size) and compulsive behavior (washing, reduction of the weight, exercising). When considering all these possible similarities between MD and various DSM-IV disorders, we think that a simple inclusion of MD in a pre-existing disorder classification could be an over-simplification and also premature. It would be more useful to conceptualize muscle dysmorphia as an independent disorder and thus concentrate on developing measures that adequately capture its uniqueness and allow a more efficient differential diagnosis process.

Several instruments for the assessment of MD and other related disorders have been validated and proposed in the last ten years, such as the Muscle Dysmorphia Inventory (Rhea, Lantz, & Cornelius, 2004), the Muscle Appearance Satisfaction Scale (Mayville, Williamson, White, Netemeyer, & Drab, 2002) and the Body Building Dependence Scale (Smith & Hale, 2004). However there is currently a lack of validated instruments in the Italian language that prevents study of this disorder in both clinical and research fields.

This current study aims to provide an Italian validation of two specific instruments for muscle dysmorphia: the Muscle Dysmorphia Disorder Inventory (MDDI) and the Bodybuilding Image Grid (BIG), both published by (Hildebrandt, Langenbucher, & Schlundt, 2004). We believe these instruments could help clinicians to better identify muscle dysmorphia or similar conditions, since a specific tool for aiding differential diagnosis is lacking in Italy. The Italian versions of these assessments are provided in the online supplementary materials linked to this article.

Test–Retest Reliability of the MDDI and BIG-S (Study 1)

A 3-week test–retest correlational study was conducted to test the reliability of MDDI and BIG-S both in competing and non-competing bodybuilders.

Participants

Ten male competing bodybuilders (M_{age} = 31 SD_{age} = 10; $range_{age}$ 26–35; BMI = 29.35; $range_{BMI}$ 28–32), and 25 non-competing males (M_{age} = 33 SD_{age} = 5; $range_{age}$ 24–37; BMI = 24.09; $range_{BMI}$ 22–26) with at least 1 year of continuous weightlifting experience were participants in the study. Body mass index (BMI) evaluation was performed through a direct height/weight measurement, following the canonical formula weight/(height)^2.

Assessments

The Muscle Dysmorphia Disorder Inventory (MDDI) is a measure of muscle dysmorphia derived from the Schlundt Muscle Dysmorphia Inventory (MDI) [unpublished manuscript] that originally consisted of 16 self-report items based on MD research criteria. Hildebrandt et al. (2004) revised the original MDI for the purpose of integrating the instrument with questions about the Functional Impairment characteristic of MD. The final version of MDDI items includes seven questions assessing the three diagnostic factors associated with MD: desire for size, appearance anxiety/avoidance,

and Functional Impairment. Participants rate all questions on a 5-point Likert-type scale from "never" ("1") to "always" ("5").

The factorial analysis conducted by Hildebrandt et al. (2004) reveals a consistent three-factor structure, regarding cognitions, emotions, and behaviors related to body image. The first subscale, Desire For Size (DFS), consists of questions concerning thoughts of being smaller, less muscular, and weaker than desired, or a wish to increase size and strength. The thinking style represented by this subscale is consistent with the preoccupation about inadequate size in MD as described by Pope et al. (1997). The second factor, Appearance Intolerance (AI), explores negative beliefs about one's body and resulting appearance anxiety or body exposure avoidance. The negative cognitions and behavioral manifestations of core negative beliefs about one's body are consistent with features in MD, such as wearing baggy clothes to the beach or the belief that one's body is ugly and distasteful. Finally, the Functional Impairment (FI) factor consists of questions about behaviors related to maintaining exercise routines, the interference of negative emotions when deviating from exercise routines, or avoidance of social situations because of negative feelings and preoccupation with one's body.

The Bodybuilder Image Grid (BIG) is an instrument designed to measure the perceptual body image disturbance in males and perceived attractiveness of the male body to both men and women. The grid was published by Hildebrandt et al. (2004) together with the MDDI, and is composed of two different versions: BIG-S (BIG-Scaled) and BIG-O (BIG-Original).

