

DIFFERENCES IN THE PRESENTATION OF ANOREXIA NERVOSA BETWEEN MALES AND FEMALES

Justin Michael Barnes

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Approved by:

Advisor

Introduction

Anorexia nervosa (AN) is a serious psychiatric illness with an estimated lifetime prevalence of 0.3% in males and 0.9% in females.¹ AN has the highest mortality rate of any psychiatric disorder²—10-12 times greater than the general population.^{3,4} Approximately 20% of those with AN commit suicide,² though prevalence estimates of history of suicide attempts range from approximately 17% up to 27%.⁵⁻⁸ Unfortunately, most studies related to AN and other eating disorders (ED's) have focused on females,⁹⁻¹¹ leaving a relative scarcity of literature related to the presentation of AN among males.

AN is characterized by a restriction of energy intake relative to an individual's energy needs, leading to significantly low body weight. Despite low body weight, individuals with AN exhibit an intense fear of gaining weight or becoming fat or behaviors that interfere with weight gain. AN is further divided into restricting subtype (in the absence of recurrent binge eating or purging behavior) and binge-eating/purging subtype (in the presence of binge eating or purging behavior).¹² These criteria have largely been developed based on the clinical presentation of girls and women with the illness. As a result, boys and men with AN do not always fit these criteria neatly: some identify medically reasonable motives for weight loss (such as a history of overweight), while others express a drive for a muscular body, rather than one characterized solely by thinness.¹³

Given the severity of AN, understanding its signs, symptoms, and characteristics is crucial for early detection and intervention. This is especially important because patients with ED's typically are unable to gauge the seriousness of their illnesses, conceal disordered attitudes and behaviors from those around them, and often do not seek help for their disorder.^{14,15} Therefore, early and reliable detection by healthcare professionals is critical. The ability to detect AN, however, especially among those who are unable to recognize the seriousness of the illness,

hinges on a thorough understanding of its signs and symptoms. A complete understanding of AN's signs and symptoms in both males and females is required for reliable detection in all individuals, as diagnostic bias favoring typical presentations of AN among females may contribute to under-detection, late detection, or improper treatment for males with AN.¹⁶⁻²⁰ The current review summarizes the state of the literature on differences in the presentation of AN between males and females in order to improve detection of AN in all individuals as well as guide future research investigating the efficacy and appropriateness of treatment methods in both females and males.

It should be noted that research related to AN in the transgender and gender-fluid communities is ongoing, and the information gathered from these studies will be crucial to understanding the presentation of AN in all individuals. Given that work in that area is nascent and is beyond the scope of this review, the binary terms “male” and “female” will be used, with the acknowledgment that future research may uncover more accurate or meaningful ways to associate sex or gender with ED's. Also, despite this review's focus on AN, studies with a broader focus that include multiple ED's will be discussed when AN-specific information is not available.

Literature Review

Excessive Exercise

Exercise can be used as a method of weight control, and a few studies have examined the prevalence and nature of exercise that is deemed to be excessive in an effort to control weight. It has been hypothesized that males may engage in excessive exercise at a higher frequency than females because over-exercising may be more socially accepted as a means of weight control in

men than other methods.²¹ In a study of 24 male and 25 female patients (both adolescents and adults) diagnosed with AN in an inpatient setting between 1970 and 1987, excessive exercise was more prevalent in males (16 males vs. 11 females).²² Unfortunately, most literature on this topic has examined females only and has not employed a standard definition of “excessive exercise,” leaving too many knowledge gaps to fully compare this symptom between males and females with AN.²³⁻²⁷ Second, few studies stratify results by ED type (AN, bulimia nervosa [BN], binge-eating disorder [BED], etc.).

The manner in which these two issues complicate interpretation can be illustrated with two examples. First, in a prospective clinical registry for pediatric ED’s in Western Australia that included 53 boys and 704 girls, aged 8 to 17 years, the prevalence of “intense exercise” did not differ between the sexes; however, “intense exercise” was not defined, and the analysis was not stratified by ED type.²⁸ Second, a large study of high school adolescents did report a higher prevalence of excessive exercise among males, but, again, results were not stratified by ED type, “partial syndromes” based on modifications to the DSM-IV criteria were included, and the Eating Disorders Symptoms Questionnaire assessment that examined disordered eating behaviors (including excessive exercise) was conducted 2 years (on average) after the diagnostic interview.¹⁰ Future studies that carefully examine nuances in exercise behavior across ED types, delineate exercise for weight loss from other intentions, account for exercise related to sports participation, and use standardized methods and definitions may reveal important differences between males and females.

Although the current literature may not include enough data to fully assess differences in excessive exercise between males and females, several interesting leads deserve further exploration. A study of 1,278 active duty service women in the Army, Navy, Air Force, and

Marines found that exercise rates were significantly higher among Marines, with 13% reporting exercising twice per day, compared to rates of 2-4% among the other services. At the same time, the prevalence of suspected AN based on survey responses compared to DSM-IV criteria was 4.9% in the Marines, compared to 0.8-1.3% in the other services.²⁹ These results may indicate that, under pressure to conform to weight and performance standards that are very strict or demanding, the development of AN partially characterized by excessive exercise may be more common in females than the current literature suggests. Further examination of the military population that includes comparisons with male service members and in other arenas in which weight and shape standards are high may elucidate differences in how high-pressure environments with standards for anthropometric measurements and physical performance affect males and females differently.

