Review Article

Open Access   CrossMark

The diagnostic work-up of eating disorders

Abstract

Background: The mortality of Anorexia Nervosa (AN) is the highest among all psychiatric disorders, and Eating Disorders (ED) overall pose serious health threats to a significant proportion of the population. In spite of an increasing recognition of the clinical impact of ED, often, the general readiness and knowledge of the diagnostic work-up among Physicians is insufficient.

Material and method: A literature search of recent national and international scientific publications on the diagnostic work-up of ED was done in November 2015. PUBMED was the major source of information, but also known publications were utilized to collate the relevant information.

Result: The result is presented as essential components in the diagnostic work-up, where potential relevant clinical findings such as e.g. eating behaviours, co-morbidities, laboratory findings, medical risk and risk of suicidality, are all necessary to enable an accurate diagnosis as part of a multilayered clinical problem description, in the diagnosis of ED.

Discussion: Early and accurate diagnosis of ED will enable prompt initiation of relevant treatment. This is most optimally served by a multilayered clinical problem description, where the clinical diagnosis is one part, together with several other clinical aspects, of the diagnosis of ED.

Keywords: anorexia nervosa, bulimia nervosa, binge eating disorder, assessment, diagnosis

Magnus Sjogren

Institute for Clinical Medicine, Copenhagen University, Denmark

Correspondence: Magnus Sjogren, Institute for Clinical Medicine, Copenhagen University, Denmark, Email jan.magnus..sjoegren@regionh.dk

Introduction

Classification of eating disorders

There are three primary EDs as presented in the Diagnostic and Statistical Manual of Mental Disorders-5thedition (DSM-5)[1] and these are anorexia nervosa (AN), bulimia nervosa (BN) and binge eating disorder (BED).

Anorexia Nervosa (AN): Anorexia Nervosa is characterized by an enduring restriction of food intake resulting in low body weight and low body mass index (BMI). This may progress to cachexia. Accompanying symptoms are an irrational fear of weight gain, excessive exercise, distorted body image and menstrual dysfunction in women.[2] The prevalence of AN prevalence is estimated to be between 0.3 and 0.9%, and approximately 90% of all cases are female.[2] In addition, it carries the highest mortality rate of any of the psychiatric illnesses with suicide being a common cause of death.[3–7] According to the diagnostic criteria, the body weight is so low that health impairment is to be at risk. In adults, patient enter into a zone of increased health risk when BMI drops below 17.5kg/m2; in children and adolescents, it corresponds to being below the 10th BMI-for-age percentile. Due to that children have a lower amount of fat mass than adults or adolescents, the somatic sequelae of starving early in life are more deleterious and impacts for, e.g., bone density, growth in height, and cerebral maturation. Co-morbid depression, anxiety, or compulsive disorders are often seen.

Information box 1: ICD-10 diagnostic criteria for anorexia nervosa (F 50.0)

a. Actual body weight at least 15% below expected weight, or body mass index 17.5 or less (in adults).

b. Weight loss is caused by the avoidance of high-calorie foods and at least one of the following:

   i. Self-induced vomiting

   ii. Self-induced purging

   iii. Excessive exercise

   iv. Use of appetite suppressants and/or diuretics

a. Distorted body image as a specific psychological disorder

b. Endocrine disorder, manifest in the female as amenorrhea and in the male as a loss of libido

c. If onset is prepubertal, the puberty in boys and girls may be delayed (growth ceases; in girls the breasts do not develop)

Bulimia Nervosa (BN): Bulimia Nervosa is typified by repeated episodes of binge eating (i.e. excessive food intake paired with a sense of loss of control), and associated with compensatory behaviors for example self-induced vomiting, laxative use, excessive exercise, and/or food restriction. The prevalence of BN is estimated to between 0.8 to 2.9% and, just as with AN, it is more frequent in women with men being affected in only 5% to 10% of cases.[8] Similar to AN, BN also carries an elevated mortality, albeit not as extreme as anorexia.[2,7,9,10]

Information box 2: ICD-10 diagnostic criteria for bulimia nervosa (F 50.2)

a. The constant obsession with eating and the overwhelming desire for food leads to episodes of eating large amounts of food in short time periods.

b. There are efforts made to reduce the effect of eating foods perceived as fattening in the form of self-induced vomiting and other purging techniques, alternating episodes of calorie restriction, using appetite suppressants, thyroid preparations or diuretics. People with diabetes may refrain from using their insulin treatment.

c. There is an intense fear of becoming fat, which leads to the desire to reach a specific body weight much lower than is considered normal or healthy for height and age.

d. In many cases, the bulimia follows an episode of anorexia nervosa, although the period of time between the two disorders may vary considerably.

