A systematic review of body dysmorphic disorder, muscle dysmorphia, weight and shape dissatisfaction and the use of appearance-enhancing drugs in the military

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Abstract

Background: Body Dysmorphic Disorder (BDD) and Muscle Dysmorphia (MD) are common but often underdiagnosed disorders, and in the context of military personnel, have rarely been explored by military mental health researchers despite the emphasis on physical fitness in military populations. We aimed to provide a comprehensive systematic literature review on scientific studies of BDD and MD and the accompanying symptoms within the military.

Methods: We used the Preferred Reporting Items for Systematic Reviews and Meta-Analysis (PRISMA) guidelines and used PubMed, Web of Science and PsycINFO as databases with “body dysmorphic disorder," "muscle dysmorphia," "body image," "performance and image enhancing drugs," "anabolic steroid,” military personnel," "soldiers," "navy," "air force," "army," and "armed forces" as search terms.

Results: A total of 20 eligible articles reporting data of 42,952 study participants were utilized. According to the identified literature, prevalence rates of BDD in the military are ~10% in males and ~20% in females, whereas ~15% of males and ~5% of females may suffer from muscle dysmorphia. Further identified problems in military populations were excessive bodybuilding, the use of anabolic drugs and the intake of stimulants.

Conclusions: BDD, MD, as well as the use of anabolic and stimulating drugs are highly prevalent in military personnel. Furthermore, gender-related differences are prominent with females being more affected by BDD and males by MD. Even though these problems are highly prevalent in the military, there are no military-specific treatment studies available.

Key messages

- Being in the military demands a high level of physical fitness to cope with the challenges associated with service which leads to increased attention on body weight and shape.
- Male military personnel have an increased risk of muscle dysmorphia and the use of anabolic drugs and stimulants.
- The prevalence of body dysmorphic disorder, weight and shape concerns and weight-control behaviours are high in female military personnel.
- Studies on the treatment of muscle dysmorphia or body dysmorphic disorder in the military context are needed.

Introduction

A combination of stress, exposure to combat and traumatic stimuli have been reported to put military personnel at a higher risk for mental disorders [1-4]. Military-related psychiatric disorders have gained significant traction within the scientific community over the last two decades. These disorders include anxiety disorders, post-traumatic stress disorder (PTSD), depression, alcohol and substance use disorders, and suicidality [5-7]. Recently, the field of eating disorders in the military has attracted scientific interest [8-10]. Mental health disorders that are clinically similar to eating disorders are body dysmorphic disorder (BDD) and muscle dysmorphia (MD) [11]. However, BDD and MD have received less interest from military mental health researchers, and no systematic review is available on BDD and MD.

Military personnel are required to meet body weight and composition standards to remain in the military and to be eligible for some promotions [12-15]. This might lead to an increased focus on body weight, shape, and fitness.

According to the Diagnostic and Statistical Manual of Mental Disorders (DSM-5), BDD is characterized by a preoccupation with one or more perceived defects or flaws in appearance that are not observable or appear slight to others [16]. Repetitive behaviours (e.g. mirror checking, excessive grooming, skin picking, reassurance seeking) or mental acts (e.g. comparing his or her with that of others) in response to their appearance concerns are also characteristics of BDD [16]. MD consists of a preoccupation with the idea that one's body is too small or insufficiently lean or muscular [16]. Individuals with this form of the disorder have an objectively 'normal looking' body or can be very muscular. A majority of individuals diet, exercise, and/or lift weights excessively, sometimes causing bodily damage. Some people with MD use potentially dangerous anabolic androgenic steroids and other substances to try to make their bodies bigger and more muscular [17].

BDD and MD are both relatively common but underdiagnosed disorders. International population studies have shown a BDD prevalence rate of 1.9%-3.3% and some studies have reported an even higher predisposition in males [18, 19]. In the UK, it has been reported that 427,000 males experience MD which equates to 7% of the country's total population [20].

MD is closely associated with anabolic-androgenic steroid use [21]. Due to the increased specialist selection programmes for arduous military units such as the US Navy Seals, Delta Force and Ranger units, there may be a tendency to lean on anabolic-androgenic steroid use to enhance performance.

Excessive body fat or an inability to 'make the weight', in military servicemen and women has been reported to be often deemed reflective of poor personal discipline in military populations [22], and therefore not in line with military ethos. In order to meet the requirements, and based on the strong emphasis on uniformity in this population, military personnel are at high risk of developing BDD or MD. One systematic review, focusing on eating disorders in the military, suggests an alternate theory: that such behaviours may be symptomatic coping strategies of adverse experiences or other mental health disorders, such as PTSD [23].

At present, BDD and MD are managed through various methods in the civilian population, including cognitive behavioural therapy (CBT), acceptance and commitment therapy (ACT), and medications such as serotonin reuptake inhibitors (SSRIs) [24].

In order to summarize what is known about the two psychiatric disorders BDD and MD as well as their accompanying symptoms like problems with body image, the intake of performance- and image- enhancing drugs and the use of anabolic steroids in the military, we sought to perform a systematic review.

Material and methods

This review was conducted according to the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) guidelines [25].

Literature search: To locate potential studies for inclusion in our review, we carried out a literature search on 20/12/2021 using three electronic databases: PubMed, Web of Science, and PsycINFO. We utilized the following keywords to carry out our search: ("body dysmorphic disorder" OR "muscle dysmorphia" OR "body image" OR "performance and image enhancing drugs" OR "anabolic steroid") AND ("military personnel" OR "soldiers" OR "navy" OR "air force" OR "army" OR "armed forces").

Searches were limited to the English language. There was no limit on the publication date.

