

# Analysis of Psychological and Biological Parameters in Patients Affected by Anorexia Nervosa or Obesity

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## Abstract

**Background:** Depression and anxiety disorders have a high comorbidity with eating disorders (EDs), especially anorexia nervosa (AN) and obesity. This concomitance may complicate the diagnosis and treatment of these disorders. **Aim 1:** to study psychological and biological factors having significant roles in anxiety and depression in ED patients. **Aim 2:** to evaluate differences in ED individuals having anorexia nervosa and obesity. **Methods:** ED patients (n° 20 with anorexia nervosa; n° 15 with obesity) were enrolled at the Eating Disorder Unit of ASL Napoli 2 (Campania, Italy) and ASL Salerno (Campania, Italy) between January 2019 and January 2020. From all subjects we collected sociodemographic data, body mass index (BMI) and blood samples routinely tested for insulin, aspartate aminotransferase (AST) and alanine aminotransferase (ALT). We administered the State Trait Anxiety Inventory Scale (STAI) and Beck Depression Inventory-II (BDI-II) to assess the severity and chronicity of EDs and the presence of anxious and depressive symptoms. **Results:** We observed significant differences in the mean values of BMI in the groups of patients with AN (BMI = 16,28) or (BMI = 30,90) have clinical values that meet the diagnostic criteria while having normative values for Control group CRT (BMI = 22,1). **Conclusions:** The presence of several disorders at the same time can increase the severity and chronicity of EDs and make a favourable outcome of the treatment more problematic. Furthermore, the correlation between biological and psychological factors in our understanding of comorbidity in EDs patients may have implications for the evaluation and treatment of this population.

**Keywords:** depression, anxiety, biological parameters, anorexia nervosa, obesity

## 1. Introduction

### 1.1 About Eating Disorders

Eating disorders (EDs) are characterized by abnormal eating habits and excessive concern about body weight and physical appearance (Gowers & Shore, 2001). EDs are classified as anorexia nervosa (AN), bulimia nervosa (BN) and binge eating disorder (BED), which includes obesity. According to the *Diagnostic and Statistical Manual of Mental Disorders* (5<sup>th</sup> ed.) (DSM-5; APA, 2013), EDs may also encompass intermediate disorders such as the restrictive feeding and EDs subcategories, which do not fully meet the criteria for ED diagnosis (Bulik, 2013; Fassino et al., 2002). It is critically important to determine the spread of EDs in the population and to define their prevalence by conducting epidemiologic studies. That knowledge is fundamental to inform public opinion and awareness by health-care providers and institutions and to promote plans aiming at reducing barriers to treatment and at increasing early recognition of affected individuals (Napolitano et al., 2019).

It is well established that EDs have a multifactorial etiopathogenesis as a result of the interaction of genetic, psychological, environmental and sociocultural factors. These predisposing factors can be combined with precipitating factors (such as restrictive diet and personal psychological difficulties) or maintenance factors (such as fasting syndrome and positive reinforcement from the environment) and be further complicated by a high comorbidity rate (Striegel-Moore & Bulik, 2019) as well as by concomitant mental disorders.

### 1.2 Eating Disorders, Psychological States and Biological Risk

Numerous studies (Black-Becker et al., 2014; Hughes et al., 2013) show that depression and anxiety disorders are highly comorbid in EDs. Indeed, one study found that about 67% of hospitalized ED patients showed anxiety

disorders, whereas 90% showed depression (Blinder et al., 2006). Other studies revealed that anxiety and depression are significantly more elevated in ED patients than in healthy control patients (Billingsley-Marshall, 2013). Furthermore, many studies support the idea that depression (Franko et al., 2018) and anxiety (Carrot et al., 2017) are predictors of ED outcome, and that comorbidity may complicate diagnosis and treatment (Goel et al., 2021) either directly or as a function of ED severity and chronicity.

Depression and anxiety are both associated with obesity and are recognized as relevant risk factors for BED (Peterson et al., 2012). Most severe depression is associated with insulin resistance (Laville & Nazare, 2009). Despite this, how insulin resistance is associated with major depression has been poorly studied. In a study of blood samples taken from 1.269 patients, Watson and colleagues (2021), showed that patients suffering from major depression were largely resistant to insulin, in comparison to the control individuals, who never suffered from psychiatric disorders. On the other hand, patients already in remission did not show any differences from the controls. Finally, both systems for measuring insulin resistance have been found to be associated with the most severe cases of major depression. Stress and anxiety have variable effects: in most cases, they raise blood sugar level due to reduced insulin sensitivity, whereas in some people they can increase hypoglycaemic risk (Laville & Nazare, 2009).

### *1.3 Hypotheses of the Study*

As a result of different mechanisms, both patients suffering from obesity and those suffering from AN develop elevated levels of insulinemia (Borgo et al., 2017; Leyrolle et al., 2021; WHO, 2000). The present study aims to identify potential factors having significant effect on anxiety and depression in patients with EDs and to evaluate differences in ED individuals having AN or obesity. Furthermore, according to biopsychosocial models of ED diagnosis, we also tested ED patients for biochemical parameters, which could be useful for follow-up of the therapeutic approach.

