

Gender bias in clinical diagnosis of Borderline Personality Disorder and Autism Spectrum Disorder: a retrospective cohort study

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Word count

4,857 words

1 Abstract

Background:

Autism Spectrum Disorder (ASD) and Borderline Personality Disorder (BPD) share overlapping clinical features including social cognitive differences, interpersonal difficulties, emotional dysregulation and alexithymia. The two conditions show different gender prevalence patterns, and it has been suggested that gender bias may exist in diagnostic patterns of ASD and BPD, with females being preferentially diagnosed with BPD in lieu of ASD.

Methods:

In this analysis of real-world clinical records from $n = 417,752$ adults receiving secondary mental health care, we use natural language processing methodology to assess the subsequent incidence of ASD in cohorts diagnosed with BPD, and the incidence of BPD in cohorts diagnosed with ASD. To examine the possibility of gender-based diagnostic bias, we assess for an association between gender and the sequence and timing of diagnoses.

Results:

Results showed substantial rates of concurrent ASD and BPD; 5-year cumulative incidence of later ASD diagnosis among people with BPD was 3.02% [95% CI: 2.62, 3.43] and of later BPD diagnosis among people with ASD was 3.84% [3.08, 4.60]. Consistent with predictions of unidirectional gender-based diagnostic bias, the typical association between male gender and ASD diagnosis was reduced in cohorts first diagnosed with BPD, whereas the association between female gender and BPD remained in those first diagnosed with ASD. In addition, the interaction between gender and diagnostic sequence was associated with the length of delay between diagnoses, such that women waited longer for an ASD diagnosis (relative to a BPD diagnosis) compared to men.

Conclusion:

Together, these results provide a number of avenues for future research and highlight the need for clinicians to consider neurodevelopmental assessment for patients diagnosed with BPD, particularly women, in order to investigate and address potential gender-based diagnostic bias.

2 Community brief

Why is this an important issue?

Early recognition of autism is important, because it allows service-users (individuals receiving support from mental health services) to be offered support. It has been suggested that certain groups of service-users (particularly women) may wait longer to receive an autism diagnosis. It has also been suggested that they may be more likely to be diagnosed with alternate psychiatric diagnoses before receiving an autism diagnosis.

What was the purpose of this study?

This study analysed rates and timing of diagnosis for two conditions: autism and borderline personality disorder (BPD). We asked whether there was evidence that women were more likely to be diagnosed with BPD before receiving an autism diagnosis. We also explored whether women had to wait longer for autism diagnoses after being diagnosed with BPD.

What did the researchers do?

We analysed clinical records from over 400,000 patients in a mental health service in London. We analysed how commonly service-users were diagnosed with autism after being diagnosed with BPD (and vice versa), and whether this was more common in women than men. We also analysed the length of time service-users waited between diagnoses, and whether this was longer for women.

What were the results and conclusions of the study?

Men and women first diagnosed with BPD were equally likely to be later diagnosed with autism. Women waited longer for an autism diagnosis than men if they previously had a BPD diagnosis, whereas men waited longer for a BPD diagnosis (after an autism diagnosis).

What is new or controversial about these findings?

Our findings are in-keeping with a pattern in which women may receive diagnoses of BPD more readily than autism. This has not previously been demonstrated using service-user data from real-world clinical settings.

What are potential weaknesses in the study?

Our study used data from a UK mental health service; it is unknown if findings will generalise to other contexts. This study did not include direct assessments with the service-users involved. As such, service-users' views on which of their diagnoses were most appropriate were not obtained.

How will these findings help autistic adults now or in the future?

This study suggests that women may be more likely to receive an alternate diagnosis before being diagnosed with autism and may wait longer than men to receive an autism diagnosis. Future research may identify how this disparity can be addressed, to ensure all service-users are offered appropriate support.

3 Keywords

Autism Spectrum Disorder; Borderline Personality Disorder; Incidence; Prevalence; Gender Bias

4 Background

Autism Spectrum Disorder (ASD) is a neurodevelopmental condition characterised by social communication difficulties and restricted and repetitive behaviours and/or interests (American Psychiatric Association, 2013). ASD has a prevalence of 1-2% and a male-to-female ratio of 3:1, although aetiological evidence for a proposed ‘female protective effect’ has been inconclusive to date^{1,2,3}. In clinical practice, ASD is known to be under-recognised in females, resulting in an even higher reported male preponderance of ASD diagnosis and delayed, missed or mis-diagnosis among females^{3,4}. Hypothesised reasons for this include possible gender bias in clinical practice and standardised assessment measures and diagnostic criteria not aligning with female-typical presentations of ASD, as well as a female proclivity to engage in ‘camouflaging’ behaviours^{3,5,6,7}. Further, a wide array of psychiatric conditions commonly co-occur with ASD, making the determination of diagnoses clinically challenging and raising the possibility of diagnostic overshadowing^{8,9}.