Binge Eating Disorder (BED): Which is the most recent ED addition to the DSM-5 criteria (in the International Classification of Diseases (ICD-10;[11]) it may only be coded under the category "eating disorder, unspecified"; F50.9), is described as repeated binge eating episodes in the absence of recurrent compensatory behaviors. It is the most prevalent ED having a lifetime prevalence of between 2 and 3.5%. The gender distribution is more even compared to the other ED.[12,13] In accordance with over-eating and loss of control, BED patients are often overweight or obese and hold an increased risk of developing type II diabetes, cardiovascular disease and metabolic syndrome.[14–16] The course of BED has been the object of less research than AN and BN, but its prognosis is better. Remission rates in outpatient psychotherapy range between 50% and 80%.

Information box 3: Diagnostic criteria for binge eating disorder

a. Recurring episodes of binge eating. The two characteristics of a binge eating episode are:

    i. Eating a much larger amount of food than most people would consider normal under similar circumstances and within the same time frame (eating may continue for several hours).

    ii. While eating, there is a feeling of loss of control over the amount of food or type of food being consumed.

a. Binge eating episodes are related to at least three of the following:

    i. Eating until feeling uncomfortably full.

    ii. Eating large quantities of food when not even hungry.

    iii. Eating noticeably faster than is considered normal.

    iv. Eating alone due to embarrassment of overeating.

    v. Feelings of disgust, depression, or guilt after a binge.

a. There is obvious distress concerning binge eating behavior.

b. On average, binge eating takes place twice weekly, and has done so for 6 months.

c. There are no recurring efforts to compensate for binge eating, such as purging or excessive exercise. The disorder occurs at times other than during episodes of anorexia nervosa or bulimia nervosa.

Eating disorders are of great social significance, especially AN and BN since they almost exclusively affect young people, having serious consequences for their physical and mental health. The direct and indirect costs of ED are high,[17] and estimates have given an average cost of 5300 EUR for AN and 1300 EUR for BN per patient per year, and 4647 EUR in inpatient costs per patient.[18] The overall costs for a patient with AN has been calculated to about 12 800 EUR.[19] Although the figures differ, in general, the costs are much above the average costs for inpatients with other diseases. There are as yet no available cost analyses for BED.

Prognosis

ED are serious conditions with an overall mortality rate in AN patients that is about 10-18times higher than the expected mortality for age-matched women in the US,[20–22] and rates of suicide are 56times higher than that expected for age and gender.[23] The mortality in BN is lower than in AN, and about 50% of patients with BN are free of symptoms after more than 5years, while about 20% continue to fulfill all the criteria of the disorder.[24] For AN, the long-term outcome is similar with a chronicity of about 20% after 10years.[25]

Diagnostic overlap and wandering

A couple of studies have found mutual both genetic factors and phenotypic characteristics in AN and Bulimia Nervosa (BN) especially, but also in Eating Disorder Not Otherwise Specified (EDNOS), and there is a considerable rate of cross-over between AN, BN and EDNOS, ranging between 4 and 36%.[25–28] Thereby, it has been proposed to describe them together. In addition, family studies have revealed that AN and BN do not aggregate independently within families, but rather that the risk of developing both disorders is elevated in family members of individuals with an eating disorder.[29,30] Furthermore, a Swedish twin study, approximately half of the genetic factors contributed to liability of both AN and BN.[31] Future studies will need to clarify the relation further.

