women

MDPI

Review

Beyond Drive for Thinness: Drive for Leanness in Anorexia Nervosa Prevention and Recovery

Ronald B. Brown

School of Public Health Sciences, University of Waterloo, Waterloo, ON N2L 3G1, Canada; r26brown@uwaterloo.ca

Abstract: Anorexia nervosa is classified by the American Psychological Association as an eating-related mental disorder, which affects mostly young adult women and adolescent girls. Although refeeding programs are often used to recover bodyweight in patients with anorexia nervosa, treatment failures are high, and the determinants of the disorder remain unknown. The present paper uses a nutritional epidemiology perspective to examine determinants of anorexia nervosa from the patients' point of view. A grounded-theory literature-review method was used to search and review research findings from the peer-reviewed literature related to the etiology of anorexia nervosa, including recent qualitative interviews with patients. Unlike a systematic review, a grounded theory method is more appropriate for developing a new theory to explain phenomena like the cause, recovery, and prevention of anorexia nervosa. Reviewed research suggests that anorexia nervosa may be a problematic body-change strategy rather than a mental disorder. Additionally, the present paper proposes that replacing the drive for thinness in anorexia nervosa with a drive for leanness may help patient recovery, especially when guided by easily accessible body-composition estimates. Fat-free mass restoration in the recovery of anorexia nervosa may also be facilitated by resistance training, which improves patients' psychological status and body composition. Additionally, replacing a dysfunctional dieting strategy in anorexia nervosa with knowledge, skills, and experience in proper weight management has a potential preventive effect against the disorder. More research is needed to investigate the applied effects of the drive for leanness, body-composition assessments, resistance-training programs, and weight-management skills associated with the recovery and prevention of anorexia nervosa. Furthermore, successful application of the information in this paper may be adapted to peer role model programs to prevent anorexia nervosa.

Keywords: anorexia nervosa; eating disorders; drive for thinness; drive for leanness; body composition; fat mass; fat-free mass; weight management; refeeding; resistance training

check for updates

Citation: Brown, R.B. Beyond Drive for Thinness: Drive for Leanness in Anorexia Nervosa Prevention and Recovery. *Women* **2024**, *4*, 529–540. https://doi.org/10.3390/women4040039

Academic Editor: Richard B. Kreider

Received: 29 October 2024
Revised: 19 November 2024
Accepted: 3 December 2024
Published: 9 December 2024

Copyright: © 2024 by the author. Licensee MDPI, Basel, Switzerland. This article is an open access article distributed under the terms and conditions of the Creative Commons Attribution (CC BY) license (https://creativecommons.org/licenses/by/4.0/).

1. Introduction

Anorexia nervosa (AN) is among the deadliest diagnosed psychiatric disorders [1]. AN and other eating disorders affect people of all ages and genders, but the individuals most affected are females between 12 and 35 years of age. Feeding and eating disorders are described in the fifth edition of the Diagnostic and Statistical Manual of Mental Disorders (DSM-5), published in 2013 by the American Psychiatric Association [2]. The DSM-5 attributes most of the signs and symptoms of AN to starvation. "Approximately 20% of patients with AN develop a severe and protracted illness" [3]. AN remission rates are low, and mortality risk is high "despite evidence-based treatments" [4]; moreover, the etiology of the condition is unknown [5]. The DSM-5 diagnostic criteria for AN are defined in Table 1. Additionally, the DSM-5 uses the Body Mass Index (BMI), which calculates weight in kilograms divided by height in meters squared (kg/m^2), to categorize the severity of cases in AN as follows: mild $\geq$ 17.0, moderate 16–16.99, severe 15–15.99, and extreme < 15 [2].

Table 1. DSM-5 diagnostic criteria for AN.

A.	"Restriction of energy intake relative to requirements, leading to a significantly low bodyweight in the context of age, sex, developmental trajectory, and physical health. Significantly low weight is defined as a weight that is less than minimally normal or, for children and adolescents, less than that minimally expected."
B.	"Intense fear of gaining weight or of becoming fat, or persistent behavior that interferes with weight gain, even though at a significantly low weight."
C.	"Disturbance in the way in which one's bodyweight or shape is experienced, undue influence of bodyweight or shape on self-evaluation, or persistent lack of recognition of the seriousness of the current low bodyweight."

Drive for thinness (DT), which Krug et al. noted is a "cardinal feature" of eating disorders [6], is currently measured on a scale contained within the Eating Disorder Inventory-3 [7]. According to Garner, "The 7 items on this scale assess an extreme desire to be thinner, concern with dieting, preoccupation with weight and an intense fear of weight gain" [8]. Krug et al. suggested that DT is more clinically meaningful as an eating disorder severity indicator than BMI cited in the DSM-5. However, neither the scope of DSM-5 criteria nor DT extends beyond assessing total bodyweight in AN, and both resources overlook specific body-composition components such as fat mass (FM) and fat-free mass (FFM).

FFM is "the estimated mass of all nonfat molecules in the body" [9], e.g., nonfat portions of muscle, bone, organs, connective tissue, fluids, etc. "The assessment of body composition (FFM and FM) plays a key role in evaluating nutritional status in AN" [10]. Patients with AN "are depleted not only in FM but also in FFM" [11]. By comparison, a healthy level of FFM combined with a low level of FM is associated with a desirable "trim military appearance" [12], and most elite athletes have low levels of FM [13]. Low FM in healthy individuals implies that the depletion of FFM is the more likely determinant of starvation and emaciation in patients with AN.

The present paper addresses the knowledge gap in AN etiology using a nutritional epidemiology approach. Epidemiology is generally defined as "the study of the distribution and determinants of health-related states or events in specified populations, and the application of this study to control of health problems" [14]. Nutritional epidemiology focuses on dietary and nutritional risk factors of disease within a population [15]. For example, dieting is a risk factor associated with the development of eating disorders [16], as seen in the association of overly restrictive dietary intake in AN. This paper further proposes that dietary habits that maintain a healthy level of FFM associated with a lean appearance could address a central determinant of AN and provide the basis for prevention of the condition within the population. The paper looks at refeeding programs used in AN recovery, and discusses the limitations of these treatments. Female body ideals and the drive for leanness in AN are then discussed, followed by a section on body-composition estimates with equations to estimate FM and FFM. The paper concludes with a section on physical activity and weight-management programs for AN. Based on an analysis of the reviewed evidence, the paper suggests use of the drive for leanness scale [17] fat-free mass index [18], and body-composition equations [19] as potentially valuable intervention tools for individual AN recovery and prevention.