Borderline Personality Disorder (BPD) is a psychiatric condition characterised by mood instability, impulsivity, identity disturbance and interpersonal difficulties¹⁰. BPD has a prevalence of 0.7-2.7% and is associated with significant functional impairment, morbidity, mortality and frequent contact with clinical services¹⁰. In clinical settings, BPD is reported to have a male-to-female ratio of 1:3, although epidemiological studies suggest the female preponderance may be lower and perhaps not exist at all^{10,11,12,13,14}. Efforts to identify aetiological factors explaining gender differences have been unsuccessful to date, and it has been suggested that BPD may be under-recognised in community settings due to mistaken clinical heuristics and diagnostic bias^{15,16,17}. Similar to ASD, BPD commonly co-occurs with several psychiatric disorders, making clinical differentiation difficult¹⁷.

Despite stemming from different research traditions, ASD and BPD share a number of characteristics pertaining to their nature, clinical features and impact on functioning. Both conditions can be conceptualised as ‘spectrum conditions’, representing a range of difficulties that are typically long-standing, though their expression may change over time, and may be experienced as part of an individual’s sense of self or identity. In the case of autism, this spectrum is not solely defined by difficulties, and many individuals view autism as part of a neurodiverse identity that may include both strengths and challenges, whereas BPD is typically conceptualised within a clinical framework of distress and impairment. Clinical features common to both conditions can include interpersonal difficulties, emotional dysregulation, impulsivity and alexithymia, although these are not universally experienced by all individuals with either condition^{18,19}. Importantly, heuristics often used in clinical practice to differentiate the conditions often lack validity, given their commonality to both BPD and ASD. Examples include factors in the clinical history (such as childhood maltreatment;^{20,21}), psychological endophenotypes (such as social cognitive difficulties;^{22,23}) and clinical outcomes (such as self-harm and suicidal behaviour;^{24,25}). Furthermore, computational techniques highlight similar differences in social inference, such as aberrant volatility learning (i.e., atypical updating of beliefs about how unstable or changeable social environments are) in both conditions²⁶. These overlaps may contribute to diagnostic overshadowing, whereby characteristics of one condition are misattributed to another, potentially leading to missed or delayed diagnosis.

Given the similarities between ASD and BPD, their susceptibility to diagnostic bias and apparently complementary gender prevalence ratios, it has been suggested that gender bias may influence rates of diagnosis in clinical settings. Specifically, it has been suggested that ASD may be misdiagnosed as BPD^{27,28}, particularly among women^{29,30,31,32,33,34,35,36}. Management approaches differ significantly for the two conditions, making the correct and timely identification of each condition a priority^{28,30,37}.

Here, we assess the diagnostic patterns of ASD and BPD in a large secondary care dataset to understand how the two conditions are diagnosed in clinical practice.

Although one cannot make conclusions about the prevalence of misdiagnosis from routine clinical data, it is possible to investigate how gender influences the likelihood of being diagnosed with either condition, the timing of these diagnoses, and the sequence in which they are made. Given that ASD and BPD are both conditions that might be recognised during longitudinal follow-up, gender-based biases (females with undiagnosed ASD being preferentially diagnosed with BPD) would be expected to exert the following epidemiological signature: i) different gender prevalence ratios in ASD and BPD cohorts; ii) a proportion of individuals diagnosed with BPD later being diagnosed with ASD and iii) an attenuation of the association between male gender and ASD diagnosis among individuals initially diagnosed with BPD. Furthermore, amongst individuals diagnosed with both conditions, one would expect iv) female gender to be associated with being diagnosed with BPD before ASD, rather than ASD before BPD; and v) female gender to be associated with the length of diagnostic delay for ASD, but not BPD. A bidirectional gender bias, in which males with undetected BPD were preferentially diagnosed with ASD, would be expected to exert the following additional signature: vi) an attenuation of the association between female gender and BPD diagnosis among individuals initially diagnosed with ASD.

Although the first of these criteria is supported by existing literature, the others have been under-explored to date^{2,10}. A small number of studies exploring the prevalence of BPD in ASD cohorts (and vice versa), have provided heterogeneous results, limited by small sample sizes and potential confounding factors including psychiatric comorbidity, inconsistent diagnostic procedures and unclear methodology^{38,39}. Specifically, evidence is lacking on the effect of demographic factors on the prevalence or timing of subsequent ASD diagnosis among clinical BPD cohorts and vice versa³⁹. The possibility of gender bias in diagnosis of ASD and BPD has therefore not been robustly assessed.