We reviewed both the title and abstract of the retrieved publications, and those meeting the criteria were selected for a more in-depth review. Titles and abstracts of retrieved publications were imported into EndNote, duplicates were removed, and papers that were deemed highly unlikely to be relevant based on the exclusion criteria were disregarded. Full-text versions of the remaining articles were then obtained and screened according to the pre-specified eligibility criteria described above. All papers that did not meet the inclusion criteria were excluded, with the reasons documented (see **Figure 1**).

Inclusion and exclusion criteria:

To be included in the systematic review, studies needed to meet the following criteria.

- Inclusion criteria:
    - The studies are published in the English language or a have an English language abstract available
    - The studies assessed any of the following psychiatric problems: Body Dysmorphic Disorder Muscle Dysmorphia, Disturbed Weight/Body/Body Shape Perception, Body Dissatisfaction
    - The studies that assessed the use of anabolic drugs, hormones or supplements respecting the DSM or ICD
    - The studies are original articles or case reports
    - The sample only included those with military involvement such as
        - Military

        - Armed forces
        - Military personnel
        - Soldiers
        - Reservists
        - Veterans
- Exclusion criteria:
    - The study is a narrative or systematic review
        - A dissertation or thesis
        - A comment or abstract only
        - A summary of a symposium
    - The topic of the article is not related to any psychological problems around BDD, MD, weight, and shape
    - The article addresses mainly physical fitness and health
    - The article is solely related to body image problems after injury or loss of body parts/limb
    - The sample is different from military, armed forces, military personnel, soldiers, reservists, and veterans

Search selection: Titles and abstracts of retrieved publications were imported into EndNote. Duplicate papers were removed, and papers deemed highly unlikely to be relevant were disregarded. Full-text versions of the remaining articles were then obtained and screened according to the pre-specified eligibility criteria described above. All papers that did not meet the inclusion criteria were excluded. The entire search process was conducted independently by two reviewers (M.O., and B.A.) and disagreements at the final stage were resolved by consensus.

Quality assessment: All studies selected for retrieval were assessed by two independent reviewers (M.O. and B.A.) for methodological validity prior to inclusion in the review using the standardized critical appraisal instruments from the Joanna Briggs Institute Manual for Evidence Synthesis [26-28]. Studies were assessed using prevalence, analytical cross-sectional, case reports, and case-control study forms. To ensure that only methodologically valid studies were included in the review, the cut-off value for inclusion was set at a score of seven out of 10.

Data extraction: One author (B.A.) extracted data from all included studies into electronic summary tables using Microsoft Excel, which were then checked by another author (H.H.). After extraction, the studies were then thematically arranged, and the results were reported accordingly.

Results

Description of Included Studies: Following two searches, 88 articles were identified through the PubMed database, 80 articles were identified through Web of Science and 51 articles were identified in the PsycINFO database. After the removal of duplicate articles, a total of 80 articles were assessed for inclusion. A total of 20 studies which included 42,952 participants met the full

eligibility criteria and were chosen for analysis. For further information, see the PRISMA flowchart depicted in **Figure 1**.

