QUALITY IN SPORT
eISSN 2450-3118 · Open Access · Peer-reviewed
apcz.umk.pl/QS Nicolaus Copernicus University in Toruń



MARCZYK, Adrianna, HUNEK, Oliwia, GAJEWSKA, Karolina, KUCZMIŃSKI, Łukasz, JANUSZEWSKA, Natalia, MATUSZEWSKI, Piotr, ZIÓŁKOWSKA, Julia, KLEPARSKA, Aleksandra, KOCIOŁŁ, Dawid and SMĘDOWSKI, Igor. Muscle Dysmorphia in Strength and Physique Athletes: Clinical Recognition and Psychiatric Comorbidity - a narrative review. Quality in Sport. 2026.78.76476. https://doi.org/10.12775/QS.2026.78.76476

ARTICLE TIMELINE
Received: 05.10.2026.
Accepted: 15.10.2026.
Published: 05.11.2026.

INDEXING & EVALUATION
MEiN points: 20 Unique ID: 201398
Disciplines: Economics & Finance; Management & Quality Sciences

The journal has been awarded 20 points in the parametric evaluation by the Ministry of Higher Education and Science of Poland. Annex to the announcement of the Minister of Higher Education and Science of 05.01.2024 No. 32553. Unique Journal Identifier: 201398. Scientific disciplines assigned: Economics and Finance (Field of Social Sciences); Management and Quality Sciences (Field of Social Sciences).

Punkty Ministerialne z 2019 — aktualny rok 20 punktów. Załącznik do komunikatu Ministra Szkolnictwa Wyższego i Nauki z dnia 05.01.2024 Lp. 32553. Posiada Unikatowy Identyfikator Czasopisma: 201398. Przypisane dyscypliny naukowe: Ekonomia i finanse (Dziedzina nauk społecznych); Nauki o zarządzaniu i jakości (Dziedzina nauk społecznych).

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Muscle Dysmorphia in Strength and Physique Athletes: Clinical Recognition and Psychiatric Comorbidity - a narrative review

Adrianna Marczyk
adusia_m5@wp.pl
Medical University of Warsaw
https://orcid.org/0009-0006-8208-7446
Oliwia Hunek
oliwia.hunek@stud.umed.lodz.pl
Medical University of Lodz
https://orcid.org/0009-0005-4059-5111
Karolina Gajewska
gajewskaa.karolina@gmail.com
Independent researcher
https://orcid.org/0009-0000-9673-6183

Łukasz Kuczmiński
lukasz.kuczminski.19@wp.pl
University of Opole
https://orcid.org/0009-0009-0699-1961
Natalia Januszewska
Natalia.januszewska00@gmail.com
Independent Researcher
https://orcid.org/0009-0000-0588-419X
Piotr Matuszewski
piotrekmatuszewski98@gmail.com
Florian Ceynowa Specialist Hospital in Wejherowo
https://orcid.org/0009-0003-2844-8835
Julia Ziółkowska
julia2681@onet.pl
Poznan University of Medical Sciences
https://orcid.org/0009-0002-9423-5443
Aleksandra Kleparska
Kleparska.aleksandra@gmail.com
Voivodship Specialist Hospital in Wrocław
https://orcid.org/0009-0005-1991-8107
Dawid Kociołł
d.kocioll@gmail.com
Independent Researcher
https://orcid.org/0000-0002-1185-3530
Igor Smędowski
igor.smedowski@gmail.com
Independent Researcher
https://orcid.org/0009-0003-3910-8035

Abstract

Background. Muscle dysmorphia (MD) is a specifier of body dysmorphic disorder characterised by persistent preoccupation with being insufficiently muscular or lean, coupled with compulsive training, rigid dietary control, and frequent use of appearance- and performance-enhancing drugs. Strength and physique athletes, particularly bodybuilders, are considered disproportionately at risk, yet the condition remains under-recognised and its nosological status is debated.

Aim. To synthesise, from a clinical perspective, the definition, prevalence, clinical presentation, psychiatric comorbidity, and diagnostic challenges of MD in strength and physique athletes, with attention to anabolic-androgenic steroid use and its medical consequences.

Materials and Methods. Narrative review of peer-reviewed studies, including systematic reviews, meta-analyses, cross-sectional and case-control studies, network analyses, qualitative studies, case reports, and clinical/epidemiological surveys addressing MD, related eating and body-image pathology, and steroid use in athletic and non-athletic populations.

Results. MD is consistently more prevalent among bodybuilders than other resistance-trained populations, with substantial comorbidity involving eating disorder symptoms, obsessive-compulsive traits, exercise addiction, depression, anxiety, and steroid dependence. Diagnostic criteria are inconsistently applied, screening tools lack validated cut-offs, and classification within body dysmorphic, eating, or addictive-disorder frameworks remains contested.

Conclusions. MD is a clinically significant, likely under-detected condition among strength and physique athletes, demanding improved clinician awareness, standardised assessment, and integrated psychiatric and medical management, particularly given its entanglement with anabolic-androgenic steroid use disorder.

Keywords: muscle dysmorphia; bigorexia; body dysmorphic disorder; anabolic-androgenic steroids; bodybuilding; eating disorders; exercise addiction

1. Introduction

Muscle dysmorphia (MD) describes a pattern of pathological preoccupation with muscularity in which affected individuals perceive themselves as insufficiently muscular or lean despite frequently possessing an objectively well-developed physique [1]. First described under the label "reverse anorexia" in a study of male bodybuilders, the condition was subsequently reconceptualised as a form of body dysmorphic disorder (BDD) characterised by a preoccupation with the idea that one's body is not lean and muscular enough, accompanied by clinically significant distress or functional impairment [1,2]. In the fifth edition of the Diagnostic and Statistical Manual of Mental Disorders (DSM-5), MD is formally recognised as a specifier of BDD, situated within the obsessive-compulsive and related disorders section [1,3]. This classification, however, has not resolved a long-running debate about whether MD is more appropriately understood as a body dysmorphic disorder, an eating disorder, an obsessive-compulsive spectrum condition, or a behavioural addiction [1,2,4].

The clinical relevance of MD in strength and physique athletes stems from the convergence of several factors specific to this population: an occupational or recreational culture that valorises muscularity and leanness, near-universal engagement in resistance training and dietary manipulation, and, in a substantial minority, the use of anabolic-androgenic steroids (AAS) and other appearance- and performance-enhancing drugs (APEDs) [5,6]. Bodybuilders in particular have been repeatedly identified as a high-risk group for MD symptomatology, with several studies reporting a markedly greater burden of drive for size, appearance intolerance, and functional impairment compared with other resistance-trained groups such as recreational weightlifters or strength athletes [5,7]. Yet the disorder is frequently unrecognised in clinical practice, in part because the behaviours that characterise it—rigorous exercise, protein-focused dieting, careful monitoring of physique—are normalised, even admired, within both athletic and gym subcultures [1,2].

This narrative review synthesises the available evidence on MD specifically in strength and physique athletes, giving particular attention to four inter-related clinical concerns. First, the definitional and diagnostic architecture of MD, and the unresolved question of its correct

nosological placement. Second, the epidemiology of MD within bodybuilding and resistance-training populations relative to non-athletic comparators. Third, the psychiatric comorbidity that accompanies MD, spanning eating disorder pathology, obsessive-compulsive and body dysmorphic traits, exercise addiction, mood and anxiety disorders, and substance use. Fourth, the specific and clinically consequential relationship between MD and AAS use, including the psychiatric and somatic complications of AAS use disorder. The review closes with a discussion of the practical implications for clinicians who encounter strength and physique athletes in medical, psychiatric, and sports-medicine settings, and identifies the principal gaps that continue to limit the field.

2. Materials and Methods

This article was conceived as a narrative review intended to synthesise clinically relevant evidence on muscle dysmorphia in strength and physique athletes rather than to provide an exhaustive systematic account; accordingly, no review protocol was registered, and no formal risk-of-bias appraisal or quantitative pooling of results was undertaken. Sources considered comprised peer-reviewed, predominantly English-language publications addressing muscle dysmorphia, related eating-disorder and body-image pathology, exercise addiction, and anabolic-androgenic steroid use, including systematic reviews and meta-analyses, cross-sectional and case-control studies, network analyses, qualitative interview-based studies, case reports and case series, epidemiological and cross-national surveys, and narrative and opinion papers addressing classification and clinical management. Priority was given to studies conducted in bodybuilders, weightlifters, and other strength or physique athletes, supplemented by evidence from general population, university, and clinical samples where this was necessary to contextualise prevalence, comorbidity, or classification debates relevant to the athletic population. Evidence was grouped thematically into sections addressing definition and diagnostic criteria; epidemiology in athletic populations; core clinical features and behavioural manifestations; comorbidity with eating disorders; comorbidity with obsessive-compulsive and body dysmorphic phenomena; exercise addiction and behavioural-addiction models; mood, anxiety, and other general psychiatric comorbidity; the relationship with anabolic-androgenic steroid use and dependence; medical and psychiatric complications of steroid use; classification controversies; screening and assessment tools; and treatment and clinical management considerations. Because source selection and interpretation were, by design, narrative rather than systematic, the synthesis may be subject to selection and emphasis bias, and its conclusions should be read as a clinically reasoned overview rather than a formally graded account of all available evidence.