In addition, demographic and clinical factors such as co-occurring attention deficit hyperactivity disorder (ADHD), intellectual disability (ID), ethnicity, and socioeconomic deprivation may influence patterns of diagnosis and access to care. ADHD frequently co-occurs with both ASD and BPD and has been associated with increased diagnostic complexity and delays, particularly where symptom overlap complicates differential diagnosis^{9,40,41}. Intellectual disability is also known to affect diagnostic pathways, with individuals often experiencing delayed or missed diagnoses of co-occurring conditions due to diagnostic overshadowing and challenges in assessment⁴². Ethnic and socio-economic disparities in the recognition of and diagnosis of neurodevelopmental and psychiatric conditions have been widely reported, with individuals from minority ethnic backgrounds often experiencing underdiagnosis or later diagnosis and differential access to services^{43,44,45}. Together, these factors may contribute to heterogeneity in diagnostic trajectories and warrant further investigations in the context of ASD and BPD.

Using a large dataset of electronic patient records, this study aimed to examine the relationship between diagnoses of ASD and BPD. We investigated the incidence of ASD among individuals diagnosed with BPD, the incidence of BPD among individuals diagnosed with ASD, and the extent to which gender may influence diagnostic patterns across these conditions. Specifically, we investigated four hypotheses (also summarised in Figure 1 and Supplementary item A). We hypothesised that the association between male gender and likelihood of ASD diagnosis would be reduced among individuals with a diagnosis of BPD, compared to patterns observed in the wider clinical cohort and epidemiological data (Hypothesis 1). We also hypothesised that the association between female gender and likelihood of BPD diagnosis would be reduced among individuals with a

diagnosis of ASD (Hypothesis 2). Among individuals receiving both diagnoses, we further hypothesised that females would be more likely to receive an initial diagnosis of BPD, whereas males would be more likely to receive an initial diagnosis of ASD (Hypothesis 3). In addition, we hypothesised that the time taken to receive a second diagnosis would be influenced by an interaction between gender and diagnostic sequence, such that females diagnosed initially with BPD would experience longer delays before receiving an ASD diagnosis, while males diagnosed initially with ASD would experience longer delays before receiving a BPD diagnosis (Hypothesis 4).

As a secondary objective we explored the extent to which diagnostic patterns were associated with other demographic and clinical characteristics, including age at first diagnosis, ethnicity, socioeconomic deprivation and co-occurring intellectual disability (ID) and attention deficit hyperactivity disorder (ADHD).

5 Methods

5.1 Study population

We obtained clinical data from the Clinical Records Interactive Search (CRIS) system, a repository of anonymised electronic patient records from the South London and Maudsley NHS Foundation Trust⁴⁶. This trust is the largest provider of secondary mental health care in the UK, covering outpatient, psychiatric inpatient and general hospital liaison services across four London boroughs (population of 1,316,700 as of March 2021), alongside some national specialist services. CRIS was developed in 2008 and incorporates electronic records dating back to 1999 through to contemporaneous patient records in the present day⁴⁷.

We searched the CRIS system (n=417,752) for records of patients diagnosed with either BPD (or Emotionally Unstable Personality Disorder) or ASD, from inception until 26th May 2023. We ascertained diagnosis through two methods, either i) a recorded ICD-10 diagnosis of F60.3 (EUPD) or F84 (ASD, including F84.5: Asperger's syndrome and F84.9: Pervasive developmental disorder, unspecified) in the structured diagnosis field in the patient record system, or ii) a natural language processing algorithm used to detect diagnoses described in free-text entries and other clinical documents. We used these two methods, in-keeping with methodology used in the previous literature, in order to increase reliability of data collection, given that clinicians vary in where they record patients' diagnoses in the clinical records system⁴². The natural language processing operates as an information extraction methodology using the General Architecture for Text Engineering (GATE). This algorithm searches for an elaborated dictionary based on terms related to the text of the relevant diagnostic entry in ICD-10. As well as this, it gathers data on a number of rule-based associated concepts to account for contextual linguistic features, including any prefixes (such as the severity of the diagnosis), the person (i.e. who is the subject of the diagnosis - for instance the patient or a family member), any negations (such as the diagnosis being 'excluded' or 'ruled out') or different tenses (such as a previous vs current diagnosis)^{46,48}. These features enable more accurate identification of clinically relevant diagnostic statements within free-text records. (ICD-10 was used as ICD-11 was not used in the trust at the time of data extraction).

We assessed the performance of these algorithms against diagnoses established from manually extracted gold-standard annotations by two independent researchers including at least one psychiatrist. Each algorithm was evaluated against a sample of 200 manually annotated clinical records. The BPD algorithm had a precision (positive predictive value) of 97% and the ASD

algorithm had a precision of 95%. We limited the cohort to patients who received any component of their care while aged over 18 years old, given that clinical guidelines discourage the diagnosis of BPD in childhood⁴⁹. This protocol therefore generated two cohorts, each containing individuals who had received a primary diagnosis of either BPD or ASD.

