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Comorbidity between psychosis and eating disorders: a systematic review

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Abstract

Background Comorbidity has been reported between eating disorders and psychotic illnesses such as schizophrenia, and several hypotheses regarding their relationship have been proposed. Therefore, we aimed to systematically review studies involving patients who are affected by both psychotic symptoms and eating disorders (ED).

Method We systematically searched three databases for all studies describing psychotic symptoms among patients diagnosed with eating disorders. We conducted and reported the systematic review following the PRISMA statement.

Results We included 67 publications, of which 41 were case reports and 26 were descriptive studies. Most of the included studies described transient psychotic symptoms among individuals with ED or suggested comorbidity between schizophrenia and anorexia nervosa.

Discussion The included studies were highly heterogeneous. The review suggests at least three different patterns of psychopathology: 1) patients with anorexia nervosa who experience transient psychotic symptoms in correlation with severe mental or physical stress; 2) patients suffering from comorbid schizophrenia and anorexia nervosa and fulfilling diagnostic criteria for both diagnoses; and 3) patients with psychotic illness who are experiencing disordered eating as part of their psychotic illness, but do not fulfill diagnostic criteria for it. Future research could conduct psychopathological follow-up on patients enrolled in treatment for these conditions.

Introduction

Psychotic illnesses (PI) (e.g., schizophrenia) and eating disorders (ED) (e.g., anorexia nervosa (AN), bulimia nervosa (BN), binge eating disorder (BED)) comprise two distinct groups of psychiatric disorders. Schizophrenia affects 1% of the general population [1] and AN has a prevalence between 0.3–0.9% [2]. Both conditions usually have their onset in adolescence or young adulthood, and both result in decreased life expectancy due to factors such as self-harm, suicide, unhealthy lifestyle and comorbidity with other somatic and psychiatric illnesses [3–5].

Regarding ED, psychiatric comorbidity is known to be very common. For AN, the most common comorbid diagnoses are autism spectrum disorders, ADHD, OCD, affective disorders, and personality disorders [6]. In contrast, comorbidity with affective disorders and alcohol/substance abuse is most common in BN [6]. However, some individuals with ED do also experience psychotic symptoms or have comorbid schizophrenia.

Previously, AN and schizophrenia were thought to be related. They were considered similar in the presentation

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of emotionality i.e. affective flattening in schizophrenia and shallowness of mood in AN. Furthermore, it was described that both depersonalization and lack of emotional awareness were found in both conditions. However, in more recent times, they are believed to be two quite distinct illnesses [7–9].

Several studies have investigated psychopathology among patients diagnosed with ED, and have found sub-threshold psychotic symptoms on the SCL-90R (Symptom Checklist-90-Revised) [10, 11]. These findings described psychoticism as especially associated with ED in males [11], and indicated that such symptoms might be a marker of treatment severity and predict a poorer outcome [10]. Comorbidity between eating disorders and psychosis or schizophrenia appears less often: however, research suggests a significant positive genetic correlation between schizophrenia and anorexia nervosa [3].

Seeman (2014) proposed the following seven hypotheses for how eating disorders and psychosis might be connected: (1) ED and PI are entirely separate disorders that can, by chance, occur in the same person; (2) transient psychotic symptoms can occur in patients with ED due to stress; (3) ED behavior can be regarded as a strategy to provide control in individuals with PI whose sense of self-efficacy is low; (4) because of body image distortions, eating disorders are delusional and are in themselves PI; (5) ED is prodromal PI or, conversely, psychotic symptoms can herald the beginning of an eating disorder; (6) antipsychotics used to treat PI can lead to weight gain and thus induce ED, while conversely, antidepressants used to treat ED can trigger psychosis; (7) psychotic symptoms are a marker of severity in ED [12].

It is thus well known that ED symptomatology (e.g., fear of weight gain, overestimation of body size) can reach delusional intensity [13–15], and that patients with ED experience a so-called eating disorder voice [16]. It can be argued that these psychotic features are all correspondent to the core ED psychopathology. However, some patients with an ED diagnosis also exhibit psychotic symptoms which seem unrelated to the core ED psychopathology and are more consistent with schizophrenia. The latter patients might have disordered eating due to delusional fear of being poisoned, other delusions concerning food, food-commenting hallucinations, or lack of initiative and negative symptoms connected to their diagnosis [17]. A number of reviews exist on the association between schizophrenia and ED [1, 18–20]. In the most recent, Hechinger et al. (2025) [20] carried out a systematic review on studies of comorbidity of anorexia nervosa and schizophrenia, specifically. They identified 40 papers which described such overlap, of which 18 were case-report studies. They found the prevalence of AN in patients with schizophrenia to be higher than would be expected in the general population, but only few studies. Regarding the prevalence of schizophrenia in AN, they found mixed evidence, and these studies were also relatively small and few. In addition to this review,older reviews on the same topic also exist [1, 18, 19].