Sexuality

A number of studies have reported that males with ED's are more likely to be homosexual or bisexual than unaffected males, although this may not hold for females. Unfortunately, few studies have focused on AN in particular. A larger body of literature has examined the relationship between ED's (in a broader sense) and homosexuality. A study of 25 men aged 18-25, recruited from eight Boston-area colleges, with an ED (including current or past history of AN, BN, and BED, using DSM-IV criteria) found no difference in the prevalence of homosexuality or bisexuality compared to a group of 25 healthy male controls.³⁰ Given the small sample size, this study is underpowered to draw meaningful conclusions about the prevalence of homosexuality among men with ED's in the community; this study also does not provide a comparison with females. In the clinical setting, one study of 27 males and 142 females

undergoing inpatient treatment reported a significantly higher prevalence of homosexuality (26%) among males with BN or AN compared to that of all females with BN or AN on the unit (4%).³¹ A similar study of 30 males and 30 females hospitalized for a range of ED's yielded very similar results, with males reporting significantly higher prevalence of homosexuality or bisexuality (23%) than females (3%).³² Another study of 135 males presenting at Massachusetts General Hospital ascertained the sexual orientation of 122 patients and found that 27% reported being homosexual or bisexual, and 32% reported being asexual.³³ The results of these studies become even more striking when compared to the estimated prevalence of homosexuality in healthy adult males (1% - 6%)³⁴ and the estimated prevalence of homosexuality in females with ED's (2%).³⁵

Factors unique to the social experiences of homosexual men may explain these findings. A review by Murray et al. suggests that "co-occurring psychiatric conditions, such as major depression and substance use, related to sexual minority stress may partially explain the overrepresentation of sexual minority males in ED treatment settings."³⁶ Gay culture may also play a role, as it has been proposed that gay males face increased pressure to be physically attractive to conform to a thin ideal body, potentially precipitating ED's in some individuals.²¹ Homosexual men may also be more willing to seek treatment than heterosexual men.³⁰ The true reasons may be a combination of the above and likely vary based on disease severity and medical and psychiatric comorbidities. Overall, the literature suggests that the prevalence of ED's in general may be significantly higher among homosexual males compared to heterosexual males, and this association may not exist among females; however, further research specifically investigating these trends among individuals with AN is needed.

Diet Pills, Diuretics, Laxatives, and Self-Induced Vomiting

In the only study available that specifically addressed methods of weight control other than dietary restriction and exercise in patients with AN, Gueguen et al. included 23 males and 601 females who were hospitalized for AN between January 1988 and July 2004 in Paris, France. They reported no differences between the sexes in: vomiting, rumination, water intake in large quantity, laxative use, diuretic use, diet pill use, tobacco use, alcohol abuse, or drug use.³⁷ As the authors note, this population was severely ill and may not represent the general AN population. Given the paucity of literature comparing these characteristics between males and females, however, this study provides preliminary evidence that males and females with AN may be similar in this regard.

Turning to the broader ED, the results are mixed. Findings from a study of 37 matched pairs of males and females with ED's in a clinical setting agreed with Gueguen et al., finding no difference in the frequency of vomiting, but diet pills and laxatives were more likely to be used by females.³⁸ A smaller but similar study also found increased laxative abuse by females,²² and analysis of a large clinical sample reported that females were more likely than males to present with self-induced vomiting.²⁸

These discrepancies may be explained by age or duration of illness: it is possible that compensatory or weight-control behaviors evolve with age or time as patients experiment with (or gain access to) new methods of weight loss. Of note, the study by Gueguen et al. included patients with the longest duration of illness of those cited in this section, indicating the potential for convergence in compensatory behaviors over time. A second possibility is that the presence of these behaviors is associated with severity of the illness, and behaviors may be added or dropped as severity increases or decreases; there was insufficient information provided by these

studies to examine this possibility. Finally, the discrepancies found among these studies may simply be the result of failure to stratify the analyses by ED type. It is reasonable to suspect that certain compensatory behaviors may be more characteristic of certain ED's, and therefore it is not possible to draw conclusions about AN in particular when the data set includes patients with diagnoses other than AN. If there are indeed behaviors that are significantly more prevalent among non-AN ED's, then conflicting results such as those found here are expected. Overall, preliminary results suggest that methods of weight loss other than dietary restriction and exercise may not differ between males and females with AN, though this finding should be confirmed in larger samples (in particular, samples with more males), at various time points over the course of illness, and among individuals exhibiting various degrees of illness severity.

