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Overlap of Autism Spectrum Disorder and Borderline Personality Disorder: A systematic review and meta-analysis

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Abstract

Autism Spectrum Disorder (ASD) and Borderline Personality Disorder (BPD) share features, including social and emotion regulation difficulties. The evidence for the overlap in prevalence and clinical characteristics was systematically reviewed. Ovid Medline, PsycInfo, and PubMed were searched until 30 November 2020 using keywords relating to BPD and ASD. Studies that reported on the overlap of ASD and BPD diagnoses or traits and used a case, cohort or case-controlled design were included. Of 1633 screened studies, 19 were included, of which 12 reported data suitable for meta-analysis. Most samples were of small, clinically ascertained groups, with 11 having high risk of bias. The pooled prevalence of BPD in ASD was 4% [95% CI 0-9%] and of ASD in BPD, 3% [95% CI 1-8%]. There were inconsistent findings across clinical areas. The prevalence of a dual diagnosis of BPD in ASD

This is the author manuscript accepted for publication and has undergone full peer review but has not been through the copyediting, typesetting, pagination and proofreading process, which may lead to differences between this version and the Version of Record. Please cite this article as doi: 10.1002/aur.2619

cohorts and of ASD in BPD cohorts were within population prevalence estimates of each disorder. Based on this data we were not able to assess whether there is misdiagnosis of one in favour of the other. Neurocognitive differences may underlie similar behavioural symptoms, but further research using larger, well-validated samples is needed.

Lay summary

Autism Spectrum Disorder (ASD) and Borderline Personality Disorder (BPD) have overlaps in their symptoms. The overlap in how frequently they cooccur and their presentation was systematically reviewed. We searched the key databases and including all studies that reported on the overlap of ASD and BPD diagnoses or traits and used a case, cohort or case-controlled design. Of 1633 studies, 19 were included, of which 12 reported data suitable for pooling. Most samples were of small, clinical groups, with 11 having high risk of bias. The pooled prevalence of BPD in ASD was 4% [95% CI 0-9%] and of ASD in BPD, 3% [95% CI 1-8%]. There were inconsistent findings across studies comparing ASD and BPD related symptoms and problems. The prevalence of a dual diagnosis of BPD in ASD cohorts and of ASD in BPD cohorts were similar to the population prevalence of each disorder. Further research using larger, well-validated samples is needed.

Key words: Autism Spectrum Disorder, Borderline Personality Disorder

Contributors: Author May designed the study and wrote the protocol, conducted literature searches and provided summaries of previous research studies, and conducted the statistical analysis. Author May wrote the first draft of the manuscript and all authors contributed to and have approved the final manuscript.

Funding: This research did not receive any specific grant from funding agencies in the public, commercial, or not-for-profit sectors.

Conflict of Interest: All authors declare that they have no conflicts of interest.

Acknowledgements: The authors wish to thank Karen Lee Jing Li who assisted in screening studies.

Autism Spectrum Disorder (ASD) affects between 1-4% of children (Baio et al., 2018; May, Brignell, & Williams, 2020; May, Sciberras, Brignell, & Williams, 2017) and is characterised by impairment in social-communication and restricted, repetitive, and stereotyped behaviours which substantially impair everyday functioning (American Psychiatric Association, 2013). ASD affects three times more males than females (Loomes, Hull, & Mandy, 2017), emerges early in childhood, and is a lifelong condition (American Psychiatric Association, 2013). Aetiology is largely genetic with heritability estimates ranging from 64-91% based on twin studies (Tick, Bolton, Happé, Rutter, & Rijsdijk, 2016).

The presentation of ASD is varied, ranging from individuals with severe deficits and comorbid intellectual disability through to those who may not receive a diagnosis until later in life. Some individuals may not be diagnosed until adulthood, often when the person engages in help-seeking for co-occurring problems such as depression and anxiety (Geurts & Jansen, 2012) and is recognised as having ASD symptoms which result in an ASD assessment. The prevalence of ASD in adults may be lower than that in children, with some symptoms reducing resulting in no longer meeting diagnostic criteria. Studies in adults

suggest a prevalence of around 1% within the community (Brugha et al., 2011; Brugha et al., 2016; White, Ollendick, & Bray, 2011) and around 2 to 9% of adult psychiatric inpatients (Tromans, Chester, Kiani, Alexander, & Brugha, 2018). With the greater recognition of milder cases of ASD and a widening of the ASD diagnostic criteria there may now be a considerable number of adults with what we now conceptualise as ASD. They may have been undiagnosed through not meeting the narrower diagnostic criteria used during their childhoods or because of the much lower awareness of ASD in the past (Lai & Baron-Cohen, 2015). Women, in particular, may have been underdiagnosed because of differences in their presentation from males, although qualifying these differences has been challenging (Baldwin & Costley, 2016; Hull, Petrides, & Mandy, 2020). These individuals may have been diagnosed with other conditions that have overlapping symptoms or are frequently comorbid with ASD (Geurts & Jansen, 2012).

Personality disorders (PDs) are maladaptive personality traits which develop in childhood and usually endure throughout one's life (American Psychiatric Association, 2013). These disorders share some overlapping features with ASD, including interpersonal challenges, childhood origins, and chronicity (Pelletier, 1998; Wolff & Barlow, 1979). There are three clusters of PDs defined in the Diagnostic and Statistical Manual of Mental Disorders (American Psychiatric Association, 2013). 'Cluster A' PDs include schizoid and schizotypal personality disorders. These share obvious overlaps with ASD given social detachment and a lack of emotional expression are features of these disorders (Hurst, Nelson-Gray, Mitchell, & Kwapil, 2007). Cluster C personality disorders include Obsessive Compulsive PD and Avoidant PD, which both have overlapping symptoms with the preoccupations and non-functional routines and rituals, and aloof social behaviour present in ASD. Cluster B PDs include Borderline Personality Disorder (BPD). The general personality disorder criteria in the DSM includes exclusion criterion E, which requires the symptoms are not better

explained as a manifestation or consequence of another mental disorder. However, Schizoid PD and Schizotypal PD are the only two PDs excluded from being diagnosed if they occur exclusively within ASD based on the DSM-5 and DSM-IV-TR (American Psychiatric Association, 2013).

Superficially, overly emotional aspects of BPD contrast with the restricted emotions and aloofness of ASD. However, a number of studies have reported overlaps in the two conditions (Anckarsäter et al., 2006; Ryden, Ryden, & Hetta, 2008). In particular, high functioning ASD (without intellectual disability), or what was previously known as Asperger's disorder, appears to share various features of BPD (Fitzgerald, 2005). A growing awareness of the under-diagnosis of females with ASD led some researchers to explore disorders where females more frequently come to clinical attention than males, such as BPD (Ryden et al., 2008).

BPD is characterised by a pervasive pattern of instability of interpersonal relationships, impaired self-image and identity, and difficulties with emotion regulation (American Psychiatric Association, 2013). There is marked impulsivity and recurrent suicidal and self-harming behaviour, interpersonal relationships are unstable and intense, and emotion regulation issues may appear as intense anger outbursts. Symptoms also include paranoid ideation and dissociation. BPD has a lifetime prevalence of around 6% with similar rates for men (5.6%) and women (6.2%) in population-based samples, but a higher proportion of women in clinical samples (Grant et al., 2008). The point prevalence is around 1% (Ellison, Rosenstein, Morgan, & Zimmerman, 2018), as many individuals recover from BPD. For example, remission was reported to occur in 85% of individuals with BPD during a 10 year follow-up study (Gunderson et al., 2011).