2. Materials and Methods

A grounded-theory literature-review method [20] was used in the present paper to select and compare findings relevant to AN etiology, including diet, exercise, and refeeding in AN, DT, FM, FFM, drive for leanness, and equations for body-composition estimates. Sources in the present paper were located online by keyword searches of PubMed, Google, and Google Scholar. The grounded-theory literature-review method uses findings from the research literature as data for comparative analysis and new knowledge synthesis, and new information was synthesized in this paper related to AN etiology. Unlike a systematic review, a grounded theory method is more appropriate for developing a new evidence-

based theory to explain and offer novel insights about phenomena like the cause, recovery, and prevention of anorexia nervosa.

Grounded theory was originally discovered in 1967 by sociologists Glaser and Strauss as a method to bring rigor and objectivity to qualitative research, although the method can also be used for quantitative research [21]. In the conventional method of grounded theory, the researcher collects original data directly from study participants, as in interviews. However, data in the grounded-theory literature-review method are the research findings as they appear in the research literature. In both methods, the grounded theory researcher starts with a clean slate and removes all assumptions and subjective views of the research subject. Grounded theory uses induction to build up a theory grounded in a review and analysis of scientific facts. Unlike a systematic review, all relevant and reliable scientific facts are selected in a grounded-theory literature-review method, regardless of the sources, dates, and quantity of information. Through comparative analysis, data is placed in categories and categories are formed into themes as a grounded theory begins to emerge. Gaps in the theory are filled in during an iterative process of collecting and analyzing additional information until the point of theoretical saturation is reached, where no new knowledge is gained from additional selection and analysis of data. The fully developed grounded theory is then presented in a narrative review, and may introduce new insights and proposals to guide future research.

3. Refeeding Programs and AN Recovery

Refeeding programs restore healthy weight and nutritional status in patients with AN; however, "current refeeding practices are still based mainly on clinical expertise rather than on randomized control trials" [22]. A 2017 systematic review of treatments for AN found that "there are almost as many definitions of relapse, remission, and recovery as there are studies of them" [23]. Additionally, a limitation of refeeding programs is that they temporarily treat the symptoms of disordered eating without fully addressing underlying determinants of disordered eating behaviors.

Although AN patients can be successfully treated with a refeeding program, "clearly, this does not necessarily mean a lasting change of mind set in these patients" [24], and "rehospitalization is common, mostly due to symptoms' persistence after discharge" [22]. For example, celebrity singer Karen Carpenter's death in 1983 was reported to be related to ipecac ingestion soon after being discharged from a hospital following weight restoration [25,26]. Ms. Carpenter's high-profile case emphasizes the critical need to address underlying determinants in patients with eating disorders.

A questionnaire administered to a small group of former and current patients with AN reported that only 25% of respondents felt that treatment providers listened to and understood patients' concerns about the treatment they received [27]. Medical schools provide little formal training in eating disorders [28], and primary care practitioners lack the skills to manage eating disorder patients [29]. Commenting on severe and enduring anorexia that is refractory to treatment, Gutiérrez and Carrera said, "Repeated treatment failures prompt one to consider the possibility that the current conceptualization of AN may be misleading" [30].

A 2023 qualitative study of AN patients' attitudes toward weight restoration and recovery, conducted by Boston College sociology researchers Barko and Moorman [31], summarized patients' responses that AN is not "solely or even primarily about low weight". The researchers wrote the following:

> "Respondents reiterated again and again the importance of the mental components of AN in recovery, which they believe are underappreciated through hyper-focus on the body."

More research is needed to improve AN recovery from the patients' perspective, especially regarding the mental perceptions, motivation, and strategy of action that drives AN behavior.

4. Female Body Ideals and Drive for Leanness

In her 1996 book, Am I thin enough yet?: the cult of thinness and the commercialization of identity, Boston College sociologist Hesse-Biber concluded from interviews with women that "disorderly eating is not a sign of psychopathology, but a strategy that is a 'normal' part of the female existence" [32]. Accordingly, a disordered eating strategy to attain a thin ideal body promoted to women by societal pressures becomes dysfunctional if it leads to deteriorating physical and mental health and lower social well-being.

Ironically, thinness alone may no longer be sufficient as a female body ideal. In a 2018 study, Thin is in? Think again. The rising importance of muscularity in the thin ideal female body, Bozsik et al. reported that women prefer images of thin women with muscularity and a "toned" body [33]. The researchers' findings imply that the ideal woman's body has low levels of FM along with higher levels of FFM, which add shape and tone. Thus, the concept of leanness (a higher proportion of FFM relative to low FM) enters the discussion on female body ideals and challenges DT.

Earlier in 2008, in their research on drive for leanness, Smolak and Murnen wrote:

> "'Drive for Leanness' refers to a motivating interest in having relatively low body fat and toned, physically fit muscles. The desire for limited body fat is not the equivalent of wanting to be thin [17]."

Interestingly, Smolak and Murnen mentioned "problematic body change strategies" that may be associated with drive for leanness (DL), similar to Hess-Biber's comment about disorderly eating as a strategy rather than a sign of psychopathology. Smolak and Murnen developed a valid and reliable scale to measure DL. The original drive for leanness scale (DLS) consisted of 10 questionnaire items, which were later finalized to the 6 items shown in Table 2.

Table 2. Drive for leanness scale [17].

Drive for Leanness Scale
1. I think the best-looking bodies are well-toned.
2. When a person's body is hard and firm, it says they are well-disciplined.
3. My goal is to have well-toned muscles.
4. Athletic-looking people are the most attractive people.
5. It is important to have well-defined abs.
6. People with well-toned muscles look good in clothes.

Years later, in 2020, Lang and Rancourt suggested that DL "may have protective effects against the development of eating disorders and associated behaviors" [34]. The researchers found that fewer "maladaptive outcomes" are associated with DL compared with DT or drive for muscularity, and that DL "may promote compliance with more balanced exercise and eating behaviors." The researchers further suggested the inclusion of DL in treatment programs for eating disorders. Nevertheless, the present author is unaware of DL clinical assessments in AN patients. The present paper proposes that AN patients who test high on the DLS may benefit from instruction to recover, maintain, or develop adequate levels of FFM, thereby attenuating drive for thinness and eliminating risk of harm from insufficient bodyweight.

