



Review Article

Anorexia in Adolescents: A Narrative Review

Tiffany Field

University of Miami/Miller School of Medicine and Fielding Graduate University, Florida, USA

***Corresponding author:** Tiffany Field, University of Miami/Miller School of Medicine and Fielding Graduate University, Florida, USA**Citation:** Field T (2022) Anorexia in Adolescents: A Narrative Review. Arch Pediatr 7: 220. DOI: 10.29011/2575-825X.100220**Received Date:** 04 October 2022; **Accepted Date:** 19 October 2022; **Published Date:** 24 October 2022

Abstract

The prevalence of anorexia nervosa has ranged from 27% in non-clinical samples to 85% in samples of adolescents with eating disorders, with twice the prevalence noted in females. Several correlates of anorexia are reported in the recent literature reviewed here including vegetarian diets, personality characteristics such as internalizing and perfectionism as well as behavior problems including impulsivity, dysregulation and being victimized. Comorbidities have included social anxiety, depression and suicidal ideation. In most of these studies, it is not clear which is the primary disorder, as most of the samples are cross-sectional rather than longitudinal. Several of the correlates have also been identified as risk factors including gender, early attachment disturbances, excessive Internet use and negative effects of COVID-19. Potential underlying mechanisms have included involvement of the prefrontal area of the brain based on fMRI and evoked potential research. Fortunately, negative effects of anorexia including decreased body fat mass and bone density as well as lower cortical thickness and less grey matter have been reversed following weight gain. Other effective interventions have included cognitive behavior and dialectical behavior therapy. This narrative review involved entering the terms eating disorders and adolescents into PubMed and PsycINFO. The search yielded 251 papers for the last five years, but following exclusion criteria including case studies and non-English papers, this review is a summary of the research reported in 49 papers. The recent literature on eating disorders in adolescents is predominantly focused on correlates and risk factors for anorexia along with some studies on comorbidities and potential underlying mechanisms for anorexia. Although there are virtually no studies on the effects of anorexia except its effects on body mass and bone mineral density, several intervention studies appear in this literature. Related studies are focused on orthorexia. This narrative review is accordingly divided into sections on the prevalence of anorexia, comorbidities, correlates, risk factors, potential underlying mechanisms and interventions. In a separate section, the smaller literature on orthorexia and drunkorexia is briefly reviewed.

Keywords: Anorexia Depression; Adolescents; Compulsive disorder.

Anorexia Nervosa

Prevalence

Anorexia nervosa is the most prevalent form of eating disorder in adolescents. For example, in a sample of 145 adolescents with eating disorders, 85% were classified as anorexic [1]. And those who had eating disorder symptoms for a longer period also had higher depression scores. As in most of the studies in this literature, causality cannot be determined because of the cross-sectional, non-longitudinal nature of the data collection. In a larger, non-clinical sample (N=780 adolescents), the prevalence of anorexia was 27% [2]. Twice the prevalence was noted for females (37%) than for

males (18%). This gender difference has been reported in virtually all the recent studies on eating disorders in adolescents. Other data from this study suggest positive associations between eating disordered behaviors, body image and body mass index (BMI).

The categorization of eating disorders has been expanded to include restrictive eating disorder which occurs earlier and is associated with separation anxiety and ADHD as compared to anorexia nervosa-atypical and anorexia nervosa-restrictive [3]. All three forms are included in the DSM-5. Still another eating disorder was noted by these authors including avoidance /restrictive food intake disorder (ARFID). Research is needed on comparisons between these disorders including a factor analysis to differentiate the various types on significant correlates, comorbidities and risk factors (Table 1).

Variables	First authors
Prevalence	
85% anorexic in eating disorder sample	Lin
27% anorexic in non-clinical sample	Stefanova
Correlates	
Vegetarian diets	Sergentanis
response inhibition to high calorie food stimuli	Weinbach
Internalizing	Caqueo-Urzar, Malagoli
Perfectionism	Schilder, Vacca
Self -dysregulation	Evans, Trumpeter, Nalbant, Li, Perthes
Cybervictimization	Marco
Comorbidities	
social anxiety	Catone
depression	Li
borderline personality traits	Lekgabe
suicidality	Wang, Mercu
Risk factors	
female gender	Stefanova, Petrovics, Suarez-Albot
early attachment disturbances	LaPorta, Nalbant, Cortes-Garcia
excessive Internet use	Uchoa, Sablaturova, Ioannidis
COVID-19 effects	Vaccaro, Spettigue, Cernaglia, Vitagliano

Table 1: Characteristics of anorexia nervosa in adolescents.

Correlates of Anorexia Nervosa

Several correlates of anorexia nervosa have been Identified. These Include correlates that relate to food preferences, personality characteristics Including internalizing and perfectionism as well as behavior problems including impulsivity, dysregulation and being victimized.