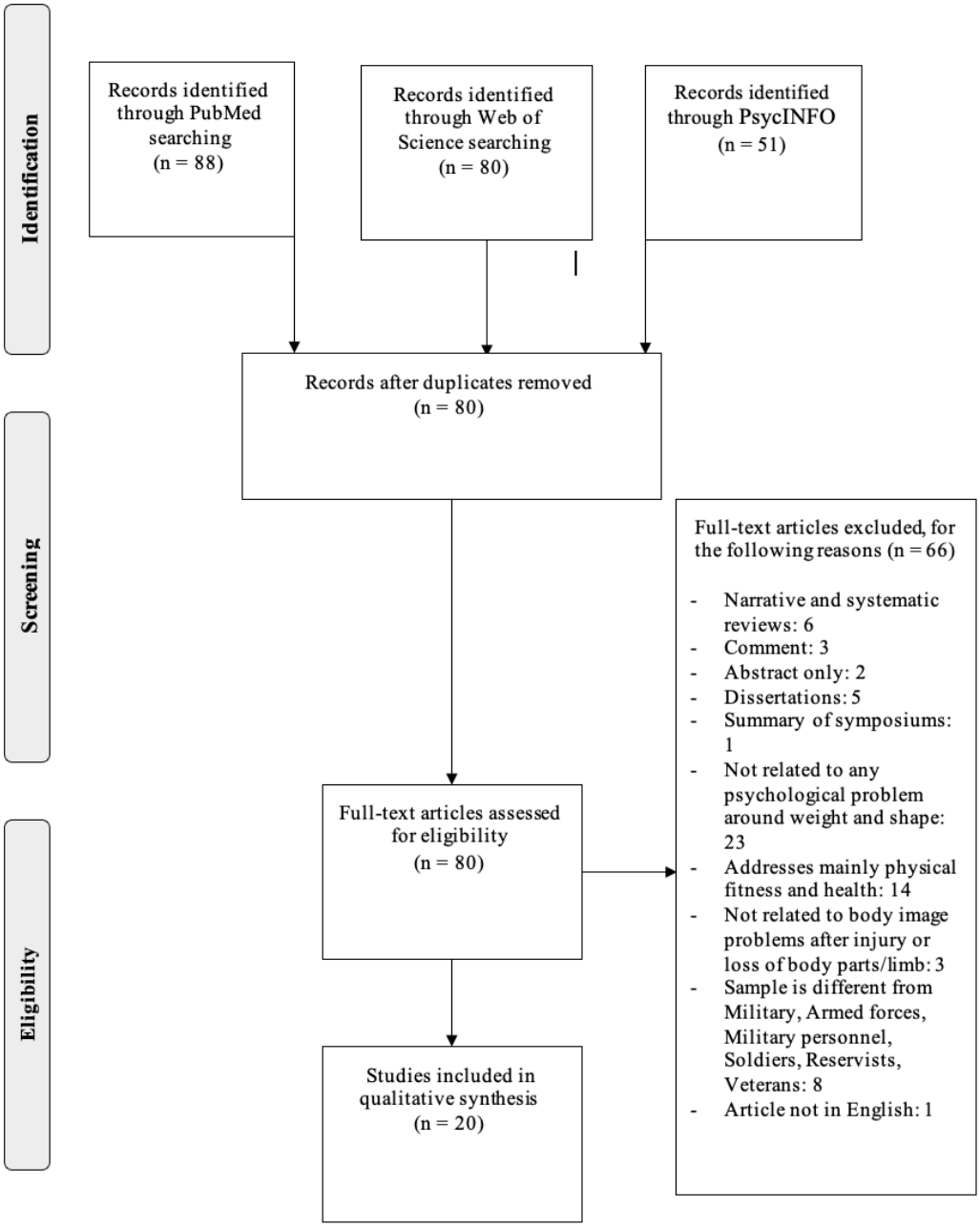

Figure 1: Flowchart of study selection process according to PRISMA.

The 20 utilized studies could be categorized into (1) studies on weight stigma and pressure of physical fitness in the military, (2) studies on the prevalence of disorders and symptoms associated with body weight and shape dissatisfaction, (3) studies on the use of dietary supplements and anabolic drugs to influence body weight and shape, and (4) studies on the use

of physical exercise and bodybuilding to influence body weight and shape in the military. These studies are summarized in **Table 1**.

Studies on weight stigma and the pressure of physical fitness in the military: Two out of the 20 identified papers focused on the weight stigma in the military. Shank et. al investigated the relationship between weight stigma and physical health in 117 US active-duty personnel [1]. 43% of participants reported their shape/weight did not meet military standards; 25% of participants had experienced disciplinary action because of their body shape or weight, and 15% experienced this treatment because they were overweight [1]. Participants also reported being overlooked for promotions or awards as a direct consequence of their body weight. Stukenborg et al. surveyed 969 US active-duty soldiers with and found associations between compliance with body composition standards, body image, and weight cycling [2].

Studies on the prevalence of disorders and symptoms associated with body weight and shape dissatisfaction in the military: Eight out of the 20 identified papers focused on the prevalence of disorders and symptoms associated with body dissatisfaction in the military. A study by Garber et al. of 2,157 women recruits in training in the US Marines, found that 77% engaged in disordered eating behaviours [3]. Another study found a linkage of gender with weight perception where 29% of women US military personnel perceived themselves as overweight even though 0% were overweight; in comparison to their male counterparts where 42% of overweight male soldiers perceived their weight to be appropriate even though their calculated BMI as overweight [4]. In a study of US military personnel by Carlton et al. [8], 18% reported the use of laxatives or diet pills to lose weight, and 25% fasted for weight loss. Lauder et al. [9] reported that 20% of the 310 US Reserve training corps cadets met the screening criteria for being at risk of an eating disorder. These cadets had a significantly higher drive for thinness and body dissatisfaction [6]; a second study by Lauder et al. of 423 female soldiers found that 8% of women were diagnosed with an eating disorder [10]. Smith et al. reported a multitude of pathological behaviours in Reserve Officers' Training Corps (ROTC) cadets such as binge eating; the use of laxatives, diuretics, or diet pills; and excessive exercise [29]. Campagna et al. [11] reported prevalence rates of BDD (13% in males, 22% in females, 18% in soldiers, 12% in sailors, 13% in airmen) and prevalence rates of MD (13% in males, 4% in females). Another study comprised of 126 Swiss male military recruits showed that symptoms of BDD were common, with 9.5% assessed for probable BDD, and 84% reporting some symptoms of BDD [30].

Studies on the use of dietary supplements and anabolic drugs to influence body weight and shape in the military: Five out of the 20 identified papers focused on the use of dietary supplements and anabolic drugs to influence a desired shape in the military. Austin et al. published a study on dietary supplements in US Army soldiers. They found that the consumption of specific nutritional supplements was related to the participants' reported desire to lose, gain, or maintain body weight. 70% reported that they consumed a nutritional supplement at least once per week [12]. A cross-sectional study by Boos et al. focused on UK military personnel based in Iraq. 66% of soldiers reported taking dietary and exercise supplements on that current deployment, 40% of users reported using supplements to increase muscle bulk and 21% stated they use them for training and recovery [13]. Costa et al. reported the lifetime prevalence of drug use of military police volunteers in Brazil for stimulants (7%) and anabolic steroids (5%) [14]. Boos et

al. found that 42% of UK military personnel take supplements or drugs. Of the selected users, 86% took proteins or amino acids, 34% took creatinine, 30% took chromium, 17% took stimulants, and 1% took testosterone boosters [15]. Brazeau et al. reported a case of a 26-year-old US male soldier who used bodybuilding supplements containing anabolic steroids and suffered drug-induced liver failure as a consequence [31].

Studies on the use of physical exercise and bodybuilding to influence body weight and shape: Five studies demonstrated increased engagement in physical activity by military personnel to influence body weight and shape. In a study by Uglem et al., Norwegian National Guard members, 67% of responders felt it was important to be slim and engaged frequently in physical activity to keep their physique [17]. A cluster analysis by Jáuregui-Lobera et al. reported a high risk for body shape concerns, increased physical activity, and disturbed eating behaviour in a group of soldiers [18]. Lukács et al. found that in comparison to their general college counterparts, a higher number of military college students reported the use of anabolic-androgenic steroids and bodybuilding [19]. An Air Force recruit study by Ward et al. found that 23% of non-smokers and 16% of smokers reported being highly physically active [20]. Finally, in a study concerning 22 Columbian soldiers with known amputations, researchers found high scores in behaviours related to maintaining physical activity whilst injured [32].