3. Definition, Diagnostic Criteria, and Historical Development

The clinical concept of MD originated in a study describing a group of male bodybuilders whose preoccupation with muscularity resembled, in structure though not content, the body-image disturbance of anorexia nervosa; the authors termed this condition "reverse anorexia" [1]. The condition was subsequently renamed muscle dysmorphia and reframed as an "underrecognized form of body dysmorphic disorder", with proposed diagnostic criteria requiring: a preoccupation with the idea that one's body is not sufficiently lean and muscular; clinically significant distress or impairment arising from this preoccupation, evidenced by giving up important social, occupational, or recreational activities because of a compulsive need to maintain a workout and diet schedule, avoidance of situations in which the body is exposed to others, or continuation of exercise, dieting, or steroid use despite awareness of adverse physical or psychological consequences; and a primary focus on being insufficiently muscular, as distinct from other body-image concerns [1,2].

The DSM-5 adopted a modified version of this formulation, recognising MD as a specifier of BDD, with core diagnostic requirements comprising: preoccupation with the idea that one's body build is too small or insufficiently muscular, in an individual who is muscular in appearance; performance of repetitive behaviours (e.g. mirror-checking, excessive grooming, skin-picking, reassurance seeking) or mental acts (comparing one's appearance with others) in response to the appearance concerns; clinically significant distress or impairment in social, occupational, or other important areas of functioning; and symptoms not better explained by concerns with body fat or weight in the context of a co-occurring eating disorder [2,8].

This last criterion is of particular relevance to strength and physique athletes, whose eating and exercise behaviours frequently sit at the interface of MD and disordered eating, and it has fuelled the longstanding debate over whether the two conditions are truly distinct. A systematic review of the literature published between 2013 and 2017—that is, the period following DSM-5 recognition of MD—retrieved 33 eligible studies and found that none of them applied the DSM-5 diagnostic criteria for MD, and that only three studies explicitly linked MD to BDD using DSM-IV criteria [3]. The same review reported that most studies enrolled non-clinical samples (97%) and employed a cross-sectional or survey-based design (78.8%), with the majority graded at the lowest level of methodological quality according to National Health and Medical Research Council criteria [3]. This finding—an almost complete failure of the post-2013 literature to operationalise the very criteria that DSM-5 introduced—constitutes one of the most consistent critiques of the MD evidence base and materially limits the confidence that can be placed in prevalence estimates and comorbidity findings discussed throughout this review [3].

Adding to this uncertainty, interrater reliability studies applying Pope's original criteria to weightlifting samples have found only modest agreement between independent clinicians, and the World Health Organization's decision to exclude MD from the body dysmorphic disorder category in the ICD-11—citing insufficient evidence for its clinical utility as a distinct diagnostic entity—reflects the persistence of this uncertainty at an international nosological level [3]. Some authors have proposed that MD would be better classified within the eating disorder spectrum given its phenomenological overlap with anorexia and bulimia nervosa, including shared features of compulsive exercise, rigid dietary control, and body-checking behaviours, while others have argued for its inclusion among obsessive-compulsive spectrum disorders on the basis of ritualistic, anxiety-driven behavioural patterns, and still others have proposed conceptualising it as a form of behavioural addiction centred on the maintenance of body image [2-4].

4. Epidemiology of Muscle Dysmorphia in Strength and Physique Athletes

Establishing the true prevalence of MD is hampered by inconsistent diagnostic operationalisation, reliance on self-report screening instruments with variable or unvalidated cut-off scores, and heterogeneous sampling strategies that frequently conflate "bodybuilders" with recreational gym-goers or resistance-trained non-competitors [1,3]. Within these constraints, however, a consistent signal emerges: individuals engaged in bodybuilding, and particularly competitive bodybuilding, report substantially more MD symptomatology than other resistance-trained comparison groups.

A cross-sectional study of 125 Italian male athletes divided into bodybuilders (n=42), strength athletes (n=61), and fitness practitioners (n=22) found that the bodybuilding group scored significantly higher than the other two groups on the Muscle Dysmorphic Disorder Inventory (MDDI) Drive for Size subscale and on the MDDI total score, and that more bodybuilders reported considering anabolic-androgenic steroid use (10 of 42 participants) than strength

athletes (4 of 61) or fitness practitioners (none) [5]. Notably, this same study found that only 6.4% of the total sample formally satisfied Pope's diagnostic criteria for MD, distributed across all three groups (four bodybuilders, two strength athletes, two fitness practitioners), underscoring that elevated symptom scores on continuous measures do not necessarily equate to full clinical caseness [5].

A meta-analysis addressed this question at the aggregate level, synthesising studies comparing bodybuilders with non-bodybuilder resistance-trained individuals on standardised measures of MD symptomatology and reported medium-to-large standardised mean differences favouring bodybuilders, with competitive bodybuilders scoring highest [9]. In a Turkish cross-sectional study of 120 male bodybuilders (62 competitive, 58 non-competitive) using the Eating Attitude Test (EAT-40) and the MDDI, 67.5% scored above the eating disorder cut-off on EAT-40 and 58.3% scored above the muscle dysmorphia cut-off on the MDDI, figures considerably higher than those typically reported in general population or non-bodybuilding athletic samples [7]. The same study found a positive correlation between EAT-40 and MDDI total scores ($r=0.614$, $p<.001$), and multivariable regression indicated that eating-disorder pathology, together with the appearance intolerance and functional impairment subscales of the MDDI, independently predicted body-image dissatisfaction as measured by the Bodybuilder Image Grid [7].

Studies employing structured or semi-structured interviews rather than self-report questionnaires alone have generally reported somewhat different, and sometimes lower, prevalence estimates, again illustrating the sensitivity of MD prevalence figures to assessment methodology. Among a large community-based sample of 1,488 boys and men in Canada and the United States assessed using an operationalised diagnostic algorithm based on multiple validated measures and DSM-5-aligned criteria—rather than a single questionnaire cut-off—2.8% met criteria for probable MD, with those meeting criteria showing markedly elevated scores across the MDDI Drive for Size and Functional Impairment subscales, and 87.8% of probable cases scoring above the conventional MDDI clinical cut-off of 40, providing some cross-validation between diagnostic-algorithm and questionnaire-based approaches [10]. Notably, this study found no significant sociodemographic differences between those with and without probable MD across age, race/ethnicity, or sexual orientation, apart from a lower body mass index among those with MD, a finding the authors interpreted as potentially reflecting a "muscular-and-lean" phenotype of the disorder rather than a purely mass-building presentation [10].

Table 1 summarises representative studies reporting prevalence or symptom-severity comparisons for muscle dysmorphia across strength and physique athlete populations.

Table 1. Representative studies reporting the prevalence or comparative severity of muscle dysmorphia symptomatology in strength and physique athlete populations.

Source [ref]	Design	Population / focus	Principal findings
Cerea et al. [5]	Cross-sectional	125 Italian male athletes: bodybuilders (n=42), strength athletes (n=61), fitness	Bodybuilders scored higher on MDDI Drive for Size and total score; 6.4% overall met Pope's diagnostic criteria for MD across groups

		practitioners (n=22)	
Mitchell et al. (cited in [9])	Meta-analysis	Bodybuilders vs non-bodybuilder resistance trainers	Medium-to-large standardised mean differences in MD symptoms favouring bodybuilders; competitive bodybuilders highest
Devrim et al. [7]	Cross-sectional	120 male bodybuilders (62 competitive, 58 non-competitive), Turkey	67.5% above EAT-40 eating-disorder cutoff; 58.3% above MDDI cutoff; EAT-40 and MDDI total scores correlated (r=0.614)
Ganson et al. [10]	Cross-sectional, community-based, diagnostic-algorithm	1,488 boys and men, Canada and USA	2.8% met probable MD criteria; 87.8% of probable cases scored ≥40 on MDDI; no major sociodemographic differences except lower BMI
Şentürk & Gobel [11]	Cross-sectional	69 adult male power and strength athletes (weightlifting, wrestling, boxing, judo), Turkey	10.1% scored ≥39 (bigorexia) on MDD-I; higher MDD-I associated with exercise addiction and body-image coping scores

Beyond bodybuilding specifically, a cross-sectional study of 69 adult male power and strength athletes across weightlifting, wrestling, boxing, and judo using the Muscle Dysmorphia Disorder Inventory (MDD-I), the Exercise Addiction Scale, and the Body Image Coping Strategies Scale found that 10.1% of athletes scored above the bigorexia cut-off, and that as MDD-I scores rose, both exercise addiction and body-image coping strategy scores increased proportionally [11]. Regression analysis in this sample indicated that a one-unit change in total MDD-I score was associated with a 0.497-unit increase in exercise addiction score and a 0.909-unit increase in body image coping strategy score, and that dietary protein intake was positively associated with MDD-I score, with a 1-gram increase in protein consumption corresponding to a 0.038-point increase on the MDD-I scale [11]. This constellation—elevated protein intake,

exercise dependence, and body-image preoccupation moving together—captures a recurring clinical pattern in strength-sport populations that is explored further in the following sections.