Food and Eating Correlates: Vegetarian diets have been associated with eating disorders in adolescents. In a review of 20 studies entitled “Vegetarian diets and eating disorders in adolescents”, this relationship was consistently noted [4]. Despite the large sample size in this review (N=14,391), the direction of effects cannot be determined given the cross-sectional nature of the studies reviewed.

Food responses have also been studied in experimental conditions. For example, in a study entitled “Superior response

inhibition to high-calorie foods in adolescents with anorexia”, a food-stop signal task was administered [5]. In this study, visual stimuli of high and low-calorie foods were presented to anorexic and healthy adolescents (N=60). Greater response inhibition was noted to the high calorie foods by the anorexic adolescents, but no group differences were noted for the low-calorie food stimuli. The results of this rare experimental study imply cognitive correlates of anorexia.

Personality Characteristics as Correlates

The two most frequently studied personality correlates of anorexia have been internalizing and perfectionism. This is not surprising since these personality characteristics have also been noted for related problems like obsessive compulsive disorder.

Internalizing: In a study on internalizing problems in Chilean adolescents (N=2277), for example, internalizing problems were

significantly associated with eating disorders [6]. In a smaller sample study, internalizing problems were associated with emotional dysregulation in adolescents with anorexia [7].

Perfectionism: Perfectionism has also been reported for adolescents with eating disorders. For example, in a study on 386 adolescents with eating disorders, the adolescents were noted to have perfectionism problems [8]. This may have related to the educational achievement of the students given that more than 50% of the adolescents were receiving pre- university education. In a very extensive review of 51 cross-sectional and 28 longitudinal studies, perfectionistic strivings and concerns were related to eating disorder symptoms [9]. Most of the studies supported perfectionistic concerns. Intervention studies that were reviewed focused on self-criticism. Unfortunately, a meta-analysis could not be conducted because of the variability of the measures across the different studies.

Self-dysregulation: Impulsivity, affect reactivity and self-dysregulation have been related to eating disorders in adolescents. For example, in one of the rare longitudinal studies entitled “Impulsivity and affect reactivity prospectively predict disordered eating”, these relationships were reported [10]. In this six-year study (N =206), latent growth modeling revealed relationships between impulsivity and eating disorder attitudes with the strongest relationship being for elevated affect reactivity.

In a study on emotional dysregulation and eating disorder symptoms, emotion dysregulation was associated with both binge eating and fasting in a large community sample (N=2699) in which the prevalence of eating disorder was only 6% [11]. In this sample, weight and body shape concerns were also associated with fasting and excessive exercise.

In a sample of both adolescents with anorexia nervosa (N=118) and bulimia nervosa (N=32), emotion regulation was more adaptive for anxiety than anger or sadness [12]. These participants may have had more experience with anxiety than anger or sadness. In a similar study entitled “Emotion regulation, emotion recognition and empathy”, greater difficulties were shown on emotion regulation and less empathy was also noted in those adolescents with anorexia [13]. Although limited ability to express emotions was also reported, there was apparently no difficulty recognizing emotions. These results suggest the possibility of preoccupation with one’s own emotions, as in narcissism.

Cybervictimization: Cybervictimization has also been associated with eating disorders in adolescents [14]. In this sample (N= 676), personal appearance evaluations by the adolescents moderated the relationship between cybervictimization and eating disorder psychopathology. This is only a cross-sectional relationship suggesting that a longitudinal study on those with eating disorders who are also victims of cyberbullying would be important to address the direction of effects for this relationship.

Comorbidities of Eating Disorders

Comorbidities of eating disorders in this recent literature have included social anxiety, depression, some borderline personality disorder traits and suicidal ideation. In the case of most of the studies it is not clear which is the primary disorder, as most of the samples are cross-sectional rather than longitudinal.

Social Anxiety: In a study entitled “A glance in the psychiatric comorbidity in adolescents with anorexia”, 86% of the sample was female, 53% had been diagnosed with social anxiety disorder, 42% with depression and 19% with generalized anxiety disorder [15]. In a sample from Naples Italy, clinical interview data were compared with survey data in 72 adolescents with anorexia. The adolescents with anorexia recognized their social anxiety disorder but tended to deny their depression. This could relate to their considering social anxiety more socially acceptable and perhaps more common than depression.

Depression: In a larger sample study on adolescents (N=1231) entitled “The mediating effect of self-control on depression and tendencies of eating disorders in adolescents”, 13% had eating disorders [16]. Females had higher scores on impulse control and impulse control had a mediating effect on depression and eating disorder tendencies. That effect was surprising given that eating disorders have been more prevalent in females.

Borderline Personality Traits: Borderline personality traits have also been associated with eating disorders including suicidality, impulsivity and anger [17]. In this sample (N =168), scores on the Eating Disorder Examination were correlated with scores on the Borderline Personality Questionnaire ($r = .64$). The scores were also correlated with scores on Identity Disturbances and Feelings of Emotions Scales. Surprisingly, the focus of this study supposedly on borderline personality disorder was on personality traits versus the psychopathology of borderline personality disorder.