## **2. Method**

### *2.1 Participants*

EDs patients were enrolled at the Eating Disorder Unit of ASL Napoli 2 (Campania, Italy) and ASL Salerno (Campania, Italy). Patients recruited between January 2019 and January 2020 were considered eligible for the study when diagnosed with AN and obesity by a psychiatrist on the basis of criteria established in the *DSM-5* (APA, 2013). Psychologists assessed the presence or absence of psychiatric comorbidities through a clinical psychiatric interview and continuous ambulatory follow-up. Patients were required to provide written informed consent before participating. A control group (CTR) matched for age and sex was referred to the study of Borgo and colleagues (2017).

### *2.2 Sociodemographic and Clinical Data*

Sociodemographic information, including age and gender, were collected on all subjects. For each patient, we calculated BMI in kilograms at the time of enrolment and height in meters. We measured BMI to indicate nutritional status. We classified the results as follows: <18.5 underweight, |18.5–24.9| healthy, |25.0–29.9| overweight and >30.0 obese (Hales et al., 2018). Blood samples were taken in the morning under fasting conditions and were routinely tested for cell blood count, insulin level, aspartate aminotransferase (AST) and alanine aminotransferase (ALT) activity.

### *2.3 Psychopathology Assessment*

We administered psychological tests to assess the severity and chronicity of EDs and the presence of anxious and depressive symptoms using the following two measures.

a) The State Trait Anxiety Inventory Scale (STAI) (Spielberg, 1985) is composed of two subscales (20 items each): the State Anxiety Scale (STAI-1), and the Trait Anxiety Scale (STAI-2). The STAI-1 scale evaluates current anxiety status, asking how respondent feels ‘right now’, using items that measure subjective feelings of apprehension, tension, nervousness, worry and activation/arousal of autonomic nervous system. The STAI-2 scale evaluates relatively stable aspects of ‘anxiety proneness’, including general states of calmness, confidence and security.

b) The Beck Depression Inventory-II (BDI-II) (Beck et al., 1996) is one of the most commonly used self-reporting measures for major depressive disorders. The questionnaire includes 21 items, divided on two subscales: affective and somatic. Each item is rated on a 4-point scale ranging from 0 to 3. The maximum total score is 63. Total score is used to estimate the level of depression:  $0 \pm 13$ , minimal depression;  $14 \pm 19$ , mild depression;  $20 \pm 28$ , moderate depression;  $29 \pm 63$ , severe depression.

### 3. Results

#### 3.1 Statistics and Data Analysis

We performed a statistical analysis using the statistical software SPSS–IBM v.23. We described sociodemographic and clinical characteristics with the mean (M) and standard deviation (SD) for the continuous variables and with frequencies and percentages for the categorical variables. We described the anxiety and depression scores using  $M \pm SD$ . We measured the effect of explanatory variables on anxiety and depression using qualitative crosstabs analysis and Spearman's correlation for the quantitative variables.

#### 3.2 Statistical Evidence of Biological Parameters

Sociodemographic and haematological parameters revealed in the three groups are reported in Table 1. Our results found that BMI, which determines the state of nutrition, was different among the groups. Indeed, in AN subjects, BMI was lower than 18.5, indicating severe underweight. In contrast, subjects with obesity had an average of  $BMI \geq 30.0$ , which corresponds to a severe overweight index. Finally, and as we would expect, the control group showed a mean of 22.1, corresponding to a normal BMI index.

Our analysis of the biochemical markers in blood samples obtained from the AN group as well as from the obese subjects revealed a marked hyperinsulinemia in either AN and obesity blood samples compared to that revealed in the control patients, confirming that hyperinsulinemia is a common hallmark of either AN or obesity (Sikaris, 2003). Conversely, the measure of AST or ALT activity, which is not related to AN or obesity, resulted in normal levels.

Table 1. Biological and clinical differences between groups

	<i>M(SD)</i>			Biochemical parameters range
	AN (n° 20)	Obesity (n° 15)	CRT (n° 15)	
Age	19.90(4.352)	25(4.309)	33.1(5.4)	-
BMI	16.28(1.966)	30.90(11.961)	22.1(2.6)	-
Insulin ( $\mu$ U/ml)	78.14(7.128)	79(6.606)	7.7(2.6)	0–25
AST (U/L)	2.283(0.499)	2.250(0.443)	22.1(4.2)	0.00–29.0
ALT (U/L)	1.073(0.132)	9.50(3.187)	25.4(7.7)	0.00–30 (male) 0.00–29 (female)

*Note.* M, mean; SD, standard deviation; AN, anorexia nervosa; CTR, control group; BMI, body mass index; ALT, alanine aminotransferase; AST, aspartate aminotransferase.