5.2 Variables

We recorded the date on which a diagnosis of BPD or ASD was entered in a structured field and/or mentioned in free-text. For the two cohorts diagnosed with BPD and ASD, we identified subsequent diagnoses of ASD and BPD through the same methodology (either structured ICD-10 diagnosis or free-text mentions), and the earliest date recorded (representing the first time the diagnosis was used in a patient's clinical record). For patients whose clinical care had terminated, we ascertained the date of most recent discharge from clinical services, or the date of death, and operationalised this as a censor date. For patients receiving ongoing care, we used the date of data extraction as the censor date.

We obtained the following demographic details from structured fields in each patient record: date of birth, gender, ethnicity, and socioeconomic deprivation (defined using the Index of Multiple Deprivation 2019 (IMD) score associated with a patient's postcode⁵⁰). The IMD is a UK-based composite measure that combines information across multiple domains, including income, employment, education, health, crime, housing and living environment to provide an estimate of relative deprivation based on an individual's address. Gender was taken from a single item in the clinical records system which does not distinguish between gender identity and sex assigned at birth (clinicians can enter patients' gender identity in this field when this differs from sex assigned at birth). Given we took this variable from the date of data extraction (rather than patients' point of entry into services) we would expect this variable to accord more closely to patients' current gender identity. However, we lack data on how often this differed from sex assigned at birth within our dataset. We ascertained any lifetime diagnosis of ID or ADHD using structured diagnostic fields and a natural language processing algorithm. Precision of the ID algorithm was 99% and the ADHD algorithm of 97%.

5.3 Statistical analysis

We derived cumulative incidence and hazard ratios using Cox (Proportional Hazards) Regression. Given ASD, unlike BPD, can be diagnosed in childhood, the analysis for the ASD cohort was limited to a subset of the cohort limited to individuals who received a diagnosis of ASD in adulthood, to ensure the hazard rates are proportional over time and to alleviate any bias arising from population demographic changes. To contextualise hazard ratios to investigate hypotheses 1 and 2, we calculated relative risk estimates to assess the association between gender and lifetime diagnosis of ASD or BPD, within the entire CRIS adult cohort (n=417,752). For sensitivity analyses, we repeated Cox (Proportional Hazards) Regression for other demographic factors (ethnicity, age at first diagnosis, socioeconomic deprivation and co-occurring diagnoses of ID and ADHD).

To assess hypothesis 3, we performed chi-squared testing to assess for an association between gender and diagnostic sequence. For other demographic factors, we performed chi-squared testing for categorical variables (ethnicity and co-occurring diagnoses of ID and ADHD) and independent sample t-testing for socioeconomic deprivation.

To test hypothesis 4, we performed a factorial ANOVA to assess whether the interaction between diagnostic sequence and gender was associated with the time lag between diagnoses. For other demographic factors, we performed ANOVA for categorical variables (ethnicity, ID and ADHD diagnoses) and multiple variable linear regression for continuous variables (age at first diagnosis and socioeconomic deprivation), with main effects and interaction terms entered as independent variables. For regression we report B (unstandardized) coefficients, reflecting the change in time lag (expressed in years) per each unit increase in the independent variable. P-values below 0.05 were considered statistically significant; we applied correction for multiple comparisons using the Benjamini–Hochberg False Discovery Rate (FDR; $\alpha=0.05$) for i) the family of primary hypotheses and ii) the secondary objectives. We performed analyses in R^{51} .

6 Results

6.1 Cumulative incidence of co-occurring diagnosis

6.1.1 Subsequent ASD diagnosis, following BPD

A total of 13,333 individuals primarily diagnosed with BPD (i.e. without a prior diagnosis of ASD in their clinical record) were included in the analysis (Table 1). Cumulative incidence of subsequent ASD diagnosis was 1.14% [95% CI: 0.93, 1.35] at 1 year, 3.02% [2.62, 3.43] at 5 years and 4.94% [4.25, 5.62] at 10 years. A Kaplan-Meier plot illustrating probability of ASD diagnosis following BPD diagnosis is outlined in Figure 2A.

6.1.2 Subsequent BPD diagnosis, following ASD

A total of 6,003 individuals primarily diagnosed with ASD in adulthood (i.e. without a prior diagnosis of BPD) were included in the analysis (Table 1). Cumulative incidence of subsequent BPD diagnosis was 1.58% [1.19, 1.97] at 1 year, 3.84% [3.08, 4.60] at 5 years and 5.58% [4.28, 6.85] at 10 years. A Kaplan-Meier plot illustrating probability of BPD diagnosis following adult ASD diagnosis is outlined in Figure 2B.