Suicidality: Suicidality has been noted to be correlated with eating disorders in at least two other recent studies. In one sample, restrictive eating explained 27% of the variance in suicidal ideation in a hierarchical logistic regression [18]. The sample size, however, was very limited (N=82) and it was a correlation not a causality study. In another study on suicidality and eating disorders, the sample was comprised of 66 with restrictive anorexia and 34 with restrictive atypical anorexia [19]. In this sample 27% expressed suicidality including 24% suicidal ideation, 19% self-cutting and 6% suicidal attempts. Those who were suicidal also experienced comorbidities, most notably depression (70 versus 30%).

Risk Factors for Eating Disorders

Several of the correlates of eating disorders already discussed might also be considered risk factors. Variables that have been specifically identified as risk factors include gender, early attachment disturbances, excessive Internet use and negative

effects of COVID-19.

Gender as a Risk Factor: Although gender differences are rarely mentioned in this literature given that gender has been matched in most of the studies, prevalence data indicate that females are more likely to experience eating disorders. For example, in a sample of 780 adolescents, the prevalence of eating disorders was 27%, with 37% being females and half as many being males (18%) [2]. And in this study, the correlates for females were body image, body weight and body mass index (BMI) which were all lower in females.

In another study on a larger sample already mentioned (N=1231), females had higher scores on impulse control which was the mediator for depression effects on eating disorder tendencies [16]. In still another sample (N=374), females had lower self-esteem and more “emotional eating problems” and males had greater obesity and overweight problems [20]. And, in a systematic review of 25 studies, female gender was noted as a significant correlate [21]. Other significant correlates were body dissatisfaction, depression and low self-esteem. Unfortunately, there was too much variability across these studies for a meta-analysis to be performed.

Early Attachment Disturbances: Attachment problems with both mothers and fathers as well as alienation from peers have been studied as risk factors for eating disorders in this recent literature. In research entitled “Attachment to parents and friends and body dissatisfaction in adolescents with eating disorders” (N=260), alienation to friends and attachment problems with fathers related to body dissatisfaction [22].

Other studies have noted attachment problems with mothers. In one of these studies entitled “Attachment security and perceived expressed emotion in adolescents with anorexia”, the perceptions of 43 anorexic and 37 healthy adolescents were recorded [23]. Less attachment security and greater perception of parental expression of criticism and hostility were specifically noted for relationships with the adolescents’ mothers. The primary problem with these studies is that they are retrospective memories of relationships.

In a rare prospective, longitudinal study (N=904 Spanish youth), the adolescents were followed biennially from 10 to 16 years of age [24]. The data were analyzed by a dynamic panel model that accounts for unmeasured time-invariant factors. The results suggested that there were more insecure attachments to mothers at 10 and 12 years which predicted more disordered eating problems at 14 and 16 years via increased depression symptoms at 12 and 14 years. Surprisingly, no gender specific effects were noted.

Excessive Internet Use: The Internet problem as a risk factor for eating disorders has been variously referred to as excessive

use of the Internet (EUI) and problematic use of the Internet (PUI). In a study on mass media effects, mass media based on the Social Cultural Attitudes Towards Appearance Questionnaire was noted to lead to body dissatisfaction based on the Body Shape Questionnaire and, in turn, to eating disorders [25]. Because these are not longitudinal data, directional effects cannot be implied. However, the data are consistent with other studies on excessive use. In a very large sample (N= 7083), for example, EUI in adolescents was correlated with eating disorder symptoms ($r=.36$) [26] in another study (N=721), a high degree of socialization on the Internet was associated with eating disorders [27]. But it was also associated with low self-esteem.

In a meta-analysis on an extremely large sample (N=32,295), PUI was not only correlated with eating disorders ($r=.22$) but also with body dissatisfaction ($r=.16$), with drive for thinness ($r=.16$) and with dietary restraint ($r=.18$) [28]. Although these are relatively low correlations, they are highly significant in a sample this size. It would have been interesting to see a stepwise regression to know the relative variance in eating disorder that was explained by each of these variables. In any case, each of these variables would appear to reflect compulsive behavior. Remarkably, the recent literature has rarely addressed the relationship between anorexia and obsessive compulsive disorder.

COVID-19 Effects: Not surprisingly, COVID-19 has impacted eating disorders. In a study from Italy based on a sample recruited in July 2020, the number of Internet users increased 60% [29]. And the number of patients with eating disorders increased 40% during the first six months of COVID-19 (2020).