5. Core Clinical Features and Behavioural Manifestations

The clinical picture of MD centres on cognitive preoccupation with muscularity and leanness, manifesting behaviourally through compulsive training, rigid and often extreme dietary control, and body-checking or body-avoidance behaviours [1,2]. Descriptive studies of individuals formally diagnosed with MD report that symptoms typically emerge around 19 to 20 years of age, and that affected individuals may spend more than three hours per day thinking about their physique, report feeling that they have little control over their training schedule, and describe their exercise and diet regimes as interfering at least moderately with occupational, social, or relationship functioning, including job loss and relationship breakdown in some cases [1].

A distinctive feature repeatedly documented in the MD literature is the coexistence of avoidance behaviour with an underlying belief that one's body is objectively healthy or acceptable; affected individuals frequently avoid situations in which their physique might be exposed—beaches, communal changing rooms, form-fitting clothing—not because they perceive their bodies as unhealthy, but because they fear that others will judge them as insufficiently muscular [12]. This pattern of concealment (e.g. wearing loose or baggy clothing) alongside continued, often escalating, pursuit of muscularity is one of the clearest behavioural markers distinguishing MD from straightforward athletic dedication to physique improvement [1,2].

Body-checking behaviours—repeated mirror inspection, muscle flexing, photographing the physique, or comparing one's body with that of others—constitute a further core feature, paralleling similar behaviours documented in body dysmorphic disorder more broadly [2]. In the qualitative literature on long-term anabolic-androgenic steroid users, several interviewees explicitly described MD-like cognitions developing alongside or as a consequence of steroid use, with one participant stating that he had become "obsessed with the way I look" and would look at his muscles "all the time," a pattern he attributed to changes that began only after starting steroid use, despite not having been preoccupied with his appearance beforehand [13]. This observation is important because it suggests that, for at least a subset of strength athletes, MD-type cognitions may emerge or intensify as a consequence of the physical and psychological effects of AAS use rather than preceding it, a point with direct implications for the temporal and causal models discussed in Section 9.

Descriptive research on female bodybuilders with MD-related symptomatology is comparatively sparse but not absent from the literature. A retrospective study of ten female bodybuilders who had experienced sexual assault found that prior to the assault, two of the ten met criteria for MD, whereas after the assault all ten did, with seven subsequently beginning steroid use; the majority also reported at least one psychiatric diagnosis prior to the assault, rising to eight of ten afterwards, including post-traumatic stress disorder [1]. While this is a small and specific clinical sample, it illustrates that MD in strength-trained women can arise in the context of significant psychological trauma and is not confined to the more commonly studied male bodybuilding population [1].

6. Muscle Dysmorphia and Eating Disorder Comorbidity

The overlap between MD and eating disorder (ED) psychopathology is one of the most extensively studied and most clinically consequential aspects of the condition, and it bears directly on the classification debate outlined in Section 3. A meta-analysis synthesising 36 independent samples (n=8,516 participants across 45 samples drawn from 39 published articles)

found a pooled positive correlation between MD and ED symptomatology of r=0.356 (95% CI 0.298–0.411), which by conventional interpretation represents a moderate-magnitude association [8]. Moderator analyses within this meta-analysis identified that studies using males reporting current AAS use showed markedly stronger MD–ED associations (r=0.710) than other samples (r=0.342), and that the specific instrument used to measure ED symptomatology significantly influenced the strength of the observed association, with the gender-modified Eating Disorder Examination Questionnaire (EDE-Q Modified) showing the strongest relationship (r=0.642) compared with other instruments (r=0.336) [8]. The authors also found that studies of higher methodological quality—particularly those reporting adequate reliability/validity data for their MD and ED instruments and avoiding dichotomisation of continuous variables—yielded systematically stronger MD–ED correlations, suggesting that measurement artefacts in lower-quality studies may previously have understated the true strength of this relationship [8].

This body of evidence has direct implications for strength and physique athletes, because AAS use is disproportionately concentrated in this population and because bulking-and-cutting dietary cycles common in bodybuilding may represent a muscularity-oriented variant of disordered eating rather than a wholly distinct phenomenon. A large-scale cross-sectional study of 5,905 social-media-recruited men and women (n=422 male, n=5,483 female) using validated instruments for binge eating (Eating Disorder Examination-Questionnaire diagnostic items), MD (MDDI), drive for thinness, and drive for leanness found that MD psychopathology was significantly positively associated with binge eating in both sexes, and that MD "at-risk" status (MDDI total score >39) yielded a predicted probability of binge eating of 25% in men and 66.9% in women [14]. Notably, only the MDDI Appearance Intolerance subscale, and not the Drive for Size or Functional Impairment subscales, was independently associated with binge eating risk once all three subscales were entered simultaneously into the regression model, indicating that it is specifically the negative self-evaluation and body-related shame component of MD, rather than the muscularity-seeking drive itself, that predicts disordered-eating comorbidity [14]. This dissociation is clinically important: it implies that not every muscularity-focused behaviour carries equivalent risk for comorbid eating pathology, and that clinicians should attend particularly to appearance-related distress and body-checking rather than to training volume or dietary strictness alone when screening for comorbid eating disorder.

A related epidemiological study of 2,001 Italian university students—including many enrolled in exercise-science and nutrition-focused degree programmes—similarly found that clinical-level MD symptomatology (MDDI >39) was one of the strongest independent predictors of eating-disorder risk (EAT-26 score >19), with an adjusted odds ratio of 2.94 (95% CI 2.03–4.25) [15]. Sensitivity analysis disaggregating the MDDI subscales in this sample again found that Appearance Intolerance (adjusted OR 1.18, 95% CI 1.14–1.23) and Functional Impairment (adjusted OR 1.22, 95% CI 1.17–1.28) were independently associated with eating-disorder risk, whereas the Drive for Size subscale showed a significant inverse association (adjusted OR 0.93) once the other two subscales were accounted for—a finding that closely mirrors the pattern reported in the binge-eating study described above and reinforces the conclusion that muscularity-seeking motivation, when uncoupled from body dissatisfaction and functional impairment, may be comparatively less pathological, potentially reflecting adaptive athletic or aesthetic goal pursuit rather than disordered eating [14,15]. The same Italian study found that intense sports practice (defined as training four or more times per week for at least six months of the year) was independently associated with elevated eating-disorder risk (adjusted OR 1.50, 95% CI 1.19–1.90), consistent with a broader pattern in which high-frequency structured exercise, when combined with body-image concern, functions as a risk amplifier rather than a protective factor [15].

An earlier Italian study of 440 university freshmen enrolled in Dietetics, Exercise and Sport Sciences, or Biology programmes similarly found that those matriculating into the Exercise and Sport Sciences school showed a more than five-fold adjusted increase in the odds of MD traits (adjusted OR 5.15, 95% CI 1.44–18.4) relative to other students, while those matriculating into Dietetics showed a roughly 2.7-fold increase in the odds of eating-disorder traits (adjusted OR 2.71, 95% CI 1.14–6.48), suggesting that pre-existing subclinical eating and body-image pathology may influence occupational and educational pathway selection into fields oriented towards fitness, nutrition, or body care, independent of any pathology induced by the training itself [16]. Muscle dysmorphia traits were found overwhelmingly among students in the Exercise and Sport Sciences programme (84.6% of those with MD traits), predominantly male (73.1%), and associated with markedly higher exercise levels (11.9 vs 7.3 hours per week in those without traits) and substantially higher rates of supplement use (61.5% vs 8.9%) [16].

The clinical picture that emerges from this comorbidity literature is therefore not one of a simple additive relationship between MD and ED, but one in which specific facets of MD—body dissatisfaction, shame, and consequent functional impairment—are the principal drivers of eating-disorder risk, while the drive to build muscle per se occupies a more ambiguous position that may, in some contexts, be protective or at least neutral with respect to eating-disorder comorbidity [14,15]. A case study of an adolescent male reported in the broader eating-disorder literature illustrated that bulimic and MD-type symptomatology can co-occur within a single emotional-regulation framework, in which binge-eating episodes and compulsive exercise served overlapping emotion-regulatory functions, a pattern the authors argued warranted further systematic investigation given its apparent rarity in the published case literature at the time [14].

Broader reviews of eating pathology among male elite athletes provide further context for interpreting these findings within a strength-sport-specific frame. A scoping review of disordered eating and eating disorders in male elite athletes across 80 identified studies found that weight-sensitive sports (a category that includes weight-class strength sports such as weightlifting and powerlifting, alongside aesthetic and endurance disciplines) showed a consistently higher prevalence of disordered eating than less weight-sensitive sports in the majority of studies reviewed, although three studies found no such difference [17]. The same scoping review emphasised that existing screening instruments, largely developed and validated in female populations focused on thinness, appear inadequately sensitive and specific for male athletes, partly because male elite athletes tend to report lower body dissatisfaction than non-athlete comparators even when engaging in clinically significant disordered eating behaviour, and partly because behaviours such as high caloric intake to support training may be misclassified as bingeing when assessed with instruments not calibrated for athletic populations [17]. This measurement problem, directly analogous to the MD-specific instrumentation concerns discussed in Section 3, compounds the difficulty of establishing accurate comorbidity estimates in strength and physique athletes specifically.