Psychological Characteristics and Psychiatric Comorbidities

Two studies have examined suicide attempts among individuals with AN. One used various Swedish National Registers and included 2,268,786 individuals born between January 1979 and December 2001, including those from the National Patient Register with ICD codes for ED's. There was a strong association between AN and suicide attempts in both sexes, even after adjustment for comorbid psychiatric disorders, indicating that this increased risk of suicide attempts is not entirely due to other psychiatric comorbidities. Furthermore, the odds of suicide attempts between males and females with AN did not differ significantly.³⁹ However, another, more modest clinical sample found that males with AN were less likely to have a history of suicide attempts compared to females with AN (4% vs. 29%).³⁷ The notably larger sample size of the registry study (453 males and 7680 females vs. 23 males and 601 females) likely played a role in this disagreement. In addition, the registry included all clinics in Sweden, instead of

focusing on those presenting to one particular clinic in Paris. For these reasons, the limited evidence available suggests that the odds of suicide attempts do not differ between the sexes, but further studies should be conducted to confirm this finding in other countries, as cultural factors may influence these findings. No studies were available that compared the rate of completed suicide between males and females with AN. CDC data indicate that, in the United States, males commit suicide at a rate 3.5 times that of women;⁴⁰ future research should investigate whether this pattern persists among those with AN.

Other studies exploring sex differences have focused on personality and psychological characteristics. Although the studies are few in number, a wide variety of assessment instruments have been used, creating a detailed clinical picture outlined in Table 1 below. Two studies also examined Global Severity Index (GSI) scores, part of the SCL-90-R psychopathology evaluation tool, which examines overall psychological distress: one study found lower scores among males, while the other study found similar scores between the sexes.^{37,41}

Table 1: Comparison of Psychological Characteristics between Males and Females with AN.

| Feature | Instrument Used | Definition | Relative Degree in Males with AN (Compared to Females with AN) |
|----------------------|-----------------|---|--|
| Motivation to Change | YBC-EDS | Degree of resistance, insight, and desire for change ⁴³ | No Significant Difference ⁴² |
| Harm Avoidance | TCI/TCI-R | Heritable bias in the inhibition or cessation of behaviors, such as pessimistic worry in anticipation of future problems, passive avoidant behaviors such as fear of uncertainty and shyness of strangers, and rapid fatigability ⁴⁴ | No Significant Difference ^{41,42} |

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| Novelty Seeking | TCI/ TCI-R | Heritable bias in the activation or initiation of behaviors such as frequent exploratory activity in response to novelty, impulsive decision making, extravagance in approach to cues of reward, and quick loss of temper and active avoidance of frustration ⁴⁴ | No Significant Difference ^{41,42} |
| Persistence | TCI/ TCI-R | Perseverance despite frustration and fatigue ⁴⁴ | No Significant Difference ^{41,42} |
| Self-Directedness | TCI/ TCI-R | Self-determination and "willpower," or the ability of an individual to control, regulate, and adapt behavior to fit the situation in accord with individually chosen goals and values ⁴⁵ | No Significant Difference ^{41,42} |
| Self-Transcendence | TCI/ TCI-R | Identification with everything conceived as essential and consequential parts of a unified whole ⁴⁴ | No Significant Difference ^{41,42} |
| Doubts about Actions | MPS | The tendency to feel that projects are not completed to satisfaction ⁴⁶ | No Significant Difference ⁴² |
| Organization | MPS | Emphasis on the importance of and preference for order and organization ⁴⁶ | No Significant Difference ⁴² |
| Personal Standards | MPS | The setting of very high standards and the excessive importance placed on these high standards for self-evaluation ⁴⁶ | No Significant Difference ⁴² |
| State Anxiety | STAI | Anxiety that fluctuates as a function of the stressors on an individual; state anxiety is high in circumstances perceived to be threatening and irrespective of the objective danger ⁴⁷ | No Significant Difference ⁴² |
| Trait Anxiety | STAI | Individual differences in the frequency and intensity with which anxiety manifests itself over time; considered to be a stable personality trait. People who are high in trait anxiety tend to perceive more situations as threatening or dangerous ⁴⁷ | No Significant Difference ⁴² |
| Obsessions | Y-BOCS | Repetitive and persistent thoughts, images, or impulses/urges that are experienced as intrusive, unwanted, and are commonly associated with anxiety. The individual attempts to ignore or suppress obsessions or to neutralize them by performing compulsions ⁴⁸ | No Significant Difference ⁴² |