Author, Year Country	Sample and group size (n)	Study Design	Questionnaires and Research Methods	Main Outcome	Statistical Significance of main results	Additional findings
Studies on weight stigma and pressure of physical fitness in the military						
Stukenborg et. al (2021), USA	• US active-duty soldiers (n=969)	• Prevalence study	• Military Body Image Scale comprised of 3 subscales: Concern with Conforming to Military Image, Agreeance with the Ideal Military Physique, and Satisfaction with Body Shape • Height/weight screening	• Compliance with body composition standards was measured by whether a soldier had ever taken and failed the circumference-based body fat assessment. • Weight cycling was self-reported as ≥3 weight fluctuations of ≥5% of body weight during their military career • Failing the circumference-based body fat assessment was associated with increased concern with conforming to military image • Negative body image was associated with higher odds of weight cycling	• Military Body Image Scale: $p<0.001$	
Shank et al. (2019), USA	• Active US military personnel with overweight or obesity (n=117)	• Prevalence study	• Body weight and height measured; BMI calculated • Medical questionnaire • Adapted version of the Experiences and Sources of Weight Stigma Questionnaire • Modified Weight Bias Internalization Scale	• Participants who reported a medical condition had a higher BMI • 43% of participants reported they had been told their shape/weight did not meet military standards • Military specific weight stigma, but not general weight stigma, was a significant predictor of having a medical condition	• Weight Stigma, Military: $p<0.04$ • Weight stigma, general: $p<0.18$	• 25% experienced disciplinary action because of their body shape or weight • 15% experienced because of being overweight – not being promoted or awarded • receiving negative weight or appearance-related feedback on performance reports
Studies on the prevalence of disorders and symptoms associated with body weight and shape dissatisfaction in the military						
Drüge et al. 2021, Switzerland	• Swiss male military recruits (n=126)	• Cross-sectional study	• Self-report measurements to assess symptoms of BDD, depression, alcohol/drug abuse. • Fragebogen Körperdysmorpher	• Symptoms of BDD were relatively common (9.5% reached the cutoff value for probable BDD, 84% reported some symptoms), with the muscles as the	• prevalence of symptoms of BDD positively correlates with depressive symptoms ($r = .38$, $p < 0.01$)	• Five of the twelve recruits reported being preoccupied with only one body part, another five recruits stated two body

			Symptome, FKS (assessing BDD) • Allgemeine Depressionsskala (ADS) • Alcohol Use Disorders Identification Unit (AUDIT) •	most common area of preoccupation. • Positive correlation between depressive symptoms and symptoms of BDD was found • No correlation between alcohol/drug abuse and symptoms of BDD.		parts, and two recruits reported three body parts. •
Smith et al. (2020), USA	• Reserve Officers Training Corps (ROTC) cadets for US South-eastern Universities (n=102)	• Cross-sectional study	• Self-reported height, current and ideal weight • Eating Attitudes Test 26 (EAT-26) • Self perceived Body Image	• The overall risk of eating disorder for ROTC cadets was 32.4% • No significant differences were found when comparing sex, ethnicity, or military branch. • Overall risk of pathogenic behaviors included 11.8% who reported binge eating; 8.8% who used laxatives, diuretics, or diet pills; 8.8% who exercised for >60 min to control their weight; and 8.8% who lost 9.1 kg or more within the last 6 months.	• Proportion of ROTC branch at risk for eating disorders: p>0.05	• significant interactions ($p \leq 0.01$) between sex of the solider, overall perceptions of male and female soldiers, and BI self-perceptions
Clark et al. (2017), USA	• Active US military service personnel (n=295)	• Cross-sectional study	• Body weight and height measured, BMI calculated • Questionnaire on education, eating behaviour and perception of body weight • Intuitive Eating Scale • Motivation for Eating Scale	• Weight status – 64% were overweight or obese – Mean BMI in males: 27.8 kg/m^2 – Mean BMI in females: 224,8 kg/m^2 • Weight perception – 29% of women with a normal BMI, but 0% of men with a normal BMI perceived themselves as overweight • 42% overweight men incorrectly perceived themselves to be at appropriate weight	• Respondents with an accurate perception of their weight status: $p < 0.001$ • Normal weight females with inaccurate perceptions of their weight were trying to lose weight :$p = 0.005$ • normal weight men trying to lose weight regardless of weight perception: $p= 0.592$ • females with an accurate perception of overweight status trying to lose weight: p=.002 • males with an accurate perception of overweight status trying to lose weight: p<0.001	• Higher education was associated with a more accurate perception of the weight status • 19% of normal BMI women were currently dieting • 81% of normal weight women with inaccurate weight perceptions were attempting to lose weight