We replicated these findings in supplementary analyses conducted with the entire cohort of 12,744 individuals who had received a primary diagnosis at any age. Cumulative incidence of subsequent BPD diagnosis was 1.08% [0.87, 1.29] at 1 year, 3.20% [2.75, 3.65] at 5 years and 5.49% [4.70, 6.26] at 10 years. A Kaplan-Meier plot illustrating probability of BPD diagnosis following ASD diagnosis is outlined in Supplementary Item D.

6.2 Gender and likelihood of subsequent ASD diagnosis

Figure 2C shows a Kaplan-Meier plot illustrating probability of ASD diagnosis following BPD diagnosis for each gender. In support of hypothesis 1, we found no association with gender (HR: male vs female gender, 1.05 [0.82, 1.35]), and the association between male gender and ASD was reduced compared to that of the cohort as a whole (RR: male gender, 2.58 [2.48, 2.68]) or general population (Loomes et al, 2017).

Regarding other demographic factors, compared with people diagnosed with BPD under 25 years of age, individuals in all other age groups were less likely to be subsequently diagnosed with ASD (HRs: 0.40 [0.30, 0.53] for 25-34 years; 0.40 [0.29, 0.55] for 35-44 years; 0.33 [0.21, 0.50] for 45-54 years; and 0.15 [0.05, 0.39] for 55+ years. Co-occurring ID or ADHD diagnosis were positively

associated with likelihood of subsequent ASD diagnosis (HRs for ID: 4.51 [3.35, 6.07]; for ADHD: 2.24 [1.74, 2.90]. Black ethnicity and socioeconomic deprivation were associated with reduced likelihood of receiving an ASD diagnosis (HRs for black ethnicity: 0.56 [0.37, 0.85] and for socioeconomic deprivation: 2nd quartile, 0.54 [0.39, 0.75]; 3rd quartile, 0.52 [0.38, 0.73], 4th quartile, 0.70 [0.52, 0.95]), although the HR for the 4th quartile was not significant at FDR of 0.05 when correcting for multiple comparisons (Supplementary Items B & C).

6.3 Gender and likelihood of subsequent BPD diagnosis

Figure 2D shows a Kaplan-Meier plot illustrating probability of BPD diagnosis following adult ASD diagnosis for each gender. Contrary to hypothesis 2, the association between female gender and likelihood of BPD diagnosis (HR: male gender, 0.26 [0.18, 0.38]), was greater than in the cohort as a whole (RR: male gender, 0.41 [0.40, 0.43]), and the general population (Leichsenring et al, 2023). This finding suggests that the female preponderance of BPD diagnosis is even higher amongst individuals first diagnosed with ASD.

Regarding other demographic factors, we found that ID was negatively associated with subsequent BPD diagnosis (HR: 0.54 [0.34, 0.84]) while ADHD was positively associated with likelihood of BPD diagnosis (HR: 1.83, [1.26, 2.67]). We found no significant associations with age, ethnicity or socioeconomic status, although we identified trend associations between black ethnicity (HR: 0.59 [0.33, 1.05]) and reduced likelihood of subsequent BPD diagnosis (Supplementary Items E & F).

6.4 Sequence of diagnoses

Of the 652 individuals diagnosed with both ASD and BPD, 277 (42.5%) were diagnosed with ASD first, 298 (45.7%) were diagnosed with BPD first. The remaining 77 (11.8%) had both diagnoses recorded at the same index time-point. Regarding hypothesis 3, the group first diagnosed with BPD had a non-significantly higher preponderance of females, compared to the group first diagnosed with ASD (70.8% vs 63.5%; $X^2 = 3.416$, $p = 0.065$). We found that ethnicity, socioeconomic status and co-prevalence of ID or ADHD were not associated with the order in which diagnoses were made.

6.5 Timing of diagnoses

Across the cohort diagnosed with both conditions, 126 (45.5%) of the first ASD diagnoses and 236 (78.9%) of the first BPD diagnoses were made in adulthood. Consistent with hypothesis 4, the interaction between gender and diagnostic sequence was significantly associated with the lag between diagnoses ($F(1, 355) = 5.472$; $p=0.020$); with males and females more promptly receiving a subsequent diagnosis of ASD and BPD, respectively (Figure 3). There was a main effect of the diagnostic sequence on the lag between diagnoses (BPD then ASD: 3.86 years vs ASD then BPD: 1.97 years; $F(1) = 21.223$; $p<0.001$), but no main effect of gender (Supplementary Item H). Together, this suggests that the length waited for a secondary ASD diagnosis was longer than the length waited for a secondary BPD diagnosis, and that this effect was particularly pronounced for women (Figure 3).