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| Compulsions | Y-BOCS | Compulsions (or rituals) are repetitive behaviors or mental acts that the individual feels driven to perform in response to an obsession, according to rigid rules, or to achieve a sense of “completeness” ⁴⁸ | No Significant Difference ⁴² |
| Interpersonal Distrust | EDI-2 | Feelings of distrust and alienation concerning close relationships ⁴⁹ | No Significant Difference ⁴¹ |
| Perfectionism | MPS/ EDI-2 | The setting of excessively high personal standards of performance ⁴⁶ | No Significant Difference ^{41,42} |
| Concern over Mistakes | MPS | A subcomponent of perfectionism; negative reactions to mistakes, a tendency to interpret mistakes as equivalent to failure, and a tendency to believe that one will lose the respect of others following failure ⁴⁶ | Significantly Less ⁴² |
| Impulse Regulation | EDI-2 | The tendency toward impulsivity, substance abuse, recklessness, hostility, destructiveness in interpersonal relationships, and self-destructiveness ⁵⁰ | No Significant Difference ⁴¹ |
| Asceticism | EDI-2 | Self-restraint and control of bodily urges ⁴⁹ | No Significant Difference ⁴¹ |
| Social Insecurity | EDI-2 | Tension and disappointment in social relationships ⁴⁹ | No Significant Difference ⁴¹ |
| Depression | SCL-90R | Depressed mood, loss of interest or pleasure in all (or almost all) activities ⁵¹ | No Significant Difference ^{37,41} |
| Hostility | SCL-90R | The tendency to wish to inflict harm on others or the tendency to feel anger toward others ⁵² | No Significant Difference ^{37,41} |
| Phobic Anxiety | SCL-90R | A fear response to moving away from familiar and safe surroundings ⁵³ | No Significant Difference ^{37,41} |
| Paranoid Ideation | SCL-90R | A style of thinking involving a high degree of suspiciousness and projection ⁵³ | No Significant Difference ^{37,41} |
| Psychoticism | SCL-90R | Impairment of mental function to a degree that interferes grossly with insight, ability to meet some ordinary demands of life, or to maintain adequate contact with reality ⁵¹ | No Significant Difference ^{37,41} |
| Cooperativeness | TCI/ TCI-R | Aspects of character related to agreeability vs self-centered aggression and hostility ⁴⁴ | Disagreement: Significantly Less ⁴² or No Significant Difference ⁴¹ |

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| Reward Dependence | TCI/ TCI-R | Heritable bias in the maintenance or continuation of ongoing behaviors, and is manifest as sentimentality, social attachment, and dependence on approval of others ⁴⁴ | Disagreement: Significantly Less ⁴² or No Significant Difference ⁴¹ |
| Anxiety | SCL-90R | Apprehension, tension, or uneasiness that stems from the anticipation of danger, which may be internal or external ⁵¹ | Disagreement: Significantly Less ³⁷ or No Significant Difference ⁴¹ |
| Interpersonal Sensitivity | SCL-90R | Suspiciousness, undue social anxiety or hypersensitivity to criticism, and ideas of reference ⁵⁴ | Disagreement: Significantly Less ³⁷ or No Significant Difference ⁴¹ |
| Somatization | SCL-90R | The expression of personal and social distress in an idiom of bodily complaints with medical help seeking ⁵⁵ | Disagreement: Significantly Less ³⁷ or No Significant Difference ⁴¹ |

YBC-EDS: Yale-Brown-Cornell Eating Disorder Scale; TCI: Temperament and Character Inventory; TCI-R: Temperament and Character Inventory-Revised; MPS: Multidimensional Perfectionism Scale; STAI: State-Trait Anxiety Inventory; Y-BOCS: Yale-Brown Obsessive Compulsive Scale; EDI-2: Eating Disorder Inventory-2; SCL-90R: Hopkins Symptom Check List-90R

These data suggest that males and females with AN are overwhelmingly similar from a psychological standpoint. Unfortunately, the studies that have been conducted so far have suffered from extremely small sample sizes (between 10 and 23 males), especially after stratification by ED category,^{37,41,42} and further research with larger samples is necessary to confirm these initial findings.

Medical Features and Survival

Amenorrhea is a common medical consequence of weight loss among females with AN, and the DSM-IV identified amenorrhea as a required criterion for postmenarcheal females.^{56,57} Unfortunately, among males, there is no comparable physiological “signal” for medically significant weight loss that can be identified via patient report or without blood tests,⁵⁷ so a

thorough understanding of the common medical presentation of males with AN is useful for clinical detection of the disorder. Males with AN begin weight loss with a lower proportion of reserve body fat to lean muscle mass, inducing ketosis and protein breakdown earlier in the weight loss process, compared to females with AN. Testosterone declines proportionately to weight loss, and testicular examination will often reveal testes that are small.⁵⁷ Low bone mineral density is a common finding in both males and females with AN, but there is evidence that males with AN present with lower bone mineral density than females with AN.⁵⁸ Elevated liver enzymes is also common among individuals with AN, though males tend to present with this condition more commonly than females.⁵⁹ This condition is not entirely understood but is believed to occur due to liver hypoperfusion, hepatocyte autophagy secondary to starvation, or fat deposition in the liver during weight restoration.⁶⁰⁻⁶³ Long-term survival does not seem to differ between males and females with AN; however, men seem to have lower short-term (3-year) survival, suggesting that men die sooner after hospitalization. Potential explanations for this finding include men dropping out of treatment at a more acute stage of illness than women, or men may find less social support than women outside of intensive treatment settings.³⁷ Men may also be prone to lower short-term survival because, as discussed previously, males with AN begin weight loss with lower fat reserves⁵⁷ and may experience the health consequences of protein breakdown sooner than females.