Campagna & Bowsher (2016), USA	• Enlisted US Army personnel attending a training course (n=722)	• Prevalence study	• Dysmorphia Concern Questionnaire • Dietary Supplement Survey • Muscle Dysmorphia Symptom Questionnaire	• Prevalence rate of body dysmorphic disorder: – 13% in males, 22% in females – 18% in soldiers, 12% in sailors, 13% in airmen • Prevalence rate of muscle dysmorphia: – 13% in males – 4% in females • Body dysmorphic disorder prevalence in service members higher than in the general population	• Service members with BDD were 5.1 times more likely than those without BDD to use weight loss supplements: $p < 0.001$ • Service members with BDD were 3.4 times (more likely to also be positive on the MDSQ than those who do not have BDD: $p<0.001$	• Service members with body dysmorphic disorder were more likely to use weight loss supplements • Muscle dysmorphia associated with a greater likelihood of using supplements to build muscles
Garber et al. (2008), USA	• Women at recruitment training, US Marine Corps (n=2157) • 17–19 years	• Prevalence study	• Body weight and height measured, BMI calculated • Self-administered questionnaire assessing – disordered eating – worries meeting the military weight requirements – weight dissatisfaction	• 38% were dissatisfied with their weight • 77% reported having engaged in a disordered eating behaviour	• 14 variables were significantly correlated with weight dissatisfaction: $p< 0.05$ • These variables included Race/ethnicity, Education ,Region of origin Body mass index, Tobacco use, Alcohol use, Diet adequacy, Disordered eating behaviors, Losses and gains, Disparity between highest and lowest adult weight, Worry about making weight, Intent to avoid junk food, Intent to avoid crash dieting, Nutrition and fitness knowledge	• Weight dissatisfaction significantly worse among those who – are overweight – perceive themselves as overweight • have a BMI <18.5 kg/m^2
Carlton et al. (2005), USA	• Active US military personnel assigned to the Naval Medical Center in Portsmouth, Virginia (n=489)	• Prevalence study	• Body weight and height measured, BMI calculated • Questionnaire on abnormal eating behaviour • Questionnaire related to worries about failing the semi-annual personal fitness assessment	• 53% dissatisfied with their physical appearance • Prevalence of eating disorder symptoms – 5% self-induced vomiting – 18% laxative, diuretic or diet pill use to lose weight – 25% fasting • Worries about failing personal fitness assessment: – 28% worried about failing because of body weight	• Inverse correlation between body image and BMI: $p<0.001$ • Positive correlation between BMI and abnormal eating behaviour($r= 0.323$, $p< 0.001$) • Positive correlation between BMI and worry ($r = 0.487$, $p < 0.001$)	• Women more likely than men to report dissatisfaction with their appearance • Women more likely to report self-esteem depending on appearance • Only 2% with diagnosis of an eating disorder

				– 29% because of lack of physical fitness		
Lauder et al. (2001), USA	• Female US reserve officer training corps cadets (n=310)	• Cross-sectional study	• Eating Disorders Inventory (Garner et al. 1983) • Supplemental questionnaire regarding military history health and activity level	• 20% met the screening criteria for being at risk for an eating disorder • The cadets at risk for eating disorders had significantly higher drive for thinness, bulimia, and body dissatisfaction subscale scores and were more dissatisfied with their weight than cadets not at risk	• Significant difference between the 'At risk' group and Negative groups at $p < 0.01$	• 85% (250 of 310 women) wanted to weigh less • The prevalence of weight dissatisfaction was higher in the group at risk for an eating disorder
Lauder et al. (1999), USA	• Female US soldiers (n=423)	• Prevalence study	• Eating Disorder Inventory	• 8% of women diagnosed with an eating disorder • Women with eating disorders – exercised more – felt dissatisfied with their weight • felt more pressure about their weight	• Body Dissatisfaction scores in the the ED and 'At risk' groups had significantly higher scores than the Negative group ($p< 0.001$)	• Women with an eating disorder had higher scores for: – Drive for thinness – Bulimia • Body dissatisfaction
Studies on the use of dietary supplements and anabolic drugs to influence body weight and shape in the military						
Brazeau et al. (2015), USA	• 26 year old US Army Male (n=1)	• Case study	• Case report on his usage of body-building supplement containing anabolic steroids leading to his drug induced liver injury (hepatoxicity)	• Patient with jaundice with scleral icterus • Took anabolic steroids • Biopsy proven drug-induced liver injury • Three months after discontinuation of all supplements, his hepatic condition improved significantly with complete resolution of jaundice	• None reported	•
Austin et al. (2013), USA	• US Army Soldiers (n=990)	• Prevalence study	• Questionnaire on desire for body-weight modification, participation in aerobic exercise and strength training, health, eating habits and the use of nutritional supplements	• Weight goals: – 43% weight loss – 38% weight maintenance – 18% weight gain • 70% had consumed nutritional supplement at least once a week • Use of specific nutritional supplements was related to participants' reported	• Using any nutritional supplements to lose weight: $p=0.667$ • Using any nutritional supplemental to maintain weight: $p=0.231$ • Using any nutritional supplement to gain weight: $p=0.294$	• Soldiers desiring weight loss or weight maintenance were less likely to use energy drinks and weight-gain dietary supplements