Hechinger et al. (2025) [20] as noted only included studies of patients with schizophrenia and AN, specifically, and some patients with ED might experience psychotic symptoms which do not qualify for a schizophrenia diagnosis.

At present, there is a lack of knowledge on the relationship between psychotic symptoms in general and ED. This lack can have clinical implications regarding the diagnosis of patients presenting with atypical ED symptoms of a psychotic nature, which in turn might have treatment implications, where the indication for antipsychotics is a major issue at stake.

Accordingly, we find it important to systematically seek and review existing literature describing comorbid psychosis and ED. We do so in order to search for information that indicates the existence of a subtype of patients with ED and atypical psychotic symptoms not consistent with ED psychopathology. By doing so, we hope to make clinicians in the field aware that a proportion of patients with ED have atypical psychotic symptoms, as this might have implications for treatment.

We categorize the literature in order of main psychopathology pattern: a) disordered eating behavior among patients with PI; b) psychotic symptoms among patients diagnosed with ED, and study methodology: 1) epidemiological studies describing symptoms of psychosis and ED on a population level; 2) case report studies describing overlap between PI and ED.

We relate our findings to the hypothetical psychopathology profiles set forth by Seeman (2014) [12] and draw attention to distinguishing features relevant for clinicians.

Methods

We conducted the systematic review according to the requirements established in the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) protocols [21].

Searches

We undertook comprehensive searches in the electronic databases PUBMED, EMBASE and PsycINFO, utilizing a search strategy that we had tested for sensitivity in advance. See Appendix 1 for the search strategy. Each database was searched since its inception. We performed a supplementary hand search of the reference sections of

retrieved papers to identify additional studies, and also included additional studies suggested in the peer-review process. We completed the main search for studies on August 22nd, 2022 and carried out an update on August 21st, 2023.

Study selection

Following the main literature search, two authors (ORH and CME) screened abstracts. Relevant references were retrieved as full-text papers for evaluation of inclusion and exclusion criteria. At the search update, two authors (ORH and LLH). The process was carried out in Covidence [37]. Disagreements between the two researchers screening the papers were resolved by discussion.

Inclusion and exclusion criteria

(1) Study participants are patients experiencing both psychotic symptoms and ED symptoms comparable to those found in AN or BN, as defined by the American Psychiatric Association's Diagnostic and Statistical Manual of Mental Disorders (DSM) III [22], IV [23], or V [24] and the WHO's International Statistical Classification of Diseases (ICD) 9 [25], 10 [26] or 11 [27]. The patients did not have to experience both types of illness at the same time to be eligible.

Only papers published in English or the Scandinavian languages in a peer-reviewed journal could be included. Papers were excluded if they involved patients who suffered from psychosis better explained by toxicity, in relation to use of psychoactive substances, or on an organic basis, except malnutrition. Papers which described delusions consistent with the ED psychopathology (e.g., perceiving oneself as fat while being severely underweight) as their only psychotic symptom were also excluded.

Data extraction

Two categories of studies emerged—quantitative studies and case reports.

Quantitative studies: Two authors (ORH and CME) extracted data regarding title/author, year, study design, study aim, number of participants, population description including diagnoses/symptoms of psychosis or ED, diagnostic tools used in the assessment of the patient, sex, age, BMI or lowest reported body weight, medical treatment, diagnosis and lastly the studies' own hypothesis regarding comorbid psychosis and ED.

Case reports: Two authors (ORH and LLH) extracted data regarding psychiatric diagnosis and possible diagnostic tool(s) used to make it, BMI, clinical characteristics including content of psychotic symptoms, and treatment.

Data synthesis

Quantitative studies: We synthesized data according to whether it included patients with a primary diagnosis of PI who experienced ED symptoms, patients with a primary diagnosis of ED who experienced PI, or the relationship between PI and ED on a population level.

Case reports: We ordered the reports into three categories based on the course of illness, namely, patients with symptoms of ED preceding the onset of psychotic symptoms; patients with psychotic symptoms preceding the onset of disordered eating; and patients with both psychotic symptoms and disordered eating presenting at the same time.

Results

Study inclusion

Figure 1 summarizes the process of study inclusion. We screened 7525 abstracts and read full texts of 233 publications. In addition to these, eight papers were suggested by the reviewers. We finally included 67 publications, of which 26 were descriptive studies and 41 were case reports.