For other demographics, there were significant positive main effects for older age ($B=0.05$ years, $p=0.024$), socioeconomic deprivation ($B=0.04$ years; IMD score; $p=0.029$) and ID (4.51 years vs 2.89 years; $F(1, 358) = 4.505$; $p=0.001$) on the lag between diagnosis, although none interacted with the sequence in which diagnoses were made and the main effects for age and socioeconomic deprivation were not significant after FDR correction. There was no association with ethnicity or ADHD.

405 7 Discussion

406 This study identified substantial rates of co-occurrence between clinical diagnoses of ASD and BPD,
407 with approximately 4.2-5.6% of the BPD cohort and 4.3-6.9% of the ASD cohort receiving a latter
408 diagnosis of the other condition within 10 years. This is consistent with another clinical cohort that
409 estimated the 5-year cumulative incidence of subsequent ASD diagnosis after BPD diagnosis at 4.5-
410 5.5%¹⁷, although there is a general lack of high quality studies primarily focused on this research
411 question³⁹. These findings highlight the need for clinicians to undertake a thorough
412 neurodevelopmental history and explore alternate or additional diagnoses when assessing patients
413 previously diagnosed with BPD, especially for those diagnosed with BPD under 25 years of age, for
414 whom the association was strongest in our cohort. Our findings also indicate that the mean length of
415 time between a diagnosis of BPD and ASD may be as high as 4 years, which is likely to have
416 profound implications on patients' clinical outcomes, given diagnoses determine access to clinical
417 services and management approaches.

418
419 Findings suggested that individuals' gender affected the timing and pattern in which diagnoses of
420 BPD and ASD were made, and results were consistent with a pattern whereby females preferentially
421 received a primary diagnoses of BPD. Specifically, a greater proportion of women diagnosed with
422 BPD were later diagnosed with ASD compared to the wider clinical cohort and general population.
423 Amongst those diagnosed with both BPD and ASD, the interaction between gender and diagnostic
424 sequence was significantly associated with the lag between diagnoses, such that women waited
425 longer for an ASD diagnosis (relative to a BPD diagnosis) compared to men. There was also a trend
426 association between female gender and the sequence in which diagnoses were made, such that the
427 proportion of women in the group first diagnosed with BPD was non-significantly higher than in
428 group first diagnosed with ASD. We found no evidence for bidirectional diagnostic bias, that is that
429 males would also preferentially receive a primary diagnosis of ASD before later receiving a diagnosis
430 of BPD.

431
432 These findings are in-keeping with previous epidemiological studies identifying that women
433 diagnosed with personality disorder have a higher likelihood of subsequently being diagnosed with
434 ASD compared to men, although previous studies were not specific to BPD nor designed to discern
435 the mechanisms of gender preponderance^{39,52}. Our findings therefore provide novel empirical support
436 for the existence of gender bias in delayed diagnosis of ASD (and potential diagnostic
437 overshadowing of BPD) amongst women. This is in-keeping with clinical observation and evidence
438 that women diagnosed with ASD in adulthood are typically known to mental health services for
439 many years, and often receive diagnoses of BPD, prior to eventual diagnosis of ASD^{31,34,35}.
440 Importantly, our methodology was unable to ascertain whether an initial diagnosis of BPD was
441 removed when a later diagnosis of ASD was made (rather than viewed as concurrent), and therefore
442 we cannot make inferences about whether BPD was misdiagnosed in these cases. Our study can,
443 however, conclude that individuals' gender affects the timing and patterns in which these two
444 diagnoses are made. One potential explanation for this finding is a pattern of diagnostic
445 overshadowing, in which BPD is preferentially given to female patients whose experiences may be
446 better explained by either a concurrent (secondary) or replacement (primary) diagnosis of ASD. We
447 note that qualitative evidence suggests that people often perceive the earlier diagnosis of BPD as a
448 misdiagnosis in this circumstance⁵³. However, this may not be universally true for all patients, and
449 many service-users may find that a BPD diagnosis is useful for developing insight into their
450 experiences and accessing effective and appropriate treatments.