				desire to lose, gain, or maintain body weight.		
Boos et al. 2011, UK	• UK military personnel deployed to Afghanistan (n=87)	• Prevalence study	• Voluntary confidential health questionnaire covering recreational habits and supplement use	• Current use – 46% smokers – 38% drinking >6 caffeinated drinks per day – 42% current supplement use	• individuals who were currently taking regular supplements, compared with non users, were younger: $p<0.0001$ • exercised more frequently: $p<0.0001$ • drank less caffeine $p=0.003$	• Selected supplements (users): – 86% proteins or amino acids – 34% creatinine – 30% chromium – 17% stimulants – 1% testosterone boosters
Costa et al. (2010), Brazil	• Military police volunteers in in Goiás, Brazil (n=221)	• Prevalence study	• Questionnaire for drug use designed by the Centro Brasileiro de Informações sobre Drogas Psicotrópicas	• Current use: – 15% tobacco – 5% stimulants	• Not significant	• Lifetime prevalence: – 40% tobacco – 2% cocaine – 7% stimulants – 5% anabolic steroids
Boos et al. (2010), UK	• UK Military personnel based in Basra, Iraq (n=1017)	• Cross-sectional study	• Cross sectional questionnaire on dietary and exercise supplements	• 32% current supplement users • Of the current users, 66% started supplements on the current deployment • The reason given for taking supplements were: – 40% to increase muscle bulk – 21% to aid training and recovery	• Not significant	• 41% had a history of supplement use • Supplements: – 19% protein – 18% amino acids – 13% creatinine – 1% anabolic steroids.
Studies on the use of physical exercise and bodybuilding to influence body weight and shape						
Herrera-Moreno et al. (2018), Colombia	• N=22 Columbian Soldiers with some degree of amputation • quantitative, cross-sectional study	• Prevalence study	• The Multidimensional Body Self-relations Questionnaire (MBSRQ) • Perceived Stress (EEP-14) • Connor-Davidson Resilience Scale (CD-RISC 10)	• High scores in behaviours aimed at maintaining physical fitness, self-assessed physical attractiveness and physical appearance • low scores in stress and scores with high trends in resilience	• None reported	• negative correlation between stress and conducts aimed to maintain physical fitness. •
Uglem et al. (2011), Norway	• Male Norwegian National Guard members (n=578)	• Prevalence study	• Body weight and height measured; BMI calculated • 4-day food diary • Questionnaire about health, weight perception and food frequency when living at home	• 28% of the recruits were overweight or obese • 67% felt it is important to be slender, and these people reported more of physical activity than the others	• BMI in relation to attitudes toward slenderness: $p<0.013$	• Subjects with high intakes of plant foods had low BMI • The drive for slenderness had a bearing on participants' physical activity pattern, but less on the food intake pattern

				• BMI was inversely related to scores on the plant food pattern, and positive attitudes to slenderness		
Jáuregui Lobera et al. (2011), Spain	• Male Spanish soldiers (n=950)	• Prevalence study	• Body weight and height measured; BMI calculated • Questionnaire of the Influences on Body Shape Model (CIMEC-V) • Eating Attitudes Test-40 (EAT-40) • Assessment of physical/sporting activity	• Study participants engaged in sports for an average of 1.63 hours a day over the last six months • A cluster analysis revealed two subgroups one of which is at higher risk group for body shape concerns, increased physical activity, disturbed eating behaviour and greater body volume	• BMI: $p < 0.01$ • EAT-40: $p < 0.01$ • CIMEC-V: $p < 0.01$	• People with a BMI exceeding the upper normal limit scored higher on the Questionnaire of the Influences on Body Shape Model and the Eating Attitudes Test-40
Lukács et al. (2007), Hungary	• Male Hungarian students (N=1232) • military college students (n=480) at the University of Budapest • general college students (n=752) University of Debrecen	• Case-control study	• Eating disorders diagnoses according to DSM-IV criteria • Questionnaire on age, body weight and height, anabolic steroid use, and history of participation in bodybuilding (to enhance body shape and size)	• In military college students: – 39% of subjects were currently engaged in bodybuilding – 35.5% had never engaged in bodybuilding – 3.3% of bodybuilders had taken/were currently taking anabolic steroids • In general college students: – 15.1% were currently engaged in bodybuilding – 70% students had never been engaged in bodybuilding •	• Rate of military students using anabolic androgenic steroids: $p<0.005$	• BMI of military students was greater than general college students • More military students used anabolic androgenic steroids • Anabolic androgenic steroid use was more frequent among military bodybuilders
Ward KD et al. (2003), USA	• US Air Force recruits (n=32144)	• Case-control study	• Questionnaire to examine smoking status, physical activity level, weight concerns and health behaviours • Comparison highly physically active smokers, highly physically active non-smokers, and less active smokers	• Physically active smokers were similar to active non-smokers across several health behaviours including diet • Compared to less active smokers, active smokers consumed more fruits and vegetables, and worried less about their weight	• Worries about weight between highly active smokers vs. less active smokers: $p<0.001$	• 23% of non-smokers, and 16% of smokers reported being highly physically active

Discussion

Summary of the main results: This systematic literature review aimed to summarize the literature on body dysmorphic disorder and muscle dysmorphia and their symptoms in service members in the military. Our review yielded 20 eligible articles including 42,952 study participants.

Prevalence rates of BDD in military samples seem to be ~10% in males and ~20% in females. Regarding the branch of service, BDD seems to be more prevalent in soldiers (18%) than in sailors (12%) and airmen (13%). The prevalence of muscle dysmorphia can be estimated to be ~15% in males and ~5% in females [4, 8, 11, 30]. These prevalence rates are much higher than those found in the normal population [18-20]. Potential reasons for this relatively high prevalence of BDD and MD in the military might be the intense emphasis on body standards and physical fitness, as well as wide-spread weight stigma [1,2].

Women expressed more dissatisfaction with their appearance and lower self-esteem compared to men [5] which might explain the higher prevalence of BDD found in women [11]. Apart from BDD and MD and their symptoms, eating disorders, eating disorder symptoms and disordered eating were also reported to be highly prevalent in military personnel, particularly in women [3, 8-11, 29, 30].

Behaviours associated with MD were more prevalent in men [11], where bodybuilding, the intake of dietary supplements, the use of anabolic drugs and the intake of stimulants [12-15, 18-21, 32].

Limitations: This systematic review has several limitations. Most studies were based on data from US military populations and the remaining studies were based on other countries where the study was one of the only of its kind and within this population. This is an important limitation as different militaries in different regions will have very different ways of practising, training, and evaluating physical fitness. Additionally, most of the included studies were from the army branch of the military and there is limited information on the risk of BDD and MD in different branches of military services.