As shown in Fig. 1, the silhouettes used in the BIG-O and BIG-S vary along dimensions of muscularity and body fat. In these validation studies we chose to limit the use of the Bodybuilder Image Grid to the more informative "S" version. The scaled version offers four different scores that refer to four different questions; subjects must choose the figure that they think (1) best represents their current body type, (2) their ideal body type, (3) the most attractive body type, and (4) the body type that is most attractive to the opposite sex. The scale is intended to be used by males with any sexual preference. The BIG-S was developed from the BIG-O by placing scales from 0 to 120 across the top of the columns and from 0 to 100 along the right side of the grid to allow for individuals to make fine distinctions between the figures and reduce lost variance due to forced figure choices.

For the BIG-S individuals must select one score for each scale (fat and muscle mass), so identifying a specific figure on the grid. After this choice, the test administrator asks the subject to report a hypothetical height and body fat percentage for each of the identified figures. The figure grid was composed by Hildebrandt et al. (2004) by choosing individual figures that represent a distance of 6.5% body fat from figure to figure, and a progressive increase from left to right starting with 3.5% and ending with 36% across the columns. The muscularity dimension was purposefully designed by the authors to include figures that have a degree of muscularity and body fat percentage that is unattainable without the use of ergogenic drugs such as steroids.

We requested a native English speaker to accurately translate the MDDI into Italian and then gave the results to another translator for back-translation. (See the online Supplementary Materials.) To evaluate the reliability and adequacy of the scale we first chose to do a test–retest study with the Italian version. In both studies the competing bodybuilders were recruited either during offseason training at gyms or at bodybuilding contests. Non-competing males, with at least 1 year of continuous weightlifting experience, voluntarily replied to an announcement published in four different commercial gyms; non-training subjects, who had never practiced bodybuilding or any form of sport at the time of the study, were recruited within the Florence and Siena University student and graduate student population. Members of competing, non-competing and non-training groups received a discount to buy supplements or fitness clothing online in exchange for their participation.

Data Analysis

To establish test–retest reliability, participants completed the MDDI and BIG-S at a 3-week interval. Both the first and the second copy of the tests were completed at the gym and immediately reported to the test administrator. Pearson's product–moment correlations were calculated for each subscale and the total score of each measure, providing a measure of test–retest reliability.

Results

Table 1 lists the means, standard deviations, and test–retest reliabilities for the MDDI and BIG-S. Test–retest reliabilities for the MDDI and the BIG-O were excellent, as reported in the original paper by Hildebrandt et al. (2004). No item fell under the $r = .65$ cutoff.

Principal Components Analysis, Convergent and Divergent Validity of MDDI and BIG-S (Study 2)

We compared three different groups of participants with varying degrees of involvement in bodybuilding activities. This could lead us to obtain both a validation of MDDI and BIG-S instruments, then to unveil the different characteristics of MD symptomatology across competing bodybuilders, non-competing bodybuilders and non-training subjects.

Participants

Participants consisted of three samples of 60 male competing bodybuilders ($M_{age} = 33$ $SD_{age} = 7$; $range_{age}$ 23–41; BMI = 27.93), 60 non-competing males ($M_{age} = 32$ $SD_{age} = 10$; $range_{age}$ 23–36; BMI = 24.60), and 60 non-training subjects ($M_{age} = 33$ $SD_{age} = 8$; $range_{age}$ 24–37; BMI = 25.02).

Measures

Participants completed both the MDDI and BIG-S as well as a series of questionnaires related to the most relevant dimensions that, in the last 15 years, have been associated with MD. When selecting the questionnaires we also thought about the proposal for a future integration of MD in the obsessive compulsive disorders spectrum (Murray et al., 2010). Specifically we used questionnaires or inventories concerning OCD, eating disorders, self-esteem and level of satisfaction with daily living. A brief description of these measures and their psychometric properties are shown below.

Satisfaction Profile (SAT-P). This is a 32-item self-report questionnaire used to evaluate subjective levels of satisfaction about aspects of daily living. It is composed of five subscales referring to five different dimensions: psychological functioning, physical functioning, work, sleep-nutrition and free-time, and social functioning. The authors reported good test–retest reliability ($ICC = .87$) and internal consistency (Cronbach $\alpha = .79$).

