Muscle Dysmorphia and its Associated Psychological Features in Three Groups of Recreational Athletes

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Muscle Dysmorphia (MD) is a psychological disorder characterized by the preoccupation with the idea that one's body is not lean and muscular. The current study aimed to explore MD behaviours and symptoms in three groups of recreational athletes: bodybuilders (BB; n = 42), strength athletes (SA; n = 61), and fitness practitioners (FP; n = 22). Furthermore, we assessed MD-related psychological features as well as possible psychological predictors of MD among groups. Results highlighted that the BB group reported more beliefs about being smaller and weaker than desired compared to the other groups, whereas individuals in the SA group reported setting higher standards for themselves than the FP group. Lastly, orthorexia nervosa and social anxiety symptoms emerged as predictors of MD symptoms in the BB group. Taken together, our findings suggest that individuals in the BB group are characterized by more MD general symptomatology than those in the other groups; furthermore, only orthorexia nervosa and social anxiety may play a specific role in predicting MD general symptoms in bodybuilders.

Muscle Dysmorphia (MD) is a subtype of Body Dysmorphic Disorder (BDD) characterized by the preoccupation with the idea that one’s body is not sufficiently lean and muscular1–3. Individuals with MD perceive themselves as small and weak even if they look normal or very muscular2. As a consequence, individuals with MD engage in behaviours aimed at achieving the desired lean and muscular physique3; these behaviours are compulsive and are comprised of excessive exercise and rigid diet, excessive use of dietary supplements and, sometimes, may also include the use of anabolic-androgenic steroids (AAS)2,4–6. Individuals with MD frequently avoid important social or occupational activities because of the compulsive need to maintain their excessive exercise and rigid diet4.

MD affects mostly men2, and its prevalence rates vary significantly depending on the sample population; in particular, athletes involved in resistance training may be at increased risk for MD development compared to other athletes and non-trainers2,7. However, a generalization for all athletes involved in resistance training activities does not appear to be justified. A discrepancy of MD prevalence and features among subgroups within the resistance training community exists and is dependent on the goals of the weight training activity5. Indeed, athletes who engage in appearance-related resistance training (e.g., bodybuilders) may be at increased risk for MD development than athletes involved in resistance training to improve strength (e.g., weightlifters)7. In fact, many studies have underlined that bodybuilders display higher MD prevalence rates and more MD features than other resistance training athletes6–11 with prevalence rates ranging from 3.4%6 to 53.6%12 within this population. Therefore, differences in goals characterizing bodybuilders and other resistance training athletes may influence the prevalence and the manifestation of MD13. Although bodybuilders are considered at increased risk for developing MD, the study by Pickett et al.14 reported that competitive bodybuilders did not differ from other resistance training athletes with respect to the self-evaluation of their body image; furthermore, both groups reported higher positive self-evaluation of their body than physically active controls. Moreover, both competitive bodybuilders and resistance training athletes were more satisfied about their upper torso muscles and general muscle tone than physically active controls. Finally, competitive bodybuilders reported higher levels of social self-esteem

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than both resistance training athletes and athletically active controls. These inconsistent findings may be due to sampling methods (e.g. different level of competition) and by the self-report measures employed to assess MD that may fail in the evaluation of the condition's key features.

Dysfunctional eating patterns, as well as psychological features such as perfectionism, self-esteem, and social anxiety, may play a key role in the development and maintenance of MD. MD shares clinical features with Eating Disorders (EDs), because of the presence of the compulsive exercise and rigid diet characterizing both disorders; accordingly, previous studies have well documented the high comorbidity between MD and EDs, but little is known about dysfunctional eating patterns, such as Orthorexia Nervosa (ON) in individuals with MD. ON is defined as an obsession for healthy food and differs from EDs since dysfunctional eating patterns are expressed in a “qualitative” way rather than in a “quantitative” one. Indeed, in order to obtain the desired lean and muscular physique, individuals with MD usually strictly control what they eat, and their food choices are focused on the healthy aspects of the food. Furthermore, men's internalization of a muscular body ideal, typical of men with MD, plays a significant role in relation to ON. The internalization of a muscular body ideal is related to higher scores of ON which explains why ON is common in individuals with MD.

Perfectionism might be involved in MD development and maintenance, given that individuals with MD struggle to reach an unattainable body shape. Perfectionism may influence the development of MD both directly and indirectly; the direct influence relies in the pursuit of the perfect body, whereas the indirect influence might be enacted through body dissatisfaction. Although the association between perfectionism and MD is well-known and established, little is known about which specific components of perfectionism are actually involved in MD. Indeed, perfectionism is a multidimensional construct composed of three dimensions (self-oriented perfectionism, other-oriented perfectionism, and socially-prescribed perfectionism) that may differentially contribute to the development and maintenance of MD.