In one study, the cross-over of ED was investigated and AN found to be the most stable and BED the most variable diagnosis. At all follow-up investigations, more patients changed from AN or BED to BN than vice versa. There was no diagnostic crossover from AN to BED or vice versa found. Overall, BED showed the greatest variability and AN the greatest stability over time, leading tha authors to conclude that AN and BED are nosologically quite distant disorders.[27]

Co-morbidity

Comorbidity in Eating disorders is very common.[12,32] For example, developmental disorders (e.g. autistic spectrum and/or attention-deficit hyperactivity disorder) have been reported in about 20% of patients with anorexia nervosa,[33,34] and a small proportion of adults with attention-deficit hyperactivity disorder also suffer from additional symptoms of eating disorders.[35] Both in affected patients with ED, both before and after the onset of the disorder, obsessive compulsive traits[13,36] or disorder,[37] and anxiety disorders,[38,39] and some borderline traits,[40] have been reported. In addition, similar traits have been found in family members.[40,41] In BN and BED, co-morbid affective disorders,[42,43] and alcohol[44] or substance[45] abuse have been described.

Diagnostic work-up of eating disorders

Principles: In the diagnostic work-up of a suspected eating disorder, a comprehensive assessment of the individual and their situation should be done in order to verify the presence of an ED, and if present, determine what type of ED, exclude medical/secondary causes of the ED, assess potential comorbid psychiatric or somatic diagnoses, evaluate medical and psychiatric health risks, and determine a strategy for treatment. The treatment strategy should include consideration of medical risk, risk of suicide, treatment level needed i.e. outpatient or inpatient treatment and engagement of ED specialists. Going forward, follow-up assessments should be done due to the changing status of an individual with ED in the course of the treatment. Below follows a description of necessary areas in the initial assessment of adults with ED such as the following.

Medical history: Starting with collecting information about medical history including heredity, previous somatic and psychiatric illnesses, social and family situation, allergies, and childhood disorders, will enable a broad picture of the patient's health status. Then moving into the previous and current situation relating to eating disorders, asking various questions concerning symptoms of eating disorders is

essential and should include for example: dietary restriction; weight loss; inability to restore weight; body image disturbance; fears about weight gain; binging; purging; excessive exercise; early satiety; constipation; and the use of laxatives, diuretics, or medications to lose or maintain low weight.[1]

Specifically addressing eating behavior and attitudes to weight will facilitate the diagnosis and help in setting the treatment strategy. Example of behavioral questions are:

a. How long have you been worried about your weight?

b. Do you exercise? How often?

c. Have you found any other ways apart from dieting to lose weight?

d. Are you having any physical symptoms?

e. Have you ever vomited because you were uncomfortably full?

f. Have others expressed concern that you're too thin?

g. Do you often think about food often?

h. Do you eat alone or in secret, separating yourself when eating, from others?

i. How long does it usually take for you to eat?

j. Do you usually divide food into very small pieces before you eat?

k. Have any of your family members ever had symptoms of an eating disorder or been diagnosed with an eating disorder?

Psychological and cognitive evaluation: Patients with ED may suffer from cognitive impairments, especially during starvation. Thereby, it is important to assess attention, short-term memory, thought processing, cognitive flexibility and concentration.[46] On brain imaging, whilst it is not a routine investigation, findings of reduced grey matter volumes that often do not reverse following weight recovery may be found.[47]

Predisposing and precipitating factors: An investigation of potential predisposing and precipitating factors should be done and include family history, especially of psychiatric and eating disorders, interpersonal problems, early attachment and developmental difficulties, premorbid obesity, and dieting or other causes of rapid weight loss.[48] To assess the event of rapid weight loss is relevant due to the cognitive changes that a rapid weight loss, from any cause including physical illness, may trigger. It may lead to obsessive thinking about food and precipitate and perpetuating the symptoms of anorexia nervosa.[49]

Psychiatric Disorders/Examination: Co-morbid psychiatric illness such as depression, anxiety, substance abuse, personality disorders, anxiety disorders and deliberate self-harm should be assessed early on and routinely. The lifetime prevalence of comorbid disorders has been reported to be in the range of 55%, in community adolescent samples, to 96% ,in adult samples[38,50–56] and the rates of comorbidity are gender equal.[57] Anxiety disorder of almost any type may occur, as exemplified in a tudy by Swinburne who reported social phobia to be most common (42%), followed by posttraumatic stress disorder (26%) and generalized anxiety disorder (23%).[58] The anxiety, especially the social anxiety, may not solely be related to eating in public, but may also pre-date the onset of the eating disorder. However, depression, obsessional thinking, anxiety and other psychiatric symptoms may mirror the reversible effects of starvation on the brain.[49]

Risk of suicidality should also routinely be assessed, and frequently during the course of the illness. All ED run a higher risk of mortality, suicide being a major cause of death in this population, especially in AN where the risk of mortality is three times higher than in schizophrenia, representing the highest mortality among all psychiatric disorders.