7. Obsessive-Compulsive Traits, Body Dysmorphic Phenomena, and Perfectionism

Given the formal DSM-5 placement of MD as a specifier of BDD within the obsessive-compulsive and related disorders category, the relationship between MD and obsessive-compulsive (OC) traits has attracted particular research attention, both to validate this classification and to identify potential shared vulnerability factors. A systematic review and meta-analysis examining this relationship synthesised data from five quantitative and five qualitative studies published between 2015 and 2025 and reported a pooled correlation between MD symptom severity and OC trait measures of approximately r=0.24, characterised by the authors as a "moderate positive correlation" [4]. The same review reported a markedly elevated odds ratio for the presence of MD among AAS-using populations (odds ratio approximately 25

to 30, though with high heterogeneity across the underlying studies), with one cited study finding that 58% of a small sample of cisgender gay and bisexual men using non-prescribed AAS met screening criteria for MD, compared with an estimated 2–6% prevalence in general male samples [4].

Effect-size estimates comparing MD symptom levels between AAS users and non-users in this meta-analysis ranged from a large effect (Cohen's d≈0.7) in samples of serious lifters to a smaller effect (d≈0.2) in more heterogeneous mixed samples, and OC symptom levels were similarly elevated among AAS users relative to non-users, though with a smaller effect size (d≈0.3) [4]. Importantly, when MD symptom severity was statistically controlled for, steroid use itself did not emerge as an independent predictor of OC symptomatology in at least one included study, suggesting that the elevated OC-trait scores observed among steroid users may be attributable to the underlying MD psychopathology rather than to a direct pharmacological or behavioural effect of steroid use [4,5].

The qualitative component of this meta-analysis, synthesising thematic findings across five qualitative studies including interviews with gay and bisexual male steroid users, female steroid users, Italian female bodybuilders, Jordanian male steroid users, and Australian men diagnosed with MD, identified five recurring themes: body image ideals and dissatisfaction characterised by perpetually moving goalposts; compulsivity and rigid routines including extreme distress over minor dietary deviations; masculinity, femininity, and identity conflicts, particularly acute among female steroid users navigating loss of conventionally feminine appearance; motivations for AAS/PED use centred on achieving an idealised physique or competitive success; and perceived harms, help-seeking barriers, and mental health consequences, frequently characterised by minimisation of side effects and profound mistrust of medical professionals [4]. One illustrative quotation from a female bodybuilder captured the perfectionistic, all-consuming character of MD-adjacent cognition: she described feeling that she had "cheated" by eating four grapes before a competition and ruminating for weeks over whether this transgression had cost her the contest [4].

Network analysis methodology has been applied to disentangle the specific symptom-level architecture connecting AAS dependence and MD. A study using both Gaussian graphical modelling and mixed graphical modelling in 153 men with current or past AAS use and 88 weight-lifting controls found that AAS consumers demonstrated significantly elevated MD symptomatology across all six MDDI subscales compared with controls, and that the symptom-network structure of MD differed qualitatively between the two groups: exercise dependence was the most central (most interconnected) symptom among AAS users, whereas size/symmetry concern was most central among non-using controls [9]. The same study found that the association between diet and exercise-dependence symptoms was significantly stronger among AAS users than controls, while the association between diet and size/symmetry concern was significantly stronger among controls, suggesting that MD symptomatology in AAS-using populations may cluster more tightly around "action-oriented" behaviours (diet, exercise, supplement and pharmacological use) than around purely cognitive or attitudinal concerns about appearance [9]. Within the AAS-dependence symptom network itself, "continuing use despite physical/mental problems" emerged as the most central symptom, closely followed by interference with work or personal life, tolerance, and withdrawal, indicating that the compulsive continuation of use despite recognised harm is the structural core of AAS dependence in this population [9].

Personality and cognitive-style research has further probed the relationship between MD, perfectionism, and related constructs, again with somewhat inconsistent findings that appear sensitive to whether samples include competitive versus purely recreational bodybuilders. In

the previously described Italian study comparing bodybuilders, strength athletes, and fitness practitioners, no significant difference in self-oriented, other-oriented, or socially prescribed perfectionism was found between bodybuilders and the other two groups, contrary to the authors' a priori hypothesis based on prior literature suggesting elevated perfectionism among bodybuilders specifically [5]. The authors proposed that this discrepancy might reflect the recreational, non-competitive status of their bodybuilder sample, since earlier studies reporting elevated perfectionism had more often included competitive bodybuilders, for whom the stakes of physique presentation are considerably higher [5]. The same study found that orthorexic eating behaviours and social anxiety symptoms, rather than perfectionism or self-esteem, emerged as significant predictors of MD symptom severity specifically within the bodybuilder subgroup in regression analysis, whereas social anxiety alone was the significant predictor among strength athletes, and no significant predictors emerged among fitness practitioners [5].

A separate line of research has examined social physique anxiety directly, finding in one study that AAS-using bodybuilders reported significantly lower levels of social physique anxiety than non-using bodybuilders, alongside significantly higher upper-body-strength self-perception, a counterintuitive finding the original authors interpreted as suggesting that steroid use may confer a subjective sense of physical adequacy that offsets, rather than exacerbates, appearance-related social anxiety, at least while actively cycling on AAS [18]. This observation dovetails with qualitative reports of AAS users describing improved confidence and reduced body-checking during periods of active use, and heightened distress and re-emergent body dissatisfaction during withdrawal or cessation, a pattern explored further in Section 9 [13].

8. Exercise Addiction and Behavioural Addiction Models

Compulsive or excessive exercise is a defining behavioural feature of MD and has independently attracted conceptualisation as a distinct behavioural addiction, raising the question of whether MD itself might be better understood through an addiction framework rather than as a body-image or eating disorder. One influential theoretical proposal, the "Addiction to Body Image" (ABI) model, applies a standard six-component addiction framework—salience, mood modification, tolerance, withdrawal, conflict, and relapse—directly to MD, framing the addictive object not as exercise or eating per se but as the maintenance of a perceived body image, with exercise, dietary control, supplement use, and steroid use serving merely as the behavioural vehicles through which this underlying addiction is sustained [2]. Under this model, the primary reinforcement is the cognitive/perceptual state of having achieved (or approaching) the desired physique, while behaviours such as training and dieting represent secondary, instrumental dependencies serving that primary goal, a formulation the authors distinguish explicitly from classical exercise addiction, in which the physical act of exercising itself, and its associated endorphin-mediated euphoria, constitutes the primary reinforcer [2].

Empirical support for a strong association between exercise addiction and MD symptomatology comes from several of the studies already discussed. In the Italian power-and-strength-athlete study, MDD-I scores correlated positively with Exercise Addiction Scale scores, and regression modelling indicated that MD symptom severity was among the strongest predictors of exercise-dependence risk [11]. A separate study of 366 Spanish university students (54.6% women) examined the relationship between exercise addiction, MD, emotional dependence in romantic relationships, and childhood attachment style, finding that exercise addiction was positively correlated with MD across all six MDDI subscales (correlation coefficients ranging from 0.42 to 0.70) and with emotional dependence and several insecure attachment dimensions (correlation coefficients ranging from 0.11 to 0.28) [19]. Regression analysis in this study found that borderline emotional expression and attention-seeking, both facets of the emotional

dependence construct, along with insecure attachment dimensions relating to family preoccupation and parental permissiveness, significantly predicted MD symptom severity, explaining 21% of variance in the full model [19]. Mediation analysis further indicated that attachment dimensions explained a substantial proportion of the association between exercise addiction and emotional dependence (ranging from 9% to 33% depending on the specific emotional-dependence subscale examined) and between MD and emotional dependence (ranging from 14% to 37%), suggesting that early attachment experiences may represent a shared developmental vulnerability underlying both exercise addiction and MD, mediated through adult emotional-regulation difficulties [19].

Notably, this Spanish study also found significant sex differences, with men scoring significantly higher than women on measures of exercise addiction, MD (including all five MDDI/MASS subscales examined), and several emotional-dependence subscales, with effect sizes in the small-to-moderate range (Cohen's d 0.10 to 0.33) [19]. This finding is broadly consistent with the male predominance of MD reported across much of the clinical literature reviewed in Section 4, though the authors note that MD and exercise addiction, while more prevalent in men, are far from exclusively male phenomena [19].