Low self-esteem is also conceptualized as a crucial factor implicated in the development and maintenance of MD. Individuals with MD may engage in appearance-improving behaviours (such as weightlifting, excessive exercise, rigid diet, and use of dietary supplements) to enhance their self-esteem; importantly, the muscular development obtained performing these activities reinforce engagement in these activities again. Therefore, low self-esteem can provide a source of motivation for MD behavioral symptoms. Furthermore, low self-esteem may contribute to the avoidance of social situations in which the body is exposed to others, and such avoidance is negatively reinforced by a temporary reduction in anxiety. Consistently, individuals with MD try to avoid places and situations in which their bodies might be seen by others (e.g., beaches, swimming pools) or endure such situations with marked distress and anxiety. Although the role of social physique anxiety has been well explored with respect to MD development, little is known about social anxiety in MD. Moreover, despite the fact that low self-esteem is theoretically linked to MD, previous studies examining self-esteem in individuals considered at increased risk for MD led to inconsistent results. For example, Muller et al. did not observe differences in self-esteem between bodybuilders/weight lifters and athletes practicing other sports (contact and non-contact sports). Even more surprisingly, Pickett et al. found that competitive bodybuilders had higher social self-esteem than physically active controls. Such contradictory results call for further research aimed to shed light on the role of self-esteem in individuals considered at increased risk for MD.

Despite the recent increased interest toward this disorder and its growing prevalence, MD is still under-studied and uncharted. As previously reviewed, individuals with MD are markedly distressed and/or impaired by their preoccupation with their perceived weakness, which negatively impacts their quality of life. A more in-depth understanding of MD, especially in athletes at increased risk, would contribute to the development and implementation of effective assessment, prevention, and treatment programs, thus further leading to higher knowledge and awareness about this disorder.

Therefore, the current study aimed to explore MD behaviours and symptoms in three groups of Italian athletes who trained regularly for recreational purposes: bodybuilders (BB group), strength training athletes (SA group), and fitness practitioners (FP group). In accordance with previous studies, we expected to observe more MD behaviours and symptoms in the BB group than in the other groups.

Furthermore, we investigated MD-related psychological features such as self-esteem, perfectionism, social anxiety, and ON symptoms among these groups of athletes. Since bodybuilders are more likely to show MD features, we expected to observe lower levels of self-esteem and higher levels of perfectionism, as well as more ON symptoms, in the BB group than in the other two groups. Furthermore, given the association between MD, low self-esteem, and social anxiety, we hypothesized higher levels of social anxiety symptoms in the BB group than in the other two groups; to note, no previous study explored social anxiety among these groups of athletes.

Lastly, we sought to explore possible MD psychological predictors among groups. In light of (1) the putative role played by high levels of perfectionism, social anxiety, ON symptoms, and low self-esteem in the development and maintenance of MD, and (2) the increased risk of MD in athletes involved in resistance training for appearance-related purposes, we hypothesized that all the above mentioned psychological features would predict MD only in the BB group.

Results

Sample Description. The mean age of the total sample was 30.89 (SD = 8.90; range = 19–55), and the mean years of education was 15.02 (SD = 2.85; range = 8–21). The majority of participants reported being single (36%) and full time employed (46.4%). Groups were equivalent with respect to age (p = 0.06), years of education (p = 0.93), marital status (p = 0.21), and occupation (p = 0.35; Table 1), whereas differences emerged on BMI (p = 0.01). Bonferroni post hoc comparisons showed that the BMI of the SA group was higher than the BMI of the FP group (p = 0.01), while the BB group did not differ from either the SA (p = 0.06) or the FP (p = 0.99).
groups (Table 1). To note, eight participants (6.4%) satisfied the Pope et al. (1997) diagnostic criteria for MD: four bodybuilders, two strength athletes, and two fitness practitioners.

**MD Behaviours and Symptoms Among Groups.** With respect to behaviours related to MD, Chi-squared analyses showed significant group differences on daily protein intake (χ² = 19.28; *p = 0.004). Indeed, protein intake was >2 g proteins/kg/day only in the BB group compared to the other two groups (18 participants vs 6 participants in the SA group and 4 participants in the FP group). Groups also differed with respect to AAS use (χ² = 13.32; *p = 0.04). More individuals in the BB group reported considering taking AAS (10 participants vs 4 participants in the SA group and no one in the FP group).

With respect to MD symptoms, ANOVAs showed significant group differences on the MDDI. In particular, the BB group scored significantly higher on the DFS subscale than the SA (*p = 0.001) and the FP (*p = 0.02) groups, whereas no difference between the SA and the FP groups emerged (*p = 0.99). Moreover, the BB group scored significantly higher on the total score of the MDDI than the FP group (*p = 0.02), while the SA group did not differ from either the BB (*p = 0.21) or the FP groups (*p = 0.49). With respect to other MDDI subscales, no differences among groups emerged (MDDI AI: *p = 0.59; MDDI FI: *p = 0.06). Means, standard deviations, and comparisons are reported in Table 2.

**Psychological Features Related to MD Among Groups.** Significant differences among groups emerged with respect to the MPS self-oriented subscale. Specifically, the SA group scored significantly higher than the FP group (*p = 0.002), whereas the BB group did not differ from both the SA (*p = 0.07) and the FP (*p = 0.39) groups. Groups did not differ on the RSES (*p = 0.31), MPS other-oriented scale (*p = 0.22), MPS socially prescribed scale (*p = 0.25), SPS (*p = 0.35), and ORTO-15 (*p = 0.11). Means, standard deviations, and comparisons are reported in Table 2.

**Psychological Features as Predictors of MD.** **BB group.** In light of correlation findings, the RSES, the MPS socially prescribed subscale, the SPS, and the ORTO-15 were included in the second step of the two-steps hierarchical multiple regression. The overall model explained 49.1% of the variance in the MDDI total score. The DASS-21 total score was entered in the first step and significantly predicted the MDDI total score, F(1, 40) = 6.62, *p = 0.01, explaining 14% of the variation in the MDDI total score. The inclusion of the other variables in the second step explained an additional 41% of variation in the MDDI total score (F change = 8.27; *p < 0.001). Results showed that, after controlling for the DASS-21 total score, the SPS and the ORTO-15 were significant predictors.