Nutritional and fluid intake: To retrieve a full picture og the health status, an assessment of nutritional and fluid intake, with specific enquiries made as to the sufficiency of main meals and snacks consumed. Collateral sources of information, such as from family members and other clinicians involved, should be utilized. Since patients with eating disorders often minimize symptoms, show poor insight or markedly reduced understandings of the seriousness of symptoms, especially in cases of AN, collateral information may be essential to gain full information about current nutritional status.[1]

Somatic disorders

An investigation of medical complications and current level of medical risk is part of the basic assessments. In order to determine if immediate hospitalization is required, it should include a brief physical examination including measurement of weight, height, calculation of BMI, seated and standing pulse rate to detect resting bradycardia and/or tachycardia on minimal exertion due to cardiac deconditioning, blood pressure (seated and standing) and temperature.

The assessment should also include any history of fainting, lightheadedness, palpitations, chest pain, shortness of breath, ankle swelling, weakness, tiredness and amenorrhea or irregular menses. Gastrointestinal signs include intestinal dilation from constipation and diminished intestinal motility.

Cardiovascular complications account for most of the morbidity and mortality associated with anorexia nervosa. An electrocardiogram (ECG) should be taken to assess risk of arrhythmia. Frequent findings in AN include sinus bradycardia, ST-segment elevation, T-wave flattening, low voltage, and rightward QRS axis. QT-interval prolongation may indicate that the patient is at risk for cardiac arrhythmias and sudden death.[59,60] In addition, occasionally it may be advisable to do an echocardiography which may reveal changes in ventricular mass and mitral valve prolapse.

When repeated vomiting is present, a chest radiograph may be helpful to exclude rib fractures or pneumomediastinum. Furthermore, X-ray investigation may reveal stress fractures due to the general vulnerability in AN associated with osteopenia and excessive exercising.

Radiographic evidence of emphysematous changes may be present on chest computed tomography (CT) scans of patients with anorexia nervosa;[61] however, these changes resolve with refeeding and weight normalization, unlike those seen in chronic obstructive pulmonary disease.

Furthermore, if a patient has been underweight for six months or longer, with or without amenorrhea, a bone mineral density scan should be routinely performed and thereafter every two years during the time which the patient suffers from an eating disorder.[62]

Laboratory tests

Laboratory investigations are routine and should be considered both as baseline assessment and done repeatedly in case of state change. The laboratory tests may include the following:

a. **A Complete blood count (CBC):** The hemoglobin levels are typically normal, although elevations are observed in cases

of dehydration. If anemia is observed, it is usually not due to menstrual blood loss, as women with AN usually are amenorrheic, and thereby further investigation for anemia are warranted. The white blood cell (WBC) count is often decreased due to increased margination, and thrombocytopenia may also be observed. The leukopenia is not a sign that the patient is at an increased risk for infection. Neutropaenia may be observed in severe cases of starvation as a sign of bone marrow suppression.

b. **Erythrocyte sedimentation rate (ESR):** The ESR is usually normal in anorexia nervosa. Therefore, elevations should prompt a search for an organic etiology, Of interest is that in systemic lupus erythematosus (SLE), a secondary ED may be induced by steroid-induced changes in weight and body shape. Furthermore, AN may also be a core presentation of neuropsychiatric SLE. Thereby, in patients with AN who have joint symptoms, a positive antinuclear antibody, or lymphopenia, investigations should be made to exclude SLE, especially as treatment of the SLE may be associated with recovery from anorexia nervosa.[63]

c. A Metabolic panel looking for signs of hypoglycaemia, metabolic alkalosis or acidosis should be done.

d. Hypoglycemia may result from the lack of glucose precursors in the diet or low glycogen stores; low blood glucose may also be due to impaired insulin clearance.

e. Hypokalemic hypochloremic metabolic alkalosis: Observed with vomiting.

f. Acidosis: Observed in cases of laxative abuse

g. Urinalysis for signs of protein and blood in the urine.