Genetic and environmental factors are both involved in the aetiology of BPD with heritability estimates around 40% (Amad, Ramoz, Thomas, Jardri, & Gorwood, 2014). Multiple factors including child temperament, parenting skills and style, and adverse childhood experiences can result in invalidating and conflictual interactions that have been theorised to result in BPD (Fruzzetti, Shenk, & Hoffman, 2005). Early traumatic experiences are also implicated in BPD aetiology (Lewis & Grenyer, 2009). Notably, individuals with ASD are more likely to experience traumatic experiences (Haruvi-Lamdan, Horesh, & Golan, 2018), and autistic like symptoms can be a response to prolonged early traumatic experiences (Haruvi-Lamdan et al., 2018).

There are several superficial overlaps between the DSM-5 diagnostic symptoms of ASD and BPD, as listed in Table 1. Both have impairment in interpersonal relationships and emotion regulation challenges. On the surface, unstable relationships in BPD are similar to the challenges in ASD with forming and maintaining relationships. The extreme emotional distress seen in ASD known as 'autistic meltdowns', usually in response to change or transitions, is comparable to some of the extreme emotional dysregulation in BPD. For example, the severe distress experienced by individuals with BPD in response to perceived abandonment, or intense anger outbursts and affect instability due to reactivity of mood. While there may be differing underlying triggers and processes the behaviours may be similar.

While not part of the diagnostic criteria, there is some research suggesting that additional symptoms present in BPD are part of the ASD nosology and vice versa. For example, although there are mixed findings, theory of mind is considered a deficit in both BPD (Németh et al., 2018) and ASD (Yirmiya, Erel, Shaked, & Solomonica-Levi, 1998). There have been mixed findings for facial emotion recognition ability in BPD, with one review reporting individuals with BPD have deficits in recognising negative and neutral

facial displays (Daros, Zakzanis, & Ruocco, 2013). ASD diagnostic criteria include deficits in understanding non-verbal behaviour such as facial expressions. Sensory sensitivities are also now part of the DSM-5 diagnostic criteria for ASD, and have been reported in BPD, including sensitivity to particular auditory stimuli (Brown, Shankar, & Smith, 2009; Rosenthal, Ahn, & Geiger, 2011).

There are also some BPD diagnostic criteria that, while not overlapping with ASD criteria, are behaviours associated with ASD. Recurrent suicidal behaviour BPD criteria is mirrored by ASD research showing high rates of self-injurious and suicidal behaviour (American Psychiatric Association, 2013; Hedley & Uljarević, 2018). Self-injurious behaviour in ASD may include repetitive headbanging and self-hitting and is often found in individuals with comorbid Intellectual Disability (Steenfeldt-Kristensen, Jones, & Richards, 2020). Identity concerns, a criterion for BPD diagnosis, may also present in some individuals with ASD. For example, autistic obsessions may relate to identity such as religious or political obsessions that may change over time, and there can be gender identity differences and changes (May, Pang, & Williams, 2017; Van Der Miesen, Hurley, & De Vries, 2016). Impulsivity in BPD may also be present in ASD due to executive functioning deficits and high overlap with Attention Deficit Hyperactivity Disorder (Lugo-Marín et al., 2019). The BPD criterion relating to chronic feelings of emptiness may overlap with the 37% lifetime prevalence of depressive disorders in ASD (Hollocks, Lerh, Magiati, Meiser-Stedman, & Brugha, 2019). The transient paranoid ideation in BPD is similar to paranoid preoccupations in ASD (Spain, Sin, & Freeman, 2016), with well-documented overlap between ASD and schizophrenia spectrum disorders (De Giorgi et al., 2019).

Only one ASD DSM-5 symptom from the repetitive behaviour domain does not have a clear overlap with a BPD symptom or research finding: highly restricted, fixated, and usual interests. However, as only two of the four repetitive symptoms are required for an ASD

diagnosis (American Psychiatric Association, 2013) individuals diagnosed with ASD may not have this characteristic. All BPD criteria have either an ASD diagnostic or related research finding overlap; and only five of the nine BPD symptoms are required for a DSM-5 diagnosis. Thus, at least at a superficial level, individuals with one or the other condition may have symptoms which could be classified under both disorders.

<Insert Table 1 about here>

The aim of this systematic review was to synthesise existing evidence from empirical studies investigating the overlap of ASD and BPD. We aimed to provide a broad summary of studies exploring the epidemiology, clinical characteristics and treatment of the comorbid disorder to guide research and clinical practice relating to diagnosis and treatment. Importantly, there are a range of effective psychological treatments for BPD including Dialectical Behaviour Therapy, Mentalisation Based Therapy, and Schema Therapy (Cristea et al., 2017; Stoffers-Winterling et al., 2012). In contrast, psychological treatments for adults with ASD are limited to cognitive and behaviour approaches including social skills training with limited quality studies and evidence for efficacy (Binnie & Blainey, 2013; Bishop-Fitzpatrick, Minshew, & Eack, 2014). If the overlap between BPD and ASD is substantive, there may be opportunities for expanding effective interventions for BPD to adult ASD.

Method

The protocol for this review was registered in PROSPERO (CRD42020145259).

Eligibility criteria

Cohort, cross-sectional and case control, and uncontrolled studies, exploring both ASD and BPD prevalence and/or phenomenology were included. ASD and BPD diagnosis

had to be conducted using a standard classification system (DSM or ICD) or measured with standardised tools or, for studies in control groups, ASD or BPD traits were explored using standardised tools. There were no participant age restrictions. Studies were excluded if they were animal studies, review articles, structured literature reviews, or conference proceedings.

Search strategy

Searches were conducted of Ovid Medline, PsycInfo, and PubMed using keywords from the period of the commencement of the database until 30 November 2020. The following search terms were used: (Borderline personality disorder or BPD) and (ASD or autism or autism spectrum or neurodevelopmental or pervasive or pervasive developmental or asperger). Two investigators independently screened articles for eligibility based on titles and abstracts, and, if necessary, the full text. The reference lists of included articles were hand searched to find any further relevant studies. Data were extracted into a standardised form.

Risk of bias in individual studies

The quality of each study was assessed using the Joanna Briggs Institute (JBI) Critical Appraisal Checklist for Case Series (Joanna Briggs Institute, 2011). This checklist was chosen given the non-intervention study designs included in the review including case studies and series and cohort designs. This checklist was developed by an international working group of experts given the paucity of quality appraisal tools that assess this type of study (Munn et al., 2020). It contains 10 questions assess methodological quality to assess potential bias. An overall risk of bias rating was given for each study, with studies having 4 or more high or unknown risks within the 10 questions being rated has high risk of bias, and less than four a low risk of bias.

Data synthesis

Where there were more than two studies with appropriate data, STATA random-effects meta-analysis was conducted to synthesise prevalence figures and pooled using Forest plots via metaprop. The inconsistency index (I^2) was used to assess the extent of heterogeneity.

Results

Figure 1 shows the PRISMA diagram for study selection. Of 1633 screened studies, 19 studies were included in the final review, with 12 having data suitable for meta-analysis of prevalence.

<Insert Figure 1 about here>

<Insert Table 2 about here>

Table 2 shows the characteristics of the included studies. There were six studies from Sweden, three from Germany, two from the UK and France, and one study from Canada, US, Spain, Italy, the Netherlands and Taiwan. Two studies were case reports, eight case-controlled, and nine cohort studies. Only one study drew from a population sample, two from community samples, and the remaining recruited clinical samples. The prevalence of BPD in ASD ($k = 7$) or vice versa ($k = 5$) was explored by 12 studies, and one study examined treatment, while five studies explored aspects of phenomenology. Only four of the 19 studies had more than 100 participants with BPD and/or ASD. Two studies were written in German (Hermann, van Elst, & Matthies, 2018; Nanchen et al., 2016) and the remainder were in English.

Risk of bias

Table 3 shows the results of the risk of bias assessment. Of the 19 studies, 8 (42%) had low risk of bias.