Body Dysmorphic Disorder – Yale-Brown Obsessive Compulsive Scale (BDD-Y-BOCS). BDD-Y-BOCS is a modified version of Yale-Brown Obsessive Compulsive Scale (Y-BOCS) (Phillips, Hollander, Rasmussen, Aronowitz, DeCaria, & Goodman, 1997). It is a semi-structured clinical scale used to evaluate the severity of OCD symptomatology in body dysmorphic disorder. BDD-Y-BOCS showed excellent inter-rater test–retest reliability ($ICC = .99$ and .88), internal consistency (Cronbach $\alpha = .80$), and good convergent and discriminant validity. For this study we used an Italian version of BDD-Y-BOCS that is not yet published. For our purposes, we

Table 1
Means, standard deviations, and Pearson correlation coefficients for 3-week test–retest reliabilities for the MDDI and BIG-S (Study 1).

Measures	Competing bodybuilders ($n = 10$)			Non-competing males ($n = 25$)		
	Week 1 M (SD)	Week 3 M (SD)	r	Week 1 M (SD)	Week 3 M (SD)	r
MDDI total score	38.52 (7.97)	33.60 (3.31)	.62	29.60 (6.56)	29.23 (6.78)	.99
MDDI Drive for Size	15.45 (4.78)	17.30 (3.83)	.83	10.00 (4.00)	9.54 (4.72)	.97
MDDI Appearance Intolerance	10.32 (3.90)	10.80 (2.30)	.79	14.63 (3.95)	14.00 (4.26)	.83
MDDI Functional Impairment	11.87 (3.58)	10.90 (3.60)	.82	6.32 (4.17)	5.88 (3.49)	.85
BIG-S Actual body shape – Fat	27.33 (17.84)	36.50 (20.82)	.97	41.67 (18.33)	37.46 (20.04)	.96
BIG-S Actual body shape – Muscle	64.33 (12.12)	64.00 (7.75)	.95	46.83 (18.55)	55.77 (16.69)	.96
BIG-S Ideal body shape – Fat	14.33 (9.63)	19.20 (13.47)	.97	30.50 (17.02)	30.77 (17.61)	.98
BIG-S Ideal body shape – Muscle	75.17 (16.00)	79.00 (14.87)	.86	53.17 (9.83)	58.85 (12.67)	.88
BIG-S Most attractive body – Fat	15.33 (9.47)	18.70 (8.58)	.95	32.50 (17.31)	35.12 (18.12)	.87
BIG-S Most attractive body – Muscle	69.00 (16.12)	60.40 (17.25)	.89	53.17 (9.11)	50.35 (10.81)	.86
BIG-S Most attractive to women – Fat	19.00 (11.75)	17.00 (11.00)	.78	31.50 (17.45)	30.15 (15.23)	.72
BIG-S Most attractive to women – Muscle	51.67 (13.92)	50.00 (12.20)	.73	47.33 (14.36)	45.18 (11.34)	.74
BIG-S Ideal-Actual discrepancies – Fat	−13.00 (8.21)	−17.30 (7.35)	.96	−12.45 (1.22)	−6.92 (2.98)	.88
BIG-S Ideal-Actual discrepancies – Muscle	10.83 (3.87)	15.00 (7.12)	.71	7.14 (4.72)	4.38 (2.01)	.76

made the same translation/back-translation procedures used for MDDI and BIG-S items.

Basic Self-Esteem Scale (Basic SE). This scale evaluates self-esteem (Forsman, Johnson, Ugolini, Bruzzi, & Raboni, 2003); it is composed of 22 items on a Likert scale from 1 ("totally disagree with this sentence") to 5 ("totally agree with this sentence"). Internal consistency is Cronbach $\alpha = .85$ and test retest correlation is Pearson $r = .81$.

Eating Disorder Inventory-3 Referral Form (EDI-3). This is a brief self-report instrument for the evaluation of eating disorders (Garner, 2004) (Italian version by Giannini & Conti, 2008), composed of three scales of the Eating Disorder Inventory-3 (EDI-3): Drive For Thinness (DT), Bulimia (B) and Body Dissatisfaction (BD). The psychometric properties were satisfactory with a Cronbach α for single subscales respectively of DT = .88, BD = .84 and $B = .73$.

Supplements, diet, and workout information. We also collected additional information through a semi-structured interview, checking for mean frequency of workouts per week, number of daily meals, and mean number of supplement types used in the last three months. These indexes were interpreted as an indirect measure of involvement in bodybuilding life style.