h. Pregnancy test (in females of childbearing age).

i. Electrolytes concentration assessment is essential and done to find evidence of hypokalaemia, hypophosphataemia, and hypomagnesaemia, all signs of risk of the refeeding syndrome. Potential other findings include:

j. Hyponatremia which may reflect excess water intake or the inappropriate secretion of antidiuretic hormone (ADH).

k. Hypokalemia as a result of diuretic or laxative use.

l. Elevated blood urea nitrogen (BUN): Renal function is generally normal except in patients with dehydration, in whom the BUN level may be elevated.

m. Liver function test results are usually minimally elevated.

n. Albumin and protein levels are usually normal, since, although the amount of food intake is restricted, patients with AN often focus their diet on high-quality proteins.

o. Thyroid function tests, prolactin, and serum follicle-stimulating hormone (FSH) levels can differentiate anorexia nervosa from alternative causes of primary amenorrhea.

p. Serum vitamin D and calcium levels may be helpful, especially if osteoporosis is suspected, and should always be obtained if a trial of bisphosphonates is attempted for confirmation of osteoporosis.[25,64]

q. A sudden and substantial elevation in cholesterol is observed in cases of starvation and may be secondary to either a) a decrease in triiodothyronine (T3) levels, b) low cholesterol-binding globulin levels, and/or c) leakage of intrahepatic cholesterol.

r. Fecal occult blood may be indicative of esophagitis, gastritis, or repetitive colonic trauma from laxative abuse.

Conclusion

To conclude, assessment of Eating Disorders should follow a broad approach, ensuring that both eating behaviors, psychological, psychiatric, nutritional and somatic aspects are considered. It is beneficial to consider a layered concept where several aspects are addressed and determined, resulting in the following:

1. A medical diagnosis

2. Co-morbid diagnoses

3. Risk of suicide

4. Health status

5. Nutritional status

6. Current level of medical risk

7. Determination of treatment level needed (see below)

When all this has been determined, a decision on the need for additional assessments as well as the optimal setting for treatment should be done. Treatment of Eating disorders may be done at several levels, in an outpatient or inpatient setting, and should usually include a team of generalists and specialists working together. The team may include a general practitioner, psychiatrist, internist/endocrinologist, psychologist, dietician, physiotherapist and a specialized nurse. In cases when the general practitioner becomes a coordinator of treatment efforts, which is usually only in mild and stable ED cases, the communication from the patient, from relatives and the treatment team, is essential to detect early signs of state change, indicating the need for specialist treatment. Knowledge of expertise and researches in the area of practice, as well as an active communicative approach from the general practitioner, will ensure high quality. Usually, it is the specialist initiate that initiate specific ED. Furthermore, in the treatment program of ED, is is critical to ensure both immediate treatment of the disorder itself, treatment of medical complications, and prevention of relapses in the treatment program. The purpose of this article is to describe assessments of ED. For specific treatments and treatment programs of ED, see dedicated treatment reviews and national guidelines.

Acknowledgments

Conflicts of interest

Author declares there are no conflicts of interest.

Funding

References

1. American Psychiatric Association (2013) Diagnostic and Statistical Manual of Mental Disorders. (5th edn), (DSM-5®). American Psychiatric Publishing, Washington DC, USA.

2. Yilmaz Z, Hardaway JA, Bulik CM (2014) Genetics and epigenetics of eating disorders. Adv Genomics Genet 4(5): 131-150.

3. Arcelus J, Mitchell AJ, Wales J, Nielsen S (2011) Mortality rates in patients with anorexia nervosa and other eating disorders. A meta-analysis of 36 studies. Arch Gen Psychiatry 68(7): 724-731.

4. Chesney E, Goodwin GM, Fazel S (2014) Risks of all-cause and suicide mortality in mental disorders: a meta-review. World Psychiatry 13(2): 153-160.

5. Franko DL, Keshaviah A, Eddy KT, Krishna M, Davis MC, et al. (2013) A longitudinal investigation of mortality in anorexia nervosa and bulimia nervosa. Am J Psychiatry 170(8): 917-925.

6. Preti A, Rocchi MB, Sisti D, Camboni MV, Miotto P (2010) A comprehensive meta-analysis of the risk of suicide in eating disorders. Acta Psychiatr Scand 124(1): 6-17.

