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The role of Post-traumatic symptomatology in Anorexia Nervosa.

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To live on a day-to-day basis is insufficient for human beings;

we need to transcend, transport, escape;

we need meaning, understanding, and explanation;

we need to see over all patterns in our lives.

We need hope, the sense of a future.

And we need freedom (or, at least, the illusion of freedom) to get beyond ourselves,

whether with telescopes and microscopes and our ever-burgeoning technology,

or in states of mind that allow us to travel to other worlds,

to rise above our immediate surroundings.

Oliver Sacks, 2012. Altered States: self-experiments in chemistry. The New Yorker, 27.

To my sister, the best part of me

Summary

1. Introduction

1.1. Anorexia Nervosa

Eating Disorders (EDs) are debilitating illnesses characterized by distorted eating behaviors that often lead to severe physical and psychosocial consequences. Anorexia Nervosa (AN) is a severe Eating Disorder defined by restrictive eating patterns which cause an extremely low body weight (APA, 2013). AN has an estimated prevalence of 2.2% among women, and 0.3% among men (Roux et al., 2013). The onset of the illness is common during adolescence, and the AN trajectory is distinguished by alternating periods of recovery and relapse; only 33% of patients affected by AN fully recover (Meczekalski et al., 2013). AN presents the highest rate of mortality among psychiatric disorders, and frequent medical complications (e.g., cardiovascular, endocrines, gastrointestinal, bone and skeletal abnormalities, electrolytes abnormalities). Indeed, the reduction in food intake leads to a dysregulation in the central homeostasis regulating systems; these mechanisms trigger metabolic changing causing compromission in many organs and systems (Chidiac, 2019).

According to the Diagnostic and Statistical Manual of Mental Disorders, Fifth Edition (DSM-5; APA, 2013), beyond the thinness (i.e., body mass index < 18.5 kg/m^2), individuals with AN report also a pathologic fear of gaining weight that does not decrease with the loss of weight. Patients with AN are thus obsessed by food and by an ideal extremely thin body image. Relatedly, the distortion of body image (i.e., even if emaciated, the individuals keep on perceiving themselves as fat) is required to make a diagnosis of AN. The body, thus, is the battleground on which AN takes place, and the control of the body is persistently pursued by patients affected by AN. Indeed, it was described a state of alienation from the body that is felt as foreign and frightening (Svenaeus, 2013). More in detail, impairment in three components of body image has been reported (Glashouwer et al., 2019). As regards the first component, the cognitive-affective one, the over-evaluation of shape and weight, and body dissatisfaction promote and maintain restrictive and weight-control behaviors. The perceptual component is also involved with visual perceptive (i.e., overestimation of the body size) and tactile processing alterations. Finally, concerning the behavioral component, body checking (i.e., hypervigilant control of body size and shape by repetitive conducts as weighing or mirror-gazing) and body avoidance (i.e., to fear the contact with the body, avoiding to look themselves at the mirror or weighing) behaviors indicate a disturbance in body image (Glashouwer et al., 2019). The body image impairment is so pervasive and central in AN that,

despite many researchers consider it as a symptom of AN, others describe it as a causal factor involved in the development and maintenance of the illness (Glashouwer et al., 2019).

Regarding eating behaviors, two phenotypes of AN have been described: the restricter (AN-R) and the binge-purging (AN-BP; APA, 2013). In the first one, the loss of weight is reached through the diet and the caloric intake restriction; binge-purging behaviors are not present, while excessive physical exercise could be reported. In the AN-BP the individuals not only restrict their food intake, but they also periodically engage in binges followed by purging behaviors (e.g., vomiting, excessive physical exercise, use of diuretics or laxatives).

The pathogenesis of AN is complex and mostly unknown. The current knowledge on risk factors and causes is better conceptualized in the biopsychosocial model (Fassino & Abbate-Daga, 2013; Karwautz et al., 2011). Relatedly, biological and environmental factors co-occur in determining the onset of AN. From the biological standpoint, although the genes involved in AN are not yet fully recognized, it is clear that a polygenic heritability exists: the heritability of AN ranges between 48% and 72% (Trace et al., 2013), and a relative of individuals affected by AN has a risk of developing AN 11,4 times higher compared to the general population (Strober et al., 2000). Moreover, genome-wide association studies showed a role of endocrinological and metabolic factors, while gastrointestinal researches described alterations in microbiomal communities and gut morphology (Bulik et al., 2021). Concerning other biological aspects, neuronal alterations have been described with altered brain structures, functions, connectivity, and neurotransmission (Christine A. & Brooke R., 2021).

As regards environmental factors, stressful or traumatic life events have been described as risk and maintaining factors of AN, especially those that occurred during childhood (Briere & Scott, 2007). Moreover, many socio-cultural aspects are involved in the genesis of AN. In this context, social pressure and cultural attitude towards an ideal thin and attractive body could have a role, but, contrary to what literature described for years, it is unlike that these aspects represent the preeminent causes of AN. Differently, the social context of the individuals (e.g., family, social support, social net), could be an important co-occurrent risk and maintaining factor (Darrow et al., 2017; Jacobi et al., 2004).

All these entangled factors often determine a complex clinical picture, made even more intricate when psychiatric comorbidities are present. It is, indeed, commonly observed that patients with AN could gain other psychiatric diagnoses, especially mood and anxiety

disorders, obsessive-compulsive disorder, and Post-Traumatic Stress Disorder (Himmerich et al., 2019).

1.2. Traumatic events and Post-Traumatic Stress Disorder

The term "trauma" literally means "wound, injury", and until the XIX century, it was used in medical fields without psychological references. The term "psychological trauma" was introduced for the first time by the German neurologist Eulenberg to indicate the impact of stressful life events on the psychological functions and central nervous system (Van Der Hart & Brown, 1990). The study of the mental consequences of traumatic events (TEs) gained a lot of interest during the XIX century with the works of Jackson and Janet. Jackson was the first author to describe the impact of TEs on the mind. According to him, the mind is organized hierarchically: evolutionary, the lower levels of functioning are the most ancient and are controlled by the most recent level, the consciousness. The consciousness is the level at which the mind represents herself and gives a coherent picture of the persons' identity and memories (Meares, 1999). In this context, a TE could produce a psychological shock causing the "dissolution" of the hierarchical organizations of the mind: thus, the lower levels of functioning are no more controlled by the consciousness (Meares, 1999).

Freud also focused on trauma during the first years of his career: the origin of the psychoanalysis, indeed, lies in the study of trauma. In his opinion, the internal representation of a TE was the nucleus of the psychopathology. However, later Freud shifted the focus from the trauma to the childhood sexual desire. Relatedly, the interest in TEs decreased at the beginning of 1900, and trauma has been a neglected area for 60 years.

Later, the concept of psychological trauma appeared as a source of psychopathology in the DSM III (APA, 1980), consequently to the studies on Vietnam War veterans. Currently, in the DSM-5 trauma was included in the section "Trauma and stress-related Disorders", in which Post-Traumatic Stress Disorder (PTSD) is the main diagnosis. The diagnostic criteria include the exposition to death, threatened death, actual or threatened serious injury, or actual or threatened sexual violence, through the direct experience or the witnessing of the event, or learning that someone close has suffered the event. The presence of symptoms from the following clusters is also required for PTSD diagnosis:

- Intrusion symptoms (e.g., nightmares)

- Persistent avoidance of the trauma (i.e., avoidance of internal and external trauma reminders)
- Negative alterations in cognition and mood that are associated with the traumatic event (e.g., negative beliefs and expectations about oneself and the world, inability to recall important aspects of the traumatic event)
- Alterations of arousal and reactivity that are associated with the traumatic event (e.g., hypervigilance, sleep disturbance)

Moreover, post-traumatic symptoms could affect the body perception and functions: indeed, it was described that traumatic events alter the way the body is felt (Radziwiłłowicz & Lewandowska, 2017). Relatedly, physical abuse increases negative emotions towards the body making it terrifying: these contribute to create a state of anxiety and repulsion toward the body (Radziwiłłowicz & Lewandowska, 2017). Furthermore, emotional and sexual abuse, especially experienced during childhood, intensify the difficulty to understand and accept body changes occurring during adolescence, thus leading to fear and repulsion toward them; it is of note, thus, that trauma could impair the perception of the body through scaring feelings such as the sense of losing control over body and its functions, hating the body, or altered perception of body boundaries (Stein et al., 2003).

Theories on the etiology of PTSD postulated that symptoms arise from an altered fear learning mechanism: the individual is not able to extinguish the behavioral responses to stimuli associated with the TE, and thus avoidance strategies are employed to deal with these uncontrolled reactions. Subsequently, avoidance interferes with fear managing by hindering the exposure to safe reminders (Kirkpatrick & Heller, 2014).

Beyond PTSD symptomatology, dissociative symptoms were described as often consequent to TEs (APA, 2013). Dissociation is a mental condition commonly known as a "disruption of and/or discontinuity in the normal integration of consciousness, memory, identity, emotion, perception, body representation, motor control and behavior" (APA, 2013). Dissociation could affect both the mind and the body; relatedly, two types of dissociation were described. The first one, psychoform dissociation, refers to a mechanism that, detaching mental contents from the consciousness, results in an impairment of awareness, memory, identity, and emotion. Differently, the second type, the somatoform dissociation, regards body functions rather than mental contents and leads to symptoms impacting on body movements and sensations such as anesthesia, paralysis, pain, without a known medical cause. In this case,

body-related components of an experience, often traumatic, are not properly integrated into consciousness (Van der Hart et al., 2006). The most approved hypothesis on the origin of dissociative symptoms describes dissociation as a defensive mechanism to cope with overwhelming traumatic experiences (Moskowitz et al., 2009). In this context, one of the first authors focusing on dissociation was Pierre Janet. According to the author, in normality, most of our experiences are automatically integrated into pre-existing schemas through adaptations called "automatisms". However, frightening or new experiences, such as TEs, could not adapt and thus be integrated into the existing schemas; memories and other components (e.g., feelings, thoughts) related to these experiences are thus dissociated from the consciousness and voluntary control, appearing later as pathologic automatisms (Van Der Kolk & Van Der Hart, 1989).

Recently, evidence on the treatment and management of Post-traumatic symptoms is emerging. In this context, many psychotherapeutic approaches were described as effective (Kirkpatrick & Heller, 2014). For instance, trauma-focused cognitive-behavioral therapy is effective within a few months of the trauma (Bisson, 2007), and promising data were also shown for other kinds of therapy such as exposure therapy and cognitive processing therapy (Kirkpatrick & Heller, 2014). Other treatments could also help in managing post-traumatic symptoms: Eye Movement Desensitization and Reprocessing is successful in integrating and elaborating unprocessed or dissociated trauma-related memories and feelings, while mindfulness and yoga could help with somatic dissociative symptoms (Van Der Kolk, 2014).

1.3. Trauma and Eating Disorders

As stated above, the pathogenesis of EDs involves the interaction between different risk factors such as the environmental and the biological ones (Carretero-García et al., 2012). Among the environmental aspects, TEs are particularly relevant. Indeed, the literature demonstrated that a history of TEs is more common in patients with EDs than in the general population, and individuals who have suffered a TE are more susceptible to develop altered eating behaviors (Briere & Scott, 2007). Concerning TEs type, childhood sexual abuse is the most studied and reported one (Brewerton et al., 2019; Caslini et al., 2016; Palmisano et al., 2018; Reyes-rodríguez et al., 2011). Overall, the literature showed that childhood abuse is a non-specific risk factor for EDs (Racine & Wildes, 2015; Sanci et al., 2008), and individuals with a history of sexual childhood abuse have a higher risk of developing a bulimic syndrome

compared to people without such a history (Racine & Wildes, 2015). Literature focused mainly on three types of childhood trauma, namely sexual abuse, physical abuse, and emotional abuse (Caslini et al., 2016). In a meta-analysis, Caslini and colleagues (2016) investigated the relationship between these types of childhood abuse and specific EDs diagnoses, finding a significant overall association between childhood abuse and EDs: individuals who suffered any type of childhood abuse had an odd risk of developing an ED 3.21 times higher compared to people without a traumatic childhood history. Moreover, authors found that Bulimia Nervosa and Binge-Eating Disorder were associated to any type of childhood abuse, while AN was related only to physical abuse (Caslini et al., 2016). However, according to a subsequent review by Molendijk and co-authors (2017), AN was associated also to emotional abuse (Molendijk et al., 2017). Relatedly, a traumatic childhood context could interfere with the individual's development in behavior, sociality, emotional sphere, physical and cognitive aspects, thus increasing the risk of psychopathology (Carr et al., 2013). Moreover, childhood abuse have been linked to low-self-esteem, body-image alteration, and emotion dysregulation (Kearney-Cooke & Ackard, 2000), that are core aspects of EDs.

Nevertheless, literature described further TEs types reported by patients with EDs: physical (Rorty et al., 1994) and emotional abuse (Kent et al., 1999), teasing and bullying (Mazzeo & Espelage, 2002), parental break-up, and loss of a family member (Mahon, 2000; Tagay et al., 2014); however, the association between EDs and TEs occurred in adulthood was less studied. Nonetheless, the few studies addressing this topic described a significant association even in this context (Forman-Hoffman et al., 2012; Kothari et al., 2012). One of the few longitudinal studies on TEs in adulthood and EDs, indeed, showed that a partial or complete rape experienced three months before the beginning of the first semester of college was associated with ED-related psychopathology at the end of the semester (Collins et al., 2014). These results are in accordance with Faravelli and colleagues (2004): the authors, in a retrospective study, described eating-related symptoms in a sample of adult women who had undergone rape during the previous nine months (Faravelli et al., 2004).