5. Body-Composition Estimates

People with AN, like other people on a diet, have no way of recognizing the type of bodyweight they are losing by simply looking in a mirror or stepping on a scale—are they losing body fat or muscle? People also have no way of sensing whether regained bodyweight is muscle or fat. Most people rely only on their weight and the thinness of their body to assess their dieting results. Dieting is a difficult challenge that requires discipline, and dieting for self-improvement appeals to the perfectionist nature of people with AN [35] who may feel that thinner is better. Consequently, individuals with AN are often proud

of their dramatic weight loss which they view as a laudable accomplishment [36], and they are often inclined to reject treatment [37], even though their problematic body-change strategy is undermining their health and quality of life.

"Intense fear of gaining weight" and "persistent behavior that interferes with weight gain" in AN (Table 1, B.) implies that a rebound of lost weight is immediately resisted, even if the regained weight includes the replenishment of depleted muscle mass, potentially driving the affected individual deeper into the disorder. Furthermore, losing muscle mass counteracts progress toward the intended goals of people with a high DL who desire low body fat and a firm and attractive body with well-toned muscle. A potential solution to the dysfunctional AN strategy is to provide individuals with easily accessible tools for estimating changes in body composition, FFM and FM levels, to guide modifications of diet and exercise behavior.

In 1975, the Young Men's Christian Association (YMCA) published The Official YMCA Fitness Handbook which contains a simple equation using bodyweight and waist circumference (WC) to estimate body fat in young and middle-aged men [38]. WC is calculated with a tape measure held horizontally just below the navel. The YMCA equation was derived from research by Wilmore and Behnke at the University of California, Berkeley in 1969 [39], and the Berkeley researchers developed similar body-composition equations for women in 1970 [40]. YMCA equations for both genders have been incorporated into estimated total body fat (eTBF) [41], a non-traditional "surrogate for total body fat" which has been strongly correlated with total body fat measured by dual X-ray absorptiometry (DXA) [19].

As shown below, YMCA equations for men and women estimate lean bodyweight (LBW) [38]. Also known as lean body mass, LBW is similar to FFM, except that LBW includes small amounts of essential body fat in the bone marrow, nerves, and cell membranes [42,43]. "Minimum healthy essential body fat values are 3–5% in men and 10–12% in women" [44]. Non-essential body fat is known as storage fat, and FM includes both storage and essential body fat [45]. Because women generally have less skeletal muscle mass than men, a woman's proportion or percentage of FM relative to her bodyweight is higher than a man's percentage of FM. The eTBF equations for men and women shown below estimate percentage body fat (%BF), which is FM divided by bodyweight [41].

$$\text{YMCA: Men's LBW (lbs.)} = 1.082 \times \text{bodyweight} - 4.15 \times \text{WC (in.)} + 98.42 \quad (1)$$

$$\text{YMCA: Women's LBW (lbs.)} = 1.082 \times \text{bodyweight} - 4.15 \times \text{WC (in.)} + 76.76 \quad (2)$$

$$\text{eTBF: Men's \%BF} = 100 * (-98.42 + [4.15 \times \text{WC (in.)}] - [0.082 \times \text{bodyweight (lbs.)}])/\text{bodyweight} \quad (3)$$

$$\text{eTBF: Women's \%BF} = 100 * (-76.76 + [4.15 \times \text{WC (in.)}] - [0.082 \times \text{bodyweight (lbs.)}])/\text{bodyweight} \quad (4)$$

LBW is lost during starvation as protein and amino acids in skeletal muscle are broken down to provide a source of energy [46]. Changes in estimated LBW may be especially useful for providing feedback of FFM levels in AN prevention and recovery. Furthermore, FFM is the "main determinant" of resting metabolic rate (RMR) [47], which is the daily caloric expenditure at rest. Interestingly, starvation secondary to AN was found to reduce resting energy expenditure in AN patients [48], likely associated with loss of FFM. Inversely, RMR may be useful to estimate the minimum dietary caloric allowance necessary to maintain FFM in AN prevention. The Katch–McArdle equation to estimate RMR, published in Exercise Physiology: Nutrition, Energy, and Human Performance, is based on LBW as follows [49]:

$$\text{Katch–McArdle: RMR} = 370 + [21.6 \times \text{LBW (lbs.)}/2.205] \quad (5)$$

The Supplementary Materials contain Excel spreadsheets for men and women that use the equations given above to estimate LBW, FM, %BF, and RMR based on bodyweight and

WC. The spreadsheets also calculate the fat-free mass index, discussed in the next section. Feedback provided by these estimates can be used to monitor and modify the effects of an individual's diet and activity levels on changes in body composition, which are useful and easily accessible tools for the prevention and recovery from AN.

6. Fat-Free Mass Index

A BMI > 20 kg/m^2 is recommended for the full recovery of bodyweight in AN refeeding programs [50]. However, early studies found that increased body fat accounted for more than half of the recovered weight in AN refeeding programs [51–53], and a more recent study confirmed significant increases in body fat from AN refeeding [54]. A patient with AN who tests high on the DLS may achieve greater satisfaction from recovering a higher level of FFM and a lower level of FM. Accordingly, the fat-free mass index (FFMI), developed in 1990 by VanItallie et al. [18], may be more suitable than BMI to assess recovered bodyweight based on FFM and height.

In 2003, researchers estimated FFMI values in 2982 healthy men and 2647 healthy women that corresponded to normal BMI values, finding that "FFMI values were 16.7 to 19.8 kg/m^2 for men and 14.6 to 16.8 kg/m^2 for women within the normal BMI ranges" [55]. In a 2018 study using bioelectric impedance data from the U.S. National Health and Nutrition Examination Survey III, "low FFMI was determined to be less than 17.4 kg/m^2 in men and less than 15.0 kg/m^2 in women with normal ranges of 17.5 to 19.7 kg/m^2 for men and 15.1 to 16.6 kg/m^2 for women" [56].