COVID-19 effects have been noted in other samples on anorexia in adolescents. For example, in a study entitled “The impact of COVID-19 on adolescents with eating disorders”, the adolescents were seen before the pandemic and during the pandemic in a rare longitudinal study [30]. Forty per cent of the adolescents reported that the pandemic was a trigger for an eating disorder episode and an increased number of adolescents were medically unstable. Further, a greater number of emergency room and hospital visits occurred for their eating disorders during the pandemic. These data were not surprising given that most problems for adolescents were exacerbated by the pandemic.

In another longitudinal study that occurred before and during the pandemic, the prevalence of eating disorders increased [31]. The increase for males was 13 to 18% and the prevalence increased from 18 to 25% for females. The longitudinal data of these two studies highlight the negative effects of COVID on eating disorders in adolescents. It’s unclear, however, which COVID variables were impacting eating disorders as many have been noted to have negative effects including loneliness, anxiety, depression, sleep problems and lack of exercise [32].

The prevalence of all of these problems was addressed in a study entitled “COVID-19 and eating disorder and mental health concerns” [33]. In this small sample survey (N=89), 63% reported a worsening of eating disorder and 74% reported an increase in eating disorder thoughts. In addition, anxiety was noted by 77% of the respondents, depression by 73%, isolation by 80% and decreased motivation for recovery by 29% of the respondents. Unfortunately, again, the degree to which each of these comorbidities contributed to eating disorders was not determined.

Orthorexia as a Newer Eating Disorder

Orthos means proper or correct and orexis means appetite and orthorexia has been defined as a fixation on healthy pure foods, dietary restrictions and omission of processed food [34]. Adolescents with orthorexia, in contrast to those with anorexia, are more concerned about their health than their weight or body shape. In this systematic review, significant correlations were noted in most of the 37 studies. The prevalence ranged from 7 to 46% with a mean of 27%, and an increasing prevalence was noted. The authors referred to four stages of orthorexia including 1-having excessive thoughts about food, 2-exercising control over collecting ingredients, 3-careful meal preparation and 4-thinking about the accomplishment or failure of the result, as in perfectionism.

Orthorexia has been associated with narcissism. In a study entitled “Orthorexia nervosa and its association with narcissism in fitness center users”, orthorexia nervosa was defined as “an obsessive attempt to reach health through ‘purity’ of food, and narcissism was defined as “a self-belief of grandiosity, importance and the need of appreciation” [35]. In this sample of 1017 fitness center users, orthorexia and narcissism were highly correlated ($r=.47$). Longitudinal data are, of course, needed to determine directionality of these problems (Table 2).

Variables	First Authors
Prevalence	Skella
Narcissism	Martinovic
obsessive compulsive disorder	Vacarri, Yilmaz
Drunkorexia	Laghi

Table 2: Characteristics of orthorexia.

Orthorexia has also been associated with obsessive compulsive disorder (OCD) In at least two studies. In one sample

considered at high risk for OCD including ballet dancers, athletes and health workers, 90% were noted to have OCD symptoms [36]. This is not surprising given the perfectionism required in these careers versus those of the general population. But anorexia was also highly prevalent in this sample at 60%. This might also not be surprising given the physical demands of these careers that might lead to less eating and underweight. And, in another result reported, anorexia symptoms were more prevalent among the participants suffering from OCD.

The association between orthorexia and OCD has also occurred in a sample of healthy volunteers who exercised three days a week for 30 minutes a day versus those with OCD and healthy controls (N=63 in each group) [37]. Orthorexic tendencies were greater in those participants who regularly exercised than those diagnosed with OCD as well as those individuals who did not exercise. These data are also not surprising given that healthy diet as in orthorexia and exercise typically go together. But longitudinal studies and differential diagnoses are needed to determine causality.

Drunkorexia is still another variant of eating disorder that has been attributed to adolescents who excessively use alcohol [38]. It is unclear why this is not referred to as alcoholism, but it is appearing as drunkorexia In the recent literature on eating disorders in adolescents. In this particular sample (N=849), a hierarchical multiple regression suggested that difficulties with emotion regulation were predictive of drunkorexia.

Potential Underlying Mechanisms

Potential underlying mechanisms have been explored for eating disorders, most especially for anorexia. These recent findings include negative effects on the prefrontal area of the brain based on fMRI studies and evoked potential research.

In a study entitled “Correlation of fMRI responses to visual food stimuli”, 18 anorexic adolescents were given fMRIs during the presentation of different food stimuli [39]. The responses occurred primarily in limbic centers including the orbitofrontal cortex and the anterior cingulate cortex. These data are consistent with those from a similar study. In this FMRI study, resting state fMRIs were taken from 16 adolescents with anorexia and 15 healthy controls [40]. The areas activated mainly involved sensory and emotional processes which may explain the body image disturbances noted in those with anorexia. Unfortunately, body image disturbances were not assessed in this study (Table 3).

Variables	First Authors
fMRI responses to food stimuli	Ziv
resting state fMRIs	Gaudio
Event related potentials	Wu
lower cortical thickness	Garcia-Garcia
decreased grey matter volume	Monzon

Table 3: Potential underlying mechanisms for anorexia.