The design of the obtained studies included prevalence studies, cross-sectional, case-control and case reports. Thus, study designs were heterogeneous. None of the included studies were randomized control trials or (RCTs) longitudinal studies so conclusions from the included studies should be drawn with caution. It was difficult to compare the results of the studies and draw firm conclusions because different questionnaires were used in each of the studies, and most were self-report measures. Because of the plethora of questionnaires utilized to trace eating disorder symptoms, weight stigma, and anabolic drug use, the study results are difficult to classify in a homogenous way.

Studies on body weight and body shape only partly focused on BDD and MD. Some of these studies had their main emphasis on eating disorders.

Taken together, there were no RCTs on BDD or MD in the military available, study designs and study outcomes were heterogeneous, outcomes were not comparable between studies, a clear line

between BDD, MD and eating disorders studies was not possible to draw due to the symptom overlap, and most studies were performed in the US army; therefore, findings and conclusions cannot be generalized to all countries and military branches.

Future directions: Future research might focus on other branches of military service to explore the possibility of BDD and MD as possibly branch-specific and should focus explicitly on screening for the two disorders when service personnel enlist. This will aid in early detection and potential preventative actions can be achieved before symptoms of the disorder manifest.

Studies may also focus on military physical health programs and policies that potentially lead to the destigmatisation of obese and overweight people within military service. Many service personnel cited arduous physical health and weight and body shape practices that they feel they need to adhere to in order to not face penalties from their supervisors [1-2, 8]. Future research could examine the attitudes of military service personnel regarding these weight goal practices set by different military branches as well as the prevalence of BDD and MD as a potential result of these weight standards.

There are multiple challenges to effective psychotherapy as a treatment for mental health in both active and veteran military personnel [33]. It may be worthwhile to try and recruit psychotherapists with military experience (e.g., veterans, reservists), because they can use their experience in the military and with this particular population which may enable them to understand and relate to their difficulties better [34]. Intensive outpatient programs [35] and eCBT [33] have been shown to be effective in military populations. Psychotherapists should create initiatives that utilize these two modalities for effective rehabilitation.

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References

1. Shank L, Schvey N, Ekundayo K., *et al*. The relationship between weight stigma, weight bias internalization, and physical health in military personnel with or at high-risk of overweight/obesity. *Body image* 2019; *28*, 25–33. https://doi.org/10.1016/j.bodyim.2018.11.003
2. Stukenborg M, Deschamps B, Jayne J, *et al*. Exceeding body composition standards is associated with a more negative body image and increased weight cycling in active duty U.S. soldiers. *Eating Behaviors*, 2021; *42*, 101532. https://doi.org/10.1016/j.eatbeh.2021.101532
3. Garber A, Boyer C, Pollack L, *et al*. Body mass index and disordered eating behaviors are associated with weight dissatisfaction in adolescent and young adult female military recruits. *Mil Med*. 2008;173(2):138-145. doi:10.7205/milmed.173.2.138
4. Clark H, Heileson J, DeMay J, *et al.* Misperceptions of Weight Status in Military Men and Women. *Mil Med*. 2017;182(5):e1792-e1798. doi:10.7205/MILMED-D-16-00202
5. Ramchand R, Rudavsky R, Grant S, *et al.* Prevalence of, risk factors for, and consequences of posttraumatic stress disorder and other mental health problems in military populations deployed to Iraq and Afghanistan. *Curr Psychiatry Rep.* 2015;17(5):37. doi:10.1007/s11920-015-0575-z
6. Asare-Doku W, Donnir G, Ayuurebobi Ae-Ngibise K, et al. Psychiatric Disorders among the Military in West Africa: A Systematic Narrative Review. *Behav Sci.* 2021;11(10):138. doi: 10.3390/bs11100138.
7. Willmund G, Waechter H, Helms C, *et al.* German research perspectives on suicidality and the rationale for future multinational suicide prevention projects among military service personnel. *Int Rev Psychiatry*. 2019 Feb;31(1):60-74. doi: 10.1080/09540261.2019.1581146
8. Carlton J, Manos G, Van Slyke J. Anxiety and Abnormal Eating Behaviors Associated with Cyclical Readiness Testing in a Naval Hospital Active-Duty Population *Military Medicine.* 2005; 170:663–7. http://dx.doi.org/10.7205/milmed.170.8.663
9. Lauder T, Campbell C. Abnormal eating behaviors in female reserve officer training corps cadets. *Mil Med.* 2001;166(3):264–8.
10. Lauder T, Williams M, Campbell C, *et al*. Abnormal eating behaviors in military women. *Medicine and science in sports and exercise*. 1999; 31(9), 1265–1271. https://doi.org/10.1097/00005768-199909000-00006
11. Campagna JD, Bowsher B. Prevalence of Body Dysmorphic Disorder and Muscle Dysmorphia Among Entry-Level Military Personnel. *Mil Med*. 2016;181(5):494-501. doi:10.7205/MILMED-D-15-00118
12. Austin K, Carvey C, Farina E, *et al*. Predictors of the relationships between nutritional supplement use and weight-modification goals of U.S. Army soldiers. *Int J Sport Nutr Exerc Metab*. 2013;23(4):322-335. doi:10.1123/ijsnem.23.4.322