Accordingly, the spreadsheets in the Supplementary Materials of the present paper suggest that low FFMI values for women and men are <15.0 kg/m^2 and <17.4 kg/m^2, respectively. Studies are needed to investigate FFMI as a measure of severity and recovery in patients with AN. Moreover, consistently monitoring body-composition changes in FFM and FM during AN refeeding can be useful to guide individualized modifications of dietary intake and exercise to minimize FM gains and maximize FFM gains.

7. Physical Activity and Weight-Management Programs for AN

Studies confirm that resistance exercise in AN recovery is especially useful for increasing FFM. A small, randomized trial in 2002 tested resistance exercise using 2.5 kg dumbbells, elastic bands, and bodyweight to train a group of hospitalized patients with AN [57]. Figure 1 illustrates a selection of bodyweight resistance exercises that could be used in a similar training program. After 8 weeks, while consuming a daily diet of 2500 calories, the resistance exercise group in the 2002 study had gained twice as much lean body mass (4.2 kg) as the control group of AN patients who did not use resistance exercise. Additionally, the resistance exercise group gained an additional half kilo of fat mass compared to the control group (1.8 kg and 1.3 kg, respectively). Note that the daily 2500 calorie intake of the resistance-trained patients supplied 500 calories above the average maintenance level of 2000 calories suggested for women [58]. For healthy LBW gain using resistance training, Slater et al. [59] advised consuming a surplus of approximately 360 to 480 calories (1500 to 2000 kilojoules) or about 300 to 500 calories above daily maintenance caloric levels.

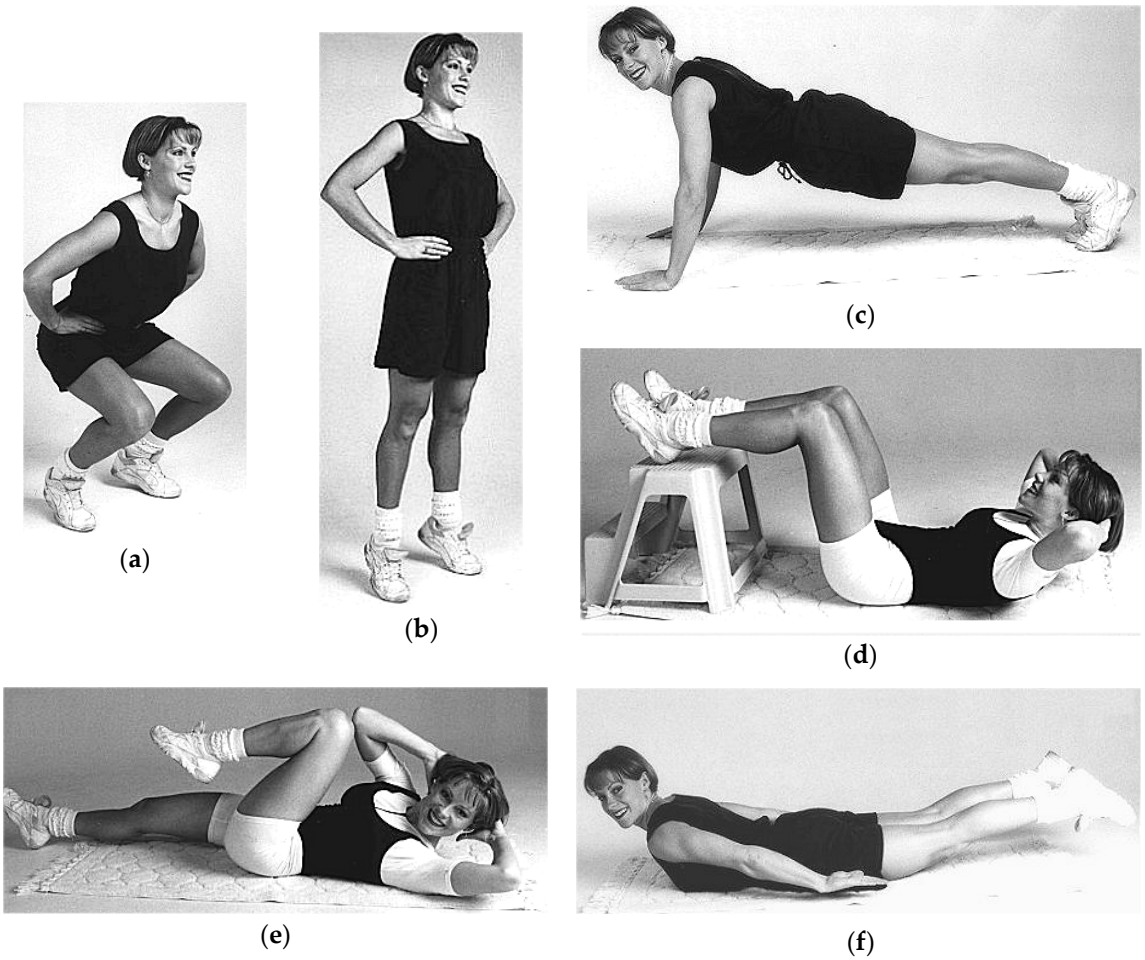

Figure 1. Bodyweight resistance exercises. (**a**) Squat: Bend your knees to lower your upper body, then stand straight up. Repeat. (**b**) Toe raise: Raise your heels as you push down with your toes. Relax and repeat. (**c**) Pushup: Keep your body straight as you push away from the floor with your arms and chest. Lower and repeat. (**d**) Abdominal crunch: Curl your upper body away from the floor. Relax and repeat. Do not pull on your neck. (**e**) Elbow to knee twist: Raise knee to opposite elbow. Relax and repeat, alternating with the other knee and elbow. (**f**) Prone hyperextension: Raise both your upper and lower body away from the floor while tensing your back, shoulders, buttocks, and leg muscles. Relax and repeat. Photos from The Body Fat Guide [60].

Many studies have investigated the effect of physical activity and resistance training in AN, and according to a 2022 systematic review of exercise therapy for AN, "the majority of studies that examined the effects of a resistance-training protocol in anorexic patients have shown significant gain in muscle mass and strength in these patients" [61]. Achamrah et al. [62] summarized the general benefits of programmed physical activity in AN. Improvements in psychological status include reduced anxiety and depression, and resulted in a better quality of life and better scores on assessments of eating disorder pathology. Other benefits include exercise capacity with improvements in strength and aerobic fitness, improvements in body composition with the restoration of FFM, and protection of bone mineral density.