Descriptive studies

Disordered eating behavior among patients with PI

Schizophrenia Eight studies described disordered eating behavior among patients with schizophrenia. Fawzi et al. (2012) [28] found that in a population of 50 patients diagnosed with schizophrenia, 30% showed disordered eating attitudes, measured in terms of EAT score over 30, compared to 12% of healthy controls ($p=0.03$). However, this study population was overweight with an average BMI of 27.1 (± 3.6), which was also the case for controls, who had an average BMI of 26.3 (± 3.5).

Stein et al. (2005) [9] examined a sample of elderly female patients (N = 30) hospitalized due to schizophrenia and found that some patients displayed high values of disordered eating, measured by the Eating Attitudes Test-26 Item (EAT-26). The group who displayed disordered eating showed considerably higher EAT scores (35.8 ± 13.1) than the group without disordered eating attitudes (6.2 ± 5.9). This sample of patients was also tested using the geriatric depression scale, which showed no overt depression in either group.

In contrast to this, a similar study by Lyketsos et al. (1985) [8], performed on individuals with schizophrenia (N = 84), found only three patients who had a score over 30 on the EAT questionnaire and only one patient who fulfilled diagnostic criteria for anorexia nervosa. The authors compared their results with two control groups—a group of patients with psychotic affective disorder and a group of healthy individuals with no