Little else is known about differences in medical complications between the sexes in AN because much of the literature has not delineated by ED diagnosis. One study found no difference between males and females with ED's in the prevalence of bradycardia, hypotension, hypothermia, and poor peripheral perfusion, but diagnoses included unspecified feeding or eating disorder (UFED), AN, atypical AN, BN, purging disorder, and BED.²⁸ Given the differences in

behaviors among the various types of ED's, it is not reasonable to assume that the medical characteristics of these groups are similar. The biochemical and medical consequences of long-term restriction and underweight may be vastly different, compared to other ED's.

Overall, the literature suggests that males and females with AN are very similar in their medical presentation, although short-term survival seems to be poorer among males. Future research should explore the root causes of this disparity in survival: if the underlying reasons are not strictly medical, then there is hope that short-term survival may improve with the provision of more intensive or effective outpatient support for males.

Age of Onset

The literature concerning sex differences in the age of onset in AN is inconsistent. A study by Zerwas et al. drawing from the Danish Civil Registration System and the Danish National Patient Register included 2,136 females and 188 males with AN, including those with atypical AN. In this study, the peak age of incidence was younger in males (13 years) than in females (16 years).⁶⁴ An even larger study by Javaras et al. using the complete Swedish 1979 – 2001 birth cohort identified 7,715 cases of incident AN in females and 459 cases of incident AN in males. In close alignment with Zerwas et al., incidence among males peaked at 12 – 17 years of age, while incidence among females peaked at 15 years of age.⁶⁵ Studies of smaller samples from individual treatment centers do not support these findings, however. Gueguen et al.'s 2012 study (23 males, 601 females hospitalized for AN in Paris) found that males were significantly *older* at age of onset (20.8 years vs. 18.1 years in females);³⁷ Sharp et al.'s 1994 study of 24 males and 25 females with AN at Royal Edinburgh Hospital found no significant difference in age of onset between the sexes (18.6 years for males, 17.5 years for females).²²

Differences in study design almost certainly play a role in the disparities between registry studies and center-based studies. In particular, it is unlikely that the patient population at any one treatment center is a representative sample. Given that treatment centers are all located within their own local “treatment networks,” there are likely differences among treatment centers in the characteristics of the typical patient cared for at each facility. For example, if an inpatient treatment center is located within a local network of many strong outpatient facilities and support programs, that location may receive referrals for a limited number of relatively serious cases that have been resistant to multiple instances of successively more intensive outpatient support—and it is quite possible that severity or resistance to treatment is associated with age of onset. On the other hand, if an inpatient treatment center is not closely connected to local outpatient facilities (or is in an area devoid of other treatment options), the age distribution in these facilities may be more representative of the underlying population of individuals with AN, as the facility would have a monopoly of sorts on ED treatment. If this hypothesis is true, representativeness of patient samples may be influenced by treatment facility interconnectedness, which is not easily assessed.

Given this potential explanation for disparities in the literature, and given the sample sizes, the findings from the registry studies of Zerwas et al. and Javaras et al. are the most compelling, as the ICD-10 diagnoses could have been made at any type of medical facility throughout the respective countries rather than at one particular facility. These studies do have one major limitation, however. The detection of ED’s may vary among various healthcare systems worldwide, which would likely influence data concerning age of onset. Despite the use of common ICD-10 codes, reliable detection by physicians who can make the diagnosis is still required. Follow-up studies should therefore confirm the findings of Zerwas et al. and Javaras et al. in the United States.

The gradual evolution of diagnostic criteria is also likely to have influenced literature on age of onset, as recent revisions to the DSM have either altered the criteria or the language used to describe the criteria.^{12,51,66} In the most recent edition, the DSM-5, the weight loss criterion was modified, fear of weight gain no longer has to be explicitly verbalized if observable behaviors interfering with weight gain are noted, and amenorrhea among postmenarcheal females is no longer a criterion.¹² Because of these changes, Mustelin et al. found that the revised criteria increased AN's prevalence by 60% among community-based young adult women, and new DSM-5 AN cases among females had a significantly later age of onset (18.8 years) compared to DSM-IV AN cases (16.5 years).⁶⁷ Although it is unclear whether changes this drastic have occurred with previous revisions, this data indicate that research on age of onset is particularly challenging due to the fluid nature of the diagnostic criteria. Given that studies on age of onset have used various editions of the DSM for their diagnostic criteria, the disagreements seen in this review are not surprising, and extreme caution should be taken when interpreting the results. Of note, both registry studies discussed above used DSM-IV criteria.^{64,65} Follow-up studies using the DSM-5 criteria should be performed to clarify the literature related to age of onset in AN.