Importantly, excessive exercising is a common symptom of AN [63], and a higher mean level of physical activity is associated with a high DT in patients with eating disorders [64]. Consequently, AN patients participating in a resistance exercise program need awareness of how excessive physical activity can needlessly waste a surplus supply of energy and nutrients required for FFM biosynthesis. Furthermore, an AN physical activity program obviously does not focus on weight-loss goals and methods, concentrating instead on the

patient's immediate recovery of bodyweight. Proposing weight-management programs for AN seems antithetical to conventional treatments that focus on the immediate symptoms rather than the underlying etiology of the disorder. Yet, the present paper proposes that dysfunctional strategies for weight loss mediate a reduction in FFM levels, disordered eating, and hyperactivity in the association of AN with DT (Figure 2—the dotted arrow indicates the association of DT with AN, and solid arrows indicate mediating factors).

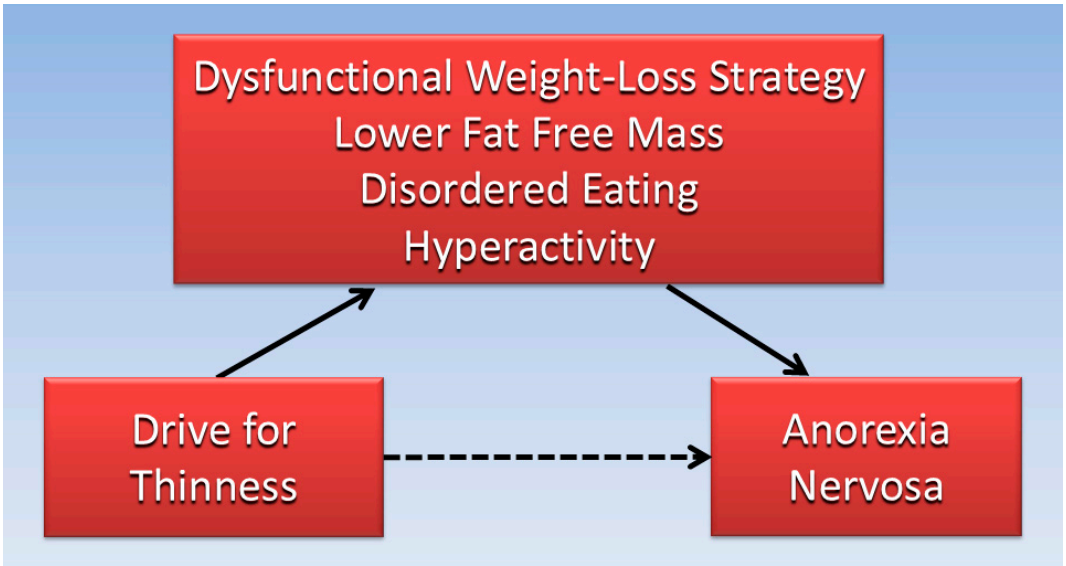

Figure 2. Dysfunctional weight-loss strategy mediates the association of drive for thinness with anorexia nervosa. Proposed mediating factors include lower fat-free mass, disordered eating, and hyperactivity.

A program to reduce recidivism in patients with AN, subsequent to bodyweight recovery, should target patients' dysfunctional weight-loss strategies. A comprehensive program that provides knowledge, skills, and experience in proper weight management, and prevents loss of FFM, avoids disordered eating, and modifies hyperactivity, may be vital to long-term AN recovery. More research is needed to investigate dysfunctional weight-loss strategies in the etiology of AN, and the incorporation of sound weight management in treatment programs. An example of healthy weight-management strategies that reduce FM while preserving FFM was discussed by Osilla et al. [58]:

> "On average, a woman should eat 2000 calories daily to maintain her weight and limit her caloric intake to 1500 or less to lose 1 pound per week. To maintain his body weight, the average male should eat 2500 calories per day, or 2000 a day, if he wants to lose 1 pound per week."

A simplified weight-loss program reduces a man's or woman's maintenance caloric intake by 500 calories a day (approximating a reasonable caloric intake to maintain FFM). Additional energy expenditures through physical activity (Table 3) totaling 500 calories a day would increase the daily caloric deficit to 1000 calories, which is equivalent to a loss of two pounds of FM a week. In another simple method, total bodyweight in pounds is multiplied by 12–13 calories to estimate the caloric intake needed to safely lose weight; 15–16 calories per pound of bodyweight is the caloric intake to maintain weight; and 18–19 calories per pound is the intake to gain healthy weight [65]. Armed with proper weight-management strategies, an individual may be more likely to pursue DL in a manner that is safe for health, effective for reaching body-composition goals, and protective against risks for AN.

Table 3. Calories burned in 30 min for a 120-pound person *.

Activity	Calories
Aerobics	187
Bicycling (<10 mph)	113
Bicycling (>10 mph)	230
Dancing	129
Hiking	144
Running/jogging (5 mph)	230
Stretching	70
Swimming (slow freestyle laps)	199
Walking (3.5 mph)	109
Walking (4.5 mph)	175
Weightlifting (general light workout)	86
Weightlifting (vigorous effort)	171

* Based on Dietary Guideline for Americans 2005 [66].

Eventually, successful application of the information in this paper may be adapted to peer role model programs for preventing eating disorders, including AN. For example, Breithaupt et al. [67] described a successful peer-led education program in a high school setting which was "designed to critique the thin ideal" and empower participants. The researchers' feasibility study found that the peer-led program was enjoyable, increased empowerment, and reduced participants' eating disorder behaviors and cognitions.

8. Conclusions

Conventional treatments for AN do not fully address the determinants of the eating disorder for long-term recovery. Using a nutritional epidemiology approach, the present paper proposes that individuals with AN may potentially recover a firm and trim body with toned muscle mass by applying methods based on DL and guided by body-composition estimates. The FFMI may be more suitable than BMI to assess levels of recovered FFM for patients with high DL. Furthermore, the restoration of FFM in AN using resistance training is associated with improvements in psychological status, body composition, and quality of life. Additionally, replacing a dysfunctional AN dieting strategy with knowledge, skills, and experience in proper weight management has a potential preventive effect against AN. More research is needed to investigate the applied use of the DLS, body-composition estimates, FFMI, resistance-training programs, and weight-management skills in the recovery and prevention of AN.