<Insert Table 3 about here>

Prevalence

BPD in ASD

Of seven studies, estimates of the prevalence of BPD in those with ASD ranged from 0 to 12%, with a pooled prevalence of BPD in individuals with ASD of 4% [95% CI 0-9%], (see Figure 2). There was significant heterogeneity detected between the studies (I^2=75.5%). Six studies did not report whether a point prevalence or lifetime prevalence for BPD was assessed. Four studies used the Structured Clinical Interview for DSM II to assess BPD criteria and three of these found no individuals meeting BPD criteria (Lopez-Perez, Ambrona, & Gummerum, 2017; Lugnegård, Hallerbäck, & Gillberg, 2012; Strunz et al., 2015). Lopez-Perez assessed lifetime diagnoses and found none of the individuals with ASD had BPD.

Six of the studies confirmed ASD diagnosis as part of the study, and six confirmed BPD diagnosis by assessing all participants for the disorders. The remaining studies relied on an existing diagnosis. One study confirmed ASD diagnosis but not BPD diagnosis and one BPD diagnosis but not ASD (Lopez-Perez et al., 2017; Rydén & Bejerot, 2008). A sensitivity analysis removing the two studies which did not confirm both ASD and BPD within the study found a pooled prevalence of 4% [95% CI 0-11%] with significant heterogeneity (I^2=80.4%).

ASD in BPD

Five studies reported the prevalence of ASD in BPD with estimates ranging from 0-15%, with a pooled prevalence of 3%, 95% CI 1-8%. There was significant heterogeneity in the studies (I^2=81.7%). Some studies using self-reported ASD symptoms measured with the

AQ found particularly high ASD traits in those with BPD. For example, Nanchen (2016) reported 47% of women with BPD met the AQ cutoff for ASD but only one of 38 had an Asperger's Disorder diagnosis. Dudas (2017) also reported almost half of 23 individuals (13% male) with BPD met the cut off on the AQ, but did not provide data suitable for meta-analysis. Dell'Osso (2018) found 6.4% of individuals (30% male) with BPD met the cutoff on the AQ.

In studies not using self-report, the highest overlap was found by Ryden who reported 15% of 41 women with BPD met ASD criteria using a clinical assessment that included the Asperger Syndrome Diagnostic Interview (ASDI). Hermann (2018) reported the largest study with 20 of 723 female BPD patients (2.8%) attending their clinic from 2001 to 2017 having comorbid ASD. They noted that the dual diagnosis was only recorded since 2008. Shen (2018) was the only population derived study and reported one case of ASD in 292 individuals with BPD, based on lifetime diagnoses in medical records using ICD-9 criteria. Of note, Shen also recruited controls and did not find a higher proportion of individuals with ASD in BPD relative to ASD in controls (0.3 versus 0.03%). Shen was the only study to explore a lifetime diagnosis, while the others reported current diagnosis.

Four of five studies confirmed ASD diagnosis, and three confirmed BPD diagnosis by assessing all participants in the study. One study did not confirm either ASD or BPD diagnosis, and one study confirmed ASD but not BPD diagnosis (Dell'Osso et al., 2018; Shen et al., 2018). When these two studies were excluded, the pooled prevalence of ASD in BPD based on three studies was 5% [95% CI 0-13%].

The discrepancies in prevalence across studies may relate to differing ASD and BPD ascertainment method across self-report, clinical interview, or medical record, and the small number of participants in most studies. There were not enough studies to complete subgroup

analyses to explore the impact of clinical factors (Jackson & Turner, 2017). The noteworthy pattern was that more recent studies reported smaller or no overlaps. The only study using gold-standard diagnostic tools for ASD, the ADOS and ADI-R, found no overlap (Strunz et al., 2015).

<Insert Figure 2 about here>

Clinical characteristics

Age

Two children were explored in one case study, with mean age 11 years (Pelletier, 1998), and the remaining studies explored adults aged 18 years and above with a mean age not older than 39 years. Chabrol and Raynal (2018) performed a cluster analysis of non-clinical college students based on ASD and BPD traits and found those with both high BPD and ASD traits were younger than those with both low BPD and ASD traits, although the difference in ages was minimal (20 versus 21 years). There were no studies that explored the age of onset or symptom change over time, in relation to the combined condition.

Sex

There were several studies which only included women or men, or prevalence by sex was not reported. Chabrol and Raynal (2018) found no sex ratio differences in the non-clinical clustered groups of high BPD/ASD, BPD, ASD and low BPD/ASD traits. In studies using a categorical diagnosis, Hofvander (2009) found 4 of 77 (5%) males and 6 of 40 (15%) females with ASD had BPD. Ryden and Bejerot (2008) reported a significantly higher median number of BPD traits on the SCID-II in females compared to males with ASD.

ASD/BPD Diagnosis and traits

Pelletier (1998) was the first author to report two case studies of children aged 10 and 12 years who were misdiagnosed with Borderline Personality Disorder and re-diagnosed with Asperger's Syndrome. Both children were also described as hyperactive and on stimulant medication. Pelletier noted the overlap between the two disorders including: interpersonal relationship difficulties, intense anger, psychotic-like symptoms, instability, identity issues, impulsive sexual behaviour and binge eating, and self-harming behaviour.

ASD subgroup. Hofvander (2009) explored prevalence of BPD in a small number of individuals with the DSM-IV categories of ASD finding 4 of 62 (6%) with Asperger's disorder, 6 of 50 (12%) with PDD-NOS and 0 of 5 with Autistic Disorder had BPD (Hofvander et al., 2009).

Association between BPD and ASD traits. Chabrol and Raynal (2018) explored autistic and BPD traits in college students (N=474) and found only a weak overlap of the measures of r=.20. They used 9 BPD items from the Personality Diagnostic Questionnaire and the short AQ-10 item version.

Autism symptom severity/traits. Dudas and colleagues (2017) reported individuals with BPD+ASD self-reported higher autistic traits on the AQ than individuals with ASD only. This was followed by individuals with BPD only, who scored higher than controls. They reported individuals with BPD only and ASD only did not score significantly different on the AQ, indicating this measure may not differentiate BPD and ASD. Notably, this was an online study with self-reported diagnoses of ASD, BPD or ASD+BPD not verified through clinical assessment.

Dell'Osso found higher levels of autistic traits, measured using the AdAS Spectrum and AQ self reports, in individuals with BPD than in controls. They found autistic traits using

the AdAS predicted BPD diagnosis; in particular the AdAS Spectrum subdomains of Adherence to routine and inflexibility and Restricted interests and rumination predicted BPD diagnosis, while subdomains such as empathy did not.

Comorbidity with other psychiatric conditions

Ryden (2008) reported no difference in the number of Axis I and Axis II DSM-IV diagnoses in women with BPD (N=35) and ASD+BPD (N=6) with the exception of substance abuse as detailed below.

ADHD. One study found a higher rate of comorbid BPD (14.8%) in those with ASD+ADHD, than in those with ASD only(10.6%) (Anckarsäter et al., 2006). They reported individuals with ASD were more likely to have Cluster A and C PDs and individuals with ADHD Cluster B PDs, with 37% of clients with ADHD (without ASD) meeting BPD criteria. In contrast, Ryden (2008) indicated no difference in ADHD diagnoses in women with ASD+BPD (N=6) and BPD alone.

Intellectual Disability. IQ level of those with ASD was not described by five studies (Anckarsäter et al., 2006; Dudas et al., 2017; Hermann et al., 2018; Lopez-Perez et al., 2017; Nanchen et al., 2016), and was reported to be in the intellectually able range for most other studies (Dell'Osso et al., 2018; Hofvander et al., 2009; Rydén & Bejerot, 2008; Ryden et al., 2008; Strunz et al., 2015) or implied by non-clinical participants or Asperger's disorder as the ASD diagnosis (Chabrol & Raynal, 2018; Lugnegård et al., 2012; Murphy, 2006; Pelletier, 1998). Many of these studies specifically excluded participants with intellectual disability. Wink (2010) described a case study of an individual with BPD, intellectual disability and ASD (Wink, Erickson, Chambers, & McDougle, 2010). Shen (2018) included participants with intellectual disability but did not report the number of individuals with ASD and BPD who also had intellectual disability. They did report an increased risk of BPD in individuals

with intellectual disability overall. The case study thus suggests that individuals with intellectual disability can have BPD and ASD.