Weight Status and Weight History

Given that AN severity is based on BMI at presentation in the DSM-5,¹² literature comparing males and females' weight status upon presentation to treatment is important to assess the relative severity at which each sex presents. Among adolescents, males and females seem to present at a similar weight status: two studies, each including about 50 adolescent males, found no differences in either percent median body weight⁶⁸ or BMI Z-score⁶⁹ at presentation. Among adults, the results are inconsistent; a study of 62 males and 751 females with AN in a clinical

setting found no difference in mean BMI at presentation,⁷⁰ while another study of 23 males and 601 females hospitalized for AN found that males had a significantly higher BMI at presentation.³⁷ This difference may be due to detection. A male with AN presenting to treatment at a significantly higher BMI than a comparable female may not always have a milder case of AN; rather, signs and symptoms may have been detected sooner by friends, family, or a physician, allowing for intervention at an earlier stage.

Weight history over the course of illness is also critical knowledge for those treating or assessing the severity of AN, as it provides information about an individual's baseline weight before restriction began and allows one to quantify the extent of weight loss and set weight goals. Research suggests that males with AN are more likely than females with AN to have had a history of overweight or obesity before the onset of their illness.^{37,69} Studies examining differences in lifetime maximum and minimum BMI disagree. However, the disagreement may be easily explained. The only study found to report higher lifetime maximum and minimum BMI in males with AN compared to females with AN examined BMI in isolation, without adjustment for differences in the underlying population;³⁷ in their discussion, the authors referenced data suggesting that males in their underlying population did indeed have higher BMI's. Other studies have employed methods such as standard deviation scores and mean matched population weights to account for disparities in the underlying population and have found no differences in lifetime minimum or maximum BMI between males and females.^{69,70}

Overall, literature concerning weight at presentation is inconsistent, potentially owing to disparities in the detection of AN between males and females. Until disparities in detection are addressed, consistent findings in this area are unlikely. After controlling for underlying differences in BMI between the sexes by using measures of relative BMI, males and females

with AN do not seem to differ in terms of their lifetime weight extremes. Interpretation of the finding of increased premorbid overweight or obesity in males with AN is difficult; the key question is whether this finding truly represents increased risk of developing AN among overweight or obese males. If males in the underlying populations studied have higher average BMI's than females, and if the risk of developing AN is not associated with premorbid weight status, then finding increased premorbid overweight and obesity among males with AN is to be expected simply due to the greater proportion of males than females being classified as overweight or obese. However, this finding would also be expected if premorbid overweight and obesity are particularly strong risk factors for AN in males and not females: in that case, even in a population with identical BMI distributions in males and females, males with AN would still display significantly greater rates of premorbid overweight and obesity due to the elevated risk experienced by those males who were overweight or obese. This possibility is discussed further in the next section. Future studies examining differences in premorbid overweight and obesity should consider the BMI distribution of the background population when interpreting results in order to assess the possibility that these findings are related to differences in the BMI distribution between the sexes.

Precipitating Events, Reasons for Dieting, and Risk Factors

One area of interest in risk factor research is weight-related teasing. A case series of 13 men with AN whose mean weight before the onset of their illness was 114% of a matched population mean revealed that these men had been particularly sensitive about their overweight and were often teased about their weight.⁷¹ A male drive to avoid teasing related to body weight is a common observation in the literature, being reported even as far away as Iraq,⁷²⁻⁷⁵ suggesting

that males who are sensitive about their overweight status are at risk for the development of AN in the face of teasing. Given the greater prevalence of premorbid overweight among males with AN than females with AN, teasing may be a particularly salient risk factor for overweight males. It should be noted, however, that teasing or weight comments have also been identified as proximal triggers for AN in females.⁷⁶ It may be the case that males become the subject of teasing after surpassing a higher weight threshold compared to females. The literature indeed supports this notion, as it is widely accepted that females live in a culture that values thinness.⁷⁷ As a result, females may fall subject to comments about their weight before reaching true overweight status, decreasing the prevalence of premorbid overweight or obesity among females. Given the retrospective nature of these studies, however, prospective research is required to ascertain weight status at the time of teasing in order to confirm this hypothesis.

Males with AN may also restrict dietary intake in pursuit of a lean physique, in order to appear more visibly muscular. In fact, even adolescent males with AN have reported a desire to have a “six-pack.”³⁶ Studies have indeed shown that exposure to messages suggesting a muscular male ideal physique negatively impacts male body image.⁷⁸ Thus, in contrast to the thin female ideal body, AN in some males may be the result of pressure to conform to a muscular ideal. Familial pressure to lose weight has also been proposed as a risk factor for both male and female adolescents; however, these studies identified dieting behavior, body dissatisfaction, and bulimic symptoms as the outcomes—not the incidence of an ED.⁷⁹ These methodological limitations seem to permeate most, if not all of the literature related to risk factors and precipitating events for ED’s. A considerable amount of research has examined risk factors for body dissatisfaction, dieting, negative affect, and disordered eating behaviors,⁸⁰ but focusing on these outcomes is distinctly different than examining risk factors that preceded the onset of diagnosable AN.