Supplementary Materials: The following supporting information can be downloaded at: https://www.mdpi.com/article/10.3390/women4040039/s1.

Funding: This research received no external funding.

Institutional Review Board Statement: Not applicable.

Informed Consent Statement: Not applicable.

Data Availability Statement: No new data were created.

Acknowledgments: Special thanks to Lisa Maslanka (Hughes) for posing in the bodyweight resistance exercises photos, and for photography by Gee Wong.

Conflicts of Interest: The author declares no conflicts of interest.

References

1. American Psychiatric Association. What are Eating Disorders? Available online: https://www.psychiatry.org/patients-families/eating-disorders/what-are-eating-disorders (accessed on 9 October 2024).
2. American Psychiatric Association. *Diagnostic and Statistical Manual of Mental Disorders*, 5th ed.; American Psychiatric Association: Washington, DC, USA, 2022.

3. Kaye, W.H.; Bulik, C.M. Treatment of Patients With Anorexia Nervosa in the US—A Crisis in Care. *JAMA Psychiatry* **2021**, *78*, 591–592. [CrossRef] [PubMed]
4. Miskovic-Wheatley, J.; Bryant, E.; Ong, S.H.; Vatter, S.; Le, A.; Aouad, P.; Barakat, S.; Boakes, R.; Brennan, L.; Bryant, E.; et al. Eating disorder outcomes: Findings from a rapid review of over a decade of research. *J. Eat. Disord.* **2023**, *11*, 85. [CrossRef] [PubMed]
5. Clemente-Suárez, V.J.; Ramírez-Goerke, M.I.; Redondo-Flórez, L.; Beltrán-Velasco, A.I.; Martín-Rodríguez, A.; Ramos-Campo, D.J.; Navarro-Jiménez, E.; Yáñez-Sepúlveda, R.; Tornero-Aguilera, J.F. The Impact of Anorexia Nervosa and the Basis for Non-Pharmacological Interventions. *Nutrients* **2023**, *15*, 2594. [CrossRef] [PubMed]
6. Krug, I.; Binh Dang, A.; Granero, R.; Agüera, Z.; Sánchez, I.; Riesco, N.; Jimenez-Murcia, S.; Menchón, J.M.; Fernandez-Aranda, F. Drive for thinness provides an alternative, more meaningful, severity indicator than the DSM-5 severity indices for eating disorders. *Eur. Eat. Disord. Rev.* **2021**, *29*, 482–498. [CrossRef]
7. Garner, D.M. *Eating Disorder Inventory-3 (EDI-3)*; Professional manual; Psychological Assessment Resources: Odessa, FL, USA, 2004; Volume 1.
8. Garner, D.M. Eating Disorder Inventory-3 (EDI-3) Scale Descriptions. Available online: https://toledocenter.com/wp-content/uploads/2015/10/EDI-3-Scale.pdf (accessed on 22 October 2024).
9. Tinsley, G.M.; Heymsfield, S.B. Fundamental Body Composition Principles Provide Context for Fat-Free and Skeletal Muscle Loss With GLP-1 RA Treatments. *J. Endocr. Soc.* **2024**, *8*, 1–9. [CrossRef]
10. Marra, M.; Sammarco, R.; De Filippo, E.; Caldara, A.; Speranza, E.; Scalfi, L.; Contaldo, F.; Pasanisi, F. Prediction of body composition in anorexia nervosa: Results from a retrospective study. *Clin. Nutr.* **2018**, *37*, 1670–1674. [CrossRef]
11. Wells, J.C.; Haroun, D.; Williams, J.E.; Nicholls, D.; Darch, T.; Eaton, S.; Fewtrell, M.S. Body composition in young female eating-disorder patients with severe weight loss and controls: Evidence from the four-component model and evaluation of DXA. *Eur. J. Clin. Nutr.* **2015**, *69*, 1330–1335. [CrossRef]
12. Institute of Medicine Committee on Military Nutrition Research. Body Composition and Physical Performance: Applications For the Military Services. In *Body Composition and Physical Performance: Applications for the Military Services*; Marriott, B.M., Grumstrup-Scott, J., Eds.; National Academies Press (US): Washington, DC, USA, 1990.
13. Fleck, S.J. Body composition of elite American athletes. *Am. J. Sports Med.* **1983**, *11*, 398–403. [CrossRef]
14. Last, J.M. Dictionary of epidemiology. *CMAJ Can. Med. Assoc. J.* **1993**, *149*, 400. [CrossRef]
15. McCullough, M.; Giovannucci, E. Chapter 6–Nutritional Epidemiology. In *Nutritional Oncology*, 2nd ed.; Heber, D., Ed.; Academic Press: Burlington, VT, USA, 2006; pp. 85–96.
16. Habib, A.; Ali, T.; Nazir, Z.; Mahfooz, A.; Inayat, Q.-u.-A.; Haque, M.A. Unintended consequences of dieting: How restrictive eating habits can harm your health. *Int. J. Surg. Open* **2023**, *60*, 100703. [CrossRef]
17. Smolak, L.; Murnen, S.K. Drive for leanness: Assessment and relationship to gender, gender role and objectification. *Body Image* **2008**, *5*, 251–260. [CrossRef] [PubMed]
18. VanItallie, T.B.; Yang, M.U.; Heymsfield, S.B.; Funk, R.C.; Boileau, R.A. Height-normalized indices of the body's fat-free mass and fat mass: Potentially useful indicators of nutritional status. *Am. J. Clin. Nutr.* **1990**, *52*, 953–959. [CrossRef] [PubMed]
19. Neeland, I.J.; McGuire, D.K.; Eliasson, B.; Ridderstråle, M.; Zeller, C.; Woerle, H.J.; Broedl, U.C.; Johansen, O.E. Comparison of Adipose Distribution Indices with Gold Standard Body Composition Assessments in the EMPA-REG H2H SU Trial: A Body Composition Sub-Study. *Diabetes Ther.* **2015**, *6*, 635–642. [CrossRef] [PubMed]
20. Wolfswinkel, J.F.; Furtmueller, E.; Wilderom, C.P.M. Using grounded theory as a method for rigorously reviewing literature. *Eur. J. Inf. Syst.* **2013**, *22*, 45–55. [CrossRef]
21. Glaser, B.G.; Strauss, A.L. *Discovery of Grounded Theory: Strategies for Qualitative Research*; Routledge: New York, NY, USA, 2017.
22. Martini, M.; Lepora, M.; Longo, P.; Amodeo, L.; Marzola, E.; Abbate-Daga, G. Anorexia Nervosa in the Acute Hospitalization Setting. In *Eating Disorders*; Patel, V., Preedy, V., Eds.; Springer International Publishing: Cham, Switzerland, 2021; pp. 1–18.
23. Khalsa, S.S.; Portnoff, L.C.; McCurdy-McKinnon, D.; Feusner, J.D. What happens after treatment? A systematic review of relapse, remission, and recovery in anorexia nervosa. *J. Eat. Disord.* **2017**, *5*, 20. [CrossRef]
24. Born, C.; de la Fontaine, L.; Winter, B.; Müller, N.; Schaub, A.; Früstück, C.; Schüle, C.; Voderholzer, U.; Cuntz, U.; Falkai, P.; et al. First results of a refeeding program in a psychiatric intensive care unit for patients with extreme anorexia nervosa. *BMC Psychiatry* **2015**, *15*, 57. [CrossRef]
25. McKay, G. Skinny blues: Karen Carpenter, anorexia nervosa and popular music. *Pop. Music* **2018**, *37*, 1–21. [CrossRef]
26. Haithman, D. *A TV Movie He Didn't Want: Brother Richard Guides CBS' 'Karen Carpenter Story'*; Los Angeles Times: Los Angeles, CA, USA, 1988.
27. Ramjan, L.M.; Fogarty, S. Clients' perceptions of the therapeutic relationship in the treatment of anorexia nervosa: Qualitative findings from an online questionnaire. *Aust. J. Prim. Health* **2019**, *25*, 37–42. [CrossRef]
28. Glasofer, D.R.; Lemly, D.C.; Lloyd, C.; Jablonski, M.; Schaefer, L.M.; Wonderlich, S.A.; Attia, E. Evaluation of an online modular eating disorders training (PreparED) to prepare healthcare trainees: A survey study. *BMC Med. Educ.* **2023**, *23*, 868. [CrossRef]
29. Ashby, C.; Ogden, J. Managing patients with eating disorders: A qualitative study in primary care. *BJGP Open* **2024**, *8*, 1–12. [CrossRef]
30. Gutiérrez, E.; Carrera, O. Severe and Enduring Anorexia Nervosa: Enduring Wrong Assumptions? *Front. Psychiatry* **2021**, *11*, 538997. [CrossRef] [PubMed]