Mood disorders. Two studies compared mood disorders in individuals who met criteria for BPD+ASD with BPD only. Hermann reported that 90% of those with BPD+ASD (N=20) had a mood disorder, compared with 45% of those with BPD only (Hermann et al., 2018). In contrast, Ryden (2008) reported no differences in major depressive disorder or bipolar disorder in ASD+BPD (N=6) and BPD alone. Using a trait approach, Chabrol and Raynal (2018) found those with high BPD/ASD traits had more depression symptoms (measured by the Centre for Epidemiological Studies-Depression scale), than the BPD, ASD and the low traits group respectively.

Drugs/Alcohol abuse: Two studies explored substance abuse and the relationship with autistic traits. Chabrol and Raynal (2018) reported no difference in cannabis use in those with high BPD/ASD traits and those with high BPD only traits. Dell'Osso (2018) also reported no difference in autistic traits in individuals with BPD who did, and did not have, a history of alcohol or substance abuse. In contrast, studies exploring substance abuse in individuals who met criteria for BPD, ASD or BPD+ASD found those with ASD (with or without BPD) were *less* likely to have substance and alcohol abuse than those with BPD only (Hermann et al., 2018; Ryden et al., 2008; Strunz et al., 2015). Hermann reported 15% of those with BPD had a substance abuse disorder compared with 0% in those with BPD+ASD. Ryden (2008) also reported higher levels of substance abuse in women with BPD than BPD+ASD. Although group differences were not described, Strunz (2015) reported higher comorbidity of drug and alcohol dependence and abuse (9-20%) in individuals with BPD with 0% occurrence in ASD.

Related behaviours

Suicidal behaviour. Ryden (2008) reported more suicide attempts in a small number of women with BPD+ASD (N=6) than in women with BPD alone (N=35). Using a trait approach, Chabrol and Raynal found the high BPD/ASD traits group had more suicidal ideation (measured by 3 items), than high BPD, high ASD and low traits groups respectively. In contrast, Dell'Osso reported no difference in autistic traits in those with BPD with or without a lifetime suicide attempt (Dell'Osso et al., 2018).

Trauma/Abuse. Dell'Osso (2018) reported individuals with BPD with a history of physical or sexual abuse had higher levels of autistic traits than did those without.

Self-Image. Ryden (2008) reported lower self-image as measured using the self-reported Structural Analysis of Social Behaviour, in women with BPD+ASD (N=6) compared with those with BPD alone. Dubrecq and colleagues explored self-stigma about having a serious mental health condition in individuals with ASD, BPD or other serious mental health conditions (Dubreucq et al., 2020). They reported those with BPD had the highest level of self-stigma and those with ASD the lowest level.

Global functioning. Ryden (2008) also reported lower global functioning assessed using the Global Assessment of Functioning scale, in women with BPD+ASD (N=6) compared with those with BPD alone.

Personality traits. Strunz (2015) explored personality traits in 59 adults with ASD and 80 with BPD. They found those with ASD scored lower on the NEO-PI-R scales extraversion and openness to experience and significantly higher on the Dimensional Assessment of Personality Pathology scales inhibitedness and compulsivity than those with BPD.

Underlying neurocognitive and interpersonal processing deficits

Theory of mind / Empathy. Mentalisation, or the ability to understand the intent or mental state of another person, has frequently been measured using the Reading the Mind in the Eyes test (RMET) as an advanced test of theory of mind. In BPD there have been mixed findings with a recent meta-analysis showing no significant difference in RMET in BPD compared to controls (Nemeth 2018). Only one study in this review explored the RTEM test in individuals with BPD compared to ASD (Murphy, 2006). Murphy examined theory of mind ability in males who were inpatients in a psychiatric ward with Asperger's Disorder, schizophrenia or personality disorder without any history of psychotic disorder, specifically Borderline Personality Disorder or Antisocial Personality Disorder. They reported impaired performance in the RMET and Modified advanced theory of mind test for second order, but not first order, stories in Asperger's disorder but not in the personality disorder group. However, there was a small number of participants and the PD group included some with antisocial personality disorders which limits the validity of the findings.

Nanchen (2016) explored cognitive empathy in 38 women with BPD using the self-reported Interpersonal Reactivity Index. They found lower levels of cognitive empathy in women with BPD with high autistic traits compared to those with low autistic traits measured using the AQ.

Emotion Regulation. Lopez-Perez explored self-reported interpersonal emotion regulation, or one's use of others to regulate their own and others emotions, in individuals with BPD or ASD and controls. They found both individuals with BPD and ASD engaged in more deliberate attempts to deteriorate another's feelings than controls. Individuals with ASD did not engage in more attempts to increase another's feelings relative to attempts to worsen feelings, whereas those with BPD and controls engaged in more affect increasing than worsening behaviours.

Nanchen (2016) also explored alexithymia using the Toronto Alexithymia Scale and similarly found more alexithymia in women with BPD with high autistic traits. Table 4 summarises the phenomenological findings.

<Insert Table 4 about here>

Treatment

No studies explored treatment approaches or outcomes for those with comorbid BPD and ASD. One study explored the impact of autistic traits using the AQ in individuals with comorbid BPD and substance abuse (Kaltenegger, Philips, & Wennberg, 2020). This small study of mentalisation based treatment conducted over 18 months via individual and group therapy explored 46 individuals randomly assigned to treatment or control. They reported that the AQ score at baseline did not influence BPD symptom severity, or alcohol use over treatment. The authors suggested this indicated that having autistic traits did not influence treatment. Higher AQ score at the start of treatment was correlated with higher reflective functioning at treatment end. They suggested that those with high autism traits had more capacity to improve mentalisation ability through the treatment.

Discussion

The aim of this study was to synthesise the data exploring the overlap between ASD and BPD. Pooled prevalence findings suggested 4% of those with ASD have BPD and 3% of those with BPD have ASD. Confidence intervals for both figures overlapped with commonly reported prevalence of BPD and ASD within the general population. Given 1-4% of the general population have ASD, 1% have a current BPD diagnosis, and 6% a lifetime BPD diagnosis, evidence of an overlap between ASD and BPD above that seen in the general

population is weak from the data explored. However, there was high heterogeneity in the studies and just over half had a high risk of bias. It is possible that some studies, particularly those using existing diagnoses from medical records, may have under-estimated the overlap, while those using ASD self-report may have over-estimated the overlap. It is also possible that women are underrepresented in included studies of participants with ASD, which could lead to under-estimating the overlap with BPD.

Examination of the overlap of clinical characteristics of ASD and BPD indicated inconsistent findings across studies. Many studies had very few participants with combined ASD+BPD, thus the findings might not be reliable or sufficiently powered to find differences (Jackson & Turner, 2017). Generally, there was rarely more than one study that studied the same factor using the same groupings of ASD/BPD. Where there was more than one study, there were mixed findings. Thus, there are still many gaps in current knowledge of the overlap of the two conditions. Exploration of underlying neurocognitive profiles relating to empathy, theory of mind, and emotion regulation may provide further clarity regarding areas of difference between ASD and BPD and assist with differential or comorbid clinical diagnosis.