TEs represent risk factors not only for the development of EDs but also for the severity of clinical presentation (Briere & Scott, 2007). Patients with EDs and TEs history report a more severe clinical picture and worse long-term outcomes compared to individuals with EDs, but without a history of TEs (Castellini et al., 2018). In particular, it was estimated that childhood abuse is related to an earlier onset of EDs and more severe psychopathology (Molendijk et al., 2017) with several comorbid symptoms such as emotion dysregulation, serotonin

dysregulation, high rates of drop-out, and relapses (Caslini et al., 2016). Relatedly, it was suggested a clinical vulnerability for illness severity in maltreated patients with EDs (Monteleone et al., 2018), and this was observed also in response to traumatic contexts such as the COVID-19 pandemic. Indeed, Cascino and colleagues described higher anxiety, post-traumatic symptoms, body dissatisfaction, ineffectiveness, and purging conducts in patients with AN and a history of childhood or adolescent TEs compared to those without such history, during all the phases of the pandemic (Cascino et al., 2021).

Eating-related psychopathology is even more complex when the TE is followed by a full-blown diagnosis of PTSD, which is associated with more frequent bulimic behaviors, and with the presence of alexithymia, anxiety, depression, self-injuries, low self-esteem, and disturbed emotions and cognition (Briere & Scott, 2007); therefore, not all persons who suffer a TE develop PTSD (Breslau, 2009), and many authors observed that post-traumatic symptoms rather than TEs per se are more strictly related to EDs (Dansky et al., 1997; Dubosc et al., 2012; Holzer et al., 2008).

Many authors tried to explain the mechanisms linking TEs and post-traumatic symptoms to EDs onset, and several hypotheses have been presented. Overall, it has been speculated that eating-related symptoms, especially the bulimic ones, could help to avoid trauma-related memories and feelings and to decrease arousal levels (Briere & Scott, 2007). Hence, the advantage coming from the reduction of post-traumatic symptoms could contribute maintaining EDs symptoms. In particular, many psychological factors, such as emotion dysregulation (Mills et al., 2015; Moulton et al., 2015; Racine & Wildes, 2015), dissociative experiences (Mills et al., 2015; Thornley et al., 2016), anger (Feinson & Hornik-Lurie, 2016), impulsivity and compulsivity (Dworkin et al., 2014), has been described as potential mediators between trauma and EDs. Among these, emotion dysregulation has an important role (Moulton et al., 2015; Racine & Wildes, 2015). Contextually, it was shown that childhood traumatic experiences involving verbal or physical punishment for emotional manifestation, could cause emotion ambivalence, avoidance, and suppression (Morris et al., 2007). Individuals with a trauma history, indeed, report significant difficulties in regulating emotions (Goldsmith et al., 2008; Gratz & Roemer, 2004), and emotion dysregulation is a construct considered essential in the onset and maintenance of EDs (Haynos et al., 2014; Pearson et al., 2015) since eating-related symptoms could serve as an attempt to control dysregulated emotions. In this context, emotion dysregulation could also threaten the EDs treatment outcome as suggested by Cassioli and colleagues. The authors, indeed, found that

higher baseline levels of emotion dysregulation predicted lower improvements in eating-related psychopathology in patients with AN after one year of treatment based on enhanced cognitive-behavior therapy (Cassioli et al., 2021).

As said above, another potential mediator is dissociation (Palmisano et al., 2018). In this case, individuals who suffer from post-traumatic dissociative symptoms could use eating behaviors, such as restriction and binge-purging conducts, as maladaptive grounding techniques aiming to restore the contact with the surrounding environment or the body.

Given these, TEs, post-traumatic symptoms, and dissociation are not only risk factors for the onset and the complexity of EDs, but they are also maintenance factors that threaten treatment outcomes and contribute to increase the levels of dropout and relapses among patients with EDs.

1.4. The role of trauma and post-traumatic symptoms in AN: state of the art and rationale of the project

Studies on trauma focused mainly on the bulimic variants of EDs, in particular bulimia nervosa and binge-eating disorder, while TEs and PTSD specifically in AN were less deepened. Relatedly, it was shown that a history of TEs, especially concerning childhood sexual abuse, is more commonly reported by patients with AN-BP than those with AN-R (Palmisano et al., 2018), with a lack of correlation between certain types of TEs (e.g., sexual abuse) and AN-R (Caslini et al., 2016). However, studies comparing and focusing on the two subtypes of AN regarding TEs features (e.g., TEs type, timing, prevalence) and post-traumatic symptoms are too few to draw conclusions. Moreover, TEs and PTSD were investigated mainly in relationship to eating-related symptoms in mixed samples (i.e., including patients with different ED diagnoses). Consequently, little data on the link between TEs and PTSD and general psychopathology (e.g., anxiety and depression) in specific samples of patients with AN exist.

As regards the possible mediators between trauma and EDs, emotion dysregulation was investigated mainly in Bulimia Nervosa (Gordon et al., 2016; Lavender et al., 2015; Rorty et al., 1994). To our knowledge, just one study investigated the relationship between childhood abuse, emotion dysregulation, and eating-related symptoms severity in a sample of patients with AN (Racine & Wildes, 2015). The authors described higher levels of emotion

dysregulation and more severe AN symptoms in patients who reported childhood emotional abuse, and the relation between childhood abuse and eating-related symptoms was mediated by emotion dysregulation (Racine & Wildes, 2015). However, no other studies replicated or deepened these results on patients with AN.

For what concerns dissociation, it is well established that dissociation is more prevalent in patients with EDs, regardless of ED diagnosis, than in healthy controls and other psychiatric disorders (Lyssenko et al., 2018; Nijenhuis et al., 1999). Many studies linked dissociative symptoms to bulimic behaviors and binge-eating disorder (Belli et al., 2019; McShane & Zirkel, 2008; Serra et al., 2020), while dissociation in AN, especially AN-R was much less studied. Furthermore, despite a strong relationship between dissociation and depressive and negative feelings toward the body was described (Radziwiłłowicz & Lewandowska, 2017), the influence of dissociation on the body in AN is much less studied. This is particularly true for somatoform dissociation. Indeed, despite the extreme importance of the body in AN, and the direct impact of somatoform dissociation on the body, just few studies addressed the somatic components of dissociation in AN, describing a relationship between somatoform dissociation and binge-purging behaviors (Fuller-Tyszkiewicz & Mussap, 2008; Palmisano et al., 2018; Waller et al., 2003).

Moreover, as described above, body perception is severely impaired in AN, and traumatic events, in turn, could alter body perception. Indeed, the distortion of body image is a feature common to AN and sexual assault syndrome (Schechter et al., 1987). However, the specific impact of trauma and post-traumatic symptoms on body perception in AN was not addressed.

To conclude, as already claimed, TEs and post-traumatic symptoms, especially when a PTSD diagnosis is present, could co-occur as risk factors for the development of AN, through the contribution of several mediators. However, up to date, there are little and discordant data on trauma in AN, thus hindering to draw conclusions and develop shared assessment and treatment protocols.

1.5. Aims of the project

The above-described gaps led us to develop a project with the general aim to attempt to disentangle the role of TEs and post-traumatic symptomatology in AN, investigating the impact of TEs and post-traumatic symptoms on eating-related and general psychopathology in

patients with AN, with a particular focus on the comparison between AN subtypes and the role of dissociation. In particular, firstly, we focused on TEs and post-traumatic symptomatology: in a descriptive phase, we explored the differences between AN subtypes in frequency, type, and timing of TEs, and post-traumatic symptoms, regardless of PTSD full-blown diagnosis; then, after having described the frequency of childhood abuse, adulthood TEs (discriminating between relational and non-relational trauma), multiple traumas, and PTSD, we aimed to describe differences between patients with and without PTSD diagnosis. Secondly, we shifted our focus to dissociative symptoms. As a first step, we wanted to review the available literature on dissociation in AN, with particular regard to the distinction between psychoform and somatoform dissociation and AN subtypes. Subsequently, basing on the review results, we focused on the differences in somatoform and psychoform dissociation in AN subtypes, and we deepened the issue of somatoform dissociation in AN exploring the differences between patients with and without it.

These scopes were addressed by four studies as follows:

Study 1:
- To describe the prevalence, type, and time of occurrence of TEs in the two subtypes of AN.
- To investigate differences in TEs (number, type, frequency) as well as clusters of post-traumatic symptoms and emotional dysregulation between the two AN subtypes.

Study 2:
- To retrospectively investigate the frequency of childhood abuse, adulthood TEs (discriminating between relational and non-relational traumas), multiple traumas, and PTSD in a sample of young patients, thus tested at the beginning phase of illness.
- To explore differences in clinical and eating-related symptoms, and general psychopathology between patients with and without TEs history, and with and without a diagnosis of PTSD.

Study 3: to provide an updated review of the literature about dissociation in AN, with a focus on AN subtypes as well as dissociation types (i.e., psychoform and somatoform), with these specific aims:
- To deepen the role of dissociation, both somatoform and psychoform, in AN, focusing on AN subtype;
- To investigate dissociation-related aspects (e.g., trauma, self-harm) in AN;

- To study the role of dissociation in the treatment of AN.

Study 4:

- To describe the sample in terms of differences between groups of patients diagnosed with AN-R and AN-BP in clinical variables, eating-related and general psychopathology, body-related variables, somatoform and psychoform dissociation, and childhood trauma.
- To explore differences between persons with and without somatoform dissociation in the above-listed variables, also controlling for the role of AN subtype and psychoform dissociation.

2. Methods

The overall project was approved by the Ethical Committee of the University of Turin under the registration number CS2/840, approval date: 18 June 2018.

In general, 156 inpatients with AN took part in the project. All patients were recruited at the Eating Disorders Centre of the 'Città della Salute e della Scienza' hospital of the University of Turin, Italy. They participated in the present thesis studies as follows:

- 23 patients were involved in all studies
- 44 patients took part just in Study 1
- Just 1 patient participated just in Study 2
- 38 patients were recruited just in Study 4
- 10 patients entered in both Study 1 and Study 4
- 40 patients took part in both Study 2 and Study 4

The specific methods applied in all studies are set out below.

2.1. Study 1

2.1.1. Participants

The sample consisted of 77 female inpatients with AN-R or AN-BP (APA, 2013) as diagnosed by an experienced psychiatrist according to a clinical interview conducted upon admission (First et al., 2015). Patients were consecutively recruited at the Eating Disorders Centre of the 'Città della Salute e della Scienza' hospital of the University of Turin, Italy. Inclusion criteria were AN diagnosis, female sex, and age between 18 and 35 years. Exclusion criteria were as follows: (a) Wechsler Adult Intelligence Scale-Revised Intellectual Quotient score <85 (Wechsler, 1997), (b) history of cranial trauma with loss of consciousness, (c) lifetime or current alcohol or substance dependence, (d) medical problems (e.g. epilepsy, diabetes, refeeding-related organic problems). All participants signed a written informed consent form according to the ethical committee of the University of Turin.

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2.1.2. Procedure

Patients' recruitment started in November 2017 and ended in December 2018. After hospital admission, trained nurses measured participants' body mass index (BMI). Upon the day of admission, an experienced psychiatrist interviewed all patients. Data was gathered on the duration of their illness (with a specific focus on illness onset), as well as general and eating psychopathology. Participants were then asked to complete the self-reported measures within the first week of hospitalization.

2.1.3. Materials

Participants were asked to complete the following self-reported measures:

Eating Disorders Inventory-2 (EDI-2; Garner 1991; Rizzardi, Trombini, and Trombini 1995) was used to evaluate eating psychopathology, measuring behavior relevant for EDs. The inventory consists of 91 items and 11 subscales measuring: (1) drive for thinness, (2) bulimia, (3) body dissatisfaction, (4) ineffectiveness, (5) perfectionism, (6) interpersonal distrust, (7) interoceptive awareness, (8) maturity fear, (9) asceticism, (10) impulse regulation and (11) social insecurity.

Life Events Checklist (LEC; Blake et al. 1995) was used to assess the occurrence of traumatic events. LEC is a self-reported trauma assessment of the Clinician-Administered PTSD Scale. It lists 16 potentially traumatic events: natural disaster, accidents or explosions, car or train or flight accident, severe accident at job place or home, exposure to toxic substances, physical violence, being assaulted with a weapon, sexual assault, other kinds of sexual assaults (e.g. unwanted and/or uncomfortable sexual experiences), exposure to fights, being kidnapped, physical illness, severe human suffering, sudden or violent death, unexpected close person's death, serious harm or death of someone caused right from her, any other traumatic or stressful events. Patients are asked to report which events they have suffered, in which way (i.e. being the actual victim, a witness, or being close to a person a TE happened to), and at what age.

Impact of Event Scale-Revised (IES-R; Weiss 2007) was administered to assess post-traumatic symptoms. This consists of 22 questions measured on a 5-point Likert Scale (0–4, 'not at all' to 'to a great extent'). The three subscales of the IES-R reflect the three (out of four, APA, 2013) clusters of symptoms presented in Post-Traumatic Stress Disorder; (1) intrusion, (2) avoidance, (3) hyper-arousal.

Difficulties in Emotion Regulation Scale (DERS; Gratz and Roemer 2004) was used to test the challenges in regulating emotions. It consisted of 36 items rated on a 5 point Likert scale which assessed six domains: (1) awareness of emotional responses, (2) understanding of emotions, (3) non-acceptance of emotions, (4) capability to engage in goal-directed action being upset, (5) ability to refrain from impulsive action experiencing negative emotions and (6) effective emotion regulation strategies. Higher scores correspond to greater difficulty in regulating emotions.

2.1.4. Statistical analysis

The SPSS 24.0 statistical software package (IBM SPSS Statistics for Windows, Version 24.0. Armonk, NY: IBM Corp) was used for data analysis. A t-test was conducted to evaluate significant differences in the number of TEs, post-traumatic symptoms, and emotional dysregulation between the AN-R and AN-BP groups. The Exact Fisher's test was used to assess any differences between categorical variables.

After descriptive analysis, patients with no traumatic events were excluded from the data analysis (n = 4). A p-value of <0.05 (two-tailed) was considered statistically significant.