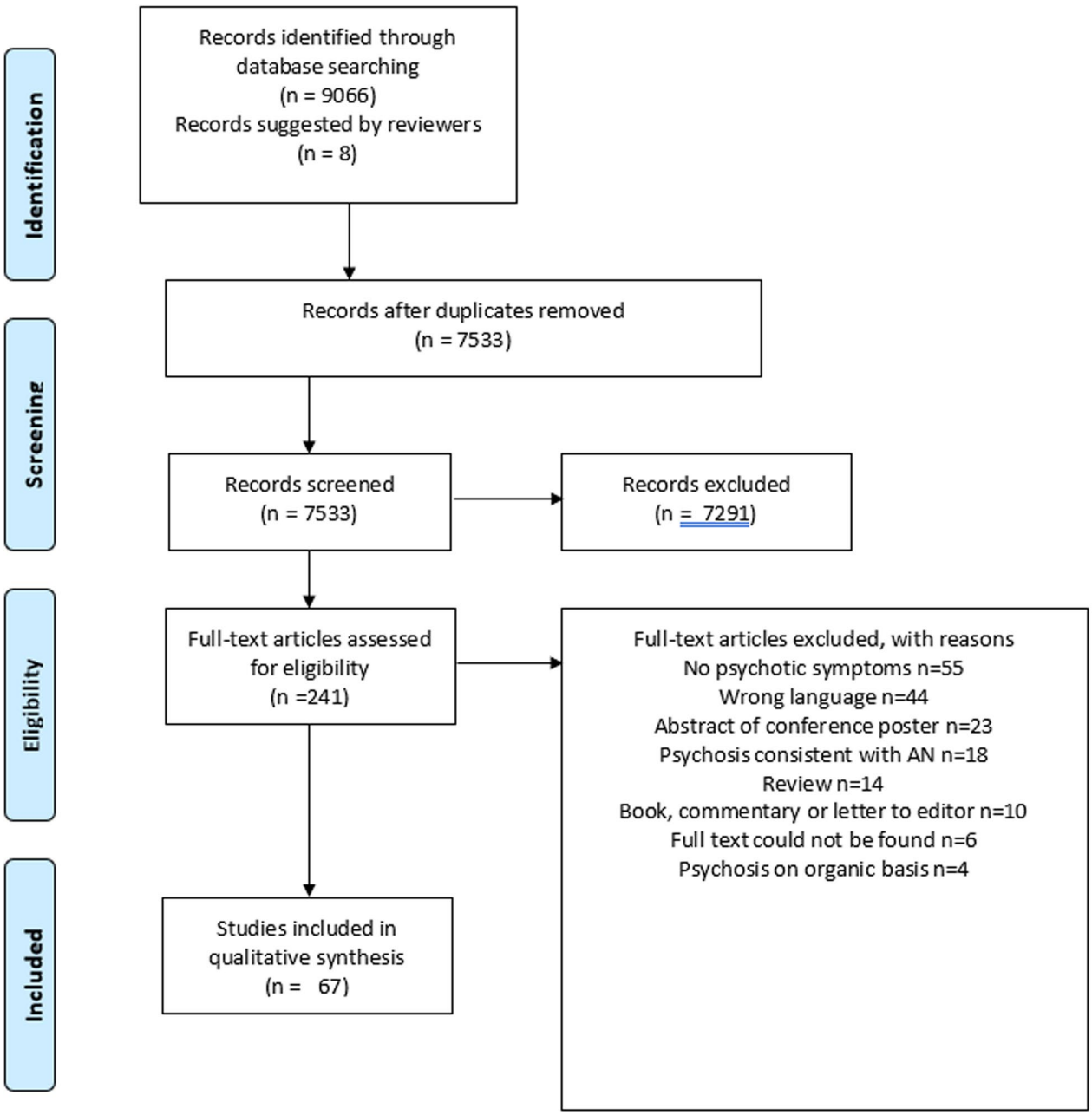

Fig. 1 PRISMA flowchart of inclusion of studies

psychiatric diagnoses. They found that individuals with schizophrenia fulfilled diagnostic criteria for AN and BN more often than either of the control groups, but without fulfilling the total number of criteria to qualify for an ED diagnosis. It was also shown that more patients with schizophrenia than controls were afraid of being fat and claimed to be fat even when emaciated.

Malaspina et al. (2019) [29] examined if premorbid eating disorders distinguishes a particular subtype of schizophrenia. They used data from 288 patients who participated in an inpatient schizophrenia research study, and of those, they found 23 (8%) who had met diagnostic criteria for AN, BN, or both prior to their onset age for psychosis. Furthermore, they found that this subgroup of patients demonstrated significantly more severe psychotic and disorganized symptoms than those without premorbid ED. It is not described

whether the patients continued to experience disordered eating after the onset of schizophrenia.

In a trial, Yum et al. (2013) explored a therapeutic intervention designed to increase self-esteem in individuals with schizophrenia and ED symptoms. Herein, they included six patients with schizophrenia who were also regarded as having an eating disorder, but which disorder(s) were not further specified [17].

Khosravi et al. (2021) examined the prevalence of feeding and eating disorders (FEDs) among patients diagnosed with schizophrenia (n = 134) and a population sample (n = 134). The included subjects were assessed with the EAT-26 and the Structured Clinical Interviews for DSM-5: Research Version. They found that the prevalence of FEDs among the patients was about 2.5 times that in non-clinical controls (32.1% vs. 12.7%, $p < 0.001$). Regression analysis found that higher EAT-26 scores were associated with more severe psychotic symptoms (R2 = 0.93, $p < 0.001$) [30].

De Beaurepaire et al. (2021) examined the prevalence of EDs (BN, BED, and subsyndromal BED) in a sample (n = 156) of patients with schizophrenia or schizoaffective disorder who were treated with antipsychotic monotherapy. They found the prevalence of BED to be 4.4% and that of subsyndromal BED to be 18.7% in patients, while 23.1% of the patients had BED-spectrum symptomatology. There were no cases of BN [31].

Momen et al. (2022) [32] collected data on eating disorders from the Danish National Healthcare Registers, referencing all individuals who had received a diagnosis of ED between 1963 and 2010. They found that, following a schizophrenia spectrum diagnosis, the median hazard ratio was 4.67 for later AN (range 4.09, 5.32) and 4.36 for other later eating disorders (range 3.92, 4.85) [32].

Lastly, Kurpad et al. (2010) examined the prevalence of BED, BED-spectrum symptoms, and other disordered eating behaviors in 73 patients receiving treatment for schizophrenia or psychosis not otherwise specified (NOS). BED was absent in the sample. Most of the BED-spectrum behaviors occurred in patients who had been in treatment for more than two years and were on concomitant antipsychotic and antidepressant medication [33].

Bipolar disorder Two studies describe ED symptoms among patients diagnosed with bipolar disorder. McElroy et al. (2016a) examined ED symptomatology using the Eating Disorder Diagnostic Scale (EDDS) in a sample of 1114 patients with bipolar disorder. Thirty percent of the patients had some binge eating symptomatology, and 27% had binge eating and an ED diagnosis [34]. McElroy et al. (2016b) also examined the prevalence of ED (BED, BN, AN) in patients with bipolar disorder (n = 1092) via the EDDS. They found that 12% had BED, 15% had BN, and 0.2% had AN. Compared to bipolar disorder patients without an eating disorder, bipolar disorder patients with an ED were younger, more likely to be female and had a higher BMI [35].

Psychotic symptoms among patients diagnosed with ED

Five studies describe patients with a primary diagnosis of ED and comorbid PI. Striegel-Moore et al. (1999) [36] examined a sample of hospitalized veterans (n = 161) with either AN or BN. 39% of the males and 10% of the females had comorbid PI. Among men with an ED, odds ratio for schizophrenia and other psychotic disorders was significant when compared to men without ED (Odds Ratio = 3.35; CI 1.47–7.14). Comparison of comorbidity rates with females with an ED revealed that male cases were significantly more likely than female cases to have comorbid schizophrenia or other psychotic disorder (Odds Ratio = 3.61; CI 1.31–8.8).