Comorbidity with other disorders

ASD and BPD are both conditions with high rates of comorbid mental health problems and they share symptoms with many other psychiatric conditions. This includes overlaps with ADHD, mood disorders and schizophrenia spectrum disorders. ADHD occurs in around 26% of those with adult ASD (Lugo-Marín et al., 2019), and around 30-40% of those with BPD (Akça, Wall, & Sharp, 2020). The overlap of BPD and ASD in some studies may be confounded by comorbid BPD and ADHD. There is some evidence of this from one study (Anckarsäter et al., 2006) which found higher rates of BPD in those with comorbid

ASD and ADHD, but there was still a high overlap of BPD in individuals with ASD without ADHD. High levels of depression may also confound the two disorders. Depression and suicidal behaviour are linked and are similar to two of the diagnostic categories for BPD. For example, chronic feelings of emptiness found in BPD may overlap with symptoms of depression, such as hopelessness. In ASD, neither is part of the diagnostic symptoms. However, empirical studies show a high rate of suicidal behaviour and depressive disorders in ASD (Hedley & Uljarević, 2018). Suicidal behaviour in individuals with ASD may prompt clinicians to consider a BPD diagnosis, given other overlapping characteristics highlighted throughout this review including intense anger outbursts and impulsivity. However, careful examination of whether such a diagnosis is warranted, given high rates of suicidal behaviour may occur in ASD without BPD and other comorbidities triggering similar behaviours need to be carefully explored. The research explored in this study showed depressive disorders and suicidal behaviour were as high in those with ASD+BPD as BPD alone; but no studies contrasted this with ASD alone.

Shared neurocognitive profiles

Anackarsater (2006) noted that neurocognitive deficits found in ADHD (and ASD) such as attention, impulse control, empathy/theory of mind/mentalisation and communication-related problems contribute to the development of personality and overlap with the neurocognitive deficits of BPD. Having these neurocognitive deficits in childhood as part of ASD may result in vulnerability to developing BPD in adulthood. There were few empirical studies that explored underlying neurocognitive profiles in BPD and ASD. This area warrants further research.

Theory of mind was found in two studies to be more impaired in individuals with ASD or ASD+BPD relative to BPD alone. Mentalisation was thought to be an area of

difficulty in BPD, with Mentalisation Based Therapy developed as a specific treatment for BPD (Bateman & Fonagy, 2004). There have, however, been mixed empirical findings regarding whether mentalisation is actually impaired in BPD (Arntz, Bernstein, Oorschot, & Schobre, 2009; Dinsdale & Crespi, 2013; Sharp et al., 2013; Sharp & Vanwoerden, 2015). This may relate to different methodologies and tests used to measure the many components of mentalisation. A systematic review suggested no impairment in mentalising in BPD (Mitchell 2014). This could be a point of differentiation between the ASD and BPD, and more research exploring these differences is warranted. The finding of impaired theory of mind in Asperger's disorder but not in comparison to a mixed BPD and anti-social PD group (Murphy, 2006), and of lower levels of empathy in women with BPD+ASD traits than BPD alone (Nanchen et al., 2016), suggests lower empathy when ASD is present.

Increased childhood trauma in ASD may predispose to BPD

Individuals with ASD experience higher rates of bullying and abuse, likely due to their social deficits and challenging behaviours, which may make them targets for bullying by peers and at risk of potential abuse from caregivers (Haruvi-Lamdan et al., 2018). This may predispose individuals to the development of BPD given traumatic early experiences are considered a causal factor for BPD (Ball & Links, 2009; MacIntosh, Godbout, & Dubash, 2015). Only one study from the current review explored trauma and found individuals with BPD with a history of physical or sexual abuse had higher levels of autistic traits (Dell'Osso et al., 2018). Longitudinal studies would be required to understand the impact of childhood trauma on the development of BPD in ASD.

Gender

ASD is diagnosed in more males and BPD more females. In general females are also more likely to be diagnosed with internalising problems and males neurodevelopmental

disorders. Clinician biases in these diagnostic differences have been implicated that add to differences due to possible, but yet unproven, biological causes (Thompson, Caruso, & Ellerbeck, 2003). The studies that compared the gender ratio of BPD diagnoses in individuals with ASD found more females had BPD than males. In contrast, the only study exploring self-reported traits of BPD in ASD and vice versa found no sex differences. This suggests clinician bias towards diagnosing females with BPD may also occur in females with additional diagnoses like ASD. Further research directly assessing both ASD and BPD traits and diagnoses in men and women is needed to confirm this. This type of evidence is required to ensure accurate diagnoses of ASD, BPD or both, on the path to appropriate interventions and supports.

Limitations and assessment issues

The diagnosis of BPD in adults using tools like the SCID-II is arguably straightforward and can be made via a clinical interview by an experienced clinician. In contrast, the diagnosis of ASD in adults requires not only understanding current problems and symptoms but gaining a developmental history, usually from a parent or caregiver to verify ASD symptoms were present in early development. This is often difficult to establish during adult assessments where caregivers may not be available, or if they are, they must retrospectively recall, often from many decades before, specific ASD features present in childhood. Diagnosis of ASD in individuals with BPD and BPD in those with ASD is more challenging. For example, in individuals with BPD who may have experienced trauma in their childhoods, ascertainment and accuracy of early childhood development is impacted by the individual's ability to recall details relating to their childhoods and their willingness to identify a caregiver they are comfortable to include in the diagnostic assessment process. Individuals with ASD may have difficulty articulating and fully expressing their social and emotional difficulties due to the symptoms of ASD.

Findings from the current review suggest that individuals with BPD have higher self-reported ASD traits than controls (Dell'Osso et al., 2018; Dudas et al., 2017). However, this may be due to adult ASD self-report measures having poor specificity and sensitivity (Conner, Cramer, & McGonigle, 2019). For example, Ketelaars (2008) found no difference in autistic traits using the self-reported AQ in those with ASD, those referred for an ASD assessment but not meeting diagnostic criteria, and in psychiatric controls. Another study found the specificity of the AQ was only 52% when exploring outpatients with ASD or other psychiatric diagnoses (Conner et al., 2019). Thus the adult AQ self-report may not differentiate adults with ASD from other psychiatric problems including BPD (Dudas et al., 2017; Ketelaars et al., 2008). More valid and reliable tools and procedures for the assessment of adult ASD are required for both research and clinical practice to prevent adults being misdiagnosed with ASD. This is also needed to better explore the overlap of these two conditions to tease apart true ASD from those experiencing adulthood social deficits and rigid behaviours that may result from various other adult psychopathologies (Fombonne, 2020).

We also acknowledge it is possible that studies using existing diagnostic information have under-reported the comorbid diagnosis of ASD and BPD. With the change in diagnostic conceptualisation of ASD over the recent years the recognition of milder cases of ASD is growing. It might be expected that the overlap would increase given the DSM has broadened what is considered ASD (American Psychiatric Association, 2013). However, the meta-analysis indicated less overlap in more recent years. It might be that individuals may not receive further assessment past an initial BPD or ASD diagnosis so studies that did not screen for ASD/BPD and relied on medical records may under-report the overlap. The finding from Hermann (2018), which had the largest number of participants in this review found from 2001-2017, the dual diagnosis was only present from 2008. However, they found only 3% of those with BPD had ASD, similar to the population prevalence. Similarly, there were some

recent studies that screened within the study using gold-standard ASD assessment methods that still found very little overlap (Strunz et al., 2015). This adds further weight to the findings of a similar population proportion overlap between the two conditions.

Clinical Implications and Future Research

Anackarsater (2006) noted that whether an adult is diagnosed with a neurodevelopmental disorder such as ASD or ADHD, or a PD may depend on the diagnosing clinician's training and theoretical orientation given the overlap of the symptoms of PD versus neurodevelopmental disorders. Those with a childhood focus may see a developmental disorder as primary, whereas those with an adult focus might see the PD as primary. The findings from this review suggest that ASD and BPD can overlap, however, the overlap based on the current research is not larger than what would be expected from that seen in the general population. Individuals with BPD may have high self-reported autistic traits on some measures such as the AQ but this may not be diagnostically relevant and due to poor tool specificity. Thus a careful ASD assessment in those with BPD is required when ASD is indicated. Self-reported ASD questionnaires may not necessarily be accurate and obtaining a developmental history from caregivers is required, as per existing ASD diagnostic guidelines. In particular, when empathy and theory of mind is impaired in individuals with BPD, it may be appropriate to consider ASD.