Further evidence for a behavioural-addiction conceptualisation, though drawn from a mixed fitness-centre population rather than a strength-sport-specific sample, comes from a cross-sectional survey of 1,711 fitness-centre users across the United Kingdom, Italy, the Netherlands, and Hungary, which found that 11.7% of the overall sample scored above the clinical cut-off for exercise addiction on the Exercise Addiction Inventory, with marked cross-national variation (from 7.9% in Italy to 20.9% in the Netherlands) [20]. This same study found that 38.5% of the overall sample scored above the risk threshold for BDD on the Appearance Anxiety Inventory, and that logistic regression modelling identified exercise-addiction risk as the strongest predictor of fitness-supplement use across the sample (odds ratio 3.03, 95% CI 2.15–4.28), with appearance anxiety and low self-esteem emerging as additional significant predictors specifically among female participants [20]. Although this study did not employ a dedicated MD-specific instrument, the authors explicitly noted that the constellation of exercise addiction, appearance anxiety, and low self-esteem observed closely parallels the clinical profile of MD, and recommended that future research in fitness-centre populations incorporate validated MD measures directly [20].

9. Muscle Dysmorphia and Anabolic-Androgenic Steroid Use: A Bidirectional Relationship

The relationship between MD and AAS use is among the most clinically important aspects of this literature, given the serious medical and psychiatric consequences of AAS use disorder, and the evidence consistently indicates that the relationship is bidirectional rather than unidirectional. A qualitative study interviewing eight long-term male AAS users recruited from a needle-exchange programme in South Wales explicitly examined the causal direction of this relationship and found evidence for both pathways within the same sample [13]. For five of the eight men, low self-esteem, body dissatisfaction, and MD-type symptoms preceded and appeared to motivate the initiation of AAS use; these individuals described childhood or adolescent experiences of feeling "small" or "scrawny" relative to peers, leading first to weight training and subsequently to steroid use when training alone failed to produce the desired transformation [13]. For the remaining three men, MD-type symptoms—obsessive body-checking, excessive training, and persistent dissatisfaction despite objective physical change—appeared to develop only after AAS use had begun, in men who reported no significant pre-existing body-image concern and who had initiated steroid use primarily out of frustration with a training plateau [13].

This bidirectionality has been corroborated, with some nuance, in earlier quantitative work. An often-cited study comparing weightlifters distinguished between short-term AAS "experimenters" (2–5 months of use) and long-term "heavy users" (6–150 months of use), finding that experimenters were largely indistinguishable from non-users on measures of self-esteem, body image, and eating attitudes, whereas heavy users showed significantly more pronounced MD symptomatology and stronger endorsement of conventional masculine role attitudes, suggesting that MD symptom severity may intensify with duration and cumulative dose of AAS exposure rather than being a static, purely premorbid trait [18]. This dose-and-duration relationship is consistent with the qualitative finding that MD-type cognitions can emerge de novo during prolonged steroid use, and it argues against a simple model in which MD is exclusively a pre-existing vulnerability factor that merely predicts, rather than is also shaped by, subsequent steroid exposure [13,18].

The continued use of AAS despite recognised negative consequences described in the Welsh qualitative sample was frequently explained by participants in terms of secondary reinforcement: several men described an "addiction" not to the pharmacological effects of AAS themselves but to the psychological benefits—confidence, social acceptance, perceived attractiveness—that accompanied the resulting physique, with more than one participant explicitly stating they feared returning to their prior "old feelings of low self-worth" if they discontinued use [13]. This pattern aligns closely with the Addiction to Body Image model discussed in Section 8, in which secondary behaviours (steroid use, exercise, dieting) serve a primary psychological need for a particular self-perceived body image [2,13].

Formal epidemiological surveys of AAS users provide further quantitative grounding for the scale and character of this population. A large web-based survey of 2,385 men using AAS, recruited primarily through online forums and a YouTube channel focused on AAS harm reduction, found that the most common motivations for use were improving physical appearance or gaining muscle (82.2%), improving strength (50%), and issues with self-esteem regarding body image (29.9%) [21]. The average age of survey respondents was 31.7 years (SD 10.1), with the most common age of initiation being 22–30 years (42.0%) or 19–21 years (29.0%), and 7.4% reporting initiation of AAS use before the age of 18 [21]. The same survey found that testosterone-based compounds, together with trenbolone, oxandrolone, and nandrolone decanoate, were the most commonly used substances, with the most frequently reported weekly base testosterone dose (47.5% of respondents) falling between 500 and 1,000 mg—five to ten times the dose typically used in clinical hypogonadism replacement therapy [21,22].

Regarding help-seeking and disclosure, the same large survey found that 56.1% of respondents had never disclosed their AAS use to a medical professional, and that among those who did disclose, 55.3% reported having felt discriminated against by a physician as a consequence [21]. Reasons cited for non-disclosure included concern about judgement (63.8%), lack of confidence in the physician's knowledge of AAS (60.7%), and fear of legal repercussions (45.7%) [21]. Physicians were rated by respondents as the least knowledgeable source of AAS-related information (mean rating 4.08 out of 10), scoring markedly lower than online bodybuilding forums (6.44), coaches or self-described "gurus" (6.52), or other current AAS users (5.92) [21]. This pattern of poor engagement with, and distrust of, formal healthcare services is a recurring theme across the AAS literature reviewed here and has direct implications for clinical practice, discussed further in Section 15 [21-23].

Cross-sectional survey data specifically addressing changing demographic patterns of AAS use over the past two decades similarly documented substantial polypharmacy and comorbid substance use, high rates of underreporting of steroid use to physicians, and increasing female

participation, with one review reporting that female steroid use in resistance-training populations has risen sufficiently that AAS-related counselling can no longer be considered a male-only clinical concern [24]. This same review noted that global lifetime AAS use prevalence estimates have risen from approximately 1–5% in older literature to as high as 6.4–29.3% in more recent studies of gym populations, though it acknowledged that stigma around AAS use may continue to bias self-report data in either direction depending on study context and population [24].

10. Adolescent Vulnerability to Anabolic-Androgenic Steroid Exposure and Muscle Dysmorphia

Adolescence represents a period of heightened vulnerability to both AAS exposure and MD-type body-image pathology, owing to the concurrent maturation of the hypothalamic-pituitary-gonadal axis, ongoing skeletal growth, and active identity formation. A narrative review addressing this population noted that symptoms of MD have been associated with intentions to use AAS, actual AAS use, and dependence-related behaviours among adolescents, suggesting that for at least a subset of young people, steroid use functions as an attempt to alleviate appearance-related distress rather than solely to enhance athletic performance [25]. The same review emphasised that adolescents should not be regarded simply as "younger adult" AAS users, because exposure occurs during ongoing biological and psychological maturation and may therefore carry distinct developmental consequences, including endocrine disruption affecting pubertal progression, premature epiphyseal closure with resultant reduction in final adult height, and interference with normal identity development, alongside the cardiovascular, neuropsychiatric, musculoskeletal, hepatic, and renal complications also documented in adult users [25].

Social media exposure was identified as a particularly salient contemporary risk factor in this adolescent-focused review, with continuous exposure to curated, muscularity-oriented content associated with greater body dissatisfaction and stronger intentions to use AAS among boys and young men, an effect the authors characterised as amplifying rather than directly causing underlying vulnerabilities such as low self-esteem, perfectionism, and social anxiety [25]. The review also highlighted that adolescent AAS use frequently co-occurs within a broader pattern of health-risk behaviour rather than representing an isolated performance-enhancement decision, with significant associations demonstrated between adolescent AAS use and other substance-use behaviours [25]. From a clinical-prevention perspective, the authors argued that educational interventions targeting adolescent AAS use may be more effective when they extend beyond traditional anti-doping messaging to address body-image concerns, unrealistic physique expectations, and social-media influence directly, rather than relying solely on messaging about medical risk, since adolescents commonly perceive long-term health consequences as abstract and distant relative to the immediate perceived benefits of improved appearance and confidence [25].

11. Mood, Anxiety, and Suicide Risk

Beyond the specific comorbidities of eating pathology, obsessive-compulsive traits, and exercise addiction discussed above, MD and AAS use are each independently, and jointly, associated with elevated rates of mood and anxiety disorder symptomatology, and with heightened suicide risk. A systematic review of AAS use and psychopathology in athletes found that 22% of a sample of 41 bodybuilders and football players using AAS displayed a full affective syndrome, with a further 12% displaying psychotic symptoms during use, and a subsequent controlled study by the same research group found that 23% of AAS-using weightlifters met criteria for a major mood disorder compared with only 6% of non-using

controls, with mood disorders occurring significantly more often during periods of active AAS use than during AAS-free periods [18]. The same body of literature documented depressive symptomatology emerging particularly during AAS withdrawal, with apathy, anhedonia, concentration difficulties, sleep disturbance, and decreased libido described as characteristic features of this withdrawal-related depression [18,22].

Suicide-related findings within this literature are of particular clinical concern. A case-series study of eight young male athletes who died by suicide while using or shortly after discontinuing AAS found that five deaths occurred during active AAS use and two following AAS discontinuation (with one case ambiguous), and that family members had frequently observed depressive symptoms associated with AAS discontinuation, with four of the eight men having developed major depressive disorder after protracted AAS use [18]. A subsequent 30-year follow-back study of 181 male former élite athletes in power sports suspected of AAS use found that although overall mortality was not significantly elevated relative to the general population across the full follow-up period, those in the 30–50 age range died from suicide 30% more often than population norms, and suicide accounted for 11.6% of all deaths recorded among the former athlete cohort [18]. A separate case series of 24 deceased male bodybuilders, fitness trainers, and bodyguards using AAS found that 16.7% of deaths were attributable to suicide by gunshot or hanging, alongside 62.5% attributable to accidental drug toxicity and 12.5% to homicide [18].