Blinder et al. (2006) analyzed data on 2436 female inpatients who had received treatment for primary AN, BN, or eating disorder not otherwise specified (EDNOS). Comorbidity of schizophrenia or other psychoses was three times more likely with restricting type AN ($p < 0.05$), and two times more with binge-purge AN ($p < 0.05$), than with other ED [37].

Patel et al. (2018) evaluated comorbidity in patients with BN (N = 3319) who had received inpatient treatment. The most prevalent psychiatric comorbidities present in this sample were psychosis (n = 1740; 52.4%) [38].

Lastly, Kopala et al. (1993) examined the prevalence of olfactory hallucinations in samples diagnosed with schizophrenia, major depression, or eating disorders and in healthy control subjects. ED patients were diagnosed with AN (n = 19), BN (n = 5), and combined AN and BN (n = 7). None of the ED patients met criteria for any other Axis I diagnosis. Olfactory hallucinations were reported by 29% of the patients with ED [39].

Besides the above five studies, six more describe patients who at one time had a primary diagnosis of ED, but who later experienced psychotic symptoms.

Momen et al. (2022) explored the association between ED and PI, via analysis of register data on all individuals who had received a diagnosis of ED in Denmark between 1963 and 2010. For AN, the median hazard ratio for a subsequent schizophrenic disorder was 6.16 [95% CI 5.69–6.68]. For any other eating disorder diagnosis, it was 5.68 [95% CI 5.20, 6.20] [32].

Zhang et al. (2021) [5] similarly examined, in a population study (N Sweden = 2,535,191, N Denmark = 1,382,367), the risk of co-occurring ED and schizophrenia. Individuals with AN had an increased

risk of schizophrenia, with reported hazard ratios of 5.66 [95% CI 4.46, 7.19] in Sweden and 6.17 [95% CI 5.38, 7.08] in Denmark. The hazard ratio for schizophrenia in individuals with other ED was also significantly increased (6.15 [95% CI 5.14, 7.36] in Sweden and 7.17 [95% CI 6.41, 8.01] in Denmark). Among patients with both AN and schizophrenia, 80% in Sweden and 81% in Denmark had received an AN diagnosis prior to the schizophrenia.

Shioiri et al. (2007) evaluated any diagnoses given to a sample of 219 patients prior to a later diagnosis of schizophrenia. Within this sample, two individuals (0.9%) had previously had an ED [40].

Steinhausen et al. (1997) evaluated the diagnosis of young individuals with eating disorders at follow-up. Of the 941 individuals who had a primary diagnosis of ED as children or adolescents, 195 (20.7%) had a diagnosis of schizophrenia at follow-up [41].

Hudson et al. (1984) evaluated the occurrence of psychotic symptoms in 130 patients who had met the criteria for AN or BN previously. Seventeen (13.1%) had experienced psychotic symptoms at some point in their lives after AN/BN diagnosis, though no cases of schizophrenia were identified [42].

Lastly, Jenkins et al. (1987) conducted a follow-up study of AN patients (n = 21) who had received treatment in an adolescent unit. One (4.8%) was found to have a diagnosis of bipolar disorder [43].

Symptoms of psychosis and ED on a population level

Three studies explored PI and ED on a population level. Solmi et al. (2018) [44] conducted a study where, via questionnaires, they explored the association between psychotic experiences and BMI at age 13, and ED symptoms at age 18, among children in Great Britain. They used data from 6361 children, of whom 12% self-reported psychotic experiences at age 13. Endorsement of such experiences was associated with greater odds of reporting any disordered eating behaviors (odds ratio 1.92, 95% [CI 1.46–2.52]; $p < 0.0001$), and greater severity of symptoms, as judged by the number of disordered eating behaviors (odds ratio 0.58, [0.32–0.84]; $p < 0.0001$) at age 18. Psychotic experiences were further tied to purging, fasting, and binge eating behaviors. They noted no connection between psychotic experiences and excessive exercise or BMI.

Ganson et al. (2022) used the Sick, Control, One, Fat, Food (SCOFF) questionnaire to screen for ED in a sample of 96,791 college or university students participating in a health survey. The authors analyzed the link between self-reported lifetime symptoms of psychosis, self-reported lifetime diagnosis of an ED and a positive screen for eating disorders. They found that individuals who reported four lifetime psychosis symptoms were more likely to screen positive for an eating disorder, while participants who reported three lifetime psychosis symptoms were more likely to report any lifetime eating disorder diagnosis. In addition, they found that those who reported a higher cumulative number of lifetime psychosis symptoms, and who reported any psychosis symptoms in the past 12 months, were more likely to screen positive for an eating disorder and report any lifetime eating disorder diagnosis [45].