2.2. Study 2

2.2.1. Participants

A sample of 64 inpatients with AN, both restricting (AN-R) and binge-eating/purging (AN-BP) subtypes, was recruited at the Eating Disorders Centre of the 'Città della Salute e della Scienza' hospital of the University of Turin, Italy. Inclusion criteria were: (a) maximum age 25 y.o.; (b) formal diagnosis of AN according to DSM-5 criteria as assessed by an experienced psychiatrist per clinical interview (First et al., 2015); (c) female gender. The following exclusion criteria were applied: (a) Wechsler Adult Intelligence Scale-Revised Intellectual Quotient score < 85 (Wechsler, 1997); (b) medical problems such as diabetes or epilepsy; (c) anamnesis of cranial trauma with loss of consciousness; (d) comorbid psychotic spectrum disorders and/or bipolar disorders; (e) substance and/or alcohol abuse. All the participants provided written informed consent according to the ethical committee of the University of Turin.

2.2.2. Procedure

All participants were interviewed upon admission by an experienced psychiatrist to confirm the diagnosis of AN and collect clinical and demographic data. At the same time point, trained nurses measured participants' body mass index (BMI). During the first days of hospitalization, patients completed a standardized diagnostic interview and several self-report questionnaires.

2.2.3. Materials

Participants were administered the Structured Clinical Interview for the DSM-5 (SCID-5; First et al., 2015) to assess the presence of a current diagnosis of PTSD. Moreover, patients completed the following measures:

Eating Disorder Examination Questionnaire (EDE-Q; Calugi et al. 2017; Fairburn and Beglin 1994): This tool assesses the typical attitudes and behaviors of eating disorders as they occurred during the last 28 days. It consists of 28 items and four subscales: dietary restraint, eating concern, weight concern, and shape concern. A global score is also provided. Internal consistency is acceptable with Cronbach's alpha value of 0.90.

Childhood Trauma Questionnaire (CTQ; Bernstein and Fink 1998): The questionnaire is composed of 28 items measured on a five-point Likert scale ranging from 1 (never true) to 5 (very often true). The severity of five types of childhood abuse is assessed and reported by the following subscales: childhood emotional abuse, childhood physical abuse, childhood sexual abuse, childhood emotional neglect, childhood physical neglect, and global score. Cut-off values for each scale are also available for categorical analysis. Internal consistency is good, as estimated by a Cronbach's alpha value of 0.91 (Scher et al., 2001).

State-Trait Anxiety Inventory (STAI-Y; Spielberger 2010): the measure consists of two sets of questions: 20 questions on the current state of anxiety to assess state anxiety, whereas the other 20 questions investigate the trait anxiety as a stable trait. Answers range on a scale from 1 (never) to 4 (always). Internal consistency values range from 0.86 to 0.95 (Spielberger, 2010).

Beck Depression Inventory (BDI; Beck et al., 1961): The 21-items questionnaire investigates the severity of depressive symptoms, as described by the global score. Indeed, a score from 0 to 4 reflects low depression, from 5 to 15 moderate symptoms, and from 16 to 39 severe depressive symptomatology. Internal consistency is high, as indicated by a Cronbach's alpha value of 0.86 (Wang & Gorenstein, 2013).

Life Events Checklist (LEC; Blake et al. 1995): see study 1 for details.

Dissociative Experience Scale (DES-II; Bernstein and Putnam 1986): It is a self-report questionnaire assessing the presence of several dissociative symptoms such as absorption, amnesia, derealization, and depersonalization. It consists of 28 items asking the patients how frequently the symptoms occur on a scale ranging from 0 (never) to 100 (always). A total score above 30 suggests the presence of a dissociative disorder. The internal consistency of the Italian version is good (Cronbach's alpha: 0.81–0.94; Bombi et al. 1996).

2.2.4. Statistical Analysis

The SPSS 26.0 statistical software package (IBM SPSS Statistics for Windows, Version 26.0. Armonk, NY, USA: IBM Corp) was used for data analysis. Descriptive analyses were conducted to assess the distribution of clinical, demographic, and trauma-related variables. As the distribution of the groups was not normal, a Wilcoxon-Mann-Whitney test was run to investigate differences between groups in continuous variables. For differences between groups in categorical variables Exact Fisher's Test was used instead.

2.3. Study 3

2.3.1. Search methodology

A systematic literature search was conducted between February and July 2019 using PubMed and PsycInfo databases. We used a combination of the following Boolean terms: "anorexia nervosa" OR "eating disorders" AND "dissociation" OR "psychoform dissociation" OR "somatoform dissociation" OR "dissociative symptoms". Additionally, we undertook a hand search of references cited in selected papers that met inclusion criteria.

2.3.2. Eligibility criteria

We included those papers meeting the following criteria: (a) studies published between 1986 and 2019; (b) studies investigating dissociation (independently of the type) in EDs with validated tools; (c) studies that recruited at least one subset of patients with a diagnosis of AN (both AN-R and AN-BP); (d) papers written in English; (e) original papers published on peer-reviewed journals and (f) studies recruiting human participants. Single case studies, reviews,

and studies on pediatric populations were excluded. Studies were excluded neither because of age, gender, or nationality of participants nor due to the lack of healthy controls.

2.3.3. Selection and revision of the studies

We included a total of 29 studies. The study-selection process is described in Figure 1. The present systematic review was conducted following the PRISMA criteria.

2.3.4. Assessment of quality of the studies

We used the Mixed Methods Appraisal Tool (MMAT 2018 version; Hong et al., 2018) to evaluate the quality of the studies. The final result of the assessment is a global rate ranging from 1 to 5, and it is based on the rating of five sections different for quantitative, qualitative, and mixed methods studies. Two authors (P.L. and E.M.) independently evaluated the studies and then compared and discussed the ratings in case of discrepancies.

2.4. Study 4

2.4.1. Participants

We recruited 111 inpatients with AN, both AN-R and AN-BP subtypes, at the Eating Disorders Centre of the 'Città della Salute e della Scienza' hospital of the University of Turin, Italy. Inclusion criteria applied for this study were: a) diagnosis of AN according to the Structured and Clinical Interview for the DSM-5 (SCID-5; First et al., 2015) b) age > 18 years. Exclusion criteria were: a) medical problems (e.g., diabetes or neurological diseases); b) anamnesis of cranial trauma with loss of consciousness; c) comorbidity with psychotic spectrum disorders and/or bipolar disorders; d) current substance and/or alcohol use.

Patients signed a written informed consent following the Ethical Committee of the University of Turin.

2.4.2. Procedure

An experienced psychiatrist interviewed all patients upon admission to collect clinical and demographic data, and to confirm the AN diagnosis with a structured clinical interview based on DSM-5 criteria (First et al., 2015). Body Mass Index (BMI) was calculated by measuring height and weight by trained nurses. Participants completed a battery of self-report questionnaires during the first days of hospitalization.

2.4.3. Materials

Participants completed the following self-report questionnaires:

- **Eating Disorder Examination Questionnaire**, Italian validation (EDE-Q; Calugi et al., 2017): see Study 2 for details.

- **Body Shape Questionnaire** (BSQ; Cooper et al., 1987): this questionnaire evaluates body image and body dissatisfaction. It consists of 34 items asking for patients' feelings on body shape during the last weeks. Higher scores indicate higher levels of body dissatisfaction. The internal consistency is acceptable, with Cronbach's alpha values between 0.82 and 0.89 (Franko et al., 2012).

- **Beck Depression Inventory** (BDI; Beck et al., 1961): see Study 2 for details.

- **State-Trait Anxiety Inventory** (STAI-Y; Spielberger 2010): see Study 2 for details.

- **Dissociative Experience Scale** (DES; Bernstein and Putnam 1986): see Study 2 for details.

- **Somatoform Dissociation Questionnaire** (SDQ-20; Nijenhuis et al., 1998): it consists of 20 items investigating the presence of somatoform dissociative symptoms such as blindness, anesthesia, analgesia, loss of motor control, pain. Patients are asked to answer on a scale ranging from 1 (this applies to me not at all) to 5 (this applies to me totally). A cut-off score of ≥ 30 was set according to the previous researches (Brunner et al., 2000; Nilsson et al., 2015; Vanderlinden et al., 1993). The Italian version of the questionnaire has a high internal consistency with Cronbach's alpha value of 0.96 (Nijenhuis, 2004).

- **Body Checking Questionnaire** (BCQ; Reas et al., 2002): it measures the body checking behavior through 23 items. Participants are asked to report how frequently they act body checking behavior on a scale ranging from 1 (never) to 5 (always). We used the Italian validation of the questionnaire which has a good internal consistency with Cronbach's alpha values ranging from 0.84 to 0.92 (Calugi et al., 2006).

- **Body Image Avoidance Questionnaire** (BIAQ; Calugi et al., 2006; Rosen et al., 1991): this is a 19-items tool used to assess the tendencies to avoid body image contents. Four main avoidance behaviors are investigated: hiding the body with clothes, avoidance of social contexts, eating restrain, body checking. A total score is also provided. Answers range from 0 (never) to 5 (always). The internal consistency is good, as shown by Cronbach's alpha values from 0.64 to 0.80 (Maïano et al., 2009).

- **Childhood Trauma Questionnaire** (CTQ; Bernstein and Fink 1998): see Study 2 for details.

2.4.4. Statistical analysis

The SPSS 27.0 statistical software package (IBM SPSS Statistics for Windows, Version 27.0. Armonk, NY, USA: IBM Corp) was used for data analysis. An independent sample t-test was run to assess differences in continuous variables between AN-R and AN-BP, and between patients with and without somatoform dissociation. When differences were significant between groups with or without somatoform dissociation, analysis of covariance (ANCOVA) was also conducted to control for the AN subtype and psychoform dissociation. Effect sizes in t-test were evaluated with Cohen's d as follows: negligible effect: d = -.15 - .15; small effect: d = .15 - .40; medium effect: d = .40 - .75; large effect: d = .75 – 1.10; very large effect: d = 1.10 – 1.45; huge effect: d = 1.45. As regards ANCOVA, effect sizes were calculated with partial eta squared, and differences were estimated as small η_p^2=.01-.06; moderate η_p^2=.06-.14; large η_p^2>.14 (Cohen, 1988).

3. Results

3.1. Study 1

3.1.1. Demographic and clinical features of the sample

The sample consisted of 77 adult female inpatients diagnosed with AN: 40 were affected by AN-R and 37 by AN-BP. No differences were found between the AN-R and AN-BP groups in terms of age, years of illness, age at illness onset, and BMI (see Table 1). Those with AN-BP reported higher scores than those with AN-R on all EDI-2 'core' subscales: drive for thinness, bulimia, and body dissatisfaction.

Table 1. Demographic and clinical variables of the sample

	AN-R (n=40) Mean (SD)	AN-BP (n=37) Mean (SD)	t	p
Age, years	24.85 (9.54)	26.08 (8.59)	-.593	.555
Duration of illness, years	8.77 (9.57)	8.88 (8.04)	-.054	.957
Age at illness onset, years	17.92 (3.79)	17.48 (4.90)	.436	.664
BMI*	14.64 (2.01)	15.59 (1.62)	-1.964	.054

Legend: BMI = body mass index; AN-R: restricting anorexia nervosa; AN-BP: binge-purging anorexia nervosa
*available for 73 participants (34 AN-BP and 39 AN-R) because 4 patients were weight-restored.

3.1.2. Traumatic events: prevalence, type, and timing

The majority of AN-R (90%) and all AN-BP patients (100%) reported the occurrence of TEs (i.e., as measured as a yes/no response), with a significantly higher occurrence of TEs in AN-BP than in AN-R (Pearson Chi-squared = 3.903; p = 0.048). Regarding the type of TEs suffered, a significant difference between the two subtypes was found with sexual assault occurring more frequently in individuals with AN-BP than AN-R. Patients with AN-R had suffered from a physical illness, severe human suffering, or the unexpected death of a close relative/acquaintance. Differently, physical violence, sexual assault, and other kinds of sexual assaults mainly occurred in those with AN-BP (see Table 2). Moreover, those in the AN-BP group reported significantly more TEs (i.e. as measured as a cumulative number of lifetime

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TEs) than those in the AN-R group (Table 2). No significant differences regarding the timing of the TEs were seen between the two groups. Exposure to TEs happened before the onset of illness for 58% of AN-R patients, and for 81.1% of AN-BP patients (Pearson's Chi-squared: 4.498; p = 0.105). However, 16.7% of AN-R and 8.1% of AN-BP patients could not clearly define the timing of TEs.

Table 2. Differences in type and number of traumatic experiences (TEs) between participants with anorexia nervosa restricting subtype (AN-R) and binge purging subtype (AN-BP)

	AN-R (n=40) N(%)	AN-BP (n=37) N(%)	Chi squared	p
Natural disaster	3 (7.5)	0 (0)	3.215	.073
Accidents or explosions	0 (0)	0 (0)		
Car or train, or flight accident	1 (2.5)	1 (2.7)	<.001	.984
Severe accidents on job place, or at home	0 (0)	0 (0)		
Exposure to toxic substances	0 (0)	0 (0)		
Physical violence	2 (5.6)	4 (10.8)	.668	.414
Being assaulted with a weapon	0 (0)	0 (0)		
Sexual assault	1 (2.5)	4 (10.8)	1.845	.174
Other kind of sexual assaults	1 (2.5)	7 (18.9)	4.872	**.027**
Exposure to fights	0(0)	0(0)		
Being kidnapped	0 (0)	0 (0)		
Physical illness	8 (20)	8 (21.6)	.004	.991
Severe human suffering	5 (12.5)	2 (5.4)	1.515	.218
Sudden or violent death	2 (5)	1 (2.7)	1.117	.291
Unexpected close person's death	7 (17.5)	3 (8.1)	1.237	.226
Serious harm or death of someone caused right from her	0 (0)	0 (0)		
Any other traumatic or stressful event	6 (15)	7 (18.9)	.063	.522
No events	4 (10)	0 (0)	.063	.801
	RAN	BPAN	t	p

	(n=36) Mean (SD)	(n=37) Mean (SD)		
Number of TEs	3.14 (2.39)	4.44 (2.25)	-2.409	**.019**

3.1.3. Post-traumatic symptoms and emotional dysregulation in AN subtypes

Patients with AN-BP scored significantly higher than those with AN-R on all three IES – R subscales and in terms of emotion dysregulation, as measured by the DERS (Table 3).