The recent recommendation to formally recognise AAS use disorder as a distinct substance use disorder category explicitly cites psychiatric comorbidity, including depression, body dysmorphic disorder, and suicide risk, as central justification for improved diagnostic recognition, noting that men presenting with suicide attempts, body dysmorphic disorder, or major depressive disorder should routinely be investigated for a history of AAS use by treating clinicians, given the frequency with which this history goes undisclosed or unrecognised [23]. This recommendation is consistent with survey findings that a substantial minority of AAS users report a history of suicide attempt, and that AAS-dependent users are significantly more likely than non-dependent users to report a lifetime major depressive disorder diagnosis or anxiety disorder diagnosis [18,23].

A case report illustrating the acute cardiovascular and psychiatric consequences of AAS abuse in a young bodybuilder with formally diagnosed body dysmorphic disorder described a 24-year-old man who presented with palpitations, dizziness, nausea, vomiting, and shortness of breath following long-term use of a multi-drug "blasting-then-cruising" regimen incorporating testosterone, nandrolone, oxandrolone, clenbuterol, and growth hormone [26]. This patient was found to have severely impaired left ventricular systolic function (ejection fraction 27%), atrial fibrillation with rapid ventricular response, and non-sustained ventricular tachycardia, and psychiatric evaluation during admission confirmed a DSM-5 diagnosis of body dysmorphic disorder alongside a history of childhood trauma [26]. The case underscores that severe, life-threatening cardiovascular complications of AAS use can occur in young, previously healthy individuals, and that the coexistence of body dysmorphic pathology adds substantial complexity to clinical management, requiring coordinated cardiology, endocrinology, and psychiatric input; the authors specifically recommended that clinicians consider targeted screening for AAS use in young patients presenting with unexplained cardiac symptoms, particularly those with a bodybuilding background [26].

12. Medical Complications of Anabolic-Androgenic Steroid Use Relevant to Muscle Dysmorphia Management

Because MD in strength and physique athletes is so frequently intertwined with AAS use, clinicians managing this population must be conversant with the somatic complications that accompany chronic supraphysiological androgen exposure, both because these complications carry independent morbidity and because their emergence may itself precipitate or exacerbate MD-related psychological distress. A comprehensive review of anabolic steroid effects on physical health summarised evidence for adverse cardiovascular effects, including hypertension, dyslipidaemia with reduced high-density lipoprotein and elevated low-density lipoprotein cholesterol, left ventricular hypertrophy, arrhythmias, and increased risk of myocardial infarction and coronary artery disease, with one cohort study cited as reporting significantly higher prevalence of coronary artery disease among long-term AAS users independent of other cardiovascular risk factors [27].

Hepatotoxicity was identified as a particular concern with orally administered 17-alpha-alkylated AAS compounds owing to their resistance to first-pass hepatic metabolism, with reported complications ranging from asymptomatic transaminase elevation to cholestasis, peliosis hepatis, hepatic adenoma, and, rarely, hepatocellular carcinoma [27]. Endocrine disruption was described as near-universal among chronic AAS users, manifesting as suppression of the hypothalamic-pituitary-gonadal axis leading to hypogonadism, testicular atrophy, reduced sperm count, and infertility in men, with recovery of normal testosterone production following cessation reported as variable and sometimes incomplete [22,27]. In women, virilising effects including hirsutism, voice deepening, menstrual irregularity, and clitoromegaly were noted as frequently irreversible even after discontinuation of use [27]. Musculoskeletal complications specifically relevant to strength athletes included tendon injury and rupture, attributed to a mismatch between rapidly increasing muscle strength (facilitated pharmacologically) and slower-adapting connective tissue, alongside premature epiphyseal closure and consequent growth impairment in adolescents who initiate use before completing puberty [25,27].

A large-scale, primarily male-oriented survey of AAS users provided further quantitative detail on the prevalence of self-reported side effects, finding testicular atrophy (62.9%), acne (55.4%), hypersexuality (50.7%), hypertension (43.4%), and mood changes (42.6%) as the most commonly reported adverse effects, with erectile dysfunction (33.0%), dyslipidaemia (28.0%), and gynaecomastia (26.1%) also frequently reported [21]. This same survey found that older respondents (aged 35 and above) reported significantly higher rates of several more serious complications, including polycythaemia (20.9% versus 9.0% in younger users), tendon rupture (9.9% versus 3.2%), and left ventricular hypertrophy (6.6% versus 2.9%), consistent with a cumulative-dose or cumulative-duration relationship between AAS exposure and the emergence of these more severe complications [21]. Notably, despite this substantial reported side-effect burden, 74.7% of respondents in this survey reported believing that AAS/performance-enhancing drugs could be used safely in the long term, a discrepancy the authors interpreted as reflecting either underestimation of personal risk or a rationalisation process consistent with the compulsive, addiction-like continuation of use despite recognised harm described in the AAS-dependence literature discussed in Section 9 [9,21].

A systematic review of AAS-associated polypharmacy synthesising 50 qualitative and descriptive studies found that AAS users very commonly co-administer a wide range of ancillary substances, including anti-oestrogens (to manage gynaecomastia and oestrogenic side effects), diuretics (to reduce water retention, particularly before competition), human chorionic gonadotropin and clomiphene citrate (in attempts to restore endogenous testosterone

production, so-called "post-cycle therapy"), and growth hormone, alongside recreational substances such as alcohol, cannabis, and cocaine [6]. This review classified the identified substances into 13 functional groups spanning analgesics, anti-oestrogens, cardiovascular drugs, central nervous system depressants and stimulants, cosmetic drugs, dietary supplements, diuretics, fat-burning agents, hormonal and non-hormonal muscle-enhancement drugs, recreational substances, and sexual-enhancement drugs, underscoring the pharmacological complexity that clinicians may encounter when managing AAS-using patients with comorbid MD [6]. The authors specifically warned that many of these substances are obtained from unregulated illicit markets and may be adulterated, mislabelled, or contaminated, compounding the medical risk beyond that attributable to the intended active compounds alone [6].

The endocrinological consequences of AAS discontinuation—termed "AAS withdrawal syndrome" or, in a proposed reformulation, a component of AAS use disorder—have themselves been proposed as warranting formal recognition as a distinct substance use disorder category with specific diagnostic criteria, on the grounds that existing DSM-5 substance-use-disorder criteria, developed primarily for intoxicating psychoactive substances, translate imperfectly to AAS, which do not produce acute intoxication but instead act cumulatively through profound and sometimes prolonged suppression of the hypothalamic-pituitary-gonadal axis [23]. This proposal noted that approximately one in three AAS users develop dependence, a rate the authors characterised as higher than that seen with prescription opioids and comparable to that of cannabis, and recommended that withdrawal criteria specifically incorporate hypogonadism-related symptoms (fatigue, erectile dysfunction, reduced libido, depression) rather than relying solely on generic substance-withdrawal frameworks [23].

13. Muscle Dysmorphia and Social Media, Diet, and Nutritional Behaviour

Contemporary discussions of MD risk factors in strength and physique athletes increasingly implicate social media exposure and nutritionally extreme dietary practices as compounding influences. A cross-sectional study of 721 young Italian adults (mean age 24.1 years) found that social media addiction (SMA) symptomatology, assessed using the Bergen Social Media Addiction Scale, was significantly positively associated with both MD symptomatology (assessed with the MDDI) and eating-disorder symptomatology (assessed with the EAT-26), and that mediation analysis indicated the relationship between SMA and eating-disorder symptoms was substantially mediated by MD-related symptoms (indirect effect B=0.083, p=0.021), with the direct effect of SMA on eating-disorder symptoms becoming non-significant once MD was entered as a mediator [28]. This finding suggests a specific causal pathway in which problematic social media use fosters muscularity-and-leanness preoccupation, which in turn drives disordered eating behaviour, rather than SMA acting on eating pathology through an independent route [28]. In this sample, 21.4% of participants met criteria for problematic social media use, and those meeting this threshold showed significantly higher rates of clinically relevant eating-disorder symptoms (25.3% versus 14.3%) and significantly higher MD symptom scores than those without problematic use [28].

The role of dietary behaviour, and specifically protein intake, in relation to MD symptom severity has been directly examined in strength-sport populations. As noted in Section 4, the Turkish study of power and strength athletes found a significant positive correlation between total protein consumption and MDD-I score, with regression analysis indicating that a 1-gram increase in daily protein intake was associated with a 0.038-point increase in MDD-I score [11]. The authors of this study noted that this finding is consistent with prior observations that individuals with MD frequently adopt high-protein, high-energy dietary regimens specifically intended to promote lean mass accrual, and that this dietary pattern may itself become a further ritualised, rule-bound behaviour that reinforces the broader MD symptom complex rather than

remaining a neutral or purely instrumental training-support behaviour [11]. In the same sample, vegetable protein consumption was also positively correlated with MDD-I total score, and the authors recommended that dietitians working with strength-sport populations be alert to disproportionate dietary rigidity around protein intake as a potential early marker of emerging MD pathology, alongside the more commonly recognised behavioural markers of excessive training and body-checking [11].