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### Table 1. Comparisons among groups on age, education, marital status, occupation and Body Mass Index (BMI). Note. BB = bodybuilders; SA = strength athletes; FP = fitness practitioners. **p < 0.01. *Significantly different to SA and FP; **Significantly different to FP.

|                  | BB group (N = 42) | SA group (N = 61) | FP group (N = 22) | χ²/F | df | η²p | p  |
|------------------|-------------------|-------------------|-------------------|------|----|-----|----|
| Age              | 28.17 (8.14)      | 32.26 (9.08)      | 32.27 (8.97)      | 3.05 | 2,122 | 0.04 | 0.06 |
| Education        | 15.10 (2.93)      | 14.92 (2.73)      | 15.14 (3.17)      | 0.07 | 2,122 | 0.001 | 0.93 |
| Marital status   | 50                | 26.23             | 36.36             | 8.38 | 6   | —   | 0.21 |
| Occupation       | 45.24             | 45.90             | 50                | 11.12| 10  | —   | 0.35 |
| BMI              | 24.77 (2.12)      | 25.89 (2.36)      | 24.23 (2.53)      | 5.32 | 2,122 | 0.08 | 0.01** |

### Table 2. Comparisons among bodybuilders (BB group), strength athletes (SA group) and fitness practitioners (FP group) on MD and related psychological and psychopathological features. Note. MDDI = Muscle Dysmorphic Disorder Inventory; RSES = Rosenberg Self-Esteem Scale; MPS = Multidimensional Perfectionism Scale; SPS = Social Phobia Scale. *p < 0.05. **p < 0.001. *Significantly different to SA and FP; **Significantly different to FP; ‘Significantly different to FP.

|                  | BB group (N = 42) | SA group (N = 61) | FP group (N = 22) | F(1,122) | η²p | p  |
|------------------|-------------------|-------------------|-------------------|----------|-----|----|
| MDDI desire for size | 10.31 (4.32)**   | 7.05 (4.18)      | 7.14 (4.64)      | 7.85     | 0.11 | 0.001** |
| MDDI appearance intolerance | 4.17 (2.94) | 3.93 (3.02) | 3.36 (2.84) | 3.07 | 0.01 | 0.59 |
| MDDI functional impairment | 6.93 (4.20) | 7.34 (3.61) | 4.91 (4.51) | 0.53 | 0.04 | 0.06 |
| MDDI total score  | 21.40 (8.44)**   | 18.33 (7.83)     | 15.41 (9.80)     | 3.90     | 0.06 | 0.02** |
| RSES             | 30.74 (4.95)     | 31.70 (5.41)     | 32.77 (4.68)     | 1.17     | 0.02 | 0.31 |
| MPS self-oriented| 68.09 (15.67)    | 74.98 (15.35)**  | 62.14 (11.61)    | 6.78     | 0.10 | 0.02** |
| MPS other-oriented| 57.17 (12.52)  | 60.87 (9.73)     | 59.91 (9.20)     | 1.52     | 0.02 | 0.22 |
| MPS socially prescribed | 50.40 (12.97) | 54 (13.31)       | 50 (8.16)       | 1.41     | 0.02 | 0.25 |
| SPS total score  | 16 (10.57)       | 14.18 (9.64)     | 12.41 (7.73)     | 1.05     | 0.02 | 0.35 |
| ORTO-15 total score | 34.31 (3.54) | 35.80 (3.44) | 35.54 (3.07) | 2.24 | 0.03 | 0.11 |

With respect to the RSES, the MPS self-oriented subscale, the SPS, and the ORTO-15 were included in the second step of the two-steps hierarchical multiple regression. The overall model explained 49.1% of the variance in the MDDI total score. The DASS-21 total score was entered in the first step and significantly predicted the MDDI total score, F(1, 40) = 6.62, *p = 0.01, explaining 14% of the variation in the MDDI total score. The inclusion of the other variables in the second step explained an additional 41% of variation in the MDDI total score (F change = 8.27; *p < 0.001). Results showed that, after controlling for the DASS-21 total score, the SPS and the ORTO-15 were significant predictors.
in unhealthy behaviours such as use of AAS 16,28. These results are also in accordance with studies reporting strict group. These findings are consistent with studies underlining that being involved in sports that reward building adherence to a high-protein diet in bodybuilders 25,29. Importantly, individuals in the BB group think about tak-

ing MD is a subtype of BDD1 that is still under-recognized and frequently left untreated, despite its associated unhealthy behaviours (such as rigid adherence to dietary regimes, excessive exercise and, frequently, AAS use), which negatively impacts quality of life and well-being2,3. The current study aimed at expanding extant knowledge about MD in athletes at increased risk and, specifically, in three groups of recreational athletes: bodybuilders (BB group), strength athletes (SA group), and fitness practitioners (FP group).