7. Smink FR, van Hoeken D, Hoek HW (2013) Epidemiology, course, and outcome of eating disorders. Curr Opin Psychiatry 26(6): 543-548.

8. Fichter MM 2008) Epidemiologie der Essstörungen. In: Herpertz S, de Zwaan M, et al. (Eds.), Handbuch Essstörungen und Adipositas. (Springer-Verlag: Heidelberg).

9. Berg KC, Crosby RD, Cao L, Peterson CB, Engel SG, et al. (2013) Facets of negative affect prior to and following binge-only, purge-only, and binge/purge events in women with bulimia nervosa. J Abnorm Psychol 122(1): 111-118.

10. Smyth JM, Wonderlich SA, Heron KE, Sliwinski MJ, Crosby RD, et al. (2007) Daily and momentary mood and stress are associated with binge eating and vomiting in bulimia nervosa patients in the natural environment. J Consult Clin Psychol 75(4): 629-638.

11. (2010) International Statistical Classification of Diseases and Related Health Problems. 10th revision WHO, Geneve.

12. Hudson JI, Hiripi E, Pope HG Jr, Kessler RC (2007) The prevalence and correlates of eating disorders in the National Comorbidity Survey Replication. Biol Psychiatry 61(3): 348-358.

13. Kessler RC, Berglund PA, Chiu WT, Deitz AC, Hudson JI (2013) The prevalence and correlates of binge eating disorder in the World Health Organization World Mental Health Surveys. Biol Psychiatry 73(9): 904-914.

14. Dingemans AE, Bruna MJ, van Furth EF (2002) Binge eating disorder: a review. Int J Obes Relat Metab Disord 26(3): 299-307.

15. Gluck ME, Geliebter A, Lorence M (2004) Cortisol stress response is positively correlated with central obesity in obese women with binge eating disorder (BED) before and after cognitive-behavioral treatment. Ann N Y Acad Sci 1032: 202-207.

16. Hudson JI, Lalonde JK, Coit CE, Tsuang MT, McElroy SL, et al. (2010) Longitudinal study of the diagnosis of components of the metabolic syndrome in individuals with binge-eating disorder. Am J Clin Nutr 91(6): 1568-1573.

17. Stuhldreher N, Konnopka A, Wild B, Herzog W, Zipfel S, et al. (2012) Cost-of-illness studies and cost-effectiveness analyses in eating disorders: a systematic review. Int J Eat Disord 45(4): 476-491.

18. Haas L, Stargardt T, Schreyoegg J, Schlösser R, Danzer G, et al. (2012) Inpatient costs and predictors of costs in the psychosomatic treatment of anorexia nervosa. Int J Eat Disord 45(2): 214-221.

19. Krauth C, Buser K, Vogel H (2002) How high are the costs of eating disorders - anorexia nervosa and bulimia nervosa - for German society? Eur J Health Econ 3(4): 244-250.

20. Mehler PS, Krantz M (2003) Anorexia nervosa medical issues. J Womens Health (Larchmt) 12(4): 331-340.

21. Steinhausen HC (2002) The outcome of anorexia nervosa in the 20th century. Am J Psychiatry 159(8): 1284-1293.

22. Steinhausen HC (2009) Outcome of eating disorders. Child Adolesc Psychiatr Clin N Am 18(1): 225-242.

23. Keel PK, Dorer DJ, Eddy KT, Franko D, Charatan DL, et al. (2003) Predictors of mortality in eating disorders. Arch Gen Psychiatry 60(2): 179-183.

24. Keel PK, Mitchell JE, Miller KB, Davis TL, Crow SJ (1999) Long-term outcome of bulimia nervosa. Arch Gen Psychiatry 56(1): 63-69.

25. Steinhausen HC, Weber S (2009) The outcome of bulimia nervosa: findings from one-quarter century of research. Am J Psychiatry 166(12): 1331-1141.

26. Eddy KT, Dorer DJ, Franko DL, Tahilani K, Thompson-Brenner H, et al. (2008) Diagnostic crossover in anorexia nervosa and bulimia nervosa: implications for DSM-V. Am J Psychiatry 165(2): 245-250.