Lastly, Koyanagi et al. (2016) designed a study where they studied psychotic-like experiences (PLE) and eating disorders in the general population. They examined data from 7403 English adults aged ≥ 16 years who had been administered the Psychosis Screening Questionnaire and questions from the five-item SCOFF screening instrument for ED symptoms. After adjustment for potential confounders, possible ED was associated with hypomania/mania in females (OR = 3.23 95% CI = 1.002–10.39), strange experiences in females (OR = 1.85 95% CI = 1.07–3.20) and males (OR = 3.54 95% CI = 1.65–7.57), and any PLE in males (OR = 3.44 95% CI = 1.85–6.39) [46].

Case report studies

The papers described 69 unique cases. Out of these cases, 44 patients had ED symptoms preceding onset of psychotic symptoms [7, 47–67], 12 had psychotic symptoms preceding onset of ED symptoms [49, 52, 68–73], and 15 had symptoms of ED and psychosis appearing to occur at the same time [17, 51, 53, 64, 71, 74–79]. For a thorough description of each case and their clinical characteristics, see Appendix 1. Eighteen of the reported cases included psychotic symptoms with a thematic core related to eating and body image. Both patients diagnosed with transient psychosis and schizophrenia are to be found in this group. Examples of the recorded symptoms are auditory hallucinations telling the patient not to eat or commenting on their body [7, 53, 58, 60, 78], kinesthetic and olfactory hallucinations, and paranoid delusions regarding others' opinions of their body [7, 17, 47, 53, 58, 62, 75]. Most (16) of the patients with an eating disorder core to their psychotic symptoms had experienced their eating disorder symptoms prior to onset of psychotic symptoms [7, 47, 53, 58, 60, 62] with two exceptions [70, 71].

In contrast, 27 case reports describe patients having psychotic symptoms without an eating disorder-related core. Only half (15) of the patients had presented with eating disorder symptoms prior to psychosis, while eight patients had onset of both types of symptoms at the same time and six patients had experienced their psychotic symptoms prior to onset of their eating disorder. Examples of these symptoms include delusions of being

dead, religious delusions, food poisoning and catatonia. The auditory hallucinations in patients with transient psychosis are usually depicted as voices commanding the patient not to eat [58, 60, 78]. On occasion, third-person auditory hallucinations are recorded in patients diagnosed with transient psychosis, however, the specific content of these hallucinations is not described [47, 53].

In eight cases, onset of psychotic symptoms could be seen as being tied to severe mental or organic stress in patients, as illustrated by psychotic symptoms usually beginning in the context of hospitalization or severe malnutrition [47, 53, 58, 60, 62].

Nine of the included case reports described male patients, of which one was a trans-male.

Discussion

Our systematic review shows that a substantial amount of research exists on PI co-occurring with ED, but that this research is highly heterogeneous. Many different hypotheses have been presented as to how eating disorders, and in particular AN and schizophrenia, are associated. As noted in the introduction, Seeman (2014) [12] proposed seven different hypotheses regarding the connection between the two conditions.

The findings in the current review suggest the presence of at least three different types of patients: (1) those with AN who are experiencing transient psychotic symptoms in correlation with severe mental or physical stress; (2) those suffering from comorbid schizophrenia and AN and fulfilling diagnostic criteria for both diagnoses; and 3) those with PI who are experiencing disordered eating as part of their psychotic illness, which can be similar to the psychopathology found in AN but without the same severity and fulfillment of diagnostic criteria.

Through case studies, we have found descriptions of patients with a longer or shorter history of anorexia nervosa who experience psychotic symptoms associated with hospitalization or severely low body weight. A common feature among these patients is that their psychosis is comparatively short and remits either rather quickly in response to antipsychotic medication or spontaneously. Some papers report psychotic symptoms usually found within the schizophrenic psychopathology and in some cases a diagnosis of schizophrenia is considered likely; however, many of these patients experience improvement of their psychosis with no need for maintaining treatment with antipsychotic medication [47, 53, 58, 60, 62]. Upon follow-up, many patients still struggle with disordered eating. In addition, the psychotic symptoms experienced by this group of patients have, for the most part, thematic content related to their eating disorder. Patients may experience auditory hallucinations (sometimes even the Schneiderian first-rank symptom of third-person auditory hallucinations), which for the most part are portrayed as voices commanding the patient to stop eating or commenting on their body and appearance [7, 53, 58, 60, 78]. Delusions of persecution or reference have likewise been reported—again with the content related to the patient's body, appearance, eating habits and so forth [7, 17, 47, 53, 58, 62, 75]. These case studies suggest that patients affected by ED, when also affected by severe organic stress, can develop psychosis.