451

Future research investigating gender bias across different clinical and cross-cultural settings is needed. Studies should explore the diverse barriers to accurate and prompt recognition of diagnosis of BPD and ASD, and the reasons why these might differentially affect men and women in clinical practice. In particular, it may be prudent to explore why a BPD diagnosis – often highly stigmatised in a way which is qualitatively different to the stigma autistic individuals often face – may be preferentially and disproportionately assigned to some females relative to an ASD diagnosis, which in turn is typically welcomed by patients and their families^{21,53,54,55}. This is especially true in relation to the noticeable differences in management (individualised therapy vs social adaptations) and conceptual self-narratives (psychodynamic vs biological/neurodevelopmental/neurodiverse formulations) associated with the two diagnoses. Research should explore at what stage of the diagnostic pathway bias may emerge, and the potential factors associated with this, including any potential association with the professional background or gender of the assessing clinician and the heuristics used when making a diagnosis⁵⁶. Ultimately, development of more robust diagnostic classification and clarification of areas of divergent validity between ASD and BPD may be necessary to reduce diagnostic bias, given their traits are moderately correlated in the general population^{57,58, 59} and that current assessment tools may include gender bias⁶⁰.

Analysis of secondary objectives also provides avenues for future research. Black ethnicity was associated with both a reduced likelihood of subsequent ASD diagnosis and a trend towards reduced likelihood of subsequent BPD diagnosis, possibly indicative of racial bias manifesting as a general reticence to explore psychiatric co-morbidities or re-appraise existing diagnoses^{61,62,63,64,65}. Socioeconomic deprivation was associated with reduced likelihood of subsequent ASD diagnosis, consistent with previous literature and possibly arising from inequitable access to healthcare^{66,67}. Younger age at BPD diagnosis was associated with greater likelihood of subsequent ASD diagnosis, which might be explained by previous findings that clinical services are less likely to recognise ASD in older cohorts^{18,68}. Alternatively, these findings may reflect that accurate identification of BPD is particularly difficult at earlier ages, perhaps in part due to the higher prevalence of identity disturbance, impulsivity and relational instability in cohorts of this age generally⁶⁹. The co-occurrence of ID was associated with reduced likelihood of BPD diagnosis, possibly consistent with a tendency to neglect psychodynamic formulations in this population contributing to diagnostic overshadowing⁷⁰.

These associations may also carry important clinical implications. The finding that Black ethnicity and socioeconomic deprivation was associated with a reduced likelihood of receiving subsequent ASD diagnosis, and a trend towards reduced likelihood of subsequent BPD diagnosis, may reflect systemic disparities in access to assessment, differences in help-seeking behaviour, or potential biases in clinical recognition. This highlights the need for culturally informed assessment practices alongside increased awareness of how neurodevelopmental and personality presentations may present across diverse populations. These findings also underscore the importance of addressing inequities in service provision.

ADHD was associated with an increased likelihood of a subsequent BPD diagnosis among those with a primary diagnosis of ASD. ADHD and BPD share clinical features including impulsivity and emotional dysregulation - with estimated co-prevalence between 30 to 60% - and the relationship between the two diagnoses is of clinical and academic interest^{40,71}. This may reflect overlapping clinical features such as impulsivity and emotional dysregulation, which can complicate diagnostic differentiation. It is possible that being diagnosed with BPD may contribute to delayed or missed diagnosis of ADHD, particularly amongst women^{40,72}. Although this question was beyond the scope of our study, it is a worthy area of future research and reflection for practicing clinicians, especially

given previous observational data suggests ADHD medication might have positive effects for individuals diagnosed with BPD⁷³.

7.1 Limitations

This study has limitations worth noting. Our analyses used secondary care clinical data, and therefore our findings cannot be generalised to general population or primary care cohorts, and awaits replication in those populations. The use of longitudinal clinical data to investigate diagnostic biases relies on the eventual detection of the additional diagnosis by existing clinical services. Therefore, our methodology may be less sensitive than studies assessing co-prevalence using standardised researcher-ascertained diagnosis and may underestimate co-prevalence. Furthermore, our method of detecting diagnoses (by using both structured entries and natural language processing searches of clinical records), may have introduced error in case detection, although our natural language processing methodology showed high precision during validation and followed methodology used in previous literature⁴². Importantly, it was not possible to ascertain whether a secondary diagnosis superseded a patient's primary diagnosis, or was seen as concurrent; future work may explore patient and clinician perspectives on receiving these diagnoses in sequence or combination. Finally, it is possible that our cohort of individuals diagnosed with ASD in adulthood included a small proportion of individuals who received childhood diagnoses from other geographical regions or services not detected by our methodology; this is unlikely to have significantly confounded our results, as confirmed by supplementary replication analysis conducted on the cohort as a whole.

Regarding our study design, hypotheses 1 and 2 contextualised hazard ratios against risk ratios derived from the wider cohort, prohibiting formal statistical comparison. Finally, it is possible that the confirmation of hypothesis 1 reflects the under-detection of ASD among men diagnosed with BPD rather than women being preferentially diagnosed with BPD, although the former explanation lacks face validity, especially when the hypotheses are considered in combination.