The relationship between food insecurity—a very different nutritional stressor from the food abundance typically associated with bodybuilding culture—and muscularity-oriented eating and exercise behaviour has also been examined, with a large Taiwanese study of 1,500 young adults finding that food insecurity was indirectly associated with increased risk of both exercise addiction and muscularity-oriented eating through the mediating pathway of MD symptomatology, and that this indirect effect was significantly moderated by individual resilience [29]. While this study was not conducted specifically in a strength-athlete population, its findings are relevant to understanding the socioeconomic and psychological context in which muscularity-oriented eating behaviours, closely related to core MD symptomatology, can develop even in the absence of the food abundance and structured training access typically available to competitive strength and physique athletes, suggesting that MD-related eating patterns may represent a more general psychological response to perceived scarcity or lack of control over one's body and environment, rather than being wholly specific to elite athletic or bodybuilding subcultures [29].

14. Screening Instruments and Their Limitations in Athletic Populations

Accurate clinical detection of MD in strength and physique athletes depends heavily on the psychometric properties and appropriate application of available screening instruments, and this remains an area of considerable limitation. The Muscle Dysmorphic Disorder Inventory (MDDI), developed to assess three theoretically derived dimensions of MD—Drive for Size, Appearance Intolerance, and Functional Impairment—has become the most widely used self-report instrument in this literature and was employed, in various translated or adapted versions, across the majority of the studies discussed throughout this review [5,9,11,14,15]. However, the conventional clinical cut-off score of 39, used in several of the studies cited above to define "at-risk" or probable-MD status, was derived in specific validation samples and its generalisability across different populations, sexes, and cultural contexts has not been comprehensively established, a limitation explicitly noted in the systematic review documenting the post-DSM-5 literature's failure to apply formal diagnostic criteria consistently [3,10].

The Muscle Appearance Satisfaction Scale (MASS) and various iterations of the Muscle Dysmorphia Inventory (MDI, distinct from the MDDI) have also been used across the literature, alongside instruments not originally designed for MD assessment but frequently co-administered, including the Drive for Muscularity Scale, the Eating Disorder Examination-Questionnaire (including gender-modified versions), and the Body Image Coping Strategies Scale [4,8,11]. The meta-analysis addressing MD–ED comorbidity found that the specific instrument used to assess eating-disorder symptomatology significantly moderated the strength of the observed MD–ED association, with structured clinical interview approaches (such as the Structured Clinical Interview for DSM Disorders) yielding the weakest observed associations, a pattern the authors interpreted as reflecting the more conservative and comprehensive nature of interview-based assessment relative to self-report questionnaires that may show greater conceptual overlap with MD constructs [8].

The Bodybuilder Image Grid (BIG), used in its Original (BIG-O) and Scaled (BIG-S) forms, offers a complementary perceptual approach to MD assessment, presenting a grid of male figures varying systematically in muscularity and body fat and asking respondents to identify their current, ideal, and perceived "most attractive" body shapes [7]. In the Turkish bodybuilder study employing this instrument, participants consistently selected an ideal body fat percentage lower than what they believed the opposite sex would find attractive, and an ideal muscle mass discrepant from their current self-perceived muscularity, illustrating the perceptual dimension of body dissatisfaction that self-report symptom inventories alone may not fully capture [7].

Network analysis of disordered-eating symptoms in adult men has further suggested that existing eating-disorder assessment tools, developed predominantly based on female presentations centred on thinness, may inadequately capture muscularity-oriented symptomatology relevant to strength-sport populations. A network analysis study of 294 adult men incorporating measures of orthorexic eating, avoidant/restrictive food intake, and muscularity-related concerns alongside standard eating-disorder measures found that ruminative thoughts about healthy eating, guilt for unhealthy eating, weight overvaluation, muscularity concerns, and selective eating emerged as the most centrally connected symptoms within the identified symptom network, and that muscle-building behaviours clustered together with broader male body-shaping and rule-based dieting behaviours rather than forming an entirely separate symptom domain [30]. This finding has direct implications for MD screening in strength athletes, suggesting that assessment instruments capturing only classical thinness-oriented eating-disorder cognitions, without attention to muscularity-specific concerns, are likely to systematically under-detect relevant pathology in this population [30,31].

15. Clinical Recognition, Help-Seeking Barriers, and Treatment Considerations

The consistent finding across multiple lines of evidence reviewed above—that AAS-using and MD-affected individuals distrust and underutilise formal medical care—has direct implications for clinical practice among physicians, psychiatrists, and sports-medicine practitioners who encounter strength and physique athletes. As detailed in Section 9, the large survey of 2,385 AAS-using men found that physicians were rated as the least knowledgeable information source regarding AAS among all sources evaluated, and that more than half of respondents had never disclosed their steroid use to a healthcare provider, citing fear of judgement, perceived physician ignorance, and concern about legal or insurance consequences as principal barriers [21]. A parallel qualitative literature review examining medical practitioners' approach to suspected AAS users emphasised that clinical interviews should be conducted without a "purely punitive or judgmental approach," since athletes who anticipate criticism are less likely to disclose use, and recommended that physicians actively screen for physical signs suggestive of AAS use (severe acne, gynaecomastia, testicular atrophy, unexplained hypertension, dyslipidaemia) alongside behavioural indicators (aggression, mood instability) in appropriate clinical contexts, while maintaining an evidence-informed, non-confrontational discussion focused on the patient's actual health goals [24].

A specific and recurring theme concerns the frequently inadequate training of outpatient mental health providers in recognising eating disorders and MD among boys and men more generally, which compounds the difficulty of appropriately identifying MD in strength-athlete patients presenting to psychotherapy for other reasons. A survey of 259 licensed outpatient psychotherapists across Canada and the United States found that self-reported knowledge and confidence in treating eating disorders and MD among boys and men were low overall, with 44.4% reporting no knowledge of MD in boys and men and 53.7% reporting no confidence in treating it, and that only 14.0% and 25.8% of respondents, respectively, had received any formal training on eating disorders in boys and men during or after their professional education [32].

Notably, self-identified eating-disorder specialists in this sample, while reporting greater knowledge and confidence than non-specialists, still identified substantial unmet training needs, particularly around understanding unique risk factors (endorsed by 60.7% of the full sample) and unique symptom presentations (63.9%) relevant to male patients, and around assessing muscularity-oriented behaviours and muscle dysmorphia specifically, which received among the lowest self-rated training effectiveness scores of any topic examined (mean 0.8 out of 4 for "understanding muscle dysmorphia symptoms") [32].

This training gap has direct clinical significance for strength and physique athletes, because it suggests that even patients who do seek mental health treatment—whether for MD-related distress directly or for co-occurring depression, anxiety, or substance use—may encounter clinicians poorly equipped to recognise the specific presentation of muscularity-oriented body-image pathology, particularly given that male elite athletes have been repeatedly shown to report lower general body dissatisfaction than non-athlete comparators despite exhibiting clinically significant MD or disordered-eating symptomatology, a pattern that can mislead clinicians relying on conventional body-dissatisfaction screening questions calibrated to thinness-oriented presentations [17,32].

Regarding specific treatment approaches, the available evidence base is limited, and none of the studies reviewed here reported a formally controlled treatment trial for MD in strength or physique athletes specifically. The scoping review of disordered eating in male elite athletes found no interventional studies evaluating evidence-based prevention or treatment approaches specific to this population, with the sole identified prevention study (targeting young female elite athletes) having failed to demonstrate efficacy [17]. General guidance drawn from the broader body dysmorphic disorder and eating-disorder literature, extrapolated by several of the reviewed authors, suggests that management should combine psychoeducation, cognitive-behavioural approaches targeting body-checking and reassurance-seeking behaviours, careful and gradual modification of exercise and dietary rigidity, and, where AAS use is present, coordinated endocrinological management of withdrawal symptoms alongside psychiatric treatment of comorbid depression, anxiety, or substance dependence [2,23,26].

The proposal to formally recognise AAS use disorder as a distinct substance-use-disorder category with sex-specific diagnostic criteria explicitly argues that this reclassification would improve clinical recognition, reduce diagnostic ambiguity, and thereby facilitate more consistent and appropriate treatment pathways, including earlier identification of comorbid MD and other psychiatric conditions in this population [23]. Until such formal recognition and corresponding clinical guidelines are established, the available evidence suggests that clinicians managing strength and physique athletes with suspected MD should routinely and non-judgementally enquire about AAS and other appearance- and performance-enhancing drug use, screen for comorbid eating-disorder, obsessive-compulsive, and mood symptomatology using instruments sensitive to muscularity-oriented presentations, and coordinate care across psychiatric, endocrinological, and sports-medicine specialties where AAS use or significant somatic complications are identified [23,26,32].