In a study assessing event-related potentials (N=86), greater reward activation was noted to food cues [41]. The authors referred to this as “fronto-central food cue bias of the late positive potential” and concluded that there was greater activation in the prefrontal system which is consistent with the previously described fMRI studies.

Serious physical effects on the brain have also been noted in samples of anorexic adolescents. For example, in a study entitled “Restrained eating is associated with lower cortical thickness in the inferior frontal gyrus in adolescents”, this negative effect was noted in a sample of 108 adolescents [42]. Similar findings were reported in a study entitled “Grey matter volume in adolescents with anorexia and associated eating disorders” [43]. In this sample (N=26), less grey matter was noted in the insula, amygdala, prefrontal, hippocampal, cingulate cortex and precuneus. Fortunately, following weight gain, grey matter volumes increased to near control levels except for the anterior cingulate cortex, caudate nuclei and right hippocampus. This surprising “food for the brain” effect highlights the resilience of the brain, although it’s not clear why some areas did not recover.

Interventions

Several interventions have been mounted to reduce anorexia in adolescents, as reported in the recent literature. These include general education classes, weight maintenance, reducing excessive Internet use, teletherapy, cognitive behavior therapy and dialectical behavior therapy (Table 4).

Variables	First Authors
Educational program	Ovejero
Weight maintenance	Tannir
program evaluation	Zeller
Cognitive behavior therapy	Shiu, Vogel
Dialectical behavior therapy	Vogel

Table 4: Interventions.

In a study entitled “Universal prevention program of eating, weight and body image problems” that was conducted in Barcelona, Spain (N=308), 50-minute intervention sessions were given during school class hours [44]. The curriculum included media literacy, healthy eating habits, physical activity, emotional intelligence and activism. This program resulted in reduced eating, weight and body image problems. A regression analysis would have been helpful to determine the variance that was explained by each component of the intervention program in order to design more focused, transportable intervention programs.

One of the more obvious intervention strategies is to focus on normal weight maintenance. In a study called “Body composition in adolescents and young adults with anorexia”, anorexia, as usual, was noted to result in decreased body fat mass and bone mineral density [45]. The loss of lean and skeletal body mass occurred primarily in the extremities rather than central regions. Surprisingly, one year of normal weight maintenance in this study led to normalized body mass. And, after 30 months, bone mineral density returned to normal. These findings highlight the need for “food for body mass and bone mineral density”.

Inasmuch as adolescents with anorexia are noted to spend excessive time on Internet, internet-based interventions have been conducted to take advantage of their time there. These internet-based interventions were included in a systematic review that was entitled “Evaluating reach, adoption, implementation and maintenance of internet-based interventions” [46]. The data suggested that 55% of the programs were reaching adolescents with anorexia, 54% were being implemented, 47% were proving to be effective, 35% were being adopted by others and 18% of the programs were being maintained. These data are promising except for the low maintenance figure (18%). Adolescents with anorexia may be excessively using internet but apparently not for internet interventions. An exception has been noted for a teletherapy program that was successfully used for adolescents with eating disorders during COVID [47]. During a lockdown like that, adolescents with anorexia may have been a more captive audience.

Cognitive behavior therapy (CBT) has been effective with adolescents who have addictive problems like obsessive compulsive disorder [48]. Although very little recent literature has focused on the relationship between anorexia and obsessive compulsive disorder, cognitive behavior therapy has been effectively used with adolescents who have anorexia in at least two recent studies. In a randomized controlled trial of unguided internet CBT as compared to three control trials, CBT had more positive effects at follow-up assessments conducted at 3 and 6 months [49]. Unfortunately, this was a small sample of 94 participants and significant attrition had occurred.

In a systematic review of 50 CBT studies and 40 dialectical behavior therapy studies, both types of therapy were considered

reasonably feasible, acceptable and possibly effective for eating disorders [50-52]. These conclusions were not surprising given that these therapies are noted to be similar protocols and to have similarly positive effects on other disorders.

Limitations of this literature

This recent literature on eating disorders has been primarily focused on anorexia which may reflect the disproportionate number (85%) of anorexic adolescents in the eating disorder population. However, research is needed on a broader array of eating disorders in adolescents as well as comparisons of the various eating disorders.

The literature is consistent on gender findings with more females experiencing anorexia, but the gender disparity is not necessarily true for other eating disorders. Conflicting data exist for other predictor variables as, for example, attachment problems. Attachment problems concerning mothers have been reported in some studies, but the same problems have been noted for fathers in other studies.