Statistical Analysis

To test the factorial structures of MDDI, a principal components analysis with varimax rotation and Kaiser normalization were carried out. Convergent and divergent validity between measures provided were calculated using Pearson r coefficient. Cronbach's α provided a measure of internal consistency for MDDI and measures used to test convergent/divergent validity. We also evaluated relationships between the three MDDI subscales and similar correlated measures of the proposed constructs, such as workouts per week, number of daily meals and supplements type currently used at the time of testing, SAT-P subscales and self-esteem (Basic SE). Using simultaneous regression analysis, we investigated if the AI subscale would be the best predictor of EDI-3 subscale "Body Dissatisfaction" and basic SE scores; and if the FI subscale would be a good predictor of the Work and Social functioning subscale of SAT-P and if there is a relationship with the number of workouts per week.

Results

Muscle Dysmorphia Disorder Inventory

Kaiser–Meyer–Olkin measure of sampling adequacy (G1 = .72; G2 = .67; G3 = .63) and Bartlett's test of sphericity (G1–G2–G3 $p = .001$) showed the MDDI dataset was adequate. A principal components analysis (PCA) with the competing bodybuilder group (using a 1 eigenvalue cut-off) reveals the three-factor structure highlighted in Hildebrandt et al.'s (2004) standardization research.

Table 2 shows the PCA for all the groups included in our study, with factor loading of each items of the MDDI. In the competing bodybuilder group all the items reflecting their original distribution among factors revealed an original standardization PCA. The total score variance explained was equal to 66.22%, a result similar to that reported by Hildebrandt et al. (2004) (total variance explained = 63.02%). The three factors, Drive For Size, Functional Impairments and Appearance Intolerance explained, respectively, 39.32%, 15.37% and 11.52% of the total variance. In regards to the competing and non-competing bodybuilder we found an alteration of the factorial structures, with the appearance of a fourth factor with an eigenvalue over 1. The resulting models for non-competing bodybuilders and non-training men showed, respectively, 74.59% and 85.15% of the total variance. In the non-competing bodybuilders the fourth factor seemed to be the result of Appearance Intolerance subscale split in to two different factors. In the non-training group the fourth factor results were a perfectly balanced spin-off of the original tripartite factorial composition, showing items that originally loaded on to Functional Impairment, Drive For Size, and Appearance Intolerance.

Internal consistency analysis showed excellent Cronbach's α coefficient for Total MDDI score ($\alpha = .85$), Drive For Size ($\alpha = .80$) and Functional Impairment ($\alpha = .81$). However, the Appearance Intolerance subscale showed a low level of internal consistency ($\alpha = .45$). Additional measures used for convergent/divergent validity reported adequate values: BDD Y-BOCS ($\alpha = .83$), Bulimia subscale (EDI-3) ($\alpha = .76$), Body Dissatisfaction (EDI-3) ($\alpha = .81$), psychological functioning (SAT-P) ($\alpha = .71$), social functioning (SAT-P)($\alpha = .75$), Work (SAT-P) ($\alpha = .68$) and self-esteem (Basic SE) ($\alpha = .81$).

Significant differences in the MDDI (total and subscales) and other measures between groups are showed in Table 3. All the Bonferroni post hoc comparisons were significant at the $p = .01$ level, except for BDD-Y-BOCS ($p = .143$) and Drive For Thinness subscale of EDI-3 ($p = .122$) between competing and non-competing bodybuilders.

Convergent and divergent validity. The evidence for the convergent and divergent validity of the MDDI is shown in Table 4. The MDDI total and subscale scores showed good convergent validity by significantly correlating with the Bulimia subscale, and Body Dissatisfaction Scales. Moreover, Drive For Size seemed to correlate specifically with the Number of Supplements, Workouts per week and Self-esteem measures. Appearance Intolerance significantly

Table 2
Principal components analysis and relative factor loadings of MDDI items in all groups of Study 2.