In line with our expectations, individuals in the BB group displayed more MD-related behaviours than those in the other two groups; specifically, the BB group reported considering taking AAS more frequently than both the SA group and the FP group. Furthermore, the total protein intake was >2 g proteins/kg/day only in the BB group. These findings are consistent with studies underlining that being involved in sports that reward building muscles for appearance-related purposes, such as bodybuilding, may expose athletes to a greater risk of engaging in unhealthy behaviours such as use of AAS16,28. These results are also in accordance with studies reporting strict adherence to a high-protein diet in bodybuilders25,29. Importantly, individuals in the BB group think about taking AAS and engage in high-protein diet possibly due to dissatisfaction with their body size and shape and the desire to be more muscular. Accordingly, individuals in the BB group reported more beliefs about being smaller and weaker than desired and wished to be more muscular than the other two groups. A similar result was found by Lantz et al.11, who observed that bodybuilders are more likely to report body size-symmetry concerns than strength athletes because they are primarily interested in lifting weights to develop a mesomorphic physique, defined by muscular shape and symmetry. Therefore, individuals in the BB group may be concerned about their body size and shape and desire to be more muscular because of the goals of the weight training activity they perform; they struggle to reach the ideal body shape and may be concerned about failing to achieve it.

The BB group also reported more general symptomatology related to MD than the FP group, whereas no differences between the BB group and the SA group emerged. These results are in contrast with the meta-analysis by Mitchell et al.11 outlining that bodybuilders show greater MD symptomatology than strength training athletes. Nonetheless, these results are consistent with studies reporting that athletes involved in resistance training in general usually show increased MD symptoms17,30; consequently, the SA group may represent an intermediate group between BB and FP with respect to MD general symptomatology. Both bodybuilders and strength trainers usually engage in intensive sessions of weight training with the aim of increasing muscles size and strength, and this is achieved through intensive exercise. Thus, susceptible individuals of both groups may experience negative emotions when deviating from daily exercise and may experience anxiety in social situations if the desired muscle size and strength are not achieved. On the contrary, fitness practitioners would be less vulnerable to MD general symptomatology in light of the different goals pursued through their training activity.

Regarding MD-related psychological features, no differences among groups emerged with the exception of self-oriented perfectionistic traits. Indeed, the SA group reported to set higher standards for themselves than the FP group, whereas no differences between the BB group and the FP group emerged. These findings are partially in line with the study by Muller et al.25, suggesting the presence of higher perfectionistic traits in bodybuilders and strength training athletes than in contact or noncontact sports athletes. However, the lack of differences in perfectionistic traits between the BB group and both the SA and the FP group was unexpected as the majority of previous studies underlined that perfectionistic traits are more prevalent in bodybuilders than in other athletes27,31. However, it is noteworthy that such studies focused on both competitive and recreational bodybuilders, and it may be possible that perfectionistic traits characterize competitive bodybuilders rather than recreational ones; therefore, our different sample composition (only recreational athletes) might explain discrepancies in results.

The three groups were comparable also with respect to self-esteem, orthorexic behaviours, and social anxiety symptoms; these results are rather unexpected. In accordance with most of literature about MD, we hypothesized lower levels of self-esteem27 and more orthorexic behaviours25,28 in the BB group than in both the SA and the FP groups. Regarding self-esteem, current findings mirror those by Muller et al.25 who failed to detect differences in self-esteem between bodybuilders/weight lifters and contact and non-contact sports. Similarly, Blouin and Goldfield22 did not find any difference in self-esteem between bodybuilders and runners, but they observed lower levels of self-esteem in bodybuilders than in martial athletes. Taken as a whole, current data might suggest that low self-esteem does not characterize bodybuilders, at least when bodybuilding is practiced with recreational purposes. The same might apply to orthorexic behaviours: indeed, a strict adherence to rigid diet and the obsession for healthy food might be more relevant in athletes who compete32. Concerning social anxiety, Pickett et al.14 also
reported that symptoms of anxiety and social physique anxiety in bodybuilders are lower than, or comparable to, those displayed by strength training athletes and physically active controls. This may be explained, once again, by the absence of competitive bodybuilders in our sample. Indeed, individuals characterized by MD symptoms usually experience social anxiety symptoms in situations in which they are afraid of receiving a negative evaluation by others regarding their body which is definitely more common during competitions compared to recreational situations.

Lastly, findings about possible MD psychological predictors among groups showed that, within the BB group, MD symptomatology was predicted only by orthorexic behaviours and social anxiety symptoms. Social anxiety symptoms emerged as the only predictor of MD symptomatology also in the SA group. Results about social anxiety symptoms are somewhat in line with findings by Chandler et al. who underlined that these symptoms may represent a motivational factor underlying MD symptoms through negative reinforcement. The fear of negative evaluation by others, especially about one’s physique, is an aversive state; since the social ideal for the male body is a mesomorphic physique, an acceptable way to decrease social anxiety is gaining muscle through lifting weights. Therefore, lifting weights decreases anxiety, thus leading to the reinforcement of the weight lifting behaviours. This mechanism may be peculiar for both the BB group and the SA group, given that they are both characterized by intensive sessions of weight training with the aim of increasing muscles size and strength. Regarding orthorexic behaviours, the obsession for healthy food may contribute to MD development only in bodybuilders. This result is in accordance with studies affirming that the majority of individuals with MD present dysfunctional eating patterns characterized by rigid diet and by the avoidance of food when its caloric content is unknown (e.g., eating food in restaurant). In other words, the obsession for healthy food might act as a trigger fostering the engagement in MD symptoms (e.g., beliefs of being smaller and weaker than desired, or wishing to be more muscular) and MD-related behaviours (e.g., engaging in intensive sessions of weight training). Regarding the FP group, no psychological features related to MD resulted predictive for MD symptomatology; although these results should be interpreted with caution in light of the small sample size of the FP group, they are reasonable since the FP group is not considered at increased risk of developing MD symptoms.