7.2 Conclusion

In conclusion, we identified substantial co-prevalence of ASD and BPD diagnoses within adult psychiatric care, assessed in the largest study population to our knowledge^{17,39,74}. We employed novel conceptual methodology to leverage longitudinal, real-world, clinical data to investigate demographic-associated diagnostic bias and identified patterns suggestive of gender bias in the diagnoses of ASD and BPD. Future research should address the factors contributing towards bias in clinical practice and employ this methodological framework to the study of other psychiatric conditions including ADHD and BPD.

Author contributions

The project was conceptualised by GG. Study design was led by GG under supervision of NA, and facilitated by collaboration with the Maudsley BRC Clinical Records Interactive Search (CRIS) project team. Statistical analyses were conceived, designed and performed by GG. The manuscript was written by GG. All authors contributed to manuscript revision and read and approved the submitted version.

Data availability statement

Data are owned by a third party, Maudsley BRC CRIS tool, which provides access to anonymised data derived from SLam electronic medical records. These data can only be accessed by permitted

individuals from within a secure firewall (i.e. the data cannot be sent elsewhere), in the same manner as the authors. For more information please contact: cris.administrator@slam.nhs.uk.

Ethics statement

The CRIS system has approval from the South Central – Oxford C Research Ethics Committee (ref: 18/SC/0372) and this study was approved by the CRIS Oversight Committee (ref: 22-084).

Funding

Study design, data analysis and manuscript writing were carried out during protected time (Dr Gillett), although the project attracted no specific or additional grant or funding.

Declarations of interest

Dr George Gillett is a Clinical Research Fellow, funded by the Wellcome Trust, and has served as a consultant within the last 3 years for Boehringer Ingelheim. Professor Francesca Happé is funded in part by the National Institute for Health Research (NIHR) Maudsley Biomedical Research Centre and King's College London. The other authors declare no interests. The views expressed are those of the author(s) and not necessarily those of the NHS, the NIHR or the Department of Health and Social Care.

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8 Tables

Table 1: Demographics of each cohort

a. Cases where gender unknown are excluded from percentage calculations: BPD, 67; ASD, 44; adult ASD, 17. b. Ethnicity unknown: BPD, 2427; ASD, 2999; adult ASD, 2136. c. IMD score unknown: BPD, 904; ASD 329; adult ASD 198

	BPD cohort (n = 13,333)	ASD cohort (n = 12,744)	Adult ASD cohort (n = 6,003)
Gender^a, %F	72.4%	29.4%	32.8%
Age at diagnosis; mean (SD)	32.7 (12.5) years	21.9 (13.4) years	32.3 (12.6) years
Ethnicity^b			
White; %	77.1%	65.8%	71.9%
Black; %	13.3%	21.3%	17.0%
Asian; %	4.29%	5.91%	6.33%
Mixed; %	5.35%	6.98%	4.71%
IMD score; mean (SD)	25.8 (10.6)	23.7 (11.5)	22.9 (11.7)

ID; %	3.09%	22.7%	19.9%
ADHD; %	47.3%	51.7%	53.6%

9 Figures

Figure 1: Schematic of hypotheses

The weight of arrows in H1-3 corresponds to number of individuals following that pathway. Gender-based diagnostic bias might be expected to manifest such that women are more likely to be initially diagnosed with BPD, attenuating the male preponderance of subsequent ASD diagnosis within the cohort first diagnosed with BPD (H1) and men are more likely to be diagnosed with ASD, attenuating the female preponderance of subsequent BPD diagnosis amongst the cohort first diagnosed with ASD (H2). Furthermore, amongst those diagnosed with both conditions, women may be relatively more likely to receive a diagnosis of BPD before ASD and men may be relatively more likely to receive a diagnosis of ASD before BPD (H3). Finally, the time taken to receive a second diagnosis may be associated with the interaction between gender and diagnostic sequence, such that women wait longer to be diagnosed with ASD and men wait longer to be diagnosed with BPD (H4).

Figure 2: Kaplan–Meier plots of the probability of subsequent diagnosis, by gender, for each cohort

A: Shows the probability of ASD diagnosis among the cohort first diagnosed with BPD ($n = 13,333$). B: Shows the probability of BPD diagnosis among the cohort diagnosed with ASD in adulthood ($n = 6,003$). C: Shows the probability of ASD diagnosis among the cohort first diagnosed with BPD, by gender ($n = 13,333$). D: Shows the probability of BPD diagnosis among the cohort diagnosed with ASD in adulthood, by gender ($n = 6,003$). Shaded regions represent 95% confidence intervals. The y-axis represents the probability of remaining free from a subsequent diagnosis over time. A drop in the curve toward $y = 0$ indicates an increasing proportion of individuals receiving an additional diagnosis.

Figure 3: Bar plot of the interaction between gender and diagnostic sequence on the length of lag between diagnoses