Table 3. Differences in post-traumatic symptoms and emotion dysregulation between patients with anorexia nervosa restricting subtype (AN-R) and binge purging subtype (AN-BP)

	AN-R (n=36) Mean (SD)	AN-BP (n=37) Mean (SD)	t	p
IES-R intrusion	11.94 (10.71)	19.30 (10.29)	-2.992	**.004**
IES-R avoidance	9.89 (8.98)	17.43 (8.98)	-3.589	**.001**
IES-R hyper-arousal	6.94 (7.89)	14.30 (8.79)	-3.758	**<.001**
DERS	101.72 (21.524)	117.92(20.465)	-3.272	**.002**

IES-R =Impact of Events Scale-Revised; DERS = Difficulties in Emotion Regulation Scale

3.2. Study 2

3.2.1. Demographic and Clinical Features of the Sample

The sample consisted of 64 female inpatients with AN, 43 with AN-R, and 21 with AN-BP. Patients' mean age was 20.2 y.o. (SD = ± 2.3). As regards demographic variables, 2 patients were employed (3.3%), 51 (83.6%) were students, while 8 (13.1%) were unemployed. The majority of the sample (81.4%) lived with their family of origin. See Table 4 for clinical variables. Moreover, 11 patients (17.2%) practiced self-harm, 10 (15.6%) reported a suicide attempt, and 2 (3.1%) reported previous abortions.

Table 4. Demographic and clinical features of the sample

	Mean (SD)
BMI	15.2 (2.6)
Duration of illness, years	3.4 (2.7)
Age at onset, years	16.8 (2.4)
N of previous AN-related hospitalizations	1.9 (1.5)

Legend: BMI = Body Mass Index

3.2.2. Trauma-related variables

The most frequent events reported by participants were childhood trauma and lifetime traumatic events, mostly relational trauma (Table 5). In particular, concerning relational traumas, 37.7% of patients experienced physical violence, 8.2% were assaulted with a weapon, 9.8% suffered sexual assault and 23% other kinds of sexual assault, and 4.9% reported to have been kidnapped.

Table 5. Trauma-related risk factors in young patients with AN as measured by the Childhood Trauma Questionnaire (CTQ), the Life Events Checklist (LEC), and Structured Clinical Interview for the DSM-5.

	Inpatients with AN (n = 64)	
	Yes (%)	**No (%)**
Lifetime traumatic event	59 (95.2)	3 (4.8)
Relational trauma *	54 (85.7)	
Non-relational trauma	9 (14.3)	
Multiple traumas	38 (62.3)	23 (37.7)
Current PTSD	14 (22.6)	48 (77.4)
Childhood traumatic event *	51 (81)	12 (19)

Legend: PTSD = Post-traumatic Stress Disorder; * = childhood abuse and/or following LEC items: physical violence, being assaulted with a weapon, sexual assault, other kinds of sexual assault, being kidnapped.
* = persons with at least one of the total scores of the Childhood Trauma Questionnaire over cut off.

3.2.3 Differences between patients with and without PTSD

Despite very few differences emerged between patients with and without a traumatic history (i.e., patients with and without childhood abuse and patients with and without multiple traumas; see Supplementary material, Table S1, and Table S2), some discrepancies were observed instead between individuals with and without PTSD (Table 6). Patients with PTSD comorbidity had a higher BMI than non-PTSD patients. Furthermore, patients with a PTSD diagnosis reported significantly higher scores in shape concern, weight concern, and total score of the EDE-Q (but not restraint and eating concern scales), trait anxiety, and dissociation when compared to those without PTSD. Moreover, patients with AN-BP were diagnosed with a comorbid PTSD more frequently than those with AN-R (Fisher's exact test: $p = 0.008$), while no differences between PTSD and non-PTSD groups were shown in the frequency of self-harm (Fisher's exact test: $p = 1.000$) and suicide attempts (Fisher's exact test: $p = 0.213$).

Table 6. Differences in clinical presentation between young patients with AN with and without PTSD diagnosis.

	PTSD (n = 14)	Non-PTSD (n = 48)		
	Mean (SD)	Mean (SD)	Z	*p*
Duration of illness, years	4.1 (3.5)	3.3 (2.5)	−0.342	0.732
Age at onset, years	17.3 (3.4)	16.6 (2.1)	−1.119	0.263
BMI	16.4 (2.8)	14.8 (2.5)	−2.341	**0.019**
N of previous AN-related hospitalizations	2.4 (1.9)	1.9 (1.4)	−0.688	0.492
EDE-Q				
Restraint	3.5 (2.0)	2.5 (1.9)	−1.575	0.115
Food concern	3.5 (1.6)	2.8 (1.5)	−1.630	0.103
Shape concern	4.7 (1.2)	3.4 (1.6)	−2.233	**0.026**
Weight concern	4.2 (1.3)	2.9 (1.9)	−2.120	**0.034**
Total score	3.9 (1.4)	2.9 (1.6)	−2.093	**0.036**
BDI	20.4 (9.4)	15.6 (7.7)	−1.408	0.159
STAI-State	62.6 (10.4)	54.4 (12.6)	−1.799	0.072
STAI-Trait	61.1 (21.0)	55.6 (14.6)	−2.201	**0.028**

	DES	35.8 (20.4)	18.2 (14.4)	−3.260	**0.001**

Legend: BMI = body mass index; EDE-Q = eating disorder examination questionnaire; BDI = Beck depression inventory; STAI = State-trait anxiety inventory; DES = dissociative experiences scale.

3.3. Study 3

A summary of the reviewed articles is provided in Table S3 (see Supplementary materials). Studies reviewed were published mostly between 1990 and 2018. Papers were classified into three groups according to our purposes: 10 articles (34.5%) investigated the link between dissociation and eating-related psychopathology in AN, 15 (51.7%) explored dissociation-related constructs in AN, and 5 (17.2%) studied the role of dissociation in the treatment of AN. The same two authors (P.L. and E.M.) assigned the studies to the different categories with high inter-rater reliability (96.8%). Full agreement was then obtained by discussing the single studies. Studies were assigned to each group according to their main aims and focus. Categories were not mutually exclusive; one study (McCallum et al., 1992), for instance, was included in both Groups 1 and 2.

Figure 1. Study selection process

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┌─────────────────┐    ┌─────────────────┐    ┌─────────────────┐
│     n = 312     │    │     n = 296     │    │     n = 43      │
│  Total studies  │───▶│ Studies excluded│───▶│ Studies selected│
│  from Pubmed    │    │  after title and│    │  for full text  │
│     search      │    │ abstract select.│    │    revision     │
└─────────────────┘    └─────────────────┘    └─────────────────┘
         │                                              │
         ▼                                              ▼
┌─────────────────┐    ┌─────────────────┐    ┌─────────────────┐
│     n = 21      │    │     n = 22      │    │     n = 7       │
│ Studies excluded│───▶│Studies included │───▶│Studies selected │
│ after full text │    │  in the review  │    │ from hand search│
│    revision     │    │                 │    │                 │
└─────────────────┘    └─────────────────┘    └─────────────────┘
         │
         ▼
┌─────────────────┐
│     n = 29      │
│  Total studies  │
│ included in the │
│ systematic rev. │
└─────────────────┘
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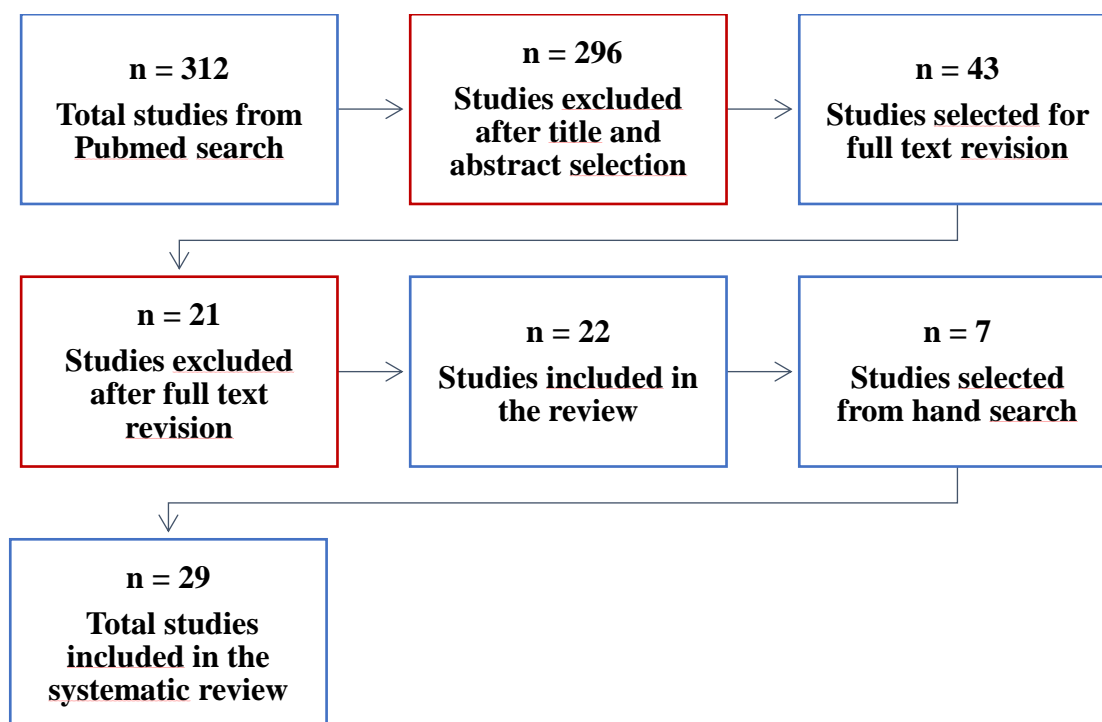
3.3.1. Study quality assessment

Global scores of quality appraisal for each study are reported in Table S3. Two authors (P.L. and E.M.) agreed upon the majority of the ratings. Most of the reviewed studies did not provide measures of the magnitude of their findings. Also, the majority of studies did not report on eventual differences in dissociation between subtypes of AN. Most of the studies (72.4%) scored high (global score: 3 or 4), fewer reports (20.6%) were evaluated as moderate (global score: 2), whereas just two studies (6.8%) got a low score (global score: 1).

3.3.2. Dissociation in AN (10 studies)

All studies included in this group (34.5%) investigated the link between dissociative symptoms and eating-related psychopathology with self-report instruments. Most of the studies (Beato et al., 2003; Demitrack et al., 1990; Farrington et al., 2002; Gleaves & Eberenz, 1995; La Mela et al., 2010; Oliosi & Dalle Grave, 2003; Waller et al., 2003) assessed levels and severity of dissociation, measured as a continuous variable, with the Dissociative Experiences Scale (DES; Bernstein and Putnam 1986) and the Dissociation Questionnaire (DIS-Q; Vanderlinden et al., 1993) for psychoform dissociation and the Somatoform Dissociation Questionnaire (SDQ; Nijenhuis et al., 1998) for somatoform dissociation. One study (Schumaker et al., 1995) measured dissociation with Riley's

Questionnaire of Experiences of Dissociation (Riley, 1988). Only one study investigated in a dichotomous fashion (i.e., dissociation present/absent) dissociative disorders (McCallum et al., 1992). Studies on patients with AN found higher levels of dissociation in such patients than in individuals with other psychiatric diagnoses and healthy controls. Similarly, full-blown dissociative disorders were described in a subgroup of patients with mixed diagnoses of EDs (Demitrack et al., 1990; La Mela et al., 2010; McCallum et al., 1992; Schumaker et al., 1995; Vanderlinden, 1993). Moreover, dissociation and eating symptoms of AN were found to be correlated (McCallum et al., 1992). Beato et al. (2003), deepening the core aspect of body perception in AN, described an association between dissociation and body dissatisfaction, as mediated by self-esteem (Table S3).

Concerning AN subtypes, some studies proposed that both psychoform and somatoform types of dissociation were more closely linked to AN-BP than AN-R (Beato et al., 2003; Oliosi & Dalle Grave, 2003; Vanderlinden, 1993; Waller et al., 2003). In addition, normal levels of psychoform and somatoform dissociation were described for AN-R (Waller et al., 2003), whereas only one study found no correlations between dissociation and eating-related symptoms (Gleaves & Eberenz, 1995).

3.3.3. Dissociation-related constructs in AN (15 studies)

Dissociation and trauma in AN (9 studies)

All studies of this group measured levels of dissociative symptoms with the DES (Berger et al., 1994; Hallings-Pott et al., 2005; Nagata et al., 1999; Palmisano et al., 2018; Pugh et al., 2018), the DIS-Q (Brown et al., 1999; Dalle Grave et al., 1996; Favaro et al., 1998; Vanderlinden et al., 1993) and the SDQ (Palmisano et al., 2018). One study (Berger et al., 1994) investigated also the presence of multiple personality disorder with the Dissociative Disorder Interview Schedule (DDIS; Ross et al., 1990), modified in a self-report version. Therefore, all measurements were performed with self-report assessments. A number of authors have found a link between trauma, dissociative symptoms, and bulimic behaviors (Brown et al., 1999; Dalle Grave et al., 1996; Palmisano et al., 2018). Brown et al. (1999) reported that sexual abuse is common among patients with EDs. Relatedly, Vanderlinden, Van Dyck, et al. (1993) found that the majority of patients with AN, presenting high levels of dissociation, had a traumatic history, and sexual abuse was correlated with amnesia symptoms. Other researchers focused on a peculiar feature typical of patients with AN: the internal eating voice (i.e., a second or third person voice commenting on eating, body shape

and weight). They showed a relationship between childhood emotional abuse and the power of ED voice partially mediated by dissociation (Pugh et al., 2018).