MDDI items	Competing bodybuilders ($n = 60$)			Non-competing males ($n = 60$)				Non-training subjects ($n = 60$)			
	DFS	FI	AI	Factor 1	Factor 2	Factor3	Factor 4	Factor 1	Factor 2	Factor3	Factor 4
PCA eigenvalues	3.11	2.12	1.99	3.81	2.22	1.94	1.73	5.73	2.07	2.00	1.87
1. I think my body is too small	**.55**	.29	.23	−.15	**.73**	.39	−.05	**.82**	.52	.03	.00
2. I wear loose clothing so that people cannot see my body	.11	.15	**.83**	−.18	.12	**.80**	.00	−.08	−.28	−.21	**.71**
3. I hate my body	−.01	−.41	**.53**	−.24	.06	.17	**.83**	**.94**	−.11	−.06	−.08
4. I wish I could get bigger	**.61**	.38	.21	.27	**.82**	−.03	−.20	.39	**.72**	.17	.10
5. I think my chest is too small	**.76**	.18	.35	.17	**.81**	−.08	.12	**.72**	.68	−.03	−.09
6. I think my legs are too thin	**.88**	−.10	.09	.26	**.83**	−.05	.08	−.10	**.90**	−.10	−.26
7. I feel like I have too much body fat	.37	.11	**.64**	.43	−.09	.01	**.68**	.05	−.14	.08	**.84**
8. I wish my arms were bigger	**.73**	.16	−.33	.39	**.62**	.37	−.06	**.75**	.52	.14	.21
9. I am very shy about letting people see me with my shirt off	.04	.22	**.86**	.25	−.06	**.75**	.22	−.03	.43	.00	**.79**
10. I feel anxious when I miss one or more workout days	.11	**.81**	.32	**.74**	.23	.21	−.04	.54	.23	**.68**	.04
11. I pass up social activities with friends because of my workout schedule	.39	**.67**	.15	**.87**	.39	−.03	.06	**.86**	−.07	.44	−.01
12. I feel depressed when I miss one or more workout days	−.05	**.78**	.42	**.91**	.14	−.15	.02	−.07	−.13	**.93**	−.06
13. I pass up chances to meet new people because of my workout schedule	.36	**.66**	.29	**.90**	.09	.00	.02	**.67**	.25	.65	−.12

Note. MDDI: Muscle Dysmorphic Disorder Inventory; DFS: Drive For Size; AI: Appearance Intolerance; FI: Functional Impairment; PCA: Principal Components Analysis. Bolded values correspond to the factor that best represent each item of MDDI.

correlated with measures of Body Dissatisfaction and self-esteem. Functional Impairment significantly correlated with measures of self-esteem, work and social functioning. Consistent with expectations, the strongest correlations occurred between the MDDI total score and two major dimensions of muscle dysmorphia, namely obsessive compulsive symptomatology and psychological, social and workplace functioning.

Regression analysis. Table 5 reports the results of the regression analysis for the variables that had at least one significant result in the competing, non-competing or non-training groups. MDDI subscales proved to be good predictors of frequency of weekly workout and social functioning, identifying Functional Impairment and Drive For Size subscales as the better explanatory variables. The regression models concerning Body Dissatisfaction (EDI-3), self-esteem (Basic SE) and workplace functioning (SAT-P) did not reach statistical significance.

Body Building Image Grid-Scaled (BIG-S)

Table 6 reports the mean and standard deviation values for all groups of the four indexes related to *current, ideal, most attractive* and *most attractive to the opposite sex* body type, shown in Fat and Muscle Mass relative scores. The table also reports the results of Bonferroni post hoc tests between the three groups. The scores related to *current* and *ideal body type* resulted in an expected significant difference between groups. Moving from competing bodybuilders to non-training subjects we could highlight an almost linear trend of increasing *current* and *ideal body* fat levels and decreasing muscle mass levels.

As for the *most attractive body* Fat score, non-competing bodybuilders and the non-training group had similar results, a phenomenon that also persisted in Fat and Muscle Mass scores of *most*

Table 3
Significant analysis of variance (ANOVA) results between all groups (Study 2).