31. Barko, E.B.; Moorman, S.M. Weighing in: Qualitative explorations of weight restoration as recovery in anorexia nervosa. *J. Eat. Disord.* **2023**, *11*, 14. [CrossRef] [PubMed]
32. Hesse-Biber, S. *Am I Thin Enough Yet? The Cult of Thinness and the Commercialization of Identity*; Oxford University Press: Oxford, UK, 1996.
33. Bozsik, F.; Whisenhunt, B.L.; Hudson, D.L.; Bennett, B.; Lundgren, J.D. Thin Is In? Think Again: The Rising Importance of Muscularity in the Thin Ideal Female Body. *Sex Roles* **2018**, *79*, 609–615. [CrossRef]
34. Lang, B.; Rancourt, D. Drive for leanness: Potentially less maladaptive compared to drives for thinness and muscularity. *Eat. Weight Disord.* **2020**, *25*, 1213–1223. [CrossRef]
35. Dahlenburg, S.C.; Gleaves, D.H.; Hutchinson, A.D. Anorexia nervosa and perfectionism: A meta-analysis. *Int. J. Eat. Disord.* **2019**, *52*, 219–229. [CrossRef]
36. Faija, C.L.; Tierney, S.; Gooding, P.A.; Peters, S.; Fox, J.R.E. The role of pride in women with anorexia nervosa: A grounded theory study. *Psychol. Psychother.* **2017**, *90*, 567–585. [CrossRef]
37. Westmoreland, P.; Johnson, C.; Stafford, M.; Martinez, R.; Mehler, P.S. Involuntary Treatment of Patients With Life-Threatening Anorexia Nervosa. *J. Am. Acad. Psychiatry Law Online* **2017**, *45*, 419–425.
38. Myers, C.R. *The Official YMCA Physical Fitness Handbook*; Popular Library: New York, NY, USA, 1975.
39. Wilmore, J.H.; Behnke, A.R. An anthropometric estimation of body density and lean body weight in young men. *J. Appl. Physiol.* **1969**, *27*, 25–31. [CrossRef] [PubMed]
40. Wilmore, J.H.; Behnke, A.R. An anthropometric estimation of body density and lean body weight in young women. *Am. J. Clin. Nutr.* **1970**, *23*, 267–274. [CrossRef]
41. Ofstad, A.P.; Sommer, C.; Birkeland, K.I.; Bjørgaas, M.R.; Gran, J.M.; Gulseth, H.L.; Johansen, O.E. Comparison of the associations between non-traditional and traditional indices of adiposity and cardiovascular mortality: An observational study of one million person-years of follow-up. *Int. J. Obes.* **2019**, *43*, 1082–1092. [CrossRef]
42. Yu, S.; Visvanathan, T.; Field, J.; Ward, L.C.; Chapman, I.; Adams, R.; Wittert, G.; Visvanathan, R. Lean body mass: The development and validation of prediction equations in healthy adults. *BMC Pharmacol. Toxicol.* **2013**, *14*, 53. [CrossRef] [PubMed]
43. Marcus, J. Chapter 10–Weight Management: Finding the Healthy Balance: Practical Applications for Nutrition, Food Science and Culinary Professionals. In *Culinary Nutrition*; Academic Press: Boston, MA, USA, 2013; pp. 431–473.
44. Jeukendrup, A.; Gleeson, M. *Sport Nutrition*, 4th ed.; Human Kinetics: Champaign, IL, USA, 2025.
45. Plank, L.D.; Hill, G.L. 58–Body Composition. In *Surgical Research*; Souba, W.W., Wilmore, D.W., Eds.; Academic Press: San Diego, CA, USA, 2001; pp. 797–812.
46. Sanvictores, T.; Casale, J.; Huecker, M.R. Physiology, Fasting. In *StatPearls*; StatPearls Publishing: Treasure Island, FL, USA, 2024.
47. Hopkins, M.; Gibbons, C.; Blundell, J. Fat-free mass and resting metabolic rate are determinants of energy intake: Implications for a theory of appetite control. *Philos. Trans. R. Soc. Lond. B Biol. Sci.* **2023**, *378*, 20220213. [CrossRef]
48. Kosmiski, L.; Schmiege, S.J.; Mascolo, M.; Gaudiani, J.; Mehler, P.S. Chronic starvation secondary to anorexia nervosa is associated with an adaptive suppression of resting energy expenditure. *J. Clin. Endocrinol. Metab.* **2014**, *99*, 908–914. [CrossRef]
49. Ryan, A.S.; Novitskaya, M.; Treuth, A.L. Predictive Equations Overestimate Resting Metabolic Rate in Survivors of Chronic Stroke. *Arch. Phys. Med. Rehabil.* **2022**, *103*, 1352–1359. [CrossRef] [PubMed]
50. Frostad, S.; Rozakou-Soumalia, N.; Dârvariu, Ş.; Foruzesh, B.; Azkia, H.; Larsen, M.P.; Rowshandel, E.; Sjögren, J.M. BMI at Discharge from Treatment Predicts Relapse in Anorexia Nervosa: A Systematic Scoping Review. *J. Pers. Med.* **2022**, *12*, 836. [CrossRef]
51. Grinspoon, S.; Thomas, L.; Miller, K.; Pitts, S.; Herzog, D.; Klibanski, A. Changes in regional fat redistribution and the effects of estrogen during spontaneous weight gain in women with anorexia nervosa123. *Am. J. Clin. Nutr.* **2001**, *73*, 865–869. [CrossRef] [PubMed]
52. Orphanidou, C.I.; McCargar, L.J.; Birmingham, C.L.; Belzberg, A.S. Changes in body composition and fat distribution after short-term weight gain in patients with anorexia nervosa. *Am. J. Clin. Nutr.* **1997**, *65*, 1034–1041. [CrossRef]
53. Scalfi, L.; Polito, A.; Bianchi, L.; Marra, M.; Caldara, A.; Nicolai, E.; Contaldo, F. Body composition changes in patients with anorexia nervosa after complete weight recovery. *Eur. J. Clin. Nutr.* **2002**, *56*, 15–20. [CrossRef]
54. Dauty, M.; Menu, P.; Jolly, B.; Lambert, S.; Rocher, B.; Le Bras, M.; Jirka, A.; Guillot, P.; Pretagut, S.; Fouasson-Chailloux, A. Inpatient Rehabilitation during Intensive Refeeding in Severe Anorexia Nervosa. *Nutrients* **2022**, *14*, 2951. [CrossRef]
55. Kyle, U.G.; Schutz, Y.; Dupertuis, Y.M.; Pichard, C. Body composition interpretation: Contributions of the fat-free mass index and the body fat mass index. *Nutrition* **2003**, *19*, 597–604. [CrossRef]
56. Kudsk, K.A.; Munoz-Del-Rio, A.; Busch, R.A.; Kight, C.E.; Schoeller, D.A. Stratification of Fat-Free Mass Index Percentiles for Body Composition Based on National Health and Nutrition Examination Survey III Bioelectric Impedance Data. *JPEN J. Parenter. Enter. Nutr.* **2017**, *41*, 249–257. [CrossRef] [PubMed]
57. Szabo, C.P.; Green, K. Hospitalized anorexics and resistance training: Impact on body composition and psychological well-being. A preliminary study. *Eat. Weight Disord.* **2002**, *7*, 293–297. [CrossRef] [PubMed]
58. Osilla, E.V.; Safadi, A.O.; Sharma, S. Calories. In *StatPearls*; StatPearls Publishing: Treasure Island, FL, USA, 2024.
59. Slater, G.J.; Dieter, B.P.; Marsh, D.J.; Helms, E.R.; Shaw, G.; Iraki, J. Is an Energy Surplus Required to Maximize Skeletal Muscle Hypertrophy Associated With Resistance Training. *Front. Nutr.* **2019**, *6*, 131. [CrossRef] [PubMed]
60. Brown, R. *The Body Fat Guide*; Healthstyle Publications: Kitchener, ON, CA, 1999.