27. Fichter MM, Quadflieg N (2007) Long-term stability of eating disorder diagnoses. Int J Eat Disord 40 Suppl: S61-S66.

28. Milos G, Spindler A, Schnyder U, Fairburn CG (2005) Instability of eating disorder diagnoses: prospective study. Br J Psychiatry 187: 573-578.

29. Strober M, Freeman R, Lampert C, Diamond J, Kaye W, et al. (2000) Controlled family study of anorexia nervosa and bulimia nervosa: evidence of shared liability and transmission of partial syndromes. Am J Psychiatry 157(3): 393-401.

30. Lilenfeld LR, Kaye WH, Greeno CG, Merikangas KR, Plotnicov K, et al. (1998) A controlled family study of anorexia nervosa and bulimia nervosa: psychiatric disorders in first-degree relatives and effects of proband comorbidity. Arch Gen Psychiatry 55(7): 603-610.

31. Bulik CM, Thornton LM, Root TL, Pisetsky EM, Lichtenstein P, et al. (2010) Understanding the relation between anorexia nervosa and bulimia nervosa in a Swedish national twin sample. Biol Psychiatry 67(1): 71-77.

32. Jacobi F, Wittchen HU, Holting C, Höfler M, Pfister H, et al. (2004) Prevalence, co-morbidity and correlates of mental disorders in the general population: results from the German Health Interview and Examination Survey (GHS). Psychol Med 34(4): 597-611.

33. Wentz E, Lacey JH, Waller G, Råstam M, Turk J, et al. (2005) Childhood onset neuropsychiatric disorders in adult eating disorder patients. A pilot study. Eur Child Adolesc Psychiatry 14(8): 431-437.

34. Gillberg IC, Gillberg C, Råstam M, Johansson M (1996) The cognitive profile of anorexia nervosa: a comparative study including a community-based sample. Compr Psychiatry 37(1): 23-30.

35. Nazar BP, Pinna CM, Coutinho G, Segenreich D, Duchesne M, et al. (2008) Review of literature of attention-deficit/hyperactivity disorder with comorbid eating disorders. Rev Bras Psiquiatr 30(4): 384-389.

36. Anderluh MB, Tchanturia K, Rabe-Hesketh S, Treasure J (2003) Childhood obsessive-compulsive personality traits in adult women with eating disorders: defining a broader eating disorder phenotype. Am J Psychiatry 160(2): 242-247.

37. Halmi KA, Tozzi F, Thornton LM, Crow S, Fichter MM, et al. (2005) The relation among perfectionism, obsessive-compulsive personality disorder and obsessive-compulsive disorder in individuals with eating disorders. Int J Eat Disord 38(4): 371-374.

38. Kaye WH, Bulik CM, Thornton L, Barbarich N, Masters K (2004) Comorbidity of anxiety disorders with anorexia and bulimia nervosa. Am J Psychiatry 161(12): 2215-2221.

39. Godart NT, Flament MF, Curt F, Perdereau F, Lang F, et al. (2003) Anxiety disorders in subjects seeking treatment for eating disorders: a DSM-IV controlled study. Psychiatry Res 117(3): 245-258.

40. Lilenfeld LR, Wonderlich S, Riso LP, Crosby R, Mitchell J (2006) Eating disorders and personality: a methodological and empirical review. Clin Psychol Rev 26(3): 299-320.

41. Strober M, Freeman R, Lampert C, Diamond J (2007) The association of anxiety disorders and obsessive compulsive personality disorder with anorexia nervosa: evidence from a family study with discussion of nosological and neurodevelopmental implications. Int J Eat Disord 40 Suppl: S46-S51.

42. McElroy SL, Kotwal R, Keck PE Jr (2006) Comorbidity of eating disorders with bipolar disorder and treatment implications. Bipolar Disord 8(6): 686-695.

43. Mangweth B, Hudson JI, Pope HG, Hausmann A, De Col C, et al. (2003) Family study of the aggregation of eating disorders and mood disorders. Psychol Med 33(7): 1319-1323.

44. Gadalla T, Piran N (2007) Co-occurrence of eating disorders and alcohol use disorders in women: a meta analysis. Arch Womens Ment Health 10(4): 133-140.