Furthermore, as Striegel-Moore and Bulik note, “Entire classes of risk factors (e.g. personality, family environment factors) have not yet been studied prospectively.”⁷⁷ The study of risk factors for AN is critical to understanding the etiology, developing prevention interventions, and identifying effective treatments; however, a degree of temporality and causality has to be ascertained, which is not possible with the current reliance on cross-sectional and retrospective studies. Large prospective studies with detailed data collection related to AN are critical to the advancement of research related to risk factors for AN in males and females. Population registries are likely the most economical choice, as sample sizes “in the tens of thousands” will be required to ensure adequate statistical power.⁷⁷ In summary, teasing and other forms of social pressure may be involved in the development of AN in both males and females; however, in the absence of longitudinal studies, current hypotheses are unable to identify the risk factors that are particularly salient for each sex.

Body Image and Muscle Dysmorphia

Evidence continues to grow that societal ideal body norms influence body image, and these norms seem to be affecting males and females in different ways. A 1997 study of 43 male and 69 female university students utilized the Eating Attitudes Test (EAT) and a set of drawn figures (9 men and 9 women of varying body shapes) to assess perceived current and ideal body shapes.⁸¹ In this study, women with both low and high EAT scores wanted to be thinner than they perceived themselves to be; furthermore, women with high EAT scores (indicating greater disordered eating behaviors) wanted to be thinner than what they believed men found attractive. Importantly, these results were true regardless of the female’s weight status. No men met the threshold for high EAT scores, so data were not stratified by EAT results in males. Males were

more nuanced in their weight preference, however. Overweight males desired to be thinner, while normal weight males desired to be heavier. Although the authors do not provide a written definition of “heavier,” and the diagrams presented to participants did not have textual descriptions of the figures, the diagrams shown to participants were included in the publication. After reviewing these figures, it is conceivable that the “heavier” male figures were perceived as also being more muscular, rather than strictly more adipose. Consistent with these results, a significant number of males underestimated their weight status, while a significant number of females overestimated their weight status.

The results of this study are aligned with considerable literature indicating that both males and females are susceptible to societal body norms, with males (even those as young as six years old) expressing a desire for greater muscularity⁸² and women endorsing pressure to pursue thinness.³⁶ As discussed earlier, further work needs to be done in order to investigate to what degree these social messages are to blame for the incidence of ED’s, but these same body image-related ideals have been identified in those with ED’s,³⁶ indicating that the social pressures felt by those both with and without ED’s are similar, if not identical. Although there is evidence to suggest that adolescent males with ED’s are less concerned about their body shape and weight than adolescent females, some instruments used to assess ED symptoms, such as the Eating Disorder Examination (EDE), are only sensitive to beliefs that an individual’s weight is too high or their shape is too large, rather than vice-versa.²⁸ Given the findings discussed above, the instruments currently available and widely used to assess ED’s may not be sensitive or specific enough to the male perspective.^{9,68,83}

The clinical extreme of males’ drive for muscularity is represented by a subtype of body dysmorphic disorder known as muscle dysmorphia (MD), which “represents the pathological

pursuit of muscularity.”³⁶ MD was originally conceptualized as “reverse anorexia” and was identified in a study of 108 male body builders in 1993.⁸⁴ The central feature of the condition is a belief that one is too small and skinny, with a desire for a larger and more muscular body,⁸⁵ consistent with the societal ideal body norms expressed by males in the community. Importantly, this belief translates to “anorectic” behaviors in MD, but in pursuit of the reverse outcome of that typically expected in AN.⁸⁴ Individuals with MD exercise and lift weights excessively (with “excessive” indicating that it is associated with clinically significant distress and/or functional impairment), frequently avoid social situations, avoid being seen partially undressed in front of others, wear heavy clothes even during the heat of summer out of fear of being perceived as too small, engage in body checking, and allow their exercise and dietary regimens to interfere with interpersonal relationships.^{36,84-90} In fact, the rigidity of self-imposed rules surrounding activity and eating, as well as the responses to interruptions in these habits, are strikingly similar to those expressed by individuals with AN.^{84,85} Rules related to dietary composition generally dictate diets that are high in protein and low in fat, with carefully monitored caloric intake.⁸⁸ Feelings of guilt, anxiety, and distress can follow if these rules are not adhered to. Similar to purging, additional workouts are used as a form of compensation when dietary rules are broken.^{88,91} Prevalence estimates vary widely but may be comparable to the rate of AN in women, implicating millions of men.⁹²