	Group 1 competing bodybuilders ($n = 60$)	Group 2 non-competing males ($n = 60$)	Group 3 non-training subjects ($n = 60$)	Post hoc comparisons		
	M (*SD*)	*M* (*SD*)	*M* (*SD*)	Group 1 vs. group 2	Group 2 vs. group 3	Group 1 vs. group 3
				Cohen *d*		
MDDI total score	38.50 (7.97)	29.60 (6.56)	16.10 (3.45)	−1.22***	2.69***	3.92***
MDDI Drive for Size	15.45 (4.78)	10.00 (4.00)	5.83 (2.66)	−1.24***	1.25**	2.58***
MDDI Appearance Intolerance	10.32 (3.90)	14.63 (3.95)	6.23 (2.79)	1.10**	2.49***	1.22**
MDDI Functional Impairment	11.87 (3.58)	6.32 (4.17)	3.57 (1.68)	−1.43***	0.93**	3.15***
Number of daily meals	5.68 (1.32)	4.48 (1.03)	2.67 (1.14)	−1.01**	1.66**	2.44***
Number of supplements	4.20 (2.24)	0.90 (1.82)	–	−1.62***	–	–
Workouts per week	4.78 (2.59)	3.22 (1.24)	–	−0.81*	–	–
BDD Y-BOCS total score	8.13 (6.14)	6.20 (6.10)	2.97 (3.13)	−0.31	0.70*	1.11**
SAT-P social functioning	60.33 (28.62)	74.72 (19.53)	55.11 (31.47)	0.59*	0.76*	0.17
EDI-3 Drive For Thinness subscale	8.77 (5.64)	6.80 (7.57)	2.63 (2.09)	−0.29	0.86*	1.58***
EDI-3 Bulimia subscale	2.62 (4.34)	4.88 (7.36)	1.03 (1.46)	0.38	0.87*	0.54*

* $p < .05$.
** $p < .01$.
*** $p < .001$.

Table 4
Convergent and divergent validity of MDDI and BIG-S (Study 2).

	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
1. MDDI total score	–	.38**	.24**	.23**	.32*	.32	.49**	.33**	−.32**	−.31*	−.38*	−.31*	−.23	−.31*	.42*
2. MDDI Drive for Size		–	.36**	.38**	.22*	.35**	.24*	.31**	−.35**	−.36*	−.35*	−.22	−.29*	−.47*	.38*
3. MDDI Appearance Intolerance			–	.39**	.25	.29	.31*	.47**	−.36**	−.24*	.27	−.25	−.28*	−.38*	.31*
4. MDDI Functional Impairment				–	.19	.32	.28*	.34**	−.24	−.68**	.71**	−.36*	−.32*	−.27*	.29*
5. Workouts per week					–	.23	.23	.31	.31	.31	.22	.31	.21	−.28	.32
6. Number of Supplements						–	.26	.23	.27	.36	.27	.36	.13	−.32	.24
7. BDD Y-Bocs							–	.35	.21	.24	.16	.24	.24	.34	.28
8. Bulimia subscale (EDI-3)								–	.34	.37	.22	.38	.27	.27	−.31
9. Body dissatisfaction (EDI-3)									–	.24	.26	.24	.32*	.26	−.24
10. Psychological functioning (SAT-P)										–	.16	.27	.20	.33	−.27
11. Social functioning (SAT-P)											.	.26	.17	.32	−.33
12. Work (SAT-P)												–	.22	.29	−.31
13. Self-esteem (BASIC-SE)													–	.21	−.28
14. BIG-S Ideal body shape – FAT														–	−.23
15. BIG-S Ideal body shape – MUSCLE															–

* $p < .05$.
** $p < .01$.

Table 5
Standard regression analyses: MDDI subscales' prediction of social functioning and frequency of workouts per week in all groups (Study 2).

Dependent variable	Independent variable	Beta			Adjusted R^2			t			p		
		CBB	NCBB	NTG	CBB	NCBB	NTG	CBB	NCBB	NTG	CBB	NCBB	NTG
Workouts per week	MDDI Drive for Size	.27	.17	–				3.85	1.31		<.001	.20	
	MDDI Appearance Intolerance	.12	−.34		.35	.17	–	2.14	−2.67	–	.03	.01	–
	MDDI Functional Impairment	.42	.15					6.07	1.11		<.001	.27	
Social functioning (SAT-P)	MDDI Drive for Size	.33	.39	−.06				3.85	3.19	−.54	<.001	.00	.59
	MDDI Appearance Intolerance	.28	.32	.08	.44	.19	.34	3.93	2.62	.74	<.001	.01	.46
	MDDI Functional Impairment	−.53	−.17	−.60				−3.90	−1.34	−5.36	<.001	.19	<.001

Note. CBB, competing bodybuilders; NCBB, non-competing males; NTG, non-training subjects.

attractive body to women, where all the groups showed no significant differences.