However, other studies reviewed here failed to find a strong role of dissociation as a bridge between trauma and AN. In particular, they described no differences in dissociation between abused and non-abused patients with EDs (Berger et al., 1994; Favaro et al., 1998; Nagata et al., 1999).

Finally, only one paper in this group investigated specifically both types of dissociation (Palmisano et al., 2018) describing higher levels of childhood trauma and both psychoform and somatoform dissociation in patients with EDs compared to a healthy control group, with patients with AN-BP reporting the highest score on somatoform dissociation; however, somatoform dissociation was not related to binge-eating severity. With regard to AN subtypes, Dalle Grave et al. (1996) described a link between the prevalence of trauma and prevalence of dissociation only in patients with AN-BP, and another study observed higher levels of dissociation in patients with AN-BP than in those with AN-R (Palmisano et al., 2018). Other studies did not investigate differences between AN subtypes (Table S3).

Dissociation, pain and self-injury behavior in AN (6 studies)

All studies measured dissociation as a continuous variable with the following self-report measures: DES (Navarro-Haro et al., 2015; Paul et al., 2002), DIS-Q (Claes et al., 2006; Claes & Vandereycken, 2007), and SDQ (Papežová et al., 2005). Four out of six studies found a relationship between pain, dissociation, and self-injury behaviors, and described the relevance of dissociative features in patients who practice self-harm in mixed EDs samples with at least one group of patients with AN, according to the inclusion criteria of this review (Claes et al., 2006; Claes & Vandereycken, 2007; Navarro-Haro et al., 2015; Paul et al., 2002). In this context, McCallum et al. (1992) found that dissociative symptoms, especially depersonalization, were correlated with self-harm as well as with suicide attempts. Insensitivity to pain was noted in patients with AN, especially in those with the binge-purging subtype (Papežová et al., 2005), during self-injury behaviors. Although Claes et al. (2006) linked the absence of pain to dissociation, Papezová et al. (2005) failed to find a significant association between pain threshold and somatoform dissociation. Finally, Claes and Vandereycken (2007), considering sexually traumatized patients, reported higher levels of dissociation in those with self-injury behavior than in ones without it.

Only one study of this group assessed differences between AN subtypes finding higher levels of pain insensitivity in patients with AN-BP than in those with AN-R (Papežová et al., 2005) (see Table S3).

3.3.4. Dissociation in treatment of AN (5 studies)

Two studies administered the DIS-Q (Claes et al., 2006; Claes & Vandereycken, 2007) to assess the quantity and the levels of dissociative symptoms (La Mela et al., 2013; Vanderlinden, 1993); the other three studies used the DES as a continuous variable (Caslini et al., 2015; Iancu et al., 2006; Strangio et al., 2017). All studies included self-report measures and were conducted on samples with at least one AN subgroup, according to the inclusion criteria of this review. An association between levels of dissociation and negative treatment outcomes (i.e., meeting DSM criteria for an ED at the 4-week follow-up after the end of treatment, or dropping-out during treatment) was found in patients with AN exposed to enhanced-cognitive behavioral therapy (La Mela et al., 2013). Two studies reported an improvement of dissociative symptoms after treatment (Caslini et al., 2015; Strangio et al., 2017). The first study, conducted by Caslini et al. (2015), performed a psychotherapeutic treatment based on the elaboration of traumatic memories on a sample of patients affected by AN-R, BN and ED not otherwise specified, and described a significant decrease of dissociative experiences. Similarly, the second study, conducted by Strangio et al. (2017), adopted psychodynamic psychotherapy on patients with AN (without subtype specification), BN, BED, and Avoidant-Restrictive Food Intake Disorder and showed a significant reduction of dissociation levels. One of the five reviewed studies showed a lack of improvement of dissociation levels after treatment (i.e., group therapy and individual insight-oriented therapy if needed) in soldiers with AN and BN (Iancu et al., 2006). Vanderlinden et al. (1995), focusing on AN subtypes, reported intermediate data, showing an improvement in dissociation symptoms after treatment (i.e., mixed treatment including group activities, individual therapeutic sessions for patients with childhood trauma and hypnotic techniques) in patients with AN-R, but not in those with AN-BP instead; no other studies deepened the difference between AN subtypes (Table S3).

3.4. Study 4

3.4.1. Comparison of patients diagnosed with AN-R and AN-BP concerning dissociation and other clinical variables

Patients with AN-BP reported higher levels in all clinical variables but age and physical activity compared to those with AN-R. As regards eating-related pathology, those with AN-BP scored higher than the AN-R group on all EDE-Q subscales. Depressive symptoms, as measured with the BDI, and state and trait anxiety were higher in patients with AN-BP than in those with AN-R. Dissociation, both psychoform and somatoform, was higher in the AN-BP group compared to AN-R. Concerning body-related variables, a significant difference was found only in the BSQ, with AN-BP reporting again higher scores than those with AN-R. Finally, patients with AN-BP reported higher severity of emotional abuse, physical abuse, emotional neglect, and a higher CTQ total score (Table 7).

Table 7. Differences between patients with Restricting Anorexia Nervosa and Binge-Purging Anorexia Nervosa.

	Total sample of inpatients with AN (n=111)				
	AN-R (n=69) Mean (SD)	AN-BP (n=42) Mean (DS)	Test statistics		
			t	p	Cohen's d
Clinical variables					
Age, years	23.6 (7.6)	25.8 (8.5)	-1.437	.154	.28
Years of illness	4.8 (5.4)	7.6 (6.7)	-2.419	**.017**	.48
BMI	13.9 (1.9)	17.2 (3.4)	-6.410	**<.001**	1.3
Binge-eating episodes per week	0.0 (0.0)	9.6 (16.5)	-4.747	**<.001**	.96
Vomit episodes per week	.2 (1.7)	10.4 (17.2)	-4.795	**.001**	.97
Number of previous AN-related hospitalizations	1.8 (1.3)	3.1 (4.1)	-2.506	**.014**	.48

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Eating-related psychopathology					
EDE-Q, dietary eating restraint	2.8 (2.1)	4.0 (1.8)	-2.567	**.012**	.61
EDE-Q, eating concern	2.8 (1.6)	3.7 (1.3)	-2.634	**.010**	.61
EDE-Q, shape concern	3.8 (1.7)	4.8 (1.3)	-2.860	**.005**	.65
EDE-Q, weight concern	3.3 (1.9)	4.4 (1.4)	-2.712	**.008**	.64
EDE-Q, global score	3.2 (1.7)	4.3 (1.2)	-3.268	**.002**	.72
General psychopathology					
BDI	15.7 (8.0)	19.9 (7.3)	-2.591	**.011**	.55
STAI-state anxiety	55.3 (13.3)	61.8 (11.3)	-2.435	**.017**	.52
STAI-trait anxiety	57.2 (11.9)	63.6 (14.9)	-2.286	**.025**	.49
Dissociation					
SDQ-20	28.5 (8.7)	32.8 (12.8)	-2.125	**.036**	.42
DES	18.8 (16.3)	29.6 (21.6)	-2.977	**.004**	.59
Body-related variables					
BSQ	113.9 (43.8)	139.4 (39.1)	-2.394	**.019**	.61
BCQ total score	55.9 (25.4)	67.7 (24.6)	-1.880	.064	.47
BIAQ total score	43.4 (15.6)	45.6 (15.1)	-.586	.560	.15
Childhood trauma					
Emotional abuse	9.2 (3.6)	12.6 (5.3)	-3.983	**<.001**	.79
Physical abuse	5.6 (1.7)	6.7 (3.2)	-2.415	**.017**	.47
Sexual abuse	6.6 (3.9)	7.9 (5.9)	-1.422	.158	.28
Emotional neglect	10.9 (4.4)	12.9 (4.7)	-2.369	**.020**	.45
Physical neglect	6.3 (2.1)	6.6 (1.6)	-1.008	.316	.16

CTQ total score	7.7 (2.4)	9.1 (2.9)	-2.798	**.006**	.54

Legend: BMI = body mass index; EDE-Q = Eating Disorder Examination Questionnaire; BDI = Beck Depression Inventory; STAI = State-Trait Anxiety Inventory; DES = Dissociative Experiences Scale; SDQ-20 = Somatoform Dissociation Questionnaire; BSQ = Body Shape Questionnaire; BCQ = Body Checking Questionnaire; BIAQ = Body Image Avoidance Questionnaire; CTQ = Childhood Trauma Questionnaire.
Cohen's d effect size: negligible effect: d = -.15 - .15; small effect: d = .15 - .40; medium effect: d = .40 - .75; large effect: d = .75 – 1.10; very large effect: d = 1.10 – 1.45; huge effect: d = 1.45.

3.4.2. Comparison of patients with and without somatoform dissociation

No differences in socio-demographic and clinical variables were observed between groups. In contrast, patients with somatoform dissociation (SDQ-20 score ≥ 30; Brunner et al., 2000; Nilsson, Lejonclou, and Holmqvist 2020; Vanderlinden et al., 1993) reported higher scores on all EDE-Q subscales compared to patients without somatoform dissociation. All these differences but dietary restraint remained significant in the model after statistical adjustment for AN subtype; however, introducing psychoform dissociation as a covariate, only the difference in eating concern remained significant. Initially, also the differences in depression and state anxiety were significant with higher scores of the somatoform dissociation group than the no-somatoform dissociation group. However, even if still significant after statistical control for AN subtype, the difference in depression was no longer significant after having introduced psychoform dissociation as covariate. As regards state-anxiety, the difference was still significant after statistical controls. Those in the somatoform dissociation group reported significantly higher scores on all body-related variables compared to those in the no-somatoform dissociation group, and such differences survived after statistical controls for AN subtype and psychoform dissociation. Finally, patients with somatoform dissociation reported higher levels of emotional abuse, physical abuse, sexual abuse, and CTQ total score; after the introduction of all covariates, differences in physical and sexual abuse were still significant (Table 8).

Table 8. Differences between patients with and without somatoform dissociation.

	No-SomD (n=70) Media (DS)	SomD (n=41) Media (DS)	t	p	Cohen's d	p*	η_p^2	P**	η_p^2
Clinical variables									
Age	23.8	25.3	-.954	.342	.19	-	-	-	-

	(7.8)	(8.3)							
Years of illness	5.8 (6.0)	6.0 (6.2)	-.197	.845	.03	-	-	-	-
BMI	14.9 (3.1)	15.7 (2.8)	-1.238	.219	.27	-	-	-	-
Binge-eating episodes per week	2.9 (9.9)	5.1 (13.2)	-1.011	.314	.2	-	-	-	-
Vomit episodes per week	3.6 (11.0)	5.1 (13.1)	-.669	.505	.13	-	-	-	-
Number of previous AN-related hospitalizations	2.1 (2.3)	2.7 (3.6)	-1.006	.317	.21	-	-	-	-
Eating-related pathology									
EDE-Q, dietary restrain	2.8 (2.0)	3.9 (2.2)	-2.339	**.022**	.53	.068	.038	-	-
EDE-Q, eating concern	2.7 (1.6)	3.8 (1.3)	-3.267	**.002**	.74	**.007**	.082	**.048**	.045
EDE-Q, shape concern	3.8 (1.6)	4.7 (1.5)	-2.643	**.010**	.58	**.038**	.049	.213	.018
EDE-Q, weight concern	3.3 (1.9)	4.4 (1.5)	-3.055	**.003**	.63	**.012**	.070	.109	.030
EDE-Q, global score	3.2 (1.6)	4.2 (1.5)	-3.028	**.003**	.65	**.017**	.064	.147	.025
General psychopathology									
BDI	15.6 (7.8)	20.3 (7.6)	-2.871	**.005**	.61	**.012**	.067	.299	.012
STAI-state anxiety	54.2 (13.2)	64.1 (9.6)	-3.793	**<.001**	.83	**.001**	.121	**.016**	.064
STAI-trait anxiety	57.8 (12.3)	63.0 (14.8)	-1.838	.069	.39	-	-	-	-
Body-related variables									
BSQ	105.9 (40.9)	147.8 (35.2)	-4.432	**<.001**	1.09	**<.001**	.249	**<.001**	.259
BCQ total score	51.7 (22.7)	74.2 (24.6)	-3.924	**<.001**	.97	**<.001**	.255	**<.001**	.224
BAQ total score	40.0 (15.3)	51.0 (13.0)	-3.157	**.003**	.77	**<.001**	.198	**.001**	.179
Childhood Trauma									
emotional abuse	9.2 (4.1)	12.6 (4.6)	-3.926	**<.001**	.80	**.001**	.100	.077	.029
Physical abuse	5.3 (1.1)	7.1 (3.5)	-3.897	**<.001**	.79	**.001**	.105	**.038**	.040
Sexual abuse	5.9 (2.9)	9.0 (6.6)	-3.323	**.001**	.68	**.002**	.082	**.045**	.038
Emotional neglect	11.3 (4.5)	12.3 (4.7)	-1.038	.302	.22	-	-	-	-
Physical neglect	6.2 (2.1)	6.7 (2.1)	-1.260	.210	.24	-	-	-	-
CTQ total score	7.6 (2.2)	9.3 (3.2)	-3.318	**.001**	.66	**.004**	.074	.063	.032

Legend: SomD = somatoform Dissociation; BMI = body mass index; EDE-Q = Eating Disorder Examination Questionnaire; BDI = Beck Depression Inventory; STAI = State-Trait Anxiety Inventory; SDQ-20 = Somatoform Dissociation Questionnaire; ; BSQ = Body Shape Questionnaire; BCQ = Body Checking Questionnaire; BIAQ = Body Image Avoidance Questionnaire; CTQ = Childhood Trauma Questionnaire.

Cohen's d effect size: negligible effect: d = -.15 - .15; small effect: d = .15 - .40; medium effect: d = .40 - .75; large effect: d = .75 – 1.10; very large effect: d = 1.10 – 1.45; huge effect: d = 1.45.

η^2_p= partial eta – squared; Cohen's effect size: 0.01-0.06 = small effect; 0.06 – 0.14 = moderate effect; >0.14 = large effect.