To note, the current study is characterized by several limitations. First, the sample size was relatively small which likely reduces the generalizability of our conclusions. Related to this issue, the statistical power of the employed regression design could not guarantee a reliable detection of MD predictors; hence, regression findings should be interpreted with caution. Secondly, the online recruitment strategy we adopted under-sampled those without internet capability and prevented the opportunity of conducting face-to-face interviews of participants self-identified as recreational bodybuilders and recreational strength athletes. Lastly, the absence of psychometric information for the MPS is another limitation.

To conclude, despite the above-mentioned shortcomings, the present study represents one of the first attempts to assess behaviours, symptoms, and possible psychological predictors of MD among athletes who trained regularly for recreational purposes. Future studies overcoming these issues are highly recommended. Indeed, to date, the distinction between pathological versus non-pathological pursuit of hyper muscularity has been scarcely addressed. Overall, the present findings suggest that the pursuit of a lean and muscular physique in bodybuilders is not always associated with MD and related psychological features. Although the BB group reported more negative beliefs about being smaller and weaker than desired, or wished to be more muscular than the other two groups, bodybuilders (as a group) are not necessarily characterized by psychological features related to MD such as low self-esteem, high perfectionism, social anxiety symptoms, and dysfunctional eating patterns. Therefore, the pursuit of a lean and muscular physique that characterized bodybuilders is not a sufficient condition to develop MD. Unlike from athletes not characterized by MD symptoms, athletes and individuals with MD set a high standard for their ideal body that, perhaps, is far from their reach. Additionally, the perception of their body may be far from their actual body. Therefore, pursuing the fitness of one’s own body is not related to MD but, rather, it is how extreme an individual sets their ideal body, and the level of discrepancy between their ideal and current body, that may contribute to the development of MD.

The present findings also suggest that orthorexic behaviours may predict MD symptomatology in bodybuilders; similarly, social anxiety symptoms may predict MD symptomatology both in bodybuilders and strength athletes. This information is crucial because it may lead to a better understanding and recognition of MD. Improving the identification of predictors and risk factors for MD, as well as its associated psychological features, might facilitate the identification of at-risk trainers, as well as the development of prevention strategies and interventions. Furthermore, a deeper understanding of MD manifestation among athletes may help to distinguishing individuals participating in a healthy manner versus those participating in an unhealthy manner.

Methods

Participants. Participants were 125 males who trained regularly for recreational purposes; they self-identified themselves as recreational bodybuilders (n = 42; BB group), recreational strength athletes (n = 61; SA group), and fitness practitioners (n = 22; FP group). All participants satisfied the following general inclusion criteria: at least 18 years of age; absence of severe neurological or medical conditions; no current or past psychotic disorders; no evidence of intellectual disabilities.

Measures. All participants completed an online brief schedule collecting socio-demographic information, self-reported weight and height, daily protein intake, AAS use, and Pope et al. diagnostic criteria for MD. Furthermore, participants completed the following online self-report measures:

- The Muscle Dysmorphic Disorder Inventory (MDDE; Italian version by Santarneccio & Dettore, 2012) is a 13 item self-report questionnaire assessing symptoms associated with muscle dysmophia (MD) on a five-point Likert scale (from 0 = never to 4 = always). It contains three subscales: desire for size (DFS), appearance
intolerance (AI), and functional impairment (FI); a total score can also be computed. The DFS subscale assesses beliefs of being smaller and weaker than desired, or wishing to be more muscular. The AI is made up of questions regarding negative beliefs and anxiety associated with one’s body and appearance. Lastly, the FI assesses the presence of negative emotions when deviating from daily exercise or avoidance of social situations because of the preoccupation with one’s body. The questionnaire showed good internal consistency, with Cronbach’s alpha coefficients ranging from $\alpha = 0.77$ to $\alpha = 0.85$44. The Italian version proved to be highly reliable as well, with the exception of the AI subscale ($\alpha = 0.45$)49. In the current study, the alpha coefficient was 0.80 for the DFS scale, 0.73 for the AI scale and 0.83 for the FI subscale. Finally, the alpha coefficient of the total score was 0.83.

The Rosenberg Self-Esteem Scale (RSES40; Italian version by Prezza, Trombaccia, & Armento, 199741) consists of 10 items measuring global self-esteem. Items are rated on a four-point Likert scale, ranging from 1 = strongly disagree to 4 = strongly agree, with higher scores representing greater self-esteem. Good internal consistency values have been reported for the original RSES, ranging between $\alpha = 0.77$ and $\alpha = 0.88$42. The Italian version showed good psychometric properties as well: its internal consistency was $\alpha = 0.84$41. The Italian version proved to be highly reliable and stable as well (internal consistency: $\alpha = 0.87$; 30-day test-retest reliability: $r = 0.89$41). The Italian version proved to be highly reliable and stable as well (internal consistency: $\alpha = 0.87$; 30-day test-retest reliability: $r = 0.87$44). Internal consistency coefficient was excellent in the present sample ($\alpha = 0.89$).