45. Calero-Elvira A, Krug I, Davis K, López C, Fernández-Aranda F, et al. (2009) Meta-analysis on drugs in people with eating disorders. Eur Eat Disord Rev 17(4): 243-259.

46. Hatch A, Madden S, Kohn MR, Clarke S, Touyz S, et al. (2010) In first presentation adolescent anorexia nervosa, do cognitive markers of underweight status change with weight gain following a refeeding intervention?. Int J Eat Disord 43(4): 295-306.

47. Phillipou A, Rossell SL, Castle DJ (2014) The neurobiology of anorexia nervosa: a systematic review. Aust N Z J Psychiatry 48(2): 128-152.

48. Machado BC, Gonçalves SF, Martins C, Hoek HW, Machado PP (2014) Risk factors and antecedent life events in the development of anorexia nervosa: a Portuguese case-control study. Eur Eat Disord Rev 22(4): 243-251.

49. Keys A (1950) The residues of malnutrition and starvation. Science 112(2909): 371-373.

50. Brand-Gothelf A, Leor S, Apter A, Fennig S (2014) The impact of comorbid depressive and anxiety disorders on severity of anorexia nervosa in adolescent girls. J Nerv Ment Dis 202(10): 759-762.

51. Bühren K, Schwarte R, Fluck F, Timmesfeld N, Krei M, et al. (2014) Comorbid psychiatric disorders in female adolescents with first-onset anorexia nervosa. Eur Eat Disord Rev 22(1): 39-44.

52. Dymek M, le Grange D (2002) Anorexia nervosa with comorbid psychosis and borderline mental retardation: a case report. Int J Eat Disord 31(4): 478-482.

53. Råstam M, Gillberg IC, Gillberg C (1995) Anorexia nervosa 6 years after onset: Part II. Comorbid psychiatric problems. Compr Psychiatry 36(1): 70-76.

54. Madden S, Morris A, Zurynski YA, Kohn M, Elliot EJ (2009) Burden of eating disorders in 5-13-year-old children in Australia. Med J Aust 190(8): 410-414.

55. Swanson SA, Crow SJ, Le Grange D, Swendsen J, Merikangas KR (2011) Prevalence and correlates of eating disorders in adolescents. Results from the national comorbidity survey replication adolescent supplement. Arch Gen Psychiatry 68(7): 714-723.

56. Milos GF, Spindler AM, Buddeberg C, Crameri A (2003) Axes I and II comorbidity and treatment experiences in eating disorder subjects. Psychother Psychosom 72(5): 276-285.

57. Raevuori A, Hoek HW, Susser E, Kaprio J, Rissanen A, et al. (2009) Epidemiology of anorexia nervosa in men: a nationwide study of Finnish twins. PLoS One 4(2): e4402.

58. Swinbourne J, Hunt C, Abbott M, Russell J, St Clare T, et al. (2012) The comorbidity between eating disorders and anxiety disorders: prevalence in an eating disorder sample and anxiety disorder sample. Aust N Z J Psychiatry 46(2): 118-131.

59. Lesinskiene S, Barkus A, Ranceva N, Dembinskas A (2008) A meta-analysis of heart rate and QT interval alteration in anorexia nervosa. World J Biol Psychiatry 9(2): 86-91.

60. Miller KK, Grinspoon SK, Ciampa J, Hier J, Herzog D, et al. (2005) Medical findings in outpatients with anorexia nervosa. Arch Intern Med 165(5): 561-566.

61. Coxson HO, Chan IH, Mayo JR, Hlynsky J, Nakano Y, et al. (2004) Early emphysema in patients with anorexia nervosa. Am J Respir Crit Care Med 170(7): 748-752.

62. Mehler PS, Cleary BS, Gaudiani JL (2011) Osteoporosis in anorexia nervosa. Eat Disord 19(2): 194-202.

63. Toulany A, Katzman DK, Kaufman M, Hiraki LT, Silverman ED (2014) Chicken or the egg: anorexia nervosa and systemic lupus erythematosus in children and adolescents. Pediatrics 133(2): e447-e450.

64. Ward L, Tricco AC, Phuong P, Cranney A, Barrowman N, et al. (2007) Bisphosphonate therapy for children and adolescents with secondary osteoporosis. Cochrane Database Syst Rev (4): CD005324.