16. Discussion

The evidence synthesised in this review supports several consistent conclusions while also revealing important gaps and unresolved controversies. First, MD is disproportionately concentrated among bodybuilders relative to other resistance-trained populations, with prevalence and symptom-severity estimates consistently favouring competitive over recreational or non-bodybuilding strength athletes across studies employing diverse assessment methodologies [5,7,9]. However, the magnitude of this elevated prevalence varies substantially

depending on whether MD caseness is defined by a continuous questionnaire cut-off or by application of full clinical diagnostic criteria, with the latter approach yielding markedly lower and more conservative prevalence estimates even within high-risk bodybuilding samples [5,10]. This measurement-dependent variability, combined with the finding that essentially no studies published in the immediate post-DSM-5 period actually applied the formal DSM-5 criteria, means that much of the epidemiological literature reviewed in this article should be interpreted as describing a continuum of subclinical-to-clinical MD symptomatology rather than confirmed clinical caseness [3].

Second, the comorbidity evidence consistently points to a specific psychological mechanism linking MD to eating-disorder risk: it is body dissatisfaction and consequent functional impairment (the Appearance Intolerance and Functional Impairment dimensions of MD), rather than the drive to build muscle per se (the Drive for Size dimension), that predicts eating-disorder comorbidity across multiple independent samples and analytic approaches [14,15]. This dissociation, replicated in both a large social-media-recruited sample and a university student sample, has clear clinical implications, suggesting that screening and intervention efforts should prioritise identification of appearance-related shame, body-checking, and functional impairment over training volume or muscularity aspiration alone. It also lends some support to the argument that muscularity-seeking behaviour, when uncoupled from distress and impairment, may in some cases represent adaptive goal-directed athletic behaviour rather than intrinsically pathological cognition—an important caveat against over-pathologising the normal dedication of competitive strength athletes.

Third, the relationship between MD and AAS use is genuinely bidirectional, with qualitative and longitudinal-comparison evidence supporting both a pathway in which pre-existing MD motivates AAS initiation and a pathway in which prolonged AAS exposure appears to induce or intensify MD-type cognition even in previously unaffected individuals [13,18]. This bidirectionality has practical clinical significance: it implies that a temporal history of AAS use relative to the onset of body-image concern should be actively elicited in clinical assessment, since this history may inform both aetiological understanding and treatment prioritisation (for instance, whether endocrinological stabilisation of AAS withdrawal should precede or accompany psychiatric treatment of MD symptoms).

Fourth, the classification debate—whether MD is best understood as a body dysmorphic disorder, an eating disorder, an obsessive-compulsive spectrum condition, or a behavioural addiction—remains genuinely unresolved and is unlikely to be settled by the currently available evidence, which shows meaningful associations with constructs from all four frameworks without providing decisive discriminating evidence favouring any single classification [2-4,8]. The persistence of this ambiguity is not merely an academic curiosity but has practical consequences: it likely contributes to the ICD-11's exclusion of MD as a distinct diagnostic entity, to the absence of dedicated, validated treatment protocols, and to the low confidence and training that mental health professionals report in recognising and managing the condition [3,32].

Fifth, the medical seriousness of AAS use as a frequent concomitant of MD in this population cannot be overstated. The cardiovascular, hepatic, endocrine, and psychiatric complications documented across the reviewed literature—including a directly relevant case report of near-fatal heart failure in a young bodybuilder with comorbid body dysmorphic disorder—underscore that MD in strength and physique athletes is not merely a psychological curiosity but frequently accompanies substantial and sometimes life-threatening somatic risk [21,26,27]. This reinforces the case for integrated, multidisciplinary clinical pathways combining psychiatric, endocrinological, and sports-medicine expertise, an approach explicitly

recommended by several of the reviewed authors but not yet, as far as the available literature indicates, formally evaluated in controlled treatment trials [17,23,26].

17. Limitations of the Evidence Base

Several limitations constrain the conclusions that can be drawn from the literature reviewed here, and by extension from this narrative synthesis itself. First, as documented explicitly by the systematic review of the post-DSM-5 literature, the overwhelming majority of studies addressing MD rely on cross-sectional, self-report designs, with formal DSM-5 diagnostic criteria essentially unapplied in the literature published in the years immediately following their introduction; this severely limits confidence in reported prevalence figures and precludes causal inference regarding the direction of associations between MD and its various comorbidities [3]. Second, sample sizes across many of the reviewed studies are modest, particularly those examining female strength athletes, adolescent populations, or specific comorbidity subgroups such as gay and bisexual male AAS users, limiting statistical power and generalisability [1,4]. Third, measurement heterogeneity across studies—differing MDDI cut-offs, differing eating-disorder instruments with demonstrably different sensitivity to MD-related constructs, and inconsistent application of full diagnostic interviews versus screening questionnaires—complicates direct comparison of prevalence and effect-size estimates across the literature and likely contributes to some of the apparent inconsistencies noted throughout this review, for instance regarding the strength of the MD–perfectionism association or the precise magnitude of MD–eating-disorder comorbidity [5,8].

Fourth, much of the literature on AAS use and its psychiatric correlates, including several of the case reports, case series, and cross-sectional surveys reviewed in Sections 9 through 12, is subject to substantial selection bias, since participants are frequently recruited through online forums, harm-reduction services, or clinical settings serving individuals who have already experienced adverse consequences of use, potentially overestimating the prevalence and severity of psychiatric comorbidity relative to the broader population of AAS users who do not present for care or engage with research [6,21]. Fifth, no controlled treatment trials specific to MD in strength or physique athletes were identified in this review, meaning that all treatment recommendations discussed in Section 15 are necessarily extrapolated from broader body dysmorphic disorder and eating-disorder treatment literature rather than grounded in evidence specific to this population [17]. Sixth, this review, being narrative in design, did not employ a systematic search strategy, formal risk-of-bias appraisal, or quantitative synthesis, and its selection and interpretation of evidence should accordingly be understood as reflecting a clinically oriented synthesis rather than an exhaustive or formally graded systematic account; the findings discussed here should therefore be interpreted as hypothesis-generating and clinically informative rather than as providing definitive, generalisable prevalence or effect-size estimates.

18. Conclusions

Muscle dysmorphia represents a clinically significant, likely under-recognised condition among strength and physique athletes, with bodybuilders in particular exhibiting consistently elevated symptom burden relative to other resistance-trained populations, albeit with considerable variability in prevalence depending on whether assessment relies on continuous questionnaire scores or full diagnostic criteria. The disorder is substantially comorbid with eating-disorder pathology, obsessive-compulsive traits, exercise addiction, mood and anxiety disorders, and—critically—anabolic-androgenic steroid use and dependence, with evidence supporting a genuinely bidirectional relationship between muscle dysmorphia and steroid use rather than a simple unidirectional causal pathway. The specific dimension of muscle dysmorphia most

consistently associated with comorbid eating-disorder risk is body-image dissatisfaction and functional impairment, rather than the drive to build muscle per se, a distinction with direct implications for targeted clinical screening. The persistent uncertainty surrounding the correct nosological classification of muscle dysmorphia—whether as a body dysmorphic, eating, obsessive-compulsive, or addictive disorder—together with widespread underapplication of formal diagnostic criteria in the published literature, continues to impede both epidemiological clarity and the development of validated, population-specific treatment approaches. Given the serious cardiovascular, endocrine, hepatic, and psychiatric complications frequently accompanying anabolic-androgenic steroid use in this population, together with consistently documented patient distrust of, and reluctance to disclose use to, medical professionals, there is a pressing need for improved clinician training, validated muscularity-sensitive screening instruments, and integrated psychiatric, endocrinological, and sports-medicine care pathways specifically designed for strength and physique athletes affected by muscle dysmorphia.

DISCLOSURE:

Conceptualization: Adrianna Marczyk, Aleksandra Kleparska

Methodology: Julia Ziółkowska, Łukasz Kuczmiński, Adrianna Marczyk

Investigation: Karolina Gajewska, Julia Ziółkowska, Łukasz Kuczmiński, Natalia Januszewska, Oliwia Hunek, Adrianna Marczyk, Piotr Matuszewski, Aleksandra Kleparska, Dawid Kociołł, Igor Smędowski

Writing – rough preparation: Natalia Januszewska, Oliwia Hunek, Igor Smędowski

Writing – review and editing: Oliwia Hunek, Piotr Matuszewski, Adrianna Marczyk, Natalia Januszewska, Łukasz Kuczmiński, Julia Ziółkowska, Dawid Kociołł, Igor Smędowski, Karolina Gajewska, Aleksandra Kleparska

Project administration: Igor Smędowski

Supervision: Igor Smędowski

Funding statement: This study received no external funding.

Informed consent statement: Not applicable.

Institutional Review Board Statement: Not applicable.

Conflict of interest: The authors declare no conflict of interest.

Declaration of the use of generative AI and AI-assisted technologies in the writing process. In preparing this work, the authors used Claude for the purpose of checking grammar and improving readability. After using this tool, the authors have reviewed and edited the content as needed and accept full responsibility for the substantive content of the publication

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