The Multidimensional Perfectionism Scale (MPS)21 is a 45 item self-report questionnaire designed to assess three different domains of perfectionism: self-oriented, socially prescribed, and other-oriented. The self-oriented subscale involves self-directed perfectionistic behaviours such as setting high standards for oneself; the socially prescribed subscale involves the perceived need to attain standards prescribed by significant others; and the other-oriented subscale involves placing unrealistic standards for significant others and placing importance on other people being perfect. Each subscale of the questionnaire contains 15 items with response options ranging from 1 = strongly disagree to 4 = strongly agree, with higher scores indicating greater levels of perfectionism. Good internal consistency values have been reported, ranging between $\alpha = 0.79$ and $\alpha = 0.89$ in a student sample41. The Italian validation of the MPS is not available to date, therefore an ad hoc translation was employed. In the present sample, the alpha coefficient was $\alpha = 0.89$ for the self-oriented scale, $\alpha = 0.80$ for the socially prescribed scale and $\alpha = 0.72$ for the other-oriented perfectionism subscale.

The Social Phobia Scale (SPS43; Italian version by Sica et al.)44 consists of 20 items assessing situations that involve being observed by others (e.g., public speaking, eating in public, etc.). Items are rated on a five-point Likert scale, ranging from 0 = not at all to 4 = extremely, with higher scores indicating greater social phobia. The SPS showed good psychometric properties; its internal consistency was $\alpha = 0.90$ in a community sample and $\alpha = 0.89$ in patients with social phobia. Test-retest reliability was $r = 0.91$ on a 4 weeks period44. The Italian version proved to be highly reliable and stable as well (internal consistency: $\alpha = 0.87$; 30-day test-retest reliability: $r = 0.87$44). Internal consistency coefficient was excellent in the present sample ($\alpha = 0.89$).

The ORTO-1545 is a 15 item self-report questionnaire assessing orthorexia. The questionnaire evaluates the presence of obsessive attitudes towards choice, preparation and consumption of healthy foods on a four-point Likert scale ranging from 1 = never to 4 = always, with lower scores indicating orthorexic behaviours. Cut-off point values can be set depending on the purpose of the study45. Within the validation sample, the ORTO-15 demonstrated high specificity (73.6%) and high negative predictive value (100%) with a threshold value of 40 points45.

The Depression Anxiety Stress Scale-21 (DASS-2146; Italian version by Bottesi et al.)47 is a 21 item self-report questionnaire assessing depression, anxiety, and stress on a four-point Likert scale (ranging from 0 = did not apply to me at all to 3 = applied to me very much), with higher scores indicating greater distress. Three subscale scores and a “general distress” total score can be computed47. The original DASS-21 demonstrated adequate reliability in non-clinical samples, with coefficient alphas ranging from $\alpha = 0.73$ to $\alpha = 0.81$46. The Italian version proved to be highly reliable as well, with internal consistency values ranging from $\alpha = 0.74$ to $\alpha = 0.90$ in a community sample47. For the purpose of the present research we focused only on the total score of the questionnaire. In the present study, the alpha coefficient for the total DASS-21 was excellent ($\alpha = 0.91$).

Procedure. Bodybuilders and strength athletes were recruited online through links posted on bodybuilding and resistance training discussion forums (www.projectinvictus.it; www.ironmanager.it); fitness practitioners were recruited in public gyms and were invited to complete online self-report questionnaires. All participants self-identified themselves as recreational bodybuilders, recreational strength athletes, and fitness practitioners. All individuals participated on a voluntary basis and provided their informed consent clicking agreement before starting to complete the survey about male body image and related psychological features; participants were also informed about the possibility to withdraw from the survey at any stage without explanation. After providing informed consent, participants completed the brief schedule collecting socio-demographic information and the self-report measures; responses were saved on the Google Drive server. Participants took approximately 30 minutes to complete the survey.

The study was conducted in accordance with the Declaration of Helsinki and approved by the Ethical Committee of the of the Psychological Sciences, University of Padova.

Statistical Analyses. In order to assess group differences on socio-demographic variables, one-way analyses of variance (ANOVA) and Chi-squared analyses were conducted. Bonferroni post hoc comparisons were computed when significant differences emerged. Chi-squared analyses and one-way ANOVAs were performed in order to compare groups (BB group vs SA group vs FP group) regarding behaviours, symptoms, and psychological features related to MD; also in this case, Bonferroni post hoc comparisons were computed when appropriate.
In order to investigate MD psychological predictors we first calculated Pearson’s correlations taking into account the MDDI total score and possible psychological predictors (RSES, MPS, SPS, and ORTO-15) within each group (BB group, SA group, and FP group) (Table 3). Finally, based on correlation findings, we performed 3 two-step hierarchical regression analyses within each group (BB group, SA group, and FP group). The MDDI total score was the dependent variable and the DASS-21 total score was always included in the first block to control for general distress; finally, appropriated psychological variables were entered in the second block.

Conventional significance levels were used (ps < 0.05). All statistical analyses were conducted using IBM SPSS statistics, version 21.

Data availability. The datasets analysed during the current study are available from the corresponding author on reasonable request.