Secondly, we find patients who are described as having concurrent comorbidity between AN and schizophrenia. Such patients are found in both descriptive studies and case reports. In descriptive studies, the prevalence of such comorbidity varies greatly from 3.1% [29] to 36% [36]. A significantly greater portion of patients had comorbid BN and schizophrenia than comorbid AN and schizophrenia (36% vs 18%) [33]. In the first study, the sample was patients with a diagnosis of schizophrenia who were examined for ED symptoms, and in the latter, it was the other way around. Of the patients with true comorbidity in case studies, most reported disturbed eating patterns or had received an eating disorder diagnosis prior to their schizophrenia diagnosis [5, 7, 29, 49, 50]. This group of patients may experience psychotic symptoms with a theme tied to their eating disorder, but they may also experience psychotic symptoms more classically found within the schizophrenic psychopathology. The described interrelation between eating disorder symptoms and psychotic symptoms also varies greatly. Some studies report patients with eating disorder symptoms that waxed and waned contingent to their psychotic symptoms [52] and others where the eating disorder "resolved" before or in regard to onset of schizophrenia [7, 69]. Finally, some report cases where the eating disorder and schizophrenia appeared to be two distinct diseases within the patients, with no apparent link between the two [50, 70, 71].

It is debatable whether patients with PI who do not eat due to fear of being poisoned or similar delusional ideas should be regarded as having AN, even though they might fulfill the diagnostic criteria. Such patients could be regarded as not being within the gestalt of AN [80], as the reason for their low weight and associated symptoms does not originate in an intense fear of gaining weight, but in a classical delusion which is part of the schizophrenic gestalt [81]. Instead, they could be regarded as suffering purely from schizophrenia, and only having ED symptoms secondary to their psychotic illness, which would also be faithful to the hierarchical nature of at least the ICD-10.

From descriptive studies, it is further noted that patients suffering from schizophrenia can experience disordered eating without qualifying for a formal ED

diagnosis. The prevalence of disordered eating among patients with schizophrenia differs among studies. Fawzi et al. [28] reported 30% of their patients suffering from disordered eating, defined as an EAT-40 score above 30, and Stein et al. [9] reported 13.3% of their patients as suffering from disordered eating, defined as an EAT-26 score over 20. In contrast, Lyketsos et al. [8] only found 2.2% of their patients to suffer from disordered eating, as defined by an EAT-40 score above 30. However, many of their patients displayed a variety of disordered eating attitudes with a score below 30. All three studies found that their patients displayed thoughts and behavior comparable to those seen within the anorexic psychopathology, though they did so without meeting the criteria for an ED diagnosis. Furthermore, the patients showed multiple delusions and hallucinations related to food, such as delusions or fears of criticism regarding their eating preferences and activities, as well as auditory, visual, olfactory, gustatory, and kinesthetic hallucinations concerned with eating. In addition to this, both Fawzi et al. (2012) [28] and Stein et al. 2005 [9] reported higher Positive and Negative Syndrome Scale (PANSS) scores regarding positive symptoms within the disordered eating groups, indicating that these patients were psychotic compared with non-disordered eating groups.

Research indicates that factors such as feelings of social defeat [82] and stress [83] and isolation [84] have been linked to schizophrenia, but also to eating disorders [85]. In animal models with mice, these factors have been tied to increased serotonin levels in the brain [86, 87]. It has been proposed that long-term stress can create a state of cortical hyper plasticity which is conducive to major adaptive change, but can also result in psychotic symptoms [88, 89]. We speculate that the link between ED and PI could long term long-term organic stress leading to a hyperplastic state subsequent resulting in psychotic symptoms.

The third type of patient is mostly reported in cohort studies [8, 9, 17, 28]. Here, we see descriptions of patients with schizophrenia who were found to experience disordered eating attitudes when screened for them using the EAT-26. However, their thoughts and behavior regarding disordered eating were not their main complaint, and many of the symptoms reported can be explained within the schizophrenic psychopathology (e.g., not eating due to fear of being poisoned). Furthermore, many of these patients are described as being either of normal weight/BMI or overweight. It is well known that patients with schizophrenia frequently gain weight while admitted or as they start treatment with antipsychotic medication [90–92]. Some of the disordered binge eating and associated obesity in schizophrenia could be tied to treatment with antipsychotic medication [31, 92–95] and the craving it elicits. However, it could also be related to difficulties with executive functioning, emotional regulation and negative symptoms, likely through dysfunctions in the brain's dopamine system [94, 96].