Psychopathological tests revealed significantly higher levels of depression and anxiety in ED groups compared to controls (Table 2). To measure the state and traits of anxiety we used the STAI test (Table 2). Our results showed that obese subjects attained a much higher average score on the scales (STAI-S = 53; STAI-T = 54.22), than patients with AN (STAI-S = 41.60; STAI-T = 41.80). Moreover, in these patients, the “trait” anxiety was much more significant than the “state” anxiety. Regarding the level of depression, patients with AN fell into the mild depression range (BDI-II = 14.75), while obese subjects had a moderate level (BDI-II = 21.60).

Table 2. Scores for psychopathological assessment

	<i>M(SD)</i>		
	AN (n° 20)	Obesity (n° 15)	CRT (n° 15)
STAI-S	41.60(29.908)	53(23.157)	33.1(5.4)
STAI-T	41.80(29.374)	54.22(22.393)	34.1(5.4)
BDI-II	14.75(7.421)	21.60(7.503)	2.5(2.6)

*Note.* M, Mean; SD, Standard Deviation; AN, Anorexia Nervosa; CTR, control group. Clinical cut-off: STAI =  $\geq 40$  clinical level; BDI-II = 0–13 (minimal); 14–19 (mild); 20–28 (moderate); 29–63 (severe).

### 4. Discussion

EDs are characterized by the presence of numerous complications, both from a psychological point of view (e.g., risk of suicide, depression, impulsivity and incongruous use of psychoactive substances) and from a physical point of view (Martin et al., 2019). The presence of several disorders at the same time can increase the severity and chronicity of EDs and make a favourable outcome of the treatment more uncertain. Numerous disorders can

occur in patients with EDs, even though not all studies have uncovered the same ones. Anxiety is one of the aspects most closely related to EDs, and it seems to represent a risk factor for the development of these disorders.

Calorie control, purging behaviours or excessive exercise can be attempted to control and manage anxiety and stress (Jansen et al., 2008). In fact, obese patients, being in a depressed or negative emotional state, often prefer foods with a high energy value. In our opinion this is only a secondary aspect. Indeed, obesity and depression share deeper metabolic relationships—linked to alterations in metabolism—in the blood levels of some hormones, including cortisol and insulin, and an increase in inflammatory factors such as cytokines (Hay, 2013; Navarro-Tapia et al., 2021).

We deem it conclusive not only that the emotional reaction to food can lead to overeating, but also that the nutrients consumed and the presence of obesity can influence mood and lead to depressive disorders, which occur through indirect and direct action on the central nervous system and through an impact on energy metabolism, endocrine function and the immune system (Hay & Caudino, 2012). In terms of psychological disease, our AN group had symptomatology of anxiety and depression, as did the obesity group.

Our study confirms that anxiety and depression are affected in patients with EDs, results consistent with findings of many studies suggesting that depressive and anxiety symptoms, among other variables, may be important targets in providing effective treatment across EDs. Furthermore, our data show that subjects with EDs display higher levels of trait anxiety, which was also structurally present in our subjects, who were unable to face daily vicissitudes and achieve a state of calm. In fact, a characteristic of EDs is the use of food as a vector and modulator of emotional state. In our recent study (Savarese et al., 2022) we found in a group of patients with AN that the psychological factors present also altered perceptions of their bodies, increasing their anxiety symptoms.

Psychotherapies such as cognitive-behavioural treatment or family therapy are treatments of choice for EDs, but pharmacotherapies have an important role in specific disorders, albeit with a moderate-to-weak evidence base.

Finally, managing emotion regulation (symptomatology of anxiety and depression) can greatly improve the well-being and quality of life of people with EDs and their attitude towards those disorders (Sloan et al., 2017).

This study has some limitations. First, the number of patients recruited with AN or obesity is limited, preventing a fair generalization of the results in the population as a whole. Second, it would be useful to hypothesize, consistently with the hypothesis of our study, about how to improve the investigation protocol of biological and psychological factors in a multicentre setting, and also to verify any differences before and after treatment. Finally, it would be better to recruit the control group at the same time as the patient group to limit any errors in the procedure, data collection and analysis.

### **Ethical Statement**

This study was conducted in accordance with the recommendations of the “Associazione Italiana di Psicologia” (AIP), and all participants provided written informed consent in accordance with the Declaration of Helsinki prior to participation. The protocol was approved by “AslNA3” (Napoli, Italy) committee (number 130/2021).

### **Data Availability**

Anonymized data are available upon request.

### **Declaration of Conflicts of Interest**

None.

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### **Informed Consent Statement**

Informed consent was obtained from all subjects involved in the study.

### **Author Contributions**

L. C. and G. S. conceptualization. L. C., V. P. and V. R. developed the proposal and research tool. G. S. and L. C. wrote the first draft with input and comments from all other authors. G.S. and L.C. conducted the statistical analysis. G. B. and V. P. contributed to the review of the article with input and comments from all the other authors. All authors contributed significantly and agree with the content of the manuscript. All authors have read and agreed to the published version of the manuscript.

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