4. Discussion

The present project aimed to investigate the impact of traumatic events and post-traumatic symptoms on eating-related and general psychopathology in patients affected by AN, with a particular focus on AN subtypes and dissociative symptoms. This general aim was addressed conducting four studies respectively assessing the role of traumatic events (i.e., prevalence, type, timing, and differences in TEs features between AN subtypes) and post-traumatic symptoms in AN (Study 1 and Study 2), and trying to disentangle the role of dissociative symptoms in AN differentiating between the two type of dissociation (i.e., psychoform and somatoform) and AN subtypes (Study 3 and Study 4).

Overall, in Study 1 (Longo et al., 2019) we found that patients with AN-BP reported more sexual-related and more frequent and numerous TEs compared to those with AN-R; moreover, higher levels of emotion dysregulation and post-traumatic symptoms (i.e., intrusion, avoidance, and hyper-arousal) were described in patients with AN-BP than in those with AN-R (Study 1). Subsequently, focusing on young patients (i.e., max 25 years old) with AN, recruited at a beginning stage of the illness, we found that relational trauma (i.e., childhood abuse, or one of the following: physical violence, being assaulted with a weapon, sexual assault, other kinds of sexual assault, being kidnapped) and childhood trauma were the most common traumatic experiences. Moreover, while few differences in the clinical picture were detected between patients with and without a history of TEs, a more severe clinical condition, especially regarding body-related variables (e.g., shape concerns, weight concerns) was observed in patients with AN and comorbid PTSD compared to patients without such comorbidity (Study 2; Longo et al. 2021).

Focusing on dissociation, we reviewed the available literature on dissociative symptoms in AN and the following main findings emerged: dissociation is more present in patients with AN compared to healthy controls and individuals affected by other psychiatric disorders; dissociation, both types, is more commonly reported by patients with AN-BP than those with AN-R, but studies assessing differences between the two subtypes are few; finally, dissociation seems to be related to other aspects relevant for AN (i.e., trauma, self-harm, treatment outcome), but data on these topics are too few and incongruent to conclude, especially concerning somatoform dissociation and AN treatment (Study 3; Longo et al. 2019). In an attempt to start filling these gaps, we investigated somatoform dissociation in AN findings higher levels in AN-BP than in AN-R, and higher eating concerns, anxiety, and body-related symptoms (e.g., body avoidance, body checking) in patients with somatoform

dissociation compared to those without it, also after the controls for psychoform dissociation and AN subtypes. Moreover, a history of body-related childhood trauma (i.e., physical and sexual abuses) was more frequently reported by patients with somatoform dissociation than those without it, regardless of psychoform dissociation and AN subtypes; the other kind of abuses, not related to a direct impact on the body, were not associated with somatoform dissociation (Study 4; Longo et al., in prep.).

4.1. Traumatic events and post-traumatic symptoms in AN

Results from Study 1 showed firstly a difference in TEs suffered between AN subtypes with a higher occurrence in those with AN-BP than in those with AN-R. Our findings agree with those already present in literature that described an association between TEs and bulimic behaviors (Briere & Scott, 2007). We also explored the type of TEs suffered between AN subtypes, finding that sexual assault was significantly more common in those with AN-BP than AN-R. This coincides with earlier data that reported a significant association between childhood sexual abuse and binge-purging behaviors (Caslini et al., 2016); however, the comparison on TEs types between AN subtypes represents a novel datum. Moreover, although the significance threshold was not reached, those with AN-BP commonly reported "physical illnesses" as TE, while those with AN-R frequently reported both "physical illness" and the "sudden and unexpected death of someone close". Regarding timing, TEs occurred before the onset of illness in 58.3% of AN-R patients, and 81.1% of AN-BP patients. This result is comparable with Reyes-Rodríguez et al. (2011), who showed that most TEs happened before illness onset (Reyes-rodríguez et al., 2011). Moreover, this finding supports the hypothesis that TEs are potential risk factors for EDs onset (Brewerton, 2007; Jacobi et al., 2004; Kent & Waller, 2000). However, in our sample, a number of patients also reported TEs after illness onset. Further research should deepen as to whether TEs sequelae after the onset of illness could somehow be worsened by AN and if post-traumatic symptomatology and AN share the same maintenance and treatment-resistance factors, as recently suggested (Castellini et al., 2018). Concerning the number of TEs and post-traumatic symptoms, we found that patients with AN-BP reported significantly more TEs and scored higher than patients with AN-R on all post-traumatic symptoms, as measured by the Impact of Events Scale-Revised (i.e., intrusion, avoidance, and hyper-arousal). This is of interest since patients with AN-BP showed higher levels of PTSD-like symptoms than those with AN-R, suggesting

a major effect of TEs on the severity of PTSD clinical presentation. This may be due to the type of TE experienced by AN-BP patients, or to a greater vulnerability of PTSD in those with the AN-BP subtype.

Moreover, patients with AN-BP showed higher emotion dysregulation when compared to those with AN-R. Although the difference between AN subtypes in emotion dysregulation linked to TEs has not been investigated so far, this result is in line with previous studies on emotion dysregulation in AN (Brockmeyer et al., 2014; Haynos et al., 2014). Notwithstanding, earlier literature found differences in the DERS impulsivity-related subscale between diagnostic subgroups.

Subsequently, we focused on the frequency of trauma-related experiences, and on the specific contribution of PTSD full-blown diagnosis to AN. In this context, Study 2 showed that childhood trauma and lifetime TEs, mostly relational trauma, were the most frequent trauma-related factors reported by young patients with AN. These results are in line with studies supporting the role of traumatic events and childhood abuse, in particular emotional and physical neglect, as risk factors for EDs, as already stated above (Briere & Scott, 2007; Jaite & Hilbert, 2012; Kong & Bernstein, 2009; Racine & Wildes, 2015; Sanci et al., 2008). Moreover, having suffered a trauma could lead to a series of further risk factors for mental diseases. For instance, negative affectivity, often a consequence of a history of abuse, was described to be a risk factor for the development of body concern (Steiner et al., 2003).

For what concerns PTSD, patients with and without a comorbid PTSD diagnosis showed several differences in their clinical presentation, mostly on body-related symptoms. Unexpectedly, a higher BMI was observed in patients with PTSD compared to those without this diagnosis, therefore partially disconfirming earlier literature (Briere & Scott, 2007; Castellini et al., 2018). However, a couple of caveats should be considered: first, BMI could not be an effective proxy for AN severity, as already proposed (Gianini et al., 2017; Machado et al., 2017); second, a higher BMI could be also related to the greater presence of patients with AN-BP in the PTSD group. In fact, our data are in line with earlier literature and our previous work reporting that patients with AN-BP are more likely to report trauma history and post-traumatic symptoms compared to patients with AN-R (Longo et al., 2019; Palmisano et al., 2018). It is also noteworthy that a diagnosis of PTSD in comorbidity with AN could contribute to a potentially different clinical presentation, also impacting on weight, when compared to patients with a pure diagnosis of AN. Furthermore, patients with PTSD showed higher scores in shape concern, weight concern, and total score of EDE-Q, in keeping with previous findings on post-traumatic symptoms and AN (Briere & Scott, 2007). Interestingly,

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anxiety traits were higher in patients with AN and PTSD compared to patients without PTSD, in line with previous literature describing a higher frequency of PTSD diagnosis in individuals predisposed to anxiety and stress-related psychopathology (Gilbertson et al., 2002).

4.2. Dissociation in AN

Given the importance of dissociative symptoms as post-traumatic consequence, we explored the role of dissociation in AN. In the Study 3, we systematically reviewed the literature on the topic in order to disentangle this issue. Results were divided into three areas according to our aims (see page 9). As regards the first area, 10 studies investigated dissociation mainly concerning eating-related psychopathology of AN. In general, these studies found a correlation between dissociation and eating-related symptoms (Beato et al., 2003; La Mela et al., 2010; McCallum et al., 1992; Waller et al., 2003). In particular, many studies showed higher levels of dissociation in patients with AN than in healthy controls and in patients affected by anxiety disorders, mood disorders, and schizophrenia (Grave et al., 1997; La Mela et al., 2010; Schumaker et al., 1995; Vanderlinden et al., 1993). These data are in accordance with those by Lyssenko et al. (2018) who, reviewing studies about dissociation in psychiatric disorders, found that patients with AN scored higher on the DES than those with other mental disorders (Lyssenko et al., 2018). Moreover, patients with AN-BP showed higher levels of dissociation, especially the somatoform type, than those with AN-R (Beato et al., 2003; Oliosi & Dalle Grave, 2003; Palmisano et al., 2018; Vanderlinden et al., 1993; Waller et al., 2003).

The second research area includes studies that investigated dissociation-related constructs in AN; these were further classified into two subgroups. In the first subgroup, studies assessed the link between trauma, dissociation, and AN. Only one study addressed somatoform dissociation (Palmisano et al., 2018) describing it as most prevalent in AN-BP and not related to the severity of binge-eating in traumatized patients with EDs. Concerning other studies of this area, it was found an association between trauma, dissociation, and AN, especially AN-BP, with a role of dissociation as a mediator (Dalle Grave et al., 1996; Pugh et al., 2018). These data are in line with literature on trauma in EDs suggesting that psychoform dissociation is a mediator between traumatic events and eating disordered behaviors, especially bingeing and purging (Moulton et al., 2015; Palmisano et al., 2018; Thornley et al., 2016). Relatedly, dissociation could be seen as a post-traumatic sequela and binge-purging

behaviors as a strategy to cope with trauma-related feelings and dissociative symptoms. This hypothesis is in line with the "escape from self-awareness theory" (Heatherton & Baumeister, 1991) describing a narrowing of attention in patients with EDs with the aim to escape from unpleasant thoughts and feeling related to trauma; this mechanism removes inhibitions and facilitates the start of binges. However, three out of nine studies failed to find any relationships between trauma, dissociation, and AN (Berger et al., 1994; Favaro et al., 1998; Nagata et al., 1999); these studies were conducted on patients with mixed ED diagnoses and did not focus on the comparison between AN subtypes. These data led us to hypothesize that the link between trauma, dissociation and eating behaviors may hold only for patients with AN-BP and may thus emerge only when diagnostic subtypes are taken into account.

In the second subgroup, six studies investigated the link between dissociation, pain, and self-injury in AN. A correlation between dissociation and self-injurious behaviors consistently emerged across the reports (Claes et al., 2006; Claes & Vandereycken, 2007; Navarro-Haro et al., 2015; Paul et al., 2002), in line with earlier literature on this topic (Armey & Crowther, 2008; Karpel & Jerram, 2015; Nobakht & Dale, 2017). With regard to pain, insensitivity during self-injury has been described, especially in AN-BP (Claes et al., 2006; Papežová et al., 2005), but results on the correlation between insensitivity to pain and dissociation are mixed. Cleas and colleagues (2005) found an association, whereas Papezová et al. (2005) did not find any relationship between somatoform dissociation and pain threshold. It is of note that these two studies adopted different measures of dissociation, that is in one paper somatoform dissociation has been specifically investigated (Papežová et al., 2005), whereas, in the other study, psychoform dissociation was taken into account instead (Claes et al., 2006).

The last group of studies (e.g., dissociation in treatment of AN) explored the role of dissociation in the treatment of AN grounded on the finding that dissociation has been linked with negative treatment outcomes (La Mela et al., 2013). In fact, dissociation is often difficult to detect, thus it could potentially, mostly when disregarded, contribute to the maintenance of eating-related pathology, as stated earlier. However, three studies reported an improvement in dissociative symptoms after treatment (Caslini et al., 2015; Strangio et al., 2017; Vanderlinden, 1993). Caslini et al. (2015) performed a treatment focused on the elaboration of traumatic memories, whereas Strangio et al. (2017) adopted a psychodynamic psychotherapy treatment. Interestingly, Valdiserri and Kihlstrom (1995) found a decrease of dissociation in AN-R but not in AN-BP. Only one study did not report an improvement of dissociation after treatment (Iancu et al., 2006); however, this result is not fully generalizable as the latter study

recruited a specific population who suffered different kinds of traumatic events compared with the population of ED patients (i.e., a sample of soldiers with ED). To note, all studies focusing on treatment considered just psychoform dissociation, thus the role of somatoform dissociation in the treatment of AN remains unexplored. Moreover, studies are very few in this group, thus conclusions regarding treatment must be interpreted with caution and further studies are needed.