To test the BIG-S convergent validity we selectively chose the Fat and Muscle Mass scale scores, correlating them with BMI, self-reported body fat percentage, workouts per week, total score and subscales of MDDI. As expected, current body type *F* score significantly correlated with BMI ($r = .24$; $p = .05$) and self-reported body Fat percentage ($r = .41$; $p = .04$). The current body type Muscle Mass score was significantly correlated with BMI ($r = .33$; $p = .05$) and ideal body type Muscle Mass score was significantly correlated with Drive For Size ($r = .32$; $p = .03$) and Appearance Intolerance ($r = .23$; $p = .04$). As highlighted in Hildebrandt et al. (2004) original work, also in our study participants who chose an ideal body type with lower fat scores tended to report a greater number of supplement usage ($r = -.29$; $p = .002$) and had a larger number of workouts per week ($r = -.23$; $p = .03$). Weaker correlations were found between the Muscle Mass score of ideal body type and supplements usage ($r = .12$; $p = .05$) and weekly workout frequency ($r = .20$; $p = .05$).

Discussion

The Muscle Dysmorphia Disorder Inventory and Body Building Image Grid were designed by Hildebrandt et al. (2004) to encompass all the features of muscle dysmorphia described during the nineties (Pope et al., 1993, 1997) and over the following years (Olivardia, 2001; Pope, Pope, Menard, Fay, Olivardia, & Phillips, 2005), concerning the preoccupation with becoming more muscular, dissatisfaction and avoidance associated with appearance and functional impairment. These characteristics perfectly placed muscle dysmorphia within the multidimensional definition of body image disturbance and include cognitive, perceptual, emotional and behavioral disturbances related to the specific desire to be

Table 6
Means and standard deviations and group comparisons of BIG-S indices (Study 2).

BIG-S indexes	Group 1 competing bodybuilders ($n = 60$)	Group 2 non-competing males ($n = 60$)	Group 3 Non-training subjects ($n = 60$)	Post hoc comparisons		
	M (SD)	M (SD)	M (SD)	Group 1 vs. group 2	Group 1 vs. group 3	Group 2 vs. group 3
				Cohen d		
Current body type – Fat	27.33 (17.84)	41.67 (18.33)	50.67 (18.40)	−0.83***	−1.33***	−0.50*
Current body type – Muscle Mass	64.33 (12.12)	46.83 (18.55)	29.33 (15.17)	1.10***	2.59***	1.06***
Ideal body type – Fat	14.33 (9.63)	30.50 (17.02)	37.33 (16.04)	−1.26***	−1.77***	−0.36*
Ideal body type – Muscle Mass	75.17 (16.00)	53.17 (9.83)	42.00 (16.95)	1.69***	2.00***	0.81***
Most attractive body – Fat	15.33 (9.47)	32.50 (17.31)	38.00 (18.48)	−1.38***	−1.70***	−0.29
Most attractive body – Muscle Mass	69.00 (16.12)	53.17 (9.11)	45.33 (15.35)	1.28***	1.55***	−0.17***
Most attractive to women – Fat	19.00 (11.75)	31.50 (17.45)	32.67 (18.58)	−0.90***	−0.90***	−0.06
Most attractive to women – Muscle Mass	51.67 (13.92)	47.33 (14.36)	50.67 (14.25)	0.36	0.07	−0.29

* $p < .05$.
*** $p < .001$.

leaner and more muscular (McFarland & Kaminski, 2009). Currently there is a lack of Italian validated instruments for the recognition of this disorder and our work was intended to overcome this gap and at the same time contribute to an additional validation of Hildebrandt et al. (2004) original work on an Italian sample. The Italian validated versions of the MDDI and BIG are available (see Supplementary Online Materials).

The Italian version of the MDDI (MDDI-ITA) seems to offer a short and reliable measure of muscle dysmorphia symptoms with good convergent and divergent validity and a factorial structure that almost perfectly traces the original one in competing bodybuilder subjects. The results suggest that the MDDI-ITA is able to distinguish various levels of muscle dysmorphia, expressed as a synthesis of time spent working out, number of daily meals and supplements, social functioning and eating disorder related problems such as drive for thinness. Total and subscale scores correlated with disorders that are reported to have several common aspects with muscle dysmorphia, for example obsessive compulsive traits regarding food and training, eating disorders aspects such as a pathologic relationship with food, preoccupation with body shape, and inadequately explored links with self-esteem.