Our first and second types of patients are consistent with Seeman's (2014) Hypothesis 2 (somatic stress). Our third type is consistent with all of Seeman's remaining hypotheses. In addition to this, our data suggests an eighth hypothesis which Seeman did not include, which is that patients with psychotic illnesses can experience disordered eating, but in a way which is not consistent with core AN psychopathology (e.g., a patient who will not eat due to fear of being poisoned). These patients can instead be regarded as having an ED secondary to their psychotic illness and should in our perspective not be regarded as suffering from AN, as they lack a core characteristic of the illness. The occurrence of a disturbed body-image where the patient's perception of their body is distorted (they wrongfully regards themselves as thick, and a self-worth influenced by body weight or shape is therefor in our opinion, the key to differentiate between AN, and disturbed eating among patients with psychotic illness. None of our data disproves any of the other proposed types.

It is well known that schizophrenia is more common in males than in females, and that ED is more common among females than males [97, 98]. Our included literature suggests that comorbid psychotic symptoms are markedly more common among male patients with ED than among females. Data presented by Striegel-Moore et al. (1999) [36] suggest that a man with an ED has a 3.6 times higher risk than a female with an ED to have comorbid schizophrenia. If this finding is replicated in another and larger study, it would suggest that clinicians should be especially on the lookout for concurrent psychotic symptoms, when treating a male patient with ED and especially AN. Clinicians should especially pay attention to why the patient have lost weight or have disturbed eating, and not only note that the patient has lost weight or has disturbed eating patterns.

Our review suggests that patients with ED have increased risk of developing comorbid psychotic illness. This notion is also supported by results presented by Mensi et al. (2020), who screened adolescent girls (N = 94) suffering from ED with the Comprehensive Assessment of At-Risk Mental States (CAARMS). They found that 84% of subjects had attenuated psychotic symptoms, and therefore could be regarded as being at high risk for psychosis. Such subjects at high risk of psychosis are in meta-analytic studies found to have a 30% higher probability of developing full-blown psychotic illness in the following 2 years [99].

It is a matter of debate how psychotic symptoms in patients with ED should be treated. Our literature search did not find any trial (randomized or open label) describing the treatment of psychotic symptoms among patients with ED. Our included case reports overall suggest that the psychotic symptoms respond to psychopharmacological treatment with antipsychotic medication. In some cases, patients even experience improvement in their ED symptoms after beginning psychopharmacological treatment with antipsychotics. Further, the included case reports suggest that treatment with antipsychotics are well-tolerated in this population. Some research also suggest that antipsychotic medications might be implicated in binge eating symptomatology and other compulsive disorders [100, 101]. It is therefore also possible that at least some ED symptoms may deteriorate with antipsychotic treatment. Overall, we suggest that psychotic symptoms are sought treated with antipsychotic medication in this population, with respect to patient's preferences, and the fact that the side-effect of antipsychotic treatment might not be acceptable for this patient population.

Our review includes a number of limitations. First, we did not rate the quality of the evidence. Secondly, as psychosis and eating disorders is a broad field, it is possible that we did not find all relevant literature. Lastly, not all case reports include the thematic content of the patients' psychotic symptoms, which is why only some cases are described in the result section.

In addition to these limitations, our included literature is also characterized by a few limitations. These include that the descriptive studies have utilized heterogeneous methods, and do not take possible confounding factors (e.g., sex, treatment with antipsychotics, socioeconomic status) into account.

In conclusion, the present review suggests the presence of at least three distinct types of patients with ED and PI: those with an eating disorder who experience transient psychotic symptoms; those who experience comorbid PI (e.g., schizophrenia) and ED; and patients with PI such as schizophrenia who experience some degree of disordered eating. However, the included studies were highly heterogeneous and of varied quality. The present review highlights the scarcity of literature describing comorbid psychosis and eating disorders. Most of the available literature consists of case reports and descriptive studies.

Thus, there is a need for more studies which conduct psychopathological follow-up on patients enrolled in treatment for these conditions to assess the patient population on more than a descriptive basis, including their response to treatment. Moreover, patients' psychopathology needs to be assessed more in depth to understand the psychopathology underlying the different patient types and trajectories. It is particularly important to explore the possible existence of a subtype of patients with ED and atypical psychotic symptoms not consistent with ED psychopathology. Future research could also explore the impact of genetics or trauma in this matter, or as noted, the possible influence of sex and/or gender. This could both inform diagnostic practice and treatment, but also start an important clinical discussion of whether these patients should be regarded as primarily suffering from ED, or from PI.

Supplementary Information

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Supplementary file 1.

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Author contributions
CME and SA conceived the study. ORH, LLH and CME screened and included studies. ORH wrote the first draft of the manuscript. All authors have discussed, reviewed, and approved the manuscript. The research was carried out in Region Zealand Mental Health Services.

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Declarations

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