Given the review results (i.e., too few data are currently available on dissociation in AN, especially regarding AN subtype, somatoform dissociation, and treatment), we tried to fill some of these gaps with Study 4. Exploring the sample, we found a significantly more severe condition in patients with AN-BP than AN-R in all eating-related and general psychopathology-related variables but Body Mass Index, in line with previous literature describing a greater severity of AN-BP patients (Elran-BaraK et al., 2014; Fernandez-aranda et al., 2007; Deborah Lynn Reas & Rø, 2018; Salbach-Andrae et al., 2008); AN-BP also scored higher than AN-R in Body Shape Questionnaire, in accordance with previous data (Marzola et al., 2020), and reported a higher rate of childhood trauma, confirming our previous study on the topic (Longo et al., 2019). Moreover, individuals with AN-BP scored higher both in psychoform and somatoform dissociation compared to those with AN-R, in agreement with researches describing higher levels of both types of dissociation in patients affected by bulimia nervosa and AN-BP (Beato et al., 2003; Longo et al., 2019; Tibon & Rothshild, 2009). Then, we compared patients with and without somatoform dissociation on the aforementioned variables, controlling for the role of AN subtypes and psychoform dissociation when differences were significant. Patients with somatoform dissociation, despite no significant differences were found in clinical variables, scored higher on all EDE-Q subscales compared to patients without somatoform dissociation. All differences but that in restraint subscale were still significant after introducing as a covariate the AN subtype; however, adding psychoform dissociation to the model, only the difference in eating concern remained significant. The first round of data is in line with the few existing data on somatoform dissociation in eating disorders (Beato et al., 2003); however, the specific focus on AN, and the introduction of AN subtypes and psychoform dissociation are elements of novelty. This datum could be important since it isolates the contribution of somatoform dissociation to eating-related symptoms from those of AN subtype and psychoform dissociation. Furthermore, anxiety and depression were higher in the group with somatoform dissociation than in the one without it, but introducing AN subtype and psychoform dissociation as covariates, the difference in depression and trait anxiety was no more

significant. No previous literature on somatoform dissociation and depressive and anxious symptoms in AN is available, so comparisons are difficult. However, it emerged that state anxiety and eating concern are more reported in patients with somatoform dissociation compared to those without it. Since eating concerns and anxiety could be related, future studies may aim to deepen the role of somatoform dissociation in this relationship. Concerning body-related variables, patients with somatoform dissociation reported higher levels than patients without it on all the examined variables (i.e. Body Shape Questionnaire, Body Checking Questionnaire, and Body Image Avoidance Questionnaire), also after statistical controls for AN subtypes and psychoform dissociation. These data are in line with literature reporting an association between somatic dissociation and body dissatisfaction (Beato et al., 2003; Fuller-Tyszkiewicz & Mussap, 2008). Relatedly, it is of note that the body is central in AN, and it could be speculated that somatoform dissociation, impacting on body and body functions, could make more severe the eating-related symptoms, through the severity of body-related symptoms. In this context, a recent study found that both dissociation and suicidality were linked to body-image related parameters, thus suggesting that dissociation could alter body perception in patients with EDs (Lewis et al., 2021). At first sight, these data seem to be in contrast with the previous lack of significant differences in body-related subscales of EDE-Q (i.e., shape concern, weight concern); however, all these results together led us to attempt a speculation: somatoform dissociation impacts on body sensations and perception, also leading to a more impaired body image, as previously demonstrated by the literature (Beato et al., 2003; Fuller-Tyszkiewicz & Mussap, 2008), and confirmed by the present study; this condition could make patients with somatoform dissociation avoidant toward the body (as suggested by results in BIAQ), and reluctant towards intentional cognitions, such as concerns and thoughts, on the body; thus, patients with somatoform dissociation could be more prone to focus on eating instead of on the body-relating symptoms of AN; further studies on the topic are needed to confirm this hypothesis.

Since dissociative symptoms were described as mediator between childhood trauma and eating disorders onset and maintenance, we also took into account childhood trauma. Results showed higher scores in emotional abuse, physical abuse, sexual abuse, and Childhood Trauma Questionnaire global score in the group with somatoform dissociation compared to the one without it, also after having controlled for AN subtype. Notwithstanding, introducing psychoform dissociation as a covariate, just differences in physical and sexual abuse remained significant. This datum is of interest since these two types of abuses, more highly reported by patients with somatoform dissociation, are specifically related to a direct traumatic impact on

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the body. Results on childhood trauma are partially in accordance with Maaranen and colleagues (2004): the authors, indeed, described a strong association between somatoform dissociation and physical abuse, but not between somatoform dissociation and sexual abuse (Maaranen et al., 2004). However, we conducted our study on patients with AN, while Maaranen and colleagues recruited individuals from the general population: this difference could have contributed to the contrasts in the results. Our data are novel, no other studies on the topic are available for comparisons. Relatedly, high CTQ scores in individuals with somatoform dissociation could suggest the presence of a history of violent childhood trauma directly impacting the body.

5. Conclusion and future directions

It is well established that traumatic events, especially occurred during childhood, and post-traumatic stress disorder are risk factors for the development of AN (Brewerton, 2007; Jacobi et al., 2004); moreover, a role of post-traumatic symptoms in the maintenance of eating-related pathology and in increasing the severity of AN clinical presentation was proposed (Briere & Scott, 2007), particularly through the contribution of mediators such as emotion dysregulation and dissociation. However, the mechanisms that link traumatic events, post-traumatic symptoms, and AN are still mostly unknown. The present project expanded the knowledge on this topic, adding novel findings to the field. Firstly, Study 1 was the first study comparing AN subtypes on traumatic events characteristics and post-traumatic symptoms, finding mainly that patients with AN-BP had higher post-traumatic symptoms and emotion dysregulation than those with AN-R, also reporting more numerous lifetime traumatic events than patients with AN-R, especially regarding sexual-related TEs. Moreover, as shown by Study 2, the diagnosis of PTSD is crucial in determining the severity of AN clinical presentation.

As regards dissociation, Study 3 represents the first systematic review on the topic. It contributed to make clearer the role of dissociation in AN assessing that dissociation, mainly the psychoform, is more related to AN, especially the binge-purging subtype, than to other psychiatric disorders, and it is linked also with trauma and self-harm; the review highlighted some gaps in the study of dissociation in AN: the most important ones regarded the lack of studies investigating somatoform dissociation in AN, and the paucity of researches focusing on and distinguishing between AN subtypes in the investigation of dissociative symptoms in AN. In an attempt to fill these gaps, Study 4 is the first one to explore differences between patients with AN with and without somatoform dissociation, also taking into account the role of AN subtypes and psychoform dissociation. From this study emerged the unique contribution of somatoform dissociation to AN, net of psychoform dissociation: somatoform dissociation is associated mostly with body-related symptoms in AN, anxiety, and childhood abuses directly impacting on the body (i.e., physical abuse and sexual abuse).

Despite the strength of the present project, given by the novelty of the main findings, some limitations should be acknowledged: firstly, all the studies have a cross-sectional design, thus a causal link between trauma and AN can not be clarified; secondly, the majority of the data was collected adopting self-report measures, so recall bias cannot be ruled out; thirdly, the lack of a healthy control group prevents the comparisons with the general population; finally,

a transversal limit could be represented by the fact that the examined variables (e.g., trauma, post-traumatic symptoms, eating-related symptoms, dissociation) are strongly intertwined in creating a complex and entangled clinical picture, thus the isolation of these aspects is not always feasible in the clinical practice.

Despite these limits, the discussed results have some clinical implications. The data, indeed, suggest adopting a trauma-focused perspective in clinical practice with patients with AN. In particular, a careful assessment of trauma history and post-traumatic symptoms is suggested, also in order to decrease the risk to develop severe and resistant forms of AN. The presence of both types of dissociation should be investigated, also in light of those researches showing higher dissociation from the body in individuals with a history of suicide attempts compared to those without it (Levinger et al., 2015). Moreover, the results recommend developing treatment protocols targeting post-traumatic symptoms in patients with AN, with particular attention to dissociation. Indeed, as described above, post-traumatic symptoms, if not treated and solved, could maintain and make more severe the eating-related pathology, also threatening the success of the treatment. In this context, several tools have been described as effective in treating post-traumatic and dissociative symptoms. For instance, Eye Movement Desensitization and Reprocessing (EMDR) is adopted to integrate and elaborate the dissociated traumatic memories and feelings, while yoga and mindfulness could help to restore the relationship with the body and to improve the somatoform symptoms (Van Der Kolk, 2014). Moreover, recent evidences also suggested the effectiveness of intensive and comprehensive standardized multidisciplinary programs based on cognitive-behavioral therapy in improving dissociative symptoms (Meneguzzo et al., 2021).

Even though some aspects of the association between trauma and AN have been clarified, much of this complex relationship remains unknown. Further studies with longitudinal design and exploring biological components (e.g., genetic, neuronal) of PTSD in AN are needed.

As regards future directions of the present project, we intend to longitudinally investigate the role of trauma, post-traumatic symptoms, and dissociation in the treatment of AN. Indeed, it has been proposed that post-traumatic symptoms and dissociation in individuals with AN contribute to negative treatment outcomes, but the topic is still minimally studied. Moreover, it is of note that patients with AN report impaired neuropsychological performances (Lauer, 2002). Post-traumatic stress disorder is associated with difficulties in neuropsychological tasks too, especially those related to executive functions (George et al., 2015; Hayes et al., 2012). The investigation of differences in neuropsychology between patients with AN with and without comorbid PTSD and dissociation is among our future intentions. Finally, we

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would like to explore whether and how the co-occurrence of AN and post-traumatic and dissociative symptomatology impact on two constructs particularly involved in daily life: peri-personal space (i.e., the space around the body where we can reach and be reached by external elements, with two functions: it allows us to interact with objects, and it has a social function regarding the interaction with other people) and time perception.

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Supplementary materials

Table S1. Differences between patients with and without childhood trauma.

	Childhood trauma (n= 51)	Non-childhood trauma (n= 12)		
	Mean (SD)	**Mean (SD)**	**z**	**p**
Years of illness	3.35 (2.54)	3.50 (3.45)	-.267	.789
Illness onset	16.80 (2.40)	16.58 (2.64)	-.736	.462
Bmi	15.40 (2.73)	13.99 (1.74)	-1.839	.066
N of hospitalizations	1.92 (1.40)	2.17 (1.85)	-.369	.712
EDE-Q				
Restrain	2.96 (1.89)	1.87 (2.15)	-1.706	.088
Food concern	3.09 (1.43)	2.52 (1.83)	-1.323	.186
Shape concern	3.89 (1.62)	3.23 (1.64)	-1.200	.230
Weight concern	3.47 (1.69)	2.65 (1.85)	-1.336	.182
Total score	3.35 (1.55)	2.50 (1.61)	-1.488	.187
BDI	17.74 (7.83)	13.25 (8.67)	-1.980	**.048**
STAI-State	58.10 (11.64)	51.00 (14.44)	-1.563	.118
State-Trait	58.68 (16.85)	52.58 (12.48)	-1.840	.066
DES	24.57 (17.58)	13.18 (12.32)	-2.343	**.019**

BMI = body mass index; EDE-Q = eating disorder examination questionnaire; BDI = Beck depression inventory; STAI = State-trait anxiety inventory; DES = dissociative experiences scale.

Table S2. Differences between patients with and without multiple traumas.

	multiple traumas (n= 38)	Non-multiple traumas (n= 23)		
	Mean (SD)	Mean (SD)	z	p
Years of illness	3.61 (2.87)	3.13 (2.51)	-.607	.544
Illness onset	16.61 (2.14)	16.83 (2.84)	-.362	.718
Bmi	15.73 (2.75)	14.27 (2.23)	-2.337	**.019**
N of hospitalizations	1.87 (1.38)	2.13 (1.69)	-.264	.791
EDE-Q				
Restrain	2.81 (2.16)	2.52 (1.83)	-.716	.474
Food concern	2.89 (1.52)	3.04 (1.62)	-.313	.754
Shape concern	4.05 (1.59)	3.29 (1.76)	-1.516	.130
Weight concern	3.33 (1.74)	3.14 (1.96)	-.265	.791
Total score	3.27 (1.61)	2.96 (1.61)	-.645	.519
BDI	16.88 (7.77)	16.32 (8.99)	-.086	.932
STAI-State	58.10 (11.35)	53.68 (13.99)	-1.307	.191
State-Trait	56.40 (18.95)	58.50 (13.30)	-.222	.824
DES	23.63 (18.90)	18.49 (13.28)	-.912	.362

BMI = body mass index; EDE-Q = eating disorder examination questionnaire; BDI = Beck depression inventory;
STAI = State-trait anxiety inventory; DES = dissociative experiences scale.

Table S3. Studies on dissociation in anorexia nervosa included in this review and grouped as follows: 1. dissociation in AN, 2. dissociation, trauma and AN, 3. dissociation, pain and self-injury in AN, 4. dissociation in treatment of AN (studies listed in alphabetical order).

	AUTHORS	COUNTRY	AIMS	SAMPLE	FEMALE %	MEASURES	MAIN FINDINGS	LIMITATIONS	MMAT v. 2018
1. Dissociation in AN	Beato et al., 2003	Spain	-To investigate the role of dissociation as predictor of severity of body dissatisfaction considering also self-esteem	22 AN-R 10 AN-P 42 BN-P 6 BN-NP 38 EDNOS 64 HCs	97.5 90.6	DES	-30.5% of patients with EDs were evaluated as at high risk for dissociative disorders -Mostly those with bulimic purging type and EDNOS presented higher levels of dissociation compared to the general population -DES score had no influence on BSQ score in HCs, but did so in patients with EDs -Dissociation and self-esteem were associated in the way the patient feels the body	n.a.	2*
	Demitrack et al., 1990	USA	-To investigate dissociative experiences in EDs and the associated clinical presentation	12 AN 18 BN 21 HCs	100	DES	-Higher dissociation levels were found in ED than in HCs -Patients with severe dissociation presented self-harm not related to impulsivity levels, illness severity and mood and anxiety comorbidity	n.a.	3*
	Farrington et al., 2002	UK	-To investigate the association between dissociation and other psychological symptoms	210 non-clinical sample 19 mixed clinical sample 20 AN	50.5 100 100	A-DES	-Dissociation was related to level of symptoms in non-clinical and clinical groups -AN was the third group regarding levels of dissociation after dissociative disorders and psychotic ones -AN did not present higher dissociation than other groups -In AN dissociation was associated with interpersonal sensitivity, hostility and paranoid ideation	The study had a cross-sectional design	3*
	Gleaves and Eberenz, 1995	USA	-To assess the specific link between dissociative symptoms and anorexic and bulimic symptoms - To replicate findings regarding the relationship	18 AN 27 BN 8 EDNOS	100	DES Dissociation scale from the trauma symptoms	-Bulimic behavior was not correlated with dissociation -Some regressions between variables of AN and dissociation were positive, but adding depression and anxiety, they lost significance -Dissociation was not related to core symptoms	-Only one measure of personality disorder was used -Sample size was small -Structured interviews were not used to test	4*