References
1. American Psychiatric Association Diagnostic and statistical manual of mental disorders: DSM-5. Washington, DC: American Psychiatric Association (2013).
2. Pope, H. G. Jr, Gruber, A. J., Choi, P., Olivardia, R. & Phillips, K. A. Muscle dysmorphia: An underrecognized form of body dysmorphic disorder. Psychosomatics 38, 548–557, https://doi.org/10.1001/s0033-3182(97)71400-2 (1997).
3. Pope, H. G. Jr., Phillips, K. A. & Olivardia, R. The Adonis complex: The secret crisis of male body obsession. New York: Simon and Schuster (2000).
4. Olivardia, R., Mirror, mirror on the wall, who's the largest of them all? The features and phenomenology of muscle dysmorphia. Harvard Rev. Psychiat. 9, 254–259, https://doi.org/10.1080/106732202129700 (2001).
5. Olivardia, R., Pope, H. G. Jr, & Hudson, J. I. Muscle dysmorphia in male weightlifters: a case-control study. Am. J. Psychiat. 157, 1291–1296, https://doi.org/10.1176/appi.ajp.157.8.1291 (2000).
6. Phillips, K. A., O’Sullivan, R. L. & Pope, H. G. Jr. Muscle dysmorphia (letter). J. Clin. Psychiat. 58, 361 (1997).
7. American Psychiatric Association (2013).
8. Brytek-Matera, A., Krupa, M., Poggiogalle, E. & Donini, L. M. Adaptation of the ORTHO-15 test to Polish women and men. Eur. Eat. Disord. Rev. 17, 242–249, https://doi.org/10.1002/erv.897 (2009).
9. Pickett, T. C., Lewis, R. J. & Cash, T. F. Men, muscles, and body image: comparisons of competitive bodybuilders, weight trainers, and athletically active controls. Eur. Eat. Disord. Rev. 15, 217–222, https://doi.org/10.1002/erv.897 (2009).
10. Cafri, G. et al. Pursuit of the muscular ideal: Physical and psychological consequences and putative risk factors. Clin. Psychol Rev. 25, 215–239, https://doi.org/10.1016/j.cpr.2004.09.003 (2005).
11. Grieve, F. G. A conceptual model of factors contributing to the development of muscle dysmorphia. Eat. Disord. 15, 63–80, https://doi.org/10.1080/1060322X.2007.975860 (2007).
12. Nieuwoudt, J. E., Zhou, S., Coutts, R. A. & Booker, R. Symptoms of muscle dysmorphia, body dysmorphic disorder, and eating disorders in a nonclinical population of adult male weightlifters in Australia. J. Strength Cond. Res. 29, 1406–1414, https://doi.org/10.1519/JSC.0b013e31825763 (2015).
13. Segura-García, C. et al. Orthorexia nervosa: a frequent eating disordered behavior in athletes. Eating and Weight Disorders-Studies on Anorexia, Bulimia and Obesity 17(4), c226–c233, https://doi.org/10.3275/8272 (2012).
14. Bhattacharjee, A., Gupta, A., Mittal, A. & Rana, S. Adaptation of the ORTHO-15 test to a nonclinical population of adult male weightlifters in India. J. Strength Cond. Res. 29, 1265–1270, https://doi.org/10.1519/JSC.0b013e31825763 (2015).
15. Segura-García, C. et al. Orthorexia nervosa: a frequent eating disordered behavior in athletes. Eating and Weight Disorders-Studies on Anorexia, Bulimia and Obesity 17(4), c226–c233, https://doi.org/10.3275/8272 (2012).
16. Bhattacharjee, A., Gupta, A., Mittal, A. & Rana, S. Adaptation of the ORTHO-15 test to a nonclinical population of adult male weightlifters in India. J. Strength Cond. Res. 29, 1265–1270, https://doi.org/10.1519/JSC.0b013e31825763 (2015).
17. Segura-García, C. et al. Orthorexia nervosa: a frequent eating disordered behavior in athletes. Eating and Weight Disorders-Studies on Anorexia, Bulimia and Obesity 17(4), c226–c233, https://doi.org/10.3275/8272 (2012).
18. Bhattacharjee, A., Gupta, A., Mittal, A. & Rana, S. Adaptation of the ORTHO-15 test to a nonclinical population of adult male weightlifters in India. J. Strength Cond. Res. 29, 1265–1270, https://doi.org/10.1519/JSC.0b013e31825763 (2015).
19. Segura-García, C. et al. Orthorexia nervosa: a frequent eating disordered behavior in athletes. Eating and Weight Disorders-Studies on Anorexia, Bulimia and Obesity 17(4), c226–c233, https://doi.org/10.3275/8272 (2012).
20. Bhattacharjee, A., Gupta, A., Mittal, A. & Rana, S. Adaptation of the ORTHO-15 test to a nonclinical population of adult male weightlifters in India. J. Strength Cond. Res. 29, 1265–1270, https://doi.org/10.1519/JSC.0b013e31825763 (2015).
21. Segura-García, C. et al. Orthorexia nervosa: a frequent eating disordered behavior in athletes. Eating and Weight Disorders-Studies on Anorexia, Bulimia and Obesity 17(4), c226–c233, https://doi.org/10.3275/8272 (2012).
22. Lantz, C. D., Rhea, D. I. & Mayhew, J. L. The drive for size: A psycho–behavioral model of muscle dysmorphia. International Sports Journal 5, 71–86 (2001).

23. Crocker, J. The costs of seeking self–esteem. J. Soc. Issues 58, 597–615, https://doi.org/10.1111/1540-4560.00279 (2002).

24. Ebbeck, V., Watkins, P. L., Concepcion, R. Y., Cardinal, B. J. & Hammermeister, J. Muscle dysmorphia symptoms and their relationships to self–concept and negative affect among college recreational exercisers. J. Appl. Sport Psychol. 21, 262–275, https://doi.org/10.1080/1041320090319376 (2009).