Many confounding variables have been apparent in this literature. Those variables include not only body dissatisfaction but also psychological problems, for example, depression as the primary comorbidity. The measures have typically been self or parent-reported and they have been so highly variable across studies that meta-analysis could not be conducted. Perhaps more problematically, regression analyses have rarely been conducted to determine the relative variance that the predictor variables have contributed to anorexia. In addition, very little mechanism research has been conducted, and that research has been limited to fMRI and evoked potential studies.

The most significant problem may be that cross-sectional versus longitudinal studies have been the norm so that causality could not be determined. Further, experimental studies are needed such as the study that presented food stimuli to those with anorexia versus healthy controls and recorded behavioral and physiological responses.

Nonetheless, the recent literature on anorexia in adolescents has been informative, and several intervention studies have been mounted that have yielded positive effects. Even surprising effects have been noted such as food maintenance reversing the reduction of grey matter in a relatively short period of time. Other therapies such as cognitive behavior therapy and dialectical behavior therapy have also reduced anorexic behavior and its negative effects.

Conclusions

The prevalence of anorexia nervosa has ranged from 27% in non-clinical samples to 85% in samples of adolescents with eating disorders, with twice the prevalence noted in females. Several correlates of anorexia are reported in the recent literature reviewed

here including vegetarian diets, personality characteristics such as internalizing and perfectionism as well as behavior problems including impulsivity, dysregulation and being victimized. Comorbidities have included social anxiety, depression and suicidal ideation. In most of these studies, it is not clear which is the primary disorder, as most of the samples are cross-sectional rather than longitudinal. Several of the correlates have also been identified as risk factors including gender, early attachment disturbances, excessive Internet use and negative effects of COVID-19. Potential underlying mechanisms have included involvement of the prefrontal area of the brain based on fMRI and evoked potential research. Fortunately, negative effects of anorexia including decreased body fat mass and bone mineral density as well as lower cortical thickness and less grey matter have been reversed following weight gain. Other effective interventions have included cognitive behavior and dialectical behavior therapy.

References

1. Lin JA, Jhe G, Vitagliano JA, Milliren CE, Spigel R, et al. (2021) The Association of Malnutrition, illness duration, and pre-morbid weight status with anxiety and depression symptoms in adolescents and young adults with restrictive eating disorders: a cross-sectional study. *J Eat Disord* 17: 60.
2. Stefanova E, Bakalár P, Baška T (2020) Eating-Disordered Behavior in Adolescents: Associations with Body Image, Body Composition and Physical Activity. *Int J Environ Res Public Health* 17: 6665.
3. Zanna V, Criscuolo M, Mereu A, Cinelli G, Marchetto C, et al. (2020) Restrictive eating disorders in children and adolescents: a comparison between clinical and psychopathological profiles. *Eat Weight Disord* 26: 1491-1501.
4. Sergeantanis TN, Chelmi ME, Liampas A, Yfanti CM, Panagouli E, et al. (2020) Vegetarian Diets and Eating Disorders in Adolescents and Young Adults: A Systematic Review. *Children (Basel)* 8: 12.
5. Weinbach N, Lock J, Bohon C (2020) Superior response inhibition to high-calorie foods in adolescents with anorexia nervosa. *Behav Res Ther* 124: 103441.
6. Caqueo-Urizar A, Urzúa A, Flores J, Acevedo D, Lorca JH, et al. (2021) Relationship between eating disorders and internalized problems in Chilean adolescents. *J Eat Disord*. 26 :118.
7. Malagoli C, Cerro PF, Vecchiato C, Usai MC (2021) Cognitive and emotional regulation in adolescents and young women with eating disorders. *Eat Weight Disord* 26: 375-383.
8. Schilder CMT, Sternheim LC, Aarts E, van Elburg AA, Danner UN (2021) Relationships between educational achievement, intelligence, and perfectionism in adolescents with eating disorders. *Int J Eat Disord* 54: 794-801.
9. Vacca M, Balleisio A, Lombardo C (2021) The relationship between perfectionism and eating-related symptoms in adolescents: A systematic review. *Eur Eat Disord Rev* 29: 32-51.
10. Evans BC, Felton JW, Lagacey MA, Manasse SM, Lejuez CW, et al. (2019) Impulsivity and affect reactivity prospectively predict disordered eating attitudes in adolescents: a 6-year longitudinal study. *Eur Child Adolesc Psychiatry* 28: 1193-1202.
11. Trompeter N, Bussey K, Forbes MK, Hay P, Goldstein M, et al. (2022) Emotion Dysregulation and Eating Disorder Symptoms: Examining Distinct Associations and Interactions in Adolescents. *Res Child Adolesc Psychopathol* 50: 683-694.