61. Toutain, M.; Gauthier, A.; Leconte, P. Exercise therapy in the treatment of anorexia nervosa: Its effects depending on the type of physical exercise-A systematic review. *Front. Psychiatry* **2022**, *13*, 939856. [CrossRef]
62. Achamrah, N.; Coëffier, M.; Déchelotte, P. Physical activity in patients with anorexia nervosa. *Nutr. Rev.* **2016**, *74*, 301–311. [CrossRef]
63. Beumont, P.J.; Arthur, B.; Russell, J.D.; Touyz, S.W. Excessive physical activity in dieting disorder patients: Proposals for a supervised exercise program. *Int. J. Eat. Disord.* **1994**, *15*, 21–36. [CrossRef]
64. Vansteelandt, K.; Rijmen, F.; Pieters, G.; Probst, M.; Vanderlinden, J. Drive for thinness, affect regulation and physical activity in eating disorders: A daily life study. *Behav. Res. Ther.* **2007**, *45*, 1717–1734. [CrossRef]
65. Kansas State University. Physical Activity and Controlling Weight. Available online: https://www.k-state.edu/paccats/Contents/PA/PDF/Physical%20Activity%20and%20Controlling%20Weight.pdf (accessed on 14 November 2024).
66. U.S. Department of Health and Human Services; U.S. Department of Agriculture. *Dietary Guidelines for Americans, 2005*; U.S. Government Printing Office: Washington, DC, USA, 2005.
67. Breithaupt, L.; Eickman, L.; Byrne, C.E.; Fischer, S. REbeL Peer Education: A model of a voluntary, after-school program for eating disorder prevention. *Eat. Behav.* **2017**, *25*, 32–37. [CrossRef]

Disclaimer/Publisher's Note: The statements, opinions and data contained in all publications are solely those of the individual author(s) and contributor(s) and not of MDPI and/or the editor(s). MDPI and/or the editor(s) disclaim responsibility for any injury to people or property resulting from any ideas, methods, instructions or products referred to in the content.