25. Muller, S. M., Dennis, D. L., Schneider, S. R. & Joyner, R. L. Muscle dysmorphia among selected male college athletes: An examination of the Lantz, Rhea, and Mayhew model. International Sports Journal 8, 119–125 (2004).

26. Leone, J. E., Sedory, E. J. & Gray, K. A. Recognition and treatment of muscle dysmorphia and related body image disorders. Journal of Athletic Training 40(4), 352 (2005).

27. Blouin, A. G., & Goldfield, G. S. Body image and steroid use in male bodybuilders. Int. J. Eat. Disorder. 18, 159–165 10.1002/1098-108X(199509)18:2<159::AID-EAT2260180208>3.0.CO;2-3 (1995).

28. Irving, L. M., Wall, M., Neumark–Sztainer, D. & Story, M. Steroid use among adolescents: findings from Project EAT. J. Adolesc Health 30, 243–252, https://doi.org/10.1016/S1054-139X(01)00414-1 (2002).

29. Baghurst, T. & Lirge, C. Characteristics of muscle dysmorphia in male football, weight training, and competitive natural and non–natural bodybuilding samples. Body Image 6, 221–227, https://doi.org/10.1016/j.bodyim.2009.03.002 (2009).

30. Choi, P. V. L., Pope, H. G. & Olivardia, R. Muscle dysmorphia: a new syndrome in weightlifters. British journal of sports medicine 36(5), 375–376, https://doi.org/10.1136/bjsm.36.5.375 (2002).

31. Babusa, B. & Türü, F. Muscle dysmorphia in Hungarian non–competitive male bodybuilders. Eat. Weight Disorder-St. 17, e49–e53, https://doi.org/10.1007/BF03052327 (2012).

32. Håman, L., Lindgren, E. C. & Prell, H. “If it’s not Iron it’s Iron f*cking biggest Ironman”: personal trainers’ views on health norms, orthorexia and deviant behaviours. International journal of qualitative studies on health and well–being 12(sup2), 1364602, https://doi.org/10.1080/17482631.2017.1364602 (2017).

33. Grieve, F. G., Jackson, L., Reece, T., Marklin, L. & Delaney, A. Correlates of social physique anxiety in men. Journal of Sport Behavior 31(4), 329 (2008).

34. Chandler, C. G., Grieve, F. G., Derryberry, W. P. & Pegg, P. O. Are anxiety and obsessive–compulsive symptoms related to muscle dysmorphia? Int J Mens Health 8, 143–154, https://doi.org/10.3148/ijm.8h.0802.143 (2009).

35. Grieve, F. G., Newton, C. C., Kelley, L., Miller, R. C. Jr. & Kerr, N. A. The preferred male body shapes of college men and women. Individ Differ Res 3, 188–192 (2005).

36. Parks, P. S. M. & Read, M. H. Adolescent male athletes: Body image, diet, and exercise. Adolescence 32, 393–602 (1997).

37. Reddick, A. T. & Gilkey, T. L. College men’s perceptions of ideal body composition and shape. Psychol. Men Masculin. 6, 209–220, https://doi.org/10.1080/1054139X.2009.1054139 (2009).

38. Hildebrandt, T., Langenbacher, J. & Schlundt, D. G. Muscularity concerns among men: Development of attitudinal and perceptual measures. Body Image 1, 169–181, https://doi.org/10.1016/j.bodyim.2004.01.001 (2004).

39. Santarone, S. & Dettore, 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 9, 396–403, https://doi.org/10.1016/j.bodyim.2012.03.006 (2012).

40. Rosenfield, M. Society and the Adolescent Self–Image. Princeton, NJ: Princeton University Press (1965).

41. Prezza, M., Trombacci, F. R. & Armento, L. La scala dell’autostima di Rosenberg: Traduzione e validazione Italiana. B. Psicol. Appl. 223, 35–44 (1997).

42. Robinson, J., Shaver, P. & Wrightman, L. Measures of personality and social psychological attitudes (VI). San Diego, CA: Academic Press (1991).

43. Mattick, R. P. & Clarke, J. C. Development and validation of measures of social phobia scrutiny fear and social interaction anxiety. Behav Res Ther. 36, 455–470, https://doi.org/10.1016/S0005-7967(97)10031-6 (1998).

44. Sica, C. & et al. Social Phobia Scale (SPS) and Social Interaction Anxiety Scale (SIAS): Italian translation and adaptation. B. Psicol. Appl. 252, 59–71 (2007).

45. Donini, L. M., Marsili, D., Graziani, M. P., Imbriale, M. & Cannella, C. Orthorexia nervosa: validation of a diagnosis questionnaire. Eat. Weight Disorder-St. 10, e28–e32, https://doi.org/10.1007/BF03327537 (2005).

46. Lovibond, P. F. & Lovibond, S. H. Manual for the Depression Anxiety Stress Scales–21: Factor structure and psychometric properties on community and clinical samples. Compr. Psychiat. 60, 170–181, https://doi.org/10.1016/j.comppsych.2015.04.005 (2015).

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Author Contributions

A.P., Q.E.P., M.G.: project design; S.C., G.B.: introduction, methods and discussion writing; S.C.: data analysis; M.G., A.P.: project supervision.

Additional Information

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