12. Perthes K, Kirschbaum-Lesch I, Legenbauer T, Holtmann M, Hammerle F, et al. (2021) Emotion regulation in adolescents with anorexia and bulimia nervosa: Differential use of adaptive and maladaptive strategies compared to healthy adolescents. *Int J Eat Disord* 54: 2206-2212.
13. Nalbant K, Kalaycı BM, Akdemir D, Akgül S, Kanbur N (2019) Emotion regulation, emotion recognition, and empathy in adolescents with anorexia nervosa. *Eat Weight Disord* 24: 825-834.
14. Marco JH, Tormo-Irun MP, Galán-Escalante A, Gonzalez-García C (2018) Is Cybervictimization Associated with Body Dissatisfaction, Depression, and Eating Disorder Psychopathology? *Cyberpsychol Behav Soc Netw* 21: 611-617.
15. Catone G, Pisano S, Muzzo G, Corrado G, Russo K, et al. A glance into psychiatric comorbidity in adolescents with anorexia nervosa. *Minerva Pediatr* 72: 501-507.
16. Li HJ, Li J, Qi M, Song TH, Chen JX (2021) The Mediating Effect of Self-Control on Depression and Tendencies of Eating Disorders in Adolescents. *Front Psychiatry* 12: 690245.
17. Lekgabe E, Pogos D, Sawyer SM, Court A, Hughes EK (2021) Borderline personality disorder traits in adolescents with anorexia nervosa. *Brain Behav* 11: e2443.
18. Wang SB, Mancuso CJ, Jo J, Keshishian AC, Becker KR, et al. (2020) Restrictive eating, but not binge eating or purging, predicts suicidal ideation in adolescents and young adults with low-weight eating disorders. *Int J Eat Disord* 53: 472-477.
19. Mereu A, Fantoni T, Caini S, Monzali F, Roselli E, et al. (2022) Suicidality in adolescents with onset of anorexia nervosa. *Eat Weight Disord* 27: 2447-2457.
20. Petrovics P, Nagy A, Sandor B, Palfi A, Szekeres Z, et al. (2021) Examination of Self-Esteem, Body Image Eating Attitudes and Cardiorespiratory Performance in Adolescents. *Int J Environ Res Public Health* 18: 13172.
21. Suarez-Albor CL, Galletta M, Gómez-Bustamante EM (2022) Factors associated with eating disorders in adolescents: a systematic review. *Acta Biomed* 93: e2022253.
22. Laporta-Herrero I, Jáuregui-Lobera I, Barajas-Iglesias B, Serrano-Troncoso E, Garcia-Argibay M (2021) Attachment to parents and friends and body dissatisfaction in adolescents with eating disorders. *Clin Child Psychol Psychiatry* 26 : 154-166.
23. Nalbant K, Kalaycı BM, Akdemir D (2020) Attachment Security and Perceived Expressed Emotion in Adolescents with Anorexia Nervosa. *Türk Psikiyatri Derg* 31: 22-30.
24. Cortés-García L, Viddal KR, Wichstrøm L, Senra C (2022) Mediating role of depressive symptoms linking insecure attachment and disordered eating in adolescents: A multiwave longitudinal study. *Dev Psychopathol* 34: 115-127.
25. Uchôa FNM, Uchôa NM, Daniele TMDC, Lustosa RP, Garrido ND, et al. (2019) Influence of the Mass Media and Body Dissatisfaction on the Risk in Adolescents of Developing Eating Disorders. *Int J Environ Res Public Health* 16: 1508.
26. Šabláturová N, Gottfried J, Blinka L, Ševčíková A, Husarova D (2021) Eating disorders symptoms and excessive internet use in adolescents: the role of internalising and externalising problems. *J Eat Disord* 9: 152.
27. Frieiro P, González-Rodríguez R, Domínguez-Alonso J (2022) Self-esteem and socialisation in social networks as determinants in adolescents' eating disorders. *Health Soc Care Community* 30: 1-9.
28. Ioannidis K, Taylor C, Holt L, Brown K, Lochner C, et al. (2021) Problematic usage of the internet and eating disorder and related psychopathology: A multifaceted, systematic review and meta-analysis. *Neurosci Biobehav Rev* 125: 569-581.
29. Vaccaro CM, Guarino G, Conte D, Ferrara E, Ragione LD, et al. (2021) Social networks and eating disorders during the Covid-19 pandemic. *Open Med (Wars)* 16: 1170-1174.
30. Spettigue W, Obeid N, Erbach M, Feder S, Finner N, et al. (2021) The impact of COVID-19 on adolescents with eating disorders: a cohort study. *J Eat Disord* 9: 65.
31. Cerniglia L, Cimino S (2022) Eating Disorders and Internalizing/Externalizing Symptoms in Adolescents before and during the COVID-19 Pandemic. *J Am Nutr Assoc* 17: 1-7.
32. Field T, Mines S, Poling S, Bendell D, Veazey C. (2021) Stressors and buffers during a COVID-19 lockdown: A narrative review. *Journal of Psychiatry Research Reviews & Reports. SRC/JPSR*-128.
33. Vitagliano JA, Jhe G, Milliren CE, Lin JA, Spigel R, et al. (2021) COVID-19 and eating disorder and mental health concerns in patients with eating disorders. *J Eat Disord* 9: 80.
34. Skella P, Chelmi ME, Panagouli E, Garoufi A, Psaltopoulou T, et al. (2022) Orthorexia and Eating Disorders in Adolescents and Young Adults: A Systematic Review. *Children (Basel)* 9: 514.
35. Martinovic D, Tokic D, Martinovic L, Rakusic M, Kumric M (2022) Orthorexia nervosa and its association with narcissism in fitness center users. *Eat Weight Disord* 27: 2155-2163.
36. Vaccari G, Cutino A, Luisi F, Giambalvo N, Navab Daneshmand S, et al. (2021) Is orthorexia nervosa a feature of obsessive-compulsive disorder? A multicentric, controlled study. *Eat Weight Disord* 26: 2531-2544.
37. Yılmaz H, Karakuş G, Tamam L, Demirkol ME, Namlı Z, et al. (2020) Association of Orthorexic Tendencies with Obsessive-Compulsive Symptoms, Eating Attitudes and Exercise. *Neuropsychiatr Dis Treat* 16: 3035-3044.
38. Laghi F, Pompili S, Bianchi D, Lonigro A, Baiocco R (2020) Psychological characteristics and eating attitudes in adolescents with drunkorexia behavior: an exploratory study. *Eat Weight Disord* 25: 709-718.
39. Ziv A, O'Donnell JM, Ofei-Tenkorang N, Meisman AR, Nash JK, et al. (2020) Correlation of Functional Magnetic Resonance Imaging Response to Visual Food Stimuli With Clinical Measures in Adolescents With Restrictive Eating Disorders. *J Adolesc Health* 67: 209-217.
40. Gaudio S, Olivo G, Beomonte Zobel B, Schiöth HB (2018) Altered cerebellar-insular-parietal-cingular subnetwork in adolescents in the earliest stages of anorexia nervosa: a network-based statistic analysis. *Transl Psychiatry* 8: 127.
41. Wu J, Willner CJ, Hill C, Fearon P, Mayes LC, et al. (2018) Emotional eating and instructed food-cue processing in adolescents: An ERP study. *Biol Psychol* 132: 27-36.
42. García-García I, Garolera M, Ottino-González J, Prats-Soteras X, Prunell-Castañé A, et al. (2021) Restrained Eating Is Associated with Lower Cortical Thickness in the Inferior Frontal Gyrus in Adolescents. *Brain Sci* 11: 978.
43. Martin Monzon B, Henderson LA, Madden S, Macefield VG, Touyz S, et al. (2017) Grey matter volume in adolescents with anorexia nervosa and associated eating disorder symptoms. *Eur J Neurosci*. 46: 2297-2307.
44. Jordana Ovejero O, Espinoza Guzmán P, González González M, Subiza Pérez I, Becerra Castro A, (2020) Universal prevention program of eating, weight and body image problems in adolescents: A 12-month follow-up. *Psicothema* 32: 204-213.