There is a lack of evidence-based appropriate treatments for adults with ASD with most studies exploring cognitive and behaviour approaches. In this review, we found one study that explored the relationship between autistic traits and treatment in individuals with BPD (Dubreucq et al., 2020). However, there were no studies that explored treatments for individuals with comorbid BPD and ASD. Given the symptom overlap and commonalities between ASD and BPD outlined in this review, the treatments used in BPD may be

considered for use in ASD. There have been numerous effective psychotherapy interventions for BPD including Dialectical Behaviour Therapy, Schema Therapy, and Mentalisation based therapy. DBT in particular is focused on dialectical thinking where multiple competing views can be true and avoiding all or nothing thinking. This has face value for ASD where there is black and white or rigid thinking patterns (Hartmann, Urbano, Manser, & Okwara, 2012). DBT includes emotion psychoeducation and emotion regulation techniques. There is a published protocol for a trial of DBT in ASD (Huntjens et al., 2020).

Schema therapy is an evidence-based treatment for BPD and focuses on understanding how maladaptive schemas develop during one's development (Kellogg & Young, 2006). The Social isolation/alienation schema is particularly relevant in the case of ASD, where individuals develop a sense of being different to other people and not fitting in (Oshima, Nishinaka, Iwasa, Ito, & Shimizu, 2014). Schema therapy involves providing corrective emotional experiences through cognitive and experiential techniques. These could target bullying and social exclusion memories in individuals ASD which often become the content of rumination and continue to distress individuals with ASD well after the incidents occurred. Similarly, behaviour experiments to act in healthy ways, rather than schema-driven ways, would teach behaviours that promote a focus on social similarities rather than differences, in the case of the social isolation schema. An early case report suggests schema therapy may be a helpful treatment in ASD (Oshima et al., 2014). There is also a published protocol for a trial of schema therapy for adults with ASD and comorbid personality disorders (Vuijk & Arntz, 2017).

Mentalisation based therapy teaches individuals to understand and differentiate their own thoughts and emotions from those around them (Bateman & Fonagy, 2004). It involves learning to recognise and understand one's own and other people's thoughts, emotions, and motives. It could thus potentially assist with theory of mind development in ASD as well as

improve emotion recognition. These treatment approaches have face validity for the treatment of ASD, at least in those with IQs within the normal range, or potentially via adaptation to individuals with lower cognitive levels. Further research exploring these treatments in adults with ASD is warranted.

Conclusion

There is superficial overlap between ASD and BPD symptom criteria, but the empirical evidence is generally low quality, reports mixed findings, and suggests weak evidence for an increased prevalence of BPD in ASD and vice versa. Pooled prevalence rates suggested that ASD occurs in BPD, and BPD in ASD, in similar levels found in the general population. More research elucidating the key underlying cognitive areas of difference between the two disorders, such as in the areas of theory of mind, could help clinical diagnostic differentiation, and whether effective psychological treatment approaches for BPD may also be helpful for adults with ASD.

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Figure captions

Figure 1. PRISMA flow chart of included studies

Figure 2. Forest plot of prevalence of overlapping ASD and BPD.

Table 1. The overlap between ASD and BPD DSM-5 diagnostic criteria and related research findings

Area	ASD DSM-5 Criteria	BPD DSM-5 Criteria
Social	A1. Deficits in social-emotional reciprocity, ranging, for example, from abnormal social approach and failure of normal back-and-forth conversation; to reduced sharing of interests, emotions, or affect; to failure to initiate or respond to social interactions.	[Theory of mind deficits in BPD]
	A2. Deficits in nonverbal communicative behaviours used for social interaction, ranging, for example, from poorly integrated verbal and nonverbal communication; to abnormalities in eye contact and body language or deficits in understanding and use of gestures; to a total lack of facial expressions and nonverbal communication.	[Facial emotion recognition deficits in BPD]
	A3. Deficits in developing, maintaining, and understanding relationships, ranging, for example, from difficulties adjusting behavior to suit various social contexts; to difficulties in sharing imaginative play or in making friends; to absence of interest in peers.	2. A pattern of unstable and intense interpersonal relationships characterized by alternating between extremes of idealization and devaluation.
Repetitive behaviour, Resistance to change	B1. Stereotyped or repetitive motor movements, use of objects, or speech (e.g., simple motor stereotypies, lining up toys or flipping objects, echolalia, idiosyncratic phrases). [Elevated levels of self-injurious, self-harm and suicidal behaviour in ASD]	5. Recurrent suicidal behaviour, gestures, or threats, or self-mutilating behaviour.
	B2. Insistence on sameness, inflexible adherence to routines, or ritualized patterns of verbal or	1. Frantic efforts to avoid real or imagined abandonment.

	nonverbal behavior (e.g., extreme distress at small changes, difficulties with transitions, rigid thinking patterns, greeting rituals, need to take same route or eat same food every day).	6. Affective instability due to a marked reactivity of mood (e.g., intense episodic dysphoria, irritability, or anxiety usually lasting a few hours and only rarely more than a few days). 8. Inappropriate, intense anger or difficulty controlling anger (e.g., frequent displays of temper, constant anger, recurrent physical fights).
	B3. Highly restricted, fixated interests that are abnormal in intensity or focus (e.g., strong attachment to or preoccupation with unusual objects, excessively circumscribed or perseverative interests).	
	B4. Hyper- or hyporeactivity to sensory input or unusual interest in sensory aspects of the environment (e.g., apparent indifference to pain/temperature, adverse response to specific sounds or textures, excessive smelling or touching of objects, visual fascination with lights or movement).	[Sensory sensitivity in BPD]
Emotion Regulation	[Increased rate of suicidal behaviour and self-injurious behaviour] [37% lifetime prevalence of depressive disorder in ASD]	5. Recurrent suicidal behaviour, gestures, or threats, or self-mutilating behaviour. 7. Chronic feelings of emptiness.
Identity disturbance	[Increased identity issues e.g. gender dysphoria]	3. Identity disturbance: markedly and persistently unstable self-image or sense of self.
Impulsivity	[27% of adults with ASD have ADHD]	4. Impulsivity in at least two areas that are potentially self-damaging (e.g., spending, sex, substance abuse, reckless driving, binge eating).

Disassociation	[Overlap with schizophrenia spectrum conditions; autistic preoccupations with paranoid themes]	9. Transient, stress-related paranoid ideation or severe dissociative symptoms.

Notes. Brackets [] indicate research findings.

Table 2. Characteristics of Included Studies

Authors	Year	Location	Study design (population, community or clinical; years)	Study aims	ASD N, % male, age M (SD) yrs	BPD N, % male, age M (SD) yrs	Controls N, % male, age M (SD) yrs	ASD Diag Method	BPD Diag Method	N (%) BPD in ASD	N (%) ASD in BPD	Comments and findings
Phenomenology studies												
Pelletier	1998	Canada	Case study (clinical)	Described cases of two children aged 12 and 10 years misdiagnosed with Borderline Personality Disorder, then diagnosed with Asperger Syndrome	N=2, 100% male, mean age age 11 yrs			DSM-IV	DSM-IV			Suggests that many adolescents and adults with BPD may have a subtle form of Asperger's syndrome. Included those with hyperactivity and normal intelligence.
Murphy	2006	UK	Cohort (Clinical)	Explored theory of mind in inpatients with Asperger's syndrome, schizophrenia and a mixed borderline/antisocial PD group	N=13, 100% male, mean age 35 (7.5) yrs	N=13, 100% male, mean age 32.1 (6.6) yrs		ICD-10	ICD-10 by experienced clinician			Found theory of mind (using Revised Eyes Test and an advanced theory of mind test) was impaired in individuals with Asperger's Syndrome but not the personality disorder group. Full-scale IQ within the average range – Aspergers M=102, PD M=94.