13. Boos C, Wheble G, Campbell M, Tabner K, *et al.* Self-administration of exercise and dietary supplements in deployed British military personnel during Operation TELIC 13. *J R Army Med Corps*. 2010;156(1):32-36. doi:10.1136/jramc-156-01-07
14. Costa S, Cunha L, Yonamine M, *et al.* Survey on the use of psychotropic drugs by twelve military police units in the municipalities of Goiânia and Aparecida de Goiânia, state of Goiás, Brazil. *Braz J Psychiatry*. 2010;32(4):389-395. doi:10.1590/s1516-44462010005000023
15. Boos CJ, Simms P, Morris FR, Fertout M. The use of exercise and dietary supplements among British soldiers in Afghanistan. *J R Army Med Corps*. 2011;157(3):229-232. doi:10.1136/jramc-157-03-08
16. American Psychiatric Association. Diagnostic and Statistical Manual of Mental Disorders DSM-V. Arlington, VA: American Psychiatric Association 2013.
17. Uglem S, Stea T, Frølich W, *et al.* Body weight, weight perceptions and food intake patterns. A cross-sectional study among male recruits in the Norwegian National Guard. *BMC Public Health*. 2011;11:343. doi:10.1186/1471-2458-11-343
18. Jáuregui Lobera I, Tomillo Cid S, Santiago Fernández M, *et al.* Body shape model, physical activity and eating behaviour. *Nutr Hosp*. 2011;26(1):201-207.
19. Lukács L, Murányi I, Túry F. Eating and body attitudes related to noncompetitive bodybuilding in military and general Hungarian male student populations. *Mil Med*. 2007;172(2):152-156. doi:10.7205/milmed.172.2.152
20. Ward K, Vander Weg M, Klesges R, *et al.* Characteristics of highly physically active smokers in a population of young adult military recruits. *Addict Behav*. 2003;28(8):1405-1418. doi:10.1016/s0306-4603(02)00267-8
21. Goldman A, Pope H, Bhasin S. The Health Threat Posed by the Hidden Epidemic of Anabolic Steroid Use and Body Image Disorders Among Young Men. *J Clin Endocrinol Metab*. 2019;104(4):1069-1074. doi:10.1210/jc.2018-01706
22. Bodell L, Forney K, Keel P, *et al.* Consequences of making weight: A review of eating disorder symptoms and diagnoses in the United States military. *Clinical Psychology: Science and Practice.* 2014; 21(4), 398–409. https://doi.org/10.1111/cpsp.12082
23. Bartlett B, Mitchell K. Eating disorders in military and veteran men and women: A systematic review. *Int J Eat Disord*. 2015;48(8):1057-1069. doi:10.1002/eat.22454
24. Hong K, Nezgovorova V, Hollander E. New perspectives in the treatment of body dysmorphic disorder. *F1000Res*. 2018;7:361. doi:10.12688/f1000research.13700.1
25. Page M, McKenzie J, Bossuyt P, *et al*. The PRISMA 2020 statement: an updated guideline for reporting systematic reviews. BMJ 2021;372:n71. doi: 10.1136/bmj.n71
26. Munn Z, Moola S, Lisy K, *et al.* Methodological guidance for systematic reviews of observational epidemiological studies reporting prevalence and cumulative incidence data. *Int J Evid Based Healthc*. 2015;13(3):147-153. doi:10.1097/XEB.0000000000000054

27. Moola S, Munn Z, Tufanaru C, *et al.* Chapter 7: Systematic reviews of etiology and risk . In: Aromataris E, Munn Z (Editors). *JBI Manual for Evidence Synthesis*. JBI, 2020. Available from https://synthesismanual.jbi.global

28. Tufanaru C, Munn Z, Aromataris E, et al. Chapter 3: Systematic reviews of effectiveness. In: Aromataris E, Munn Z (Editors). JBI Manual for Evidence Synthesis. JBI, 2020. Available from https://synthesismanual.jbi.global

29. Smith A, Emerson D, Winkelmann Z, *et al.* Prevalence of Eating Disorder Risk and Body Image Dissatisfaction among ROTC Cadets. *Int J Environ Res Public Health*. 2020;17(21):8137. doi:10.3390/ijerph17218137

30. Drüge M, Rafique G, Jäger A. *et al.* Prevalence of symptoms of body dysmorphic disorder (BDD) and associated features in Swiss military recruits: a self-report survey. *BMC Psychiatry.* 2021; **21,** 294. https://doi.org/10.1186/s12888-021-03288-x

31. Brazeau, M, Castaneda J, Huitron S, *et al.* A Case Report of Supplement-Induced Hepatitis in an Active Duty Service Member. *Military Medicine*.2015; 180(7), e844–e846. https://doi.org/10.7205/milmed-d-14-00654

32. Herrera-Moreno D, Carvajal-Ovalle D, Cueva-Nuñez M, *et al.* Body image, perceived stress, and resilience in military amputees of the internal armed conflict in Colombia. *Int J Psychol Res.* 2018; 11(2):56-62. doi: 10.21500/20112084.3487.

33. Frey, R. Ethical challenges for military psychologists: When worlds collide. *Ethics & Behavior*. 2017; *27*(4), 283–296. https://doi.org/10.1080/10508422.2016.1193811

34. Johnson T, Ganz A, Berger S, *et al.* Service Members Prefer a Psychotherapist Who Is a Veteran. *Front Psychol*. 2018;9:1068. doi:10.3389/fpsyg.2018.01068

35. Rauch S, Yasinski C, Post L, *et al.* An intensive outpatient program with prolonged exposure for veterans with posttraumatic stress disorder: Retention, predictors, and patterns of change. *Psychological services*, 2021;18(4), 606–618. https://doi.org/10.1037/ser0000422

36. Luo C, Sanger N, Singhal N, *et al.* A comparison of electronically-delivered and face to face cognitive behavioural therapies in Depressive Disorders: A systematic review and meta-analysis. *EClinicalMedicine*. 2020;24, 100442. https://doi.org/10.1016/j.eclinm.2020.100442