45. Tannir H, Itani L, Kreidieh D, El Masri D, Traboulsi S, et al. (2020) Body Composition in Adolescents and Young Adults with Anorexia Nervosa: A Clinical Review. *Curr Rheumatol Rev* 16: 92-98.
46. Zeiler M, Kuso S, Nacke B, Klesges LM, Waldherr K (2020) Evaluating reach, adoption, implementation and maintenance of Internet-based interventions to prevent eating disorders in adolescents: a systematic review. *Eur J Public Health* 30: 179-188.
47. Graell M, Morón-Nozaleda MG, Camarneiro R, Villaseñor Á, Yáñez S, et al. (2020) Children and adolescents with eating disorders during COVID-19 confinement: Difficulties and future challenges. *Eur Eat Disord Rev* 28: 864-870.
48. Field T (2022) Obsessive compulsive disorder in youth: A narrative review. *American journal of psychiatry research and reviews*, in press.
49. Shu CY, Watson HJ, Anderson RA, Wade TD, Kane RT (2019) A randomized controlled trial of unguided internet cognitive behaviour therapy for perfectionism in adolescents: Impact on risk for eating disorders. *Behav Res Ther* 120: 103429.
50. Vogel EN, Singh S, Accurso EC (2021) A systematic review of cognitive behavior therapy and dialectical behavior therapy for adolescent eating disorders. *J Eat Disord* 9: 131.
51. Pehlivanurk-Kizilkan M, Akgul S, Derman O, Kanbur N (2021) Predictors of bone mineral density in adolescents with atypical anorexia nervosa. *J Bone Miner Metab* 39: 678-683.
52. van Doornik SFW, Ostafin BD, Jonker NC, Glashouwer KA, de Jong PJ (2021) Low satisfaction with normative life domains in adolescents with anorexia nervosa. *Clin Psychol Psychother* 28: 1266-1274.