Wink	2010	US	Case study (Clinical)	Describes 3 cases with intellectual disability and BPD, one of the case studies has a diagnosis of autistic disorder	N=1, male, mean age 37 yrs			Past diagnosis of Autistic Disorder				The individual had schizoaffective disorder, anxiety disorder NOS, and IQ=72. Reports the case was incorrectly diagnosed with ASD and that BPD is the appropriate diagnosis. Treatment for BPD symptoms resulted in a reduction in self injurious behaviour and improvement in his mental health.
Dudas	2017	UK	Cohort (Community)	Explore severity of ASD symptoms in individuals with ASD, BPD and ASD+BPD	N=624, 50% male, mean age 39.36 (13.3) yrs	N=23, 13% male, mean age 38.8 (9.3) yrs		DSM-IV,5 or ICD-10	Online self-report			Using the AQ, comorbid BPD+ASD>ASD>BPD; Concludes BPD individuals have higher autistic traits. There were 16 individuals with comorbid ASD and BPD. IQ level not described.
Chabrol	2018	France	Cohort (Community)	Explored overlap of BPD and ASD traits in community controls			N=474, 20% male, 20.9 yrs	AQ 10	Personality Diagnostic Questionnaire			Used the AQ 10 self report measure and a BPD self report measure in controls only. Around 17% had high BPD and ASD traits within the whole sample. Should screen for BPD in ASD and vice-versa given increased suicidal ideation in this group. High BPD&ASD group had higher suicidal ideation than Borderline

												group (despite similar levels of depression symptoms); ASD traits group had low levels of suicidal ideation. IQ not reported by non-clinical group suggests non ID.
Dubreucq	2020	France	Cohort (Clinical)	Explored self-stigma in serious mental illness incuding BPD and ASD	N=45,	N=64, in larger sample 68% male, mean age 33 yrs		DSM-5	SAM SAH 2013 criterion			Self-stigma (accepting negative stereotypes about one's disorder) was highest in BPD (43.8%) and lowest in ASD (22.2%)
Prevalence studies												
Anackarsater	2006	Sweden	Cohort (Clinical, 2001-2003)	Explored BPD prevalence in individuals with ASD and comorbid ADHD	N=74, 55% male, median age 31 yrs			DSM-IV	DSM-IV SCID-II	9 (12.2 %)		Found 10.6% with ASD had BPD, 14.8 of both ADHD&ASD had BPD. Indicates an increased prevalence of BPD when there is comorbid ADHD. IQ not described.
Ketelaars	2008	Netherlands	Cohort (Clinical)	Explored BPD prevalence in individuals with and psychiatric controls without ASD	N=15, 80% male, mean age 22 (5) yrs		N=21, 86% male, mean age 27 (9) yrs	DSM-IV	International Personality Disorder Examination	1 (6.7%)		Found no significant difference between AQ scores in psychiatric patients with and with ASD. Found 1 in 15 with ASD had BPD but similarly 1 in 21 of the psychiatric controls partially met criteria for BPD.

									(IPDE)			
Ryden	2008	Sweden	Cohort (Clinical, 2005-2007)	Explore proportion of ASD in individuals with BPD		N=41, 0% male, mean age 29 (8.2) yrs		Asperger syndrome diagnostic interview (ASDI)	SCID-II		6 (14.6%)	Found 15% of those with BPD had ASD. Those with ASD had more suicide attempts and less substance abuse. IQ means were within the average range.
Ryden, Bejerot	2008	Sweden	Cohort (Clinical)	Explore personality disorder diagnoses in individuals with ASD	N=84, 54% male, mean age 30 (10)		N=41, 47% male, mean age 34 (8.7)	Asperger syndrome diagnostic interview (ASDI)	Prior diagnosis	7 (8.3%)		Although they reported a % overlap of 13.5% the denominator excluded patients without any comorbid diagnoses. Instead, 7 of 84 or 8.3% of individuals with ASD had a prior diagnosis of BPD. Did not report the number of individuals with ASD who met BPD cut-off on the SCID-II screen.
Hofvander	2009	Sweden	Cohort (Clinical)	Explore personality and psychiatric disorders in adults with ASD	N=117, 67% male, men age 29 yrs			ASDI using DSM-IV criteria	SCID-II	10 (8.5%)		The study excluded individuals with intellectual disability. 4/62 in Asperger group and 6/50 for PDD-NOS and 0/5 with AD had BPD. 4/77 males and 6/40 females suggesting higher rate of BPD in females with ASD than males.

Lopez-Perez	2017	Spain	Case control (Clinical)	Explored interpersonal emotion regulation in individuals with ASD, BPD and controls	N=30, 72% male, mean age 26.6 (7.32) yrs		N=60, 20% males, 26.7 (7.7) yrs	ICD-10	ICD-10	0 (0%)		Found 0% BPD in those with ASD based on the SCID-II. Emotion regulation of others and self questionnaire used. Both individuals with BPD and AS reported to engage more affect worsening than controls. Individuals with ASD did not engage in more attempts to increase another's feelings relative to attempts to worsen feelings, where as those with BPD and controls engaged in more affect increasing than worsening behaviours. in affect improvement compared to controls. IQ not described.
Lugnegård	2012	Sweden	Cohort (Clinical)	Explore personality disorders in adults with Asperger's Syndrome	N=54, 48% male, men age 27 (3.9) yrs			DSM-IV	SCID-II	0 (0%)		None of the individuals with ASD had BPD. Cluster A and C PDs were more common in Asperger's disorder.
Strunz	2014	German	Case control (Clinical)	Explore personality pathology in ASD compared to NPD and BPD	N=59, 46% male, men age 33 (10.9) yrs	N=80, 36% male, mean age 29.7	N=106, 53% male, 30.8 (10.7) yrs	DSM-IV, ADOS, ADI-R	SCID-II	0 (0%)		The study excluded individuals with intellectual disability. None of the ASD group had BPD according to the SCID-II. Compared to the BPD patients, on NEO-PI-R ASD patients scored

						(8.8) yrs						significantly lower in neuroticism and emotional dysregulation, extrovertism, openness (except intellectual curiosity); and higher on conscientiousness and compulsivity. Suggests a unique personality profile for ASD relative to BPD (and NPD & controls)
Nanchen	2016	German	Cohort (Clinical)	Explore autistic traits in women with BPD		N=38, 0% male, age range 18-45 yrs		Prior clinical diagnosis; AQ	DSM-IV		1 (2.6%) using previous diagnosis. AQ cutoff:18 (47.4%)	Only one woman had Asperger's Disorder based on an existing clinical diagnosis. Half the women with BPD scored above the cutoff on the AQ. The subgroup with high autistic traits had lower scores for cognitive empathy and higher alexithymia scores on the Toronto Alexithymia Scale (TAS), Interpersonal Reactivity Index (IRI). IQ not described.
Dell'Osso, Cremone	2018	Italy	Case control (Clinical, 2015-2016)	Explored ASD symptoms in individuals with BPD		N=50, 30% male, mean age 33.8 (10) yrs	N=69, 39% male, 31.4 (11.4) yrs	AQ	DSM-5 SCID		3 (6.4%)	BPD group had higher AQ scores than controls. 6.4% met cutoff on the AQ for ASD. Higher autistic traits were related to a history of physical or sexual abuse and lifetime suicidality in BPD. ID excluded.