					checklist	of ED -Severity of dissociation did not covary with severity of ED symptoms - Schizotypal personality disorder was the best predictor of dissociation	dissociative or personality disorders	
La Mela et al., 2010	Italy	-To investigate levels of dissociative experiences in ED patients compared to HCs and patients with anxiety and mood disorder - To explore the effect of dissociation on ED symptoms, specifically binge eating	9 AN 20 BN 25 EDNOS 58 anxiety and mood disorders 39 HCs	92.6 71.4 69.2	DIS-Q	-Higher scores of ED than anxiety and mood on DIS-Q identity confusion subscale and loss of control subscale were found - Higher level of dissociative tendencies in ED group than in others were shown -Frequency of binge eating episodes was associated with identity confusion, loss of control and amnesia -Correlation between number of episodes of uncontrolled overeating and dissociative experiences was found	-Cases with comorbidity were excluded leading to less generalizability -No diagnoses of dissociative disorders were available -Binge episodes were not ascertained with objective methods -The study had a cross-sectional design	4*
McCallum et al., 1992	USA	-To investigate the presence of dissociative disorders according to DSM-III among ED patients, and to assess the association between dissociation, eating-related attitudes, abuse history and self-harm	27 BN 8 AN 3 EDNOS	n.a.	DES DSM-III-R criteria for dissociative disorders	-Many patients showed symptoms compatible with a defined diagnosis of dissociative disorders -Dissociation was related to eating behavior such as bingeing, purging and restriction, and with self-harm and suicide attempts -Depersonalization predicted self-harm and anticonservative attempts better than depression and borderline personality disorder	Diagnosis of EDs could be difficult	3*
Oliosi e Dalle Grave, 2003	Italy	-To investigate differences in symptoms, both eating and psychiatric among AN-R, AN-P and AN-B, focusing on differences in dissociations and suicide attempts	40 AN-R 38 AN-P 40 AN-B	100	DIS-Q	Dissociation levels were higher in AN-P and AN-B than AN-R with no differences between AN-P and AN-B	Authors considered only inpatients with very low weight	3*
Schumaker et al., 1995	Australia	-To estimate dissociation and depression in a sample of individuals with EDs	26 AN 18 BN 31 HCs	100	Riley's Questionnaire of Experiences of Dissociation	-EDs sample showed higher levels of dissociation compared to HCs	n.a.	3*
Vanderlinden et al., 1995	Netherland	-To assess hypnotizability and dissociation in an EDs sample compared to HCs -To test the association between	18 AN-R 17 AN-BP	96.2	DIS-Q	-Higher levels of dissociation and hypnotizability in EDs compared to HCs were shown -Patients with BN and AN-BP showed higher	n.a.	3*

	Author	Country	Aim	Sample	%	Measures	Results	Limitations	Quality
			these constructs	18 BN 88 HCs			levels of loss of control compared to patients with AN-R -Total DIS-Q score and identity confusion and loss of control subscales were related to hypnotizability scores		
	Waller et al., 2003	UK	-To describe the association between different types of dissociation and eating-related psychopathology	21 AN-R 40 AN-BP 70 BN 75 HCs	100	DES SDQ	-Normal levels of dissociation were found in AN-R -AN-BP showed the highest levels of dissociation -A link between purging and compensatory behavior and somatoform dissociation was found -Somatoform dissociation was the best predictor of eating attitude	-No comorbidity data were available -Bulimic behaviors were self-reported	4*
2. Dissociation, trauma and AN	Berger et al., 1994	Japan	-To assess the occurrence of dissociative symptoms, with a focus on multiple personality disorders, in ED patients	35 BN 1 AN 8 AN and BN	100	DES DDIS	-Results on DES suggested dissociation was not specific to patients with EDs -Patients with more than 3 criteria for multiple personality disorder reported earlier ED onset than patients who did not meet such criteria -Patients with high DES score (>30) and those with low DES score (<30) did not differ on demographic and clinical (e.g. illness onset, self-harm, psychogenic amnesia) variables and abuse history	-Sample size was small -Questions were culturally interpreted -Potential self-report biases could be present	3*
	Brown et al., 1999	Australia	-To test the hypothesis of a positive correlation between physical and sexual abuse and dissociation	41 AN-R 19 AN+BN 43 BN 11 EDNOS	98.2	DIS-Q	-Dissociation was common in ED patients with sexual abuse history -Childhood physical abuse was related only with absorption subscale -Results suggested a general trend towards increasing dissociation levels with multiple forms of abuse reported -Dissociation could be seen as a trait in ED as no differences between inpatients and outpatients emerged	n.a.	3*
	Dalle Grave et al., 1996	Italy	-To investigate the presence of dissociation in ED compared to schizophrenic patients and HCs – To assess the frequency and type of trauma in EDs and the association with dissociation –To describe frequency and	30 AN-R 22 AN-BP 24 BN 30 BED	100	DIS-Q	-Higher levels of dissociation in ED (especially BN and AN-BP) than HCs and schizophrenics were found -Results showed an association between trauma, dissociation and bulimic behavior. -In BN and AN-BP prevalence of trauma was associated with high prevalence of dissociation,	Any causality between trauma, dissociation and eating symptoms could not be inferred	2*

		severity of dissociation in EDs	20 schizophrenia 112 HC			particularly regarding identity confusion and fragmentation and loss of control		
Favaro et al., 1998	Italy	-To investigate the impact of abuse experiences in EDs and asymptomatic patients	38 AN-R 48 AN-BP 53 BN-P 16 BN-NP 81 asymptomatic individuals	98.1 100	DIS-Q	-Results showed no significant differences between abused and non-abused subjects in dissociation levels - Regression did not describe dissociation as a significant predictor of abuse	-Only self-report measures were used -There was a lack of data about abuse (severity and age at which it took place)	2*
Hallings-Potts et al., 2005	UK	-To investigate whether subliminal abandonment threats facilitate state dissociation	16 BN 4 AN-BP 2 BED 2 EDNOS 26 HCs	100	DES	Implicit abandonment threats enhanced state dissociation	n.a.	4*
Nagata et al., 1999	Japan	-To assess the prevalence of abuse in Japanese patients with EDs -To study the relationship between traumatic events and clinical symptoms including dissociation	36 AN-R 41 AN-BP 68 BN 103 HCs	100	DES	No differences in dissociative symptoms between patients with and without sexual abuse emerged	Self-report measures were used	1*
Palmisano et al., 2018	Italy	-To explore the relationship between childhood trauma and both somatoform and psychoform dissociation and EDs	20 AN-R 10 AN-BP 25 BN	86.4	DES SDQ	-Significant higher score on dissociation in groups with EDs than in HCs was found -Dissociation in BN, BED and AN-BP was higher than in AN-R -AN-BP showed the highest score on SDQ -DES can predict the severity of BE	-The use of self-report and retrospective measures limited conclusions about causality -Sample and subsample	4*

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							-Somatoform dissociation was not related to the severity of BE	were small and inhomogeneous	
				31 BED 86 HCs					
	Pugh et al., 2018	UK	-To test 3 hypotheses: 1. eating disorder voice (EDV)is a trans-diagnostic feature of eating disorders 2. EDV could have different characteristic among different ED diagnosis 3. Dissociation could act as a mediator between power of EDV and childhood abuse	26 AN 30 BN 21 OSFED 8 BED	91.8	DES	Dissociation mediated the relationship between EDV and childhood emotional abuse	-Subsamples were relatively small -Self-report measures were used to investigate childhood abuses -Possible comorbid dissociative disorders were not assessed -Only the global score of DES was considered - The study had a cross-sectional nature	2*
	Vanderlinden et al., 1993	Belgium	-To study the association between specific traumatic events and dissociative experiences in EDs	34 AN-R 24 AN-BP 28 BN 12 AED 66 HCs	98 n.a.	DIS-Q	-ED groups presented higher levels of dissociation compared to HCs -12% of ED patients reported DIS-Q score at the same levels of patients with dissociative disorders and most of them had a history of trauma -Patients reporting incest and sexual abuse showed high levels on amnesia subscale	n.a.	3*
3. Dissociation, pain and self-injury in AN	Claes et al., 2006	Belgium	To answer 5 questions: 1 depression and substance abuse affect the pain report during self-injury behavior (SIB)? 2 Is presence or absence of pain related to ED subtypes? 3 Is pain feeling associated with type of SIB? 4 Are there differences between patients reporting pain and not? 5 What is the mechanism responsible for differences in pain report during SIB?	68 AN-R 66 AN-BP 51 BN	100	DIS-Q	-Part of ED patients did not report pain during SIB -Lower weight and BMI were associated with less pain during cutting -Absence of pain during cutting was linked to history of physical abuse and dissociation -Dissociation may be the key to the comprehension of alterations in pain sensation and body experiences	n.a.	2*

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Claes and Vandereycken, 2007	Belgium	- To assess different types of SIB and traumatic experiences in EDs -To explore the association between SIB characteristics and trauma types -To investigate the potential mediating role of dissociation, impulsiveness and low self-esteem	23 AN-R 18 AN-BP 28 BN	100	DIS-Q	Patient with sexual trauma and SIB reported more dissociative features than ones without SIB	n.a.	1*
Navarro-Haro et al., 2015	Spain	To investigate the association between emotion regulation strategies and dissociation and non-suicidal self-injury (NSSI) in women with EDs in comorbidity with Borderline Personality Disorder	18 AN 17 BN 38 EDNOS	100	DES	-Results showed a positive correlation between the increase of dissociation and the increase of NSSI -Authors observed that improvement in cognitive reappraisal attenuate the deleterious effect of dissociation on NSSI	-Only self-report measures were used to assess emotion regulation strategies and dissociation -Reliability and validity of diagnoses were unknown -Only females were recruited -High number of cases was deleted	3*
Papezova et al., 2005	Czech Republic	-To measure thermal pain threshold in patients with EDs and HCs - To describe the relation between pain sensitivity and psychological variables with a focus on somatoform dissociation and body image disturbances	16 AN-R 5 AN-BP 18 BN 70 HCs	100	SDQ	-Elevated pain threshold in EDs was found -Highest level of pain insensitivity was observed in AN-BP -Association of pain sensitivity with somatoform dissociation was weak and no-significant	-Other variables (serotonin function, sex hormones or personality variables) could contribute to the decreased pain threshold -Sample size was small -No interviews were conducted for comorbidity assessment	3*
Paul et al., 2002	German	-To describe occurrence and characteristics of self-injurious behavior -To investigate the impact of trauma, dissociation, impulsivity and obsessive-compulsive on self-injury features	59 AN-R 60 AN-BP 137 BN 120 EDNOS	100	DES	-Importance of traumatic experiences and dissociation in self-injuring patients emerged from group comparisons -Correlation between self-injury and dissociation was found	-The inpatient sample may inflate the rate of SIB compared to outpatients -No comparisons of subtype EDs for subtype SIB were conducted	3*
Caslini et al., 2015	Italy	-To investigate the effectiveness of intensive psychological	3 AN-R	100	DES	-Psychotherapeutic treatment was significantly effective in reduce dissociative experiences as	-Sample size was small -The sample was	2

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		treatment for EDs with a focus on dissociation, alexithymia and impulse regulation	2 BN 3 EDNOS			observed at one year follow up	homogeneous in terms of diagnostic features	
Iancu et al., 2006	Israel	-To test the efficacy of treatment program for EDs in a sample of soldiers -To evaluate rates of alexithymia and dissociation before and after the treatment	10 AN 15 BN 5 EDNOS	90	DES	-DES score was higher in people with EDs than in non-eating disorder groups -No decrease of DES score after treatment was observed	-Sample was small and heterogeneous with respect to diagnosis and treatment -No objective criteria were used to investigate the improvement (no BMI) -Lack of control group -Soldiers were not representative of the population with EDs	3
La Mela et al., 2013	Italy	-To determine whether self-esteem, personality disorders and dissociative experiences are treatment outcome predictors for CBT in EDs	18 AN 21 BN 18 EDNOS	100	DIS-Q	-Poor treatment outcome emerged, especially in patients with long term EDs, high prevalence of AN and dissociation -Negative outcome was correlated with dissociative dimension of identity confusion, loss of control and amnesia	-Eating measures were not replicated after treatment -Patients with BMI under 17.5 were excluded decreasing the generalizability of results to the population with EDs	4
Strangio et al., 2017	Italy	-To compare patients with EDs and childhood abuse and patients with EDs, but not childhood abuse on features and comorbidities -To compare the two types of patients in terms of psychodynamic treatment outcome	5 AN 10 BED 2 BN 9 ARFID	61.5	DES	All patients showed clinical improvements, asceticism, cognitive instability, dissociative features, and global functioning	-Sample size was small -Different therapists conducted the treatment	3
Vanderlinden et al., 1995	Belgium	-To test dissociation at three different times: at admission, at discharge after a six-months treatment, and one year after admission	38 AN-R 13 AN-BP 11 BN	100	DIS-Q	-The total sample showed a significant decrease in dissociation levels after six months of treatment -After a comparison between subgroups, at follow-up patients with AN-R reported less dissociative symptoms, while dissociation levels reported by those with AN-BP were stable	n.a.	3

n.a. = not applicable; AN = anorexia nervosa; AN-R = anorexia nervosa restricter; AN-BP = anorexia nervosa binge-purging; AN –P = anorexia nervosa purging; AN-B = anorexia nervosa bingeing; BN = bulimia nervosa; BN-P = bulimia nervosa purging; BN-NP = bulimia nervosa non-purging; BED = binge eating disorder; HC = healthy control; BE = binge eating; ED = eating disorder; EDNOS = eating disorder not otherwise specified; OSFED = other specified feeding and eating disorder; AED = atypical eating disorder; DES = Dissociative Experience Scale; M-DES = modified version of the dissociative experiences scale; DIS-Q = Dissociation Questionnaire; DDIS = Dissociative Disorders Interview Schedule; SDQ = Somatoform Dissociation Questionnaire; SIB = self-injurious behavior; NSSI = non-suicidal self-injury; BMI = body mass index; CBT = cognitive-behavioral therapy; MMAT v. 2018 = Mixed Methods Appraisal Tool version 2018; * MMAT global score for these studies ranges from 0 to 4, we omitted the section about non response bias since these reports didn't evaluate intervention outcomes.

Studies are ordered by groups (i.e. dissociation and AN, dissociation related constructs in AN, dissociation in treatment of AN), and by alphabetical order inside each group.

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