We believe this instrument has its utility in its briefness and simplicity. Nevertheless some additional items could enlarge its psychometric properties and allow the exploration of some other aspects that we consider are central to muscle dysmorphia (e.g., relationship with clothing style, thought and behavior related to anxiety levels, focusing on other muscle groups beyond legs and arms, and misperception about daily changes in muscle mass).

Furthermore, we found an interesting alteration of the original factorial structure of MDDI in the non-competing and non-training groups, with the appearance of a fourth factor in each group. Considering the different type of items that load on this factor we hypothesize that in non-competing subjects muscle dysmorphia could manifest its impact on Appearance Intolerance in two different ways. The first seems to be related to an avoidance behavior, expressed as a "covering" action, like dressing in loose clothing to hide one's body (Item 2) or feeling shy about appearing without clothes (Item 9). The other factor seems to be composed by items that referred to a specific perceptual/emotional response to uneasiness about one's own body, such as hate (Item 3) or disappointment for body composition, for example fat prevalence (Item 7).

On the other hand non-training subjects showed a different composition of the fourth factor, expressed as a mix of all the other aspects captured by the original factors Drive For Size, Functional Impairment and Appearance Intolerance. This new factor could be interpreted as a signal of the presence of a de-structured and sub-threshold muscle dysmorphia-like condition within the younger male Italian population, that shows typical concerns like a desire for a bigger and stronger body, dedication to fitness or sports' activity and a clouded global body dissatisfaction. Consequently we think that a more in depth examination of these new possible factorial structures on Italian non-training and non-competing subjects would be appropriate to unveil a subtle presence of sub-threshold muscle dysmorphia in adolescents and young men.

As for the Italian version of BIG (BIG-S-ITA), it demonstrated good convergent and divergent validity and provided a reliable measure of perceptual disturbances, which is consistent with the male desire to be leaner and more muscular. As shown in Table 5, not all the dimensions explored by this scale follow the same gradient through our three groups. Responses to *most attractive body* and *most attractive body to women* questions generated similar responses in all participants, focusing attention on a characteristic phenomenon regarding competing and non-competing bodybuilders. People who had never frequented a gym and non-competing bodybuilders tend to report similar levels of thinness regarding their idea of the most attractive body, while competing bodybuilders indicated lower levels of fat as a requirement to delineate an "attractive body". Additionally, it must be highlighted that the BIG-S was also designed to measure both perceptual disturbances between current and desired body types as well as attractiveness and different sexual orientations (Hildebrandt & Walker, 2006). This suggests that BIG-S could be a useful tool in research fields other than muscle dysmorphia. Considering all these tangential arguments, we are planning a deeper exploration of muscle dysmorphia including narcissism, sexual orientation, and personality traits assessment, both in male and female athletes, as well as a more accurate evaluation of body fat and muscle mass percentage. This could help to explain the unexpected homogeneity in most attractive body preferences between members of all groups.

Hildebrandt et al. (2004) noted that the original version of the MDDI lacks validation within a female population and the same is true for our Italian version. It is reasonable to think that muscle dysmorphia presents differently in females, especially regarding what body parts are desirous of an increase in size. A validation of these instruments within a female sample is therefore needed, however this could prove difficult in Italy, where female bodybuilding is less popular than in the USA and UK.

It is obvious that MDDI-ITA and BIGS-ITA cannot allow clinicians to make a complete diagnosis of muscle dysmorphia. However, considering their relationship with other measures like body dissatisfaction, psychological and social functioning, obsessive–compulsive disorder and bulimia symptoms, the instruments can help to assess the defined symptoms of muscle dysmorphia. A more informative study using a clinically diagnosed sample could resolve this issue, but we would also like to suggest that our exploration of muscle dysmorphia characteristics across three different levels of expression could be considered a reliable and informative approach.

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Appendix A. Supplementary data

Supplementary data associated with this article can be found, in the online version, at doi:10.1016/j.bodyim.2012.03.006.

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