Given the presence of both body image distortion and disordered eating behaviors, a nosological debate exists related to the proper classification of MD. Since 1997, MD has been classified as a subtype of body dysmorphic disorder rather than an ED, under the assumption that disordered eating behaviors are secondary to a primary disturbance in body image.^{88,89} This debate is important, as it directly influences the perspective with which the disordered eating

behaviors of MD are viewed—namely, whether or not MD is the “male analogue” of ED’s in females,³⁶ given its “reverse anorectic” features and suspected rarity among females.⁹³ As the debate over proper classification continues, compelling arguments exist for MD’s reconceptualization as an ED: research has also shown that MD symptomatology may escalate as a result of variations in eating practices alone, independent of exercise status;⁹⁴ furthermore, rigid exercise regimens and a drive for muscularity are not pathological, per se, and it is argued that the additional presence of disordered eating behaviors tip the balance toward pathology.^{85,95} Even the original study identifying MD found that three (2.8%) of the participants reported a past history of AN,⁸⁴ and another study found that as many as 29% of men with MD may have a history of AN, BN, or BED⁸⁶—both far higher than the estimated prevalence of roughly 0.3% for AN, 0.5% for BN, and 2.0% for BED among men¹, suggesting that diagnostic crossover may be common.⁸⁷

Taken together, these data and observations create a strong case for further investigation of the appropriateness of classifying MD as an ED. Given strong initial findings about the similarities between MD and AN, further research must now objectively determine where the boundary lies between the two disorders in order to examine how distinct MD pathology is from AN. Two powerful methods that have been used to examine underlying ED pathology are latent class analysis (LCA) and latent profile analysis (LPA), which divide a given population into diagnostic groups based on responses to questions about symptoms.⁹⁶ The inclusion of MD and use of LCA and LPA in studies of individuals with ED’s would provide a new objective perspective that is critical to the ongoing nosological debate.

Despite the fact that LCA and LPA have already been used to critically examine existing and historical ED diagnostic criteria,⁹⁶⁻⁹⁹ no studies could be found that incorporated individuals

with MD. An insufficient understanding of MD is likely underlying this absence from the literature: the proposed diagnostic criteria for MD have not changed since 1997,^{36,88} and the clinical utility of these criteria has been questioned¹⁰⁰; furthermore, few data have been collected on individuals meeting the proposed diagnostic threshold for MD, as most studies have relied on non-clinical convenience (e.g., college) samples.³⁶ Without a strong understanding of clinical MD, effective and valid diagnostic tools cannot be created, and without these tools, MD cannot be compared alongside AN and other ED's using LCA and LPA. In summary, while societal ideal body norms seem to pressure females toward thinness, male ideals tend to push males toward muscularity, and MD seems to represent a situation in which this drive precipitates disordered eating behavior and excessive exercise, in such a manner that the underlying pathology appears strikingly similar to AN. A more complete understanding of MD is necessary in order to objectively determine whether these similarities represent a true AN subtype.

Conclusion

The literature related to the differences in the presentation of AN between males and females is largely inconclusive. Although preliminary evidence suggests that males and females with AN may be similar in many respects, much of the literature is burdened by methodological inconsistencies. For instance, the gradual evolution of the DSM criteria, while necessary for nosological accuracy, makes interpretation of literature based on historical criteria difficult. Given the findings of Mustelin et al.,⁶⁷ it is difficult to assert that the historical populations of individuals with AN under the DSM-III or DSM-IV criteria were not significantly different from the population of individuals with AN under the current DSM-5 criteria. Even in the absence of other methodological inconsistencies, this factor alone impacts most of the literature discussed in

this review. Other common methodological issues include the inability to control for varying patient severity levels between studies, a lack of consensus on terms such as “excessive exercise,” and small sample sizes (particularly in males).

A second major barrier is the predominance of studies that do not examine each ED individually, instead presenting analyses with multiple diagnoses included. Despite rates of diagnostic crossover from AN to BN as high as 50%,¹⁰¹⁻¹⁰³ a seven-year longitudinal study found markedly different crossover behavior for those with an initial diagnosis of AN versus those with an initial diagnosis of BN, supporting the diagnostic distinction between the two disorders.¹⁰⁴ However, the mechanisms underlying these diagnostic crossovers are poorly understood, and crossover patterns may serve as prognostic indicators.¹⁰⁵ Therefore, ED research should clarify its focus, investigating each ED individually as well as patterns of diagnostic crossover, unless future studies (e.g., genetic studies) can demonstrate that the disorders are similar enough to merit amalgamation.

Finally, AN research would benefit from a shift to prospective research designs. Although the relative rarity of AN poses obvious challenges to this method, every topic mentioned in this review would benefit from the inclusion of prospective research. From providing the ability to define currently ambiguous terms such as “excessive exercise” in terms of one’s baseline to providing researchers with definitive answers related to age of onset and risk factors, prospective data have the potential to fill in many of the gaps in the literature. Data sets such as the Avon Longitudinal Study of Parents and Children (ALSPAC) and the Norwegian Mother and Child Cohort Study (MoBa) are already available.^{106,107} These data may provide valuable insight into how the experiences of males and females with AN differ, as well as offer

clues about cutting-edge treatments that can be tailored to individuals' personal experiences with AN.

The release of the DSM-5 criteria represents an important transition point for ED research, and future studies can improve methodologically on the work done in previous decades. Priorities for future research should include standardization of terms, clarified focus on specific ED's or diagnostic trajectories, and prospective designs in order to fill current knowledge gaps and develop a deeper understanding of the differences in the presentation of AN between males and females.

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