Herman n	2018	Germa n	Cohort (Clinica l)	Explore proportion of ASD in individuals with BPD between 2001-2017 in BPD treatment clinic		N=723, 0% male, age 27 (7) yrs		ICD-10	ICD-10		average 4.2%	90% with ASD+BPD had a mood disorder versus 45% in BPD only, none with ASD+BPD had a substance abuse disorder compared to 15% of those with BPD only. Only from 2008 were there comorbid ASD and BPD cases.
Shen	2018	Taiwa n	Case control (Popula tion, 2003-2006)	Explore psychiatric disorders in individuals with BPD compared to controls		N=292, 35% male, mean age 25 yrs	N=584 0, 35% males, 25 yrs	ICD-9-CM	ICD-9-CM		1 (0.3%)	There was no increased risk of the BPD group having ASD relative to controls. There was an increased odds of intellectual disability and ADHD in those with BPD.
Treatment studies												
Kaltene gger	2020	Swede n	Case control	Explore whether autistic traits in individuals with BPD+Substance Use Disorder were impacted by Mentalisation Based Treatment		N=46, 20% male, mean age 36.7 yrs		AQ	DSM-IV			Treatment was 18 months. ASD was excluded from BPD group. Found AQ did not influence BPD symptom severity, or alcohol use over treatment. Higher AQ score at the start of treatment was correlated with higher reflective functioning at treatment end.

Table 3. Risk of Bias in the included studies

Authors	**Year**	1. Were there clear criteria for inclusion in the case series?	2. Was the condition measured in a standard, reliable way for all participants included in the case series?	3. Were valid methods used for identification of the condition	4. Did the case series have consecutive inclusion of participants?	5. Did the case series have complete inclusion of participants?	6. Was there clear reporting of the demographics of the participants in the study?	7. Was there clear reporting of clinical information of the participants?	8. Were the outcomes or follow up results of cases clearly reported?	9. Was there clear reporting of the presenting site(s)/clinic(s) demographic information?	10. Was statistical analysis appropriate?	Overall ROB rating = High if 4 or more N/U/NA
Anackarsater	2006	N	Y	Y	U	U	N	Y	Y	Y	Y	H
Chabrol	2018	N	Y	N	N	U	N	N	Y	N	Y	H
Dell'Osso, Cremone	2018	Y	Y	N	Y	U	N	Y	Y	N	Y	H
Dubreucq	2020	Y	Y	Y	U	U	N	N	Y	N	Y	H
Dudas	2017	N	N	N	N	U	N	N	Y	N	Y	H
Hermann	2018	Y	Y	Y	Y	Y	N	Y	Y	Y	Y	L
Hofvander	2009	N	N	Y	Y	Y	N	Y	Y	Y	Y	L
Ketelaars	2008	Y	Y	Y	N	U	Y	Y	Y	Y	Y	L
Kaltenegger	2020	Y	Y	Y	U	U	N	N	Y	Y	Y	H
Lopez-Perez	2017	N	N	Y	N	U	N	Y	Y	N	Y	H
Lugnegård	2012	N	N	Y	N	U	Y	Y	Y	Y	Y	L

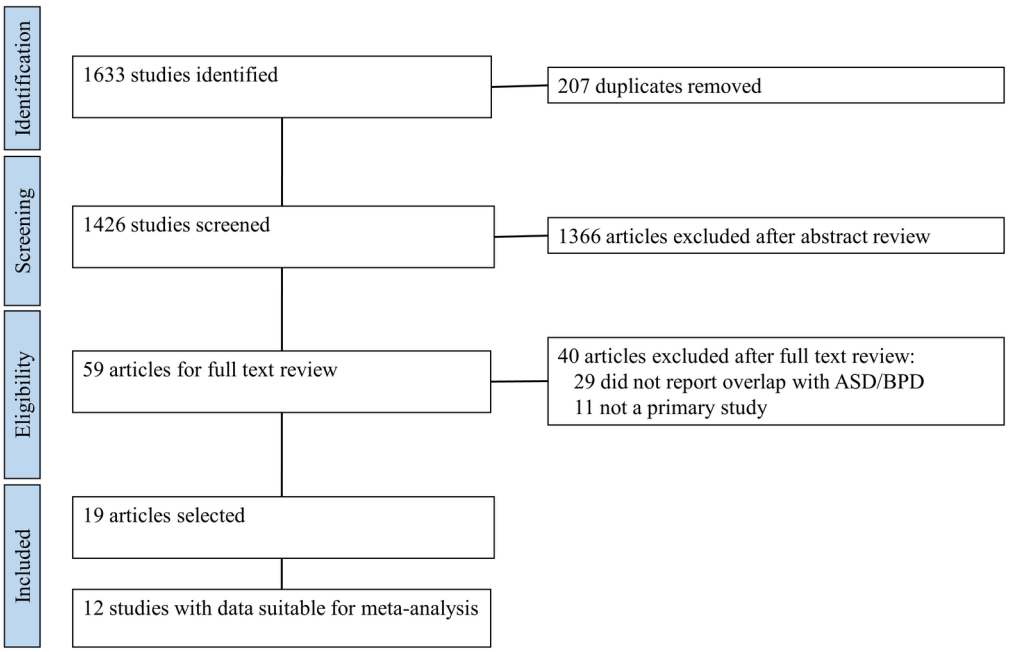
Murphy	2006	N	Y	Y	U	U	Y	Y	Y	Y	Y	L
Nanchen	2016	Y	Y	N	N	U	N	Y	Y	Y	Y	L
Pelletier	1998	N	Y	Y	N	N	Y	N	N	N	NA	H
Ryden	2008	Y	N	Y	Y	N	Y	Y	N	Y	Y	L
Ryden, Bejerot	2008	Y	Y	N	Y	N	Y	N	N	Y	Y	H
Shen	2018	Y	Y	Y	Y	Y	N	Y	Y	Y	Y	L
Strunz	2014	N	Y	Y	N	Y	N	Y	Y	N	Y	H
Wink	2010	N	N	N	NA	NA	Y	Y	Y	Y	NA	H

Table 4. Summary of phenomenological findings of ASD+BPD compared to ASD alone or BPD alone

Area	ASD+BPD Relative to BPD alone	ASD relative to BPD	Other
Age			High ASD+BPD younger than low ASD+BPD traits, Chabrol
Sex			+ females than males with BPD+ASD, Hofvander, Ryden & Bejerot = Chabrol
ADHD	= Ryden		+BPD in ASD+ADHD than ASD alone, Anckarsäter
Mood disorders	+ Hermann, Chabrol = Ryden		
ASD DSM-IV categories			BPD co-occurrence: PDDNOS> Aspergers>Autistic Disorder, Hofvander
ASD BPD Trait Association			r=0.2, Chabrol
ASD trait level			ASD+BPD>ASD, BPD>Controls, Dudas; BPD>Controls, Dell'Osso
Childhood trauma	+ Dell'Osso		
Suicidal behaviour	+ Chabrol, Ryden = Dell'Osso		
Substance/Alcohol abuse	= Dell'Osso, Chabrol		

	- Hermann, Ryden		
Self Image	- Ryden	- Dubrecq (self-stigma)	
Global function	- Ryden		
Personality traits			-Openness, Extraversion + inhibitedness, compulsivity Strunz
Theory of Mind /Empathy	- Nanchen	- Murphy	
Emotion / Emotion Regulation	- emotion awareness (higher alexithymia), Nanchen	- affect increasing relative to worsening behaviour, Lopes-Perez	

Notes: -, less than; + more than, =, equal too.



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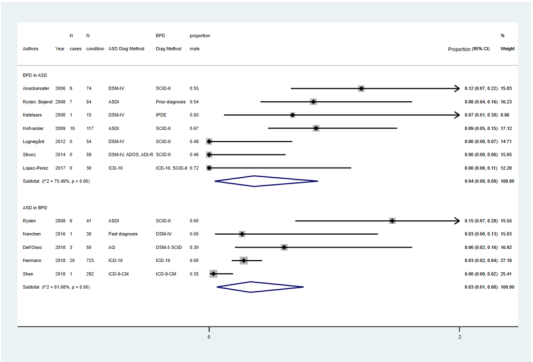

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