



**Personality disorder: Prevalence, outcomes, and
neighbourhood-level deprivation
in mental health services**

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PhD thesis**

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Declaration

I, Ka-Young Ban, confirm that the work presented in this thesis is my own. Where information has been derived from other sources, I confirm that this has been indicated in the thesis.

Signature:

Date:

Abstract

Introduction

Little is known about social-environmental factors at the neighbourhood-level in relation to personality disorder prevalence and outcomes such as mortality and readmission. I investigated personality disorder prevalence in secondary care records and whether neighbourhood-level deprivation and population density were associated with both personality disorder prevalence and its outcomes, including mortality and the first acute psychiatric admission, using data derived from secondary mental health services in the UK.

Methods

- Study 1 – I systematically reviewed literature on the association between social deprivation and frequency and prognosis of personality disorder.
- Study 2 - I examined comorbid personality disorder diagnosis prevalence and its association with neighbourhood-level deprivation and population density within six early intervention in psychosis (EIP) services in rural England (N=798) using logistic regression.
- Study 3 - I investigated prevalence of personality disorder and whether neighbourhood-level deprivation and population density were associated with personality disorder diagnosis prevalence and outcomes including mortality and first acute psychiatric admission after personality disorder diagnosis using Clinical Record Interactive Search (CRIS) database in a Camden and Islington NHS Foundation Trust (N=4,414). I used Poisson regression and Cox regression.
- Study 4 - I replicated the study 3 using CRIS database from a different large inner city NHS Foundation Trust (South London and Maudsley NHS Foundation Trust) (N=15,668).

Results

- Study 1 – The systematic review demonstrated that worse social deprivation was associated with an increased risk of personality disorder and poorer prognosis in people with personality disorder.
- Study 2 - The prevalence of comorbid personality disorder in EIP services was 9.5% and I found no association between neighbourhood-level deprivation and population density and personality disorder prevalence.
- Study 3 - I found prevalence of personality disorder in clinical records (0.99%; 95% CI: 0.96-1.02) was much lower than reported in community research-studies (4.4-13.4%). People from more deprived neighbourhoods were more likely to have personality disorder

compared with those from more affluent neighbourhoods (RR: 1.29; 95% CI: 1.20-1.39). I found no association between neighbourhood-level deprivation and population density and either mortality or the first acute psychiatric admission after personality disorder diagnosis.

- Study 4 – The prevalence of personality disorder diagnoses in secondary care (0.76%; 95% CI: 0.74-0.78%) was similar to study 3. Neighbourhood-level deprivation was associated with this personality disorder prevalence (RR: 1.30; 95% CI: 1.25-1.37), but there was no clear association with population density. Again, there was no evidence of an association between neighbourhood-level deprivation and population density and mortality or subsequent acute psychiatric admission after personality disorder diagnosis.

Conclusions

In this thesis, I found that the prevalence of personality disorder in secondary care is much lower than in community samples and is associated with neighbourhood-level deprivation, but that subsequent outcomes for these patients did not vary by neighbourhood-level deprivation or population density. This extends our knowledge of the relationship between neighbourhood-level deprivation and the development of personality disorder. It also suggests that neighbourhood-level deprivation and population density have little effect on the prognosis of personality disorder once people were diagnosed with personality disorder in this study conducted in very urban areas of London. Further studies using data that cover neighbourhoods with different characteristics are needed to examine the generalisability of my findings at a broader national level.

Impact Statement

There has been increased focus in recent research on the association between living in deprived neighbourhoods and risk of mental illnesses, including psychosis, depression and anxiety disorders. However, studies on neighbourhood-level deprivation and the risk of personality disorder are scarce, as are studies on the association between neighbourhood deprivation and subsequent prognosis for people with personality disorder. Additionally, most studies on prevalence of personality disorder use data obtained in community settings, while relatively few studies have explored the frequency of personality disorder in clinical settings. It is important to understand the potential gap between estimates in the general population and clinical practice for improving services for people with personality disorder.

In my thesis I demonstrated that the prevalence of personality disorders in secondary mental health services, including those seen comorbidly in early intervention for psychosis (EIP) services, was far lower than estimates in the community. My findings further demonstrated that people living in more deprived areas were more likely to have received a personality disorder diagnosis, but that neighbourhood-level deprivation did not predict the prognosis of personality disorder in terms of mortality or subsequent acute psychiatric admission after their diagnosis.

I expect the findings from this PhD thesis will potentially impact on people with personality disorder, providers of personality disorder services, and local and national government bodies as well as the academic community in the following ways. Firstly, the findings raised the possibility that there could be underdiagnosis of personality disorder in NHS secondary care or under-detection in the community, and this may help providers of personality disorder services to recognise the challenges that people with personality disorder may have in accessing services, including stigma and long waiting times. This recognition may be relevant in improving the care pathway to personality disorder, and thus ultimately aid people with personality disorder in accessing appropriate support. The findings could also improve awareness of public health professionals that people in deprived areas more likely to present with personality disorder or receive a diagnosis of personality disorder.

Secondly, the findings could help local and national government bodies when they design policies and plan resource allocation for people with personality disorder, potentially by paying more attention to disadvantaged neighbourhoods and providing early interventions for young people with emerging personality disorder living in less affluent areas.

Lastly, I also identified prospective directions for future research on the association between neighbourhood-level deprivation and personality disorder, including the need for research looking

into areas with different characteristics from inner-city London or in broader geographical areas including national or international studies. I expect my findings in this thesis can add new information regarding the social determinants of personality disorder.

An adopted version of a chapter (Chapter 3) in this thesis has been published in PLOS One, and I have presented the findings from this study at two international conferences: the EPA Section of Epidemiology and Social Psychiatry and European Congress of Psychiatry. I have also presented the findings from this thesis to the members of Camden and Islington NHS Foundation Trust (C&I) Clinical Record Interactive Search (CRIS) board meeting, who are involved in overseeing the key issues regarding CRIS data, and members of C&I journal club who have first-hand experience with people with personality disorder including psychiatrists, nurses, psychologists, and social workers, and therefore, transferring the knowledge I generated back to people in clinical settings.

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Acronyms

AIC	Akaike's Information Criterion
APA	American Psychological Association
APMS	Adult Psychiatric Morbidity Survey
BME	Black and Minority Ethnic
BPD	Borderline Personality Disorder
BRC	Biomedical Research Centre
CEN	complex emotional needs
CI	Confidence interval
C&I	Camden and Islington NHS Foundation Trust
CIC	Children in the Community
CMD	Common Mental Disorders
CNI	Care Need Index
CPFT	Cambridgeshire and Peterborough NHS Foundation Trust
CRIS	Clinical Record Interactive Search
DSM	Diagnostic and Statistical Manual of Mental Disorders
EHR	Electronic health record
EIP	Early Intervention in Psychosis
FEP	First episode psychosis
FET	Fisher's exact test
GATE	General Architecture for Text Engineering
HR	Hazard ratio
ICD	International Classification of Diseases
IE	Information Extraction
IMD	Index of multiple deprivation
IQR	Interquartile range
LRT	Likelihood ratio test
LSOA	Lower Layer Super Output Areas
MCAR	Missing Completely at Random
MSOA	Mid Layer Super Output Areas
NHS	National Health Service
NICE	National Institute for Health and Care Excellence
NIMHE	National Institute for Mental Health in England
NLP	Natural language processing
NOS	Newcastle Ottawa Scale
NSFT	Norfolk and Suffolk NHS Foundation Trust
NS-SEC	National Statistics Socio-Economic Classification
ONS	Office for National Statistics
OPCRIT	Operational Criteria Checklist for Psychotic Illness and Affective Illness
OR	Odds ratio
PD	Personality Disorder
PPHA	People per hectare
PPV	Positive predictive value

PRISMA	Preferred Reporting Items for Systematic Reviews and Meta-Analyses
RCT	Randomized controlled trial
RR	Risk ratio
RST	Wilcoxon Rank sum-tests
SCID-II	Structured Clinical Interview for DSM-IV AXIS-II Personality disorder
SEPEA	Social Epidemiology of Psychoses in East Anglia
SES	Socioeconomic status
SLaM	South London and Maudsley NHS Foundation Trust
SMR	Standardised mortality ratios
UPA	Underprivileged Area
WHO	World Health Organization

Chapter 1 Introduction

This introductory chapter reviews the overview of personality disorder and the epidemiology of personality disorder including prevalence, sociodemographic correlates, environmental risk factors, outcomes and comorbidities. Further, it also discusses social deprivation and its association with personality disorder reported in previous studies. Lastly, the aims and the research questions of the thesis will be introduced.

1.1 Personality disorder

1.1.1 Overview – Definition and classification

Personality is a way of thinking, feeling and behaving that makes each individual unique (American Psychological Association (APA), 2013). The distinction between personality and personality disorder occurs when these patterns of behaviour and thinking become extreme, and cause major disruptions to the life of the self and others (American Psychological Association (APA), 2013; World Health Organization (WHO), 2016). The International Classification of Diseases and Health Related Problems (ICD-10) defines personality disorder as ‘severe disturbance in the personality and behavioural tendencies of the individual’, and ‘nearly always associated with considerable personal distress and social disruption’ (World Health Organization, 1992). Under this classification, a list of nine types of personality disorders under the code F60 specific personality disorders is provided (*See Table 1.1 for details*). The fifth edition of the Diagnostic and Statistical Manual (DSM-V) gives a similar definition that describes personality disorder as ‘a way of thinking, feeling, and behaving that deviates from the expectations of the culture, causes distress or problems functioning, and lasts over time’; it categorizes them into 10 different types (American Psychological Association (APA), 2013). Unlike the ICD-10 classification, they also group these different disorders into three clusters (A, B and C) according to their primary symptoms. Cluster A comprises odd or eccentric behaviour, and includes paranoid, schizoid and schizotypal personality disorders. Cluster B comprises dramatic, emotional or erratic behaviour, which includes antisocial, borderline, narcissistic, and histrionic personality disorders. Lastly, cluster C comprises anxious or fearful behaviour, and includes avoidant, dependent and obsessive-compulsive personality disorders.

Currently, both these classification systems adopt a categorical approach to the diagnosis and classification of personality disorder, and there are ongoing debates as to whether to maintain the categorical system for personality disorder or to move towards a more dimensional approach because of considerable overlap between different types of personality disorder and doubts about the efficacy of this classification system. As a result, a hybrid classification system was proposed,

adopting elements of both categorical and dimensional approaches, and ICD-11 will be required to be used in many countries from January 2022 (Bach & First, 2018; Beckwith et al., 2014; Mulder, 2021; Tyrer et al., 2015).

Table 1.1 Specific personality disorders and characteristics in ICD-10

Specific PERSONALITY DISORDERS (ICD-10 code)	Characteristics
Paranoid (F60.0)	<ul style="list-style-type: none"> ▪ excessive sensitivity to setbacks and rebuffs ▪ suspiciousness, tendency to distort experience by misconstruing the neutral or friendly actions as hostile
Schizoid (F60.1)	<ul style="list-style-type: none"> ▪ few, if any, activities provide pleasure ▪ emotional coldness or flattened affectivity
Dissocial (F60.2)	<ul style="list-style-type: none"> ▪ callous unconcern for the feelings of others ▪ attitude of irresponsibility and disregard for social norms, rules, obligations
Emotionally unstable (F60.3)	<ul style="list-style-type: none"> ▪ emotional instability and lack of impulse control (common in two subtypes)
Impulsive type (F60.30)	<ul style="list-style-type: none"> ▪ outbursts of violence or threatening behaviour are common, particularly in response to criticism by others
Borderline type (F60.31)	<ul style="list-style-type: none"> ▪ own self-image, aims, and internal preferences (including sexual) are often unclear or disturbed ▪ liability to become involved in intense and unstable relationships, often leading to emotional crises
Histrionic (F60.4)	<ul style="list-style-type: none"> ▪ self-dramatization, theatricality, or exaggerated expression of emotions ▪ suggestibility, easily influenced by others or by circumstances
Anankastic (F60.5)	<ul style="list-style-type: none"> ▪ feelings of excessive doubt and caution ▪ preoccupation with details, rules, order, organization, or schedule
Anxious [avoidant] (F60.6)	<ul style="list-style-type: none"> ▪ persistent feelings of tension and apprehension ▪ belief that one is socially inept, personally unappealing, or inferior to others
Dependent (F60.7)	<ul style="list-style-type: none"> ▪ encouraging or allowing others to make the most of one's important life decisions ▪ subordination of own needs to others on whom is dependent, and compliance with their wishes
Other specific (F60.8)	<ul style="list-style-type: none"> ▪ a personality disorder that fits none of the above

1.1.2 Epidemiology of Personality disorder

1.1.2.1 Prevalence of personality disorder

The point prevalence of personality disorder (any personality disorder) in the general population was reported to range as low as 4.4% up to 13.4% in different studies conducted in Europe and US (Coid et al., 2006; Lenzenweger et al., 1997; Samuels, 2011; Samuels et al., 2002; Torgersen et al., 2001). Huang and her colleagues (2009) examined the prevalence of personality disorder in general population in 13 different countries in Africa, Americas, Asia, Middle East, and Western Europe, and reported that the prevalence ranged between 2.4% (Western Europe) and 7.9% (Columbia), with average prevalence of 6.1% (Huang et al., 2009)

Evidence suggests that people who seek help from health-care service are more likely to show higher prevalence of personality disorder than who are not. For example, in Great Britain, the point prevalence of personality disorder was 4.4% in a representative community sample, 24% in primary care attenders, and rose to 40%-52% and even up to 92% when examined in a secondary mental health care sample (Coid et al., 2006; Keown et al., 2002; Giles Newton-Howes et al., 2010; Ranger et al., 2004). Prevalence of personality disorder was found to range between 40% and 92% in Europe, 31% and 51% in the US among psychiatric outpatients in secondary mental health community setting (Beckwith et al., 2014)

In prison or forensic settings, the prevalence of personality disorder is particularly high; a systematic review of the prevalence of personality disorder in prison that examined 62 studies from 12 countries reported that one in two male and one in five female prisoners met diagnostic criteria for personality disorders (Fazel & Danesh, 2002).

Although some evidence suggest that the most common type of personality disorder in community samples was obsessive-compulsive personality disorder in the US, other studies also show different variance in regard to the most common type of personality disorder as in other countries (Samuels et al., 2002; Sansone & Sansone, 2011; Torgersen et al., 2001). When it comes to hospital admission, the majority (75%) of hospital admitted diagnoses in the UK were found to be borderline personality disorder (NHS England, 2010).

1.1.2.2 Sociodemographic correlates of personality disorder

In general, personality disorder is known to have an early onset. For example, DSM-IV-TR indicated onset of personality disorder may be traced back to early adulthood or even to childhood (DSM-IV-TR, 2000). Although there is no study that reported the typical age of onset of personality disorder, many number of studies reported age has an inverse relationship with the prevalence of personality

disorder. For instance, in a UK study on the general population, cluster B personality disorder (“antisocial”, “borderline”, “narcissistic” and “histrionic”) was more prevalent in younger age group (Coid et al., 2006), and another study conducted in a community setting in Australia reported people with personality disorder were more likely to be younger (H. J. Jackson & Burgess, 2002).

Other socio-demographics of people with personality disorder vary across studies. In a study with a community sample in Great Britain, men (unweighted prevalence 13.3%; weighted 5.4%) were more likely to have personality disorder compared to women (unweighted prevalence 8.7%; weighted 3.4%) (Coid et al., 2006). With regards to specific cluster or type of personality disorder, it is indicated that more women suffer from borderline personality disorder than men (DSM, 2000) whereas another study claims that borderline personality disorder is equally prevalent among men and women (Grant et al., 2008). In another study that assessed the relationship between demographic characteristics and each of the three DSM-IV personality disorder clusters, the overall prevalence of cluster A (“paranoid”, “schizoid”, and “schizotypal”) and B (“antisocial”, “borderline”, “histrionic” and “narcissistic”) was greater in men than women, and the prevalence of cluster A and C (“avoidant”, “dependent” and “obsessive-compulsive”) was higher in separated/widowed people, and highest in people who never married (Samuels et al., 2002). Age and education level were reported to be inversely related to cluster B, and unemployment positively related to borderline personality disorder (Lenzenweger et al., 2007). However, in the same study, sex, race/ethnicity, family income and marital status were found not to be associated with personality disorder, although there was a statistical trend for men to be more likely to have antisocial personality disorder than women.

In terms of race/ethnicity, a recent study suggested personality disorder in black and other ethnic minorities was at least as prevalent as in white people in the UK (Crawford et al., 2012). However, in a systematic review, black ethnicity group was found to have less prevalence of personality disorder than white group (McGilloway et al., 2010).

When it comes to living areas, such as residential neighbourhoods, there is some evidence that people living in more urban, central parts of cities are more likely to have personality disorder than those living in rural areas (Lee et al., 1990; Torgersen et al., 2001). However, these studies are either outdated or limited to a specific geographical area, and there seems to be a lack of studies examining the relationship between residential living conditions and personality disorder other than these. I have examined the available literature on this issue more thoroughly in a systematic review in Chapter 2.

1.1.2.3 Outcomes of personality disorder

There is substantially less research on the outcomes people experience following a diagnosis of personality disorder, and these studies reported mixed results. For example, In a Canadian study on young people (mean age 17.73 years old, sd 1.20) admitted in psychiatric hospitals, youth with personality disorder were more likely to stay longer and to be readmitted when compared with those without personality disorder diagnosis (Stewart et al., 2014). On the other hand, Zanarini and colleagues (2012) investigated time to remission and recovery in people with BPD and their comparison subjects with other personality disorder in their 16 year prospective study, and the result showed both groups achieved similarly high remissions rates with 78%-99% (BPD) and 97%-99% (other personality disorder s) at the time of 16 year follow-up assessment. The authors cautiously suggested the long-term outcome of personality disorder is not too pessimistic (Zanarini et al., 2012).

1.1.2.4 Environmental risk factors for personality disorder

Research suggests adverse childhood experiences contribute to the development of personality disorder. For example, the Children in the Community (CIC) study examined a sample of 800 youths over 20 years from their adolescence to adulthood, following 639 mothers and their children for nearly two decades. From this study, it was reported that people who experienced childhood abuse or neglect were more than 4 times as likely to be diagnosed with personality disorders as those who were not abused or neglected (Johnson et al., 1999), and children who experienced maternal verbal abuse during their childhood were more than three times as likely as those who did not experience verbal abuse to have borderline, narcissistic, obsessive-compulsive, and paranoid personality disorders during adolescence or early childhood (Johnson et al., 2001). Other longitudinal studies such as the Collaborative Longitudinal Personality disorders Study (CLPS) (Battle et al., 2004; Gunderson et al., 2000; Rettew et al., 2003; Yen et al., 2002), or The National Epidemiological Survey on Alcohol and Related Conditions (NESARC), a large comorbidity study which examined the alcohol consumption as well as other DSM-IV mental disorders in US population (Afifi et al., 2011) also reported similar findings that the risk of personality disorder were highly associated with childhood adversity.

1.1.2.5 Comorbidities of personality disorder

It has been reported that people with personality disorder are at increased risk for many psychiatric disorders. For instance, it was suggested that personality disorder often co-occurs with generalized anxiety disorder (comorbid proportion: 19.6%) (Grant et al., 2005) or predicts occurrence of later anxiety (OR: 2.27; 95% CI: 1.2-4.28) or depression (OR: 2.23; 95% CI: 1.24-4.01) (Moran et al., 2016).

With regards to psychosis, Newton-Howes and his colleagues reported in their systematic review that the comorbidity between personality disorder and psychosis is 39.5% (G Newton-Howes et al., 2008), and in patients using EIP services, the comorbidity between personality disorder and psychosis was reported to be 45% (Fornells-Ambrojo et al., 2015).

Evidence also suggests people with personality disorder are at increased risk of having substance abuse or alcohol dependence. The revised NESARC study reported that personality disorders were strongly associated with alcohol dependence, drug dependence, and nicotine dependence. The comorbidity rates between any personality disorder diagnosis and alcohol dependence, drug dependence, and nicotine dependence were 41.9%, 18.7%, and 48.2%, respectively (Trull et al., 2010).

People with personality disorder also are reported to have high mortality and suicidal behaviours. For example, in a UK study on life expectancy at birth and relative mortality, people with personality disorder were found to have shorter life expectancy with 19 years in men and 18 years in women, respectively, compared with general population (Lei-Yee Fok et al., 2012). Another study suggested that people with personality disorder were more likely to have high mortality rates partly due to increased rates of homicide or suicide (Hiroeh et al., 2001).

It has also been suggested that people with personality disorder are likely to have higher violent behaviour and criminal record compared with those without personality disorder. For example, a UK study conducted a survey of psychiatric morbidity among adults living in private household in England, Wales, and Scotland based on self-report, and found that the associations between any personality disorder and engagement in violent behaviours in the past five years were positive with an OR of 2.3, and the risk of violence increased even more in people with antisocial personality disorder with OR of 6.12 (Coid et al., 2006).

1.2 Social deprivation and personality disorder

1.2.1 Definition of social deprivation

Although there is no definite consensus on how social deprivation should be defined and measured in epidemiology, one definition of social deprivation introduced in a study by Ford and Highfield was 'the effect or consequences of lack of income and resources such as adequate living condition and participation in social activities' (Ford & Highfield, 2016). Different studies on social deprivation explore social deprivation in different ways, and these include individual socioeconomic status, neighbourhood-level deprivation, and social isolation. Among these, individual socioeconomic status is the mostly commonly explored form of social deprivation in studies, and SES and social class are often used interchangeably (Williams & Collins, 1995). SES is usually measured by education,

income, occupation or a combination of these indicators (Winkleby et al., 1992). In spite of varieties in their manifestation, forms of social deprivation have in common that they aim to highlight disadvantaged individuals or groups when they discuss social deprivation (Dowswell & Towner, 2002).

1.2.2 Social deprivation and mental disorders

People with lower socioeconomic status or living in socially deprived areas are more likely to be exposed to less favourable economic and social conditions, and less access to buffer and support which can mitigate the potential effect of economic disadvantage on mental health (Campion et al., 2013; World Health Organization, 2014). Accordingly, the inverse relationship between mental disorder and social deprivation has been recognised in many studies, mostly on common mental disorders (Lorant et al., 2014) (Andersen et al., 2009) or psychosis (Kirkbride et al., 2014) (Croudace et al., 2000). In the 2014 edition of the Adult Psychiatric Morbidity Survey (APMS) in the UK, the majority of recipients of out-of-work benefits were reported to have high levels of psychiatric comorbidities in addition to their poor physical health (McManus et al., 2014). Children who were living in wealthier areas or who were from a family with higher household income had lower prevalence of mental disorders compared with those who were living in more deprived area or from a family with lower household income (Green et al., 2009). This association can be different between men and women. For example, a UK study with a large sample reported that women living in the most deprived neighbourhoods were more likely to develop anxiety compared to those living in less deprived neighbourhoods whereas there was no association among men (Remes et al., 2017). Another cohort study that used the same sample also reported that men living in the most deprived areas were more likely to have depression than those living in less deprived areas, while there was no association between depression and area-level deprivation among women (Remes et al., 2019).

1.2.3 Social deprivation and personality disorder

Studies that examined the association between personality disorder and social deprivation have reported mixed results. For example, a number of studies reported personality disorder was found not to be associated with education, income, or SES (Greve, 2013; Raza et al., 2014; Swartz et al., 1990; Tomko et al., 2014). Also, neighbourhood-level deprivation was neither associated with first admission nor re-admission rates of personality disorder (Malmström et al., 1999; Peen et al., 2001). On the other hand, some studies have reported an association between social deprivation and personality disorder. Risk of personality disorder was found to be associated with education, income level and SES (Goldstein et al., 2017; Hickling & Walcott, 2013; Saraiva Leao et al., 2005; Soloff et al., 2012) (*See Chapter 2 for details*).

Not all the different indicators of SES show the same effects on personality disorder, even in the same study. For instance, people from lower income brackets were more likely to have schizotypal personality disorder, whereas there was no relationship between schizotypal personality disorder and education level (Pulay et al., 2009). Also, in a study conducted cross-nationally in 13 different countries, education was negatively associated with prevalence of personality disorder while income was not associated with personality disorder (Huang et al., 2009)

Although there has been growing recognition of the association between personality disorder and social deprivation, a gap still exists, as many studies only included personality disorder as one sub-category of an overall mental disorder variable or as an accompanying comorbidity while they were examining other mental disorders rather than focusing directly on personality disorder in relation to social deprivation. The majority of earlier studies focused more on the association between individual SES and personality disorder, while less attention has been paid to the effect of neighbourhood level deprivation in relation to personality disorder. Moreover, most studies which examined neighbourhood-level deprivation tend to be ecological studies. Ecological studies are not free from the limitation that the findings from the population level do not necessarily apply to individuals, thus making it difficult to make causal inferences. The impact of neighbourhood-level deprivation on personality disorder may differ from that of individual SES on personality disorder. Also, there is a great disparity in studies in this field, with a high proportion of them looking into the risk of developing personality disorder, and fewer studies exploring the subsequent outcomes of personality disorder. Also, there are few epidemiological studies that have used clinical data for investigating risks or outcomes of personality disorder such as mortality or admission to psychiatric care. Hence, there is a need for a thorough examination of how neighbourhood-level deprivation is associated with personality disorder in terms of both risk of receiving a personality disorder diagnosis and downstream outcomes following the onset of personality disorder using data obtained from clinical settings.

1.2.4 Social deprivation and mental health service use

As discussed earlier, it is well established that deprivation is closely related to poorer mental health. This may mean that deprivation increases the need and demand for mental health services, and those who are socially deprived would require greater use of healthcare service than those with less disadvantage. Previous studies report varying results. For example, a recent UK study examined geographical variation in mental health service use across England and found that greater deprivation was associated with a higher number of people being in contact with mental health services (Maconick et al., 2021). This study also found that people from black and minority ethnic groups and

those living in more densely populated areas had less contact with mental health services. However, there is also evidence suggesting that people with greater levels of deprivation may be less likely to access and receive treatment. This is in keeping with the inverse care law whereby “the availability of good medical care tends to vary inversely with the need for it in the population served” (Hart, 1971). For example, a UK study (Delgadillo et al., 2016) analysed data on 293,400 referrals and clinical outcomes for over 110,000 patients who accessed the Improving Access to Psychological Therapies (IAPT) across England, and found that higher referral rates were associated with greater deprivation in local areas, which may imply there is a higher demand for the psychological care in those areas. However, no evidence of an association between socioeconomic deprivation and case-load sizes was observed in this study. The authors suggested that the possible reasons behind this paradox may be that deprivation may have adversely influenced the likelihood of accessing the therapy after a referral and that healthcare resources in poorer areas could be insufficient.

People with personality disorders are high users of health care resources, in particular psychiatric services, and ambulance and emergency services (Chiesa et al., 2002). In particular, it has been shown that people with borderline personality disorder have greater use of treatment compared with those with depression and other personality disorder (Bender et al., 2001). However, there is a lack of research on how social deprivation is associated with the help-seeking behaviours and use of mental health services among people with personality disorder. These are factors which could affect rates of diagnosis of personality disorder in clinical settings.

1.3 Population density and personality disorder

1.3.1 Population density and mental health

Along with social deprivation, there has been increased interest in the role of urbanicity as an area of social environment in mental health research (Heinz et al., 2013). Urbanicity is defined as “the impact of living in urban areas at a given time” and is often measured with population density among many other measures of urbanicity such as population size, access to markets, and transportation (Allender et al., 2011; Cyril et al., 2013; Dahly & Adair, 2007; Jones-Smith & Popkin, 2010; Monda et al., 2007). Evidence suggested that urbanicity has a negative impact on mental health, particularly in the incidence of psychosis. A plethora of studies reported that urbanicity (measured by population density) is associated with elevated rates of schizophrenia and other non-affective psychoses (Allardyce et al., 2001; Kelly et al., 2010; March et al., 2008; McGrath et al., 2004; Sundquist et al., 2004). Various individual and area-level risk factors were suggested to account for the high rates of incidence of psychosis in those living in inner-urban areas (Heinz et al., 2013). For example, individual-level factors included neurodevelopmental factors such as obstetric

complications, season of birth, and cannabis use, and physical environment such as traffic density and air pollution, and lastly markers of social adversity during childhood and adulthood. Area-level factors included social deprivation, and social capital such as social mobility, social cohesion, social disorganization and social fragmentation. Interaction between individual and area-level factors, in particular, individual-level ethnicity and area-level ethnicity density was also suggested.

1.3.2 Population density and personality disorder

As with social deprivation, there is not much evidence for the effect of urbanicity/population density on personality disorder. A population-based cohort study in Denmark found birth in urban environment was associated with higher risk of psychiatric disorders including personality disorder (IRR 1.41; 95% CI: 1.37-1.44) compared with those born in rural areas (Vassos et al., 2016). The authors suggested urban-rural difference in service utilisation, diet, stress, family-level factors, fear of crime and social participation as potential explanations for this association. Further, a small number of studies explored whether population density is associated with antisocial behaviours among adolescents and reported mixed results. For example, a US study used a longitudinal data to examine how neighbourhood adversity influence juvenile antisocial behaviour in urban areas and found that mothers living in areas with greater population density did not report greater conduct problems across 4-13 years of age in their children whereas youth living in more densely populated areas self-reported greater involvement in delinquent behaviour across 10-17 years (Harden et al., 2009). Similarly, Wichstrøm and colleagues (Wichstrøm et al., 1996) reported that the rate of conduct problems were twice among adolescent living in Oslo compared with those living in less densely populated areas in Norway. In contrast, in the Great Smoky Mountains Study of youth (Costello et al., 1996) which explored the relationship between development of psychiatric disorder and use of mental health services in children and adolescents in the US found that there was no difference of conduct disorder between rural and urban children. With lack of evidence for the effect of urbanicity on personality disorder, the well-established association between urbanicity, often indexed by population density, and psychosis may provide an underpinning reasoning for exploring the association between population density and personality disorder.

1.4 Overarching aims and research questions of this thesis

The overview above indicates there is paucity of epidemiological evidence on personality disorder in relation to neighbourhood-level deprivation, especially compared with our understanding of the epidemiology of other mental disorders such as psychosis, depression and anxiety disorders. Additionally, as described in earlier sections in this chapter, there is a lot of variation in the estimates of personality disorder prevalence among the literature, depending on settings where studies were

conducted, and there is little evidence regarding prevalence of personality disorder with data obtained in clinical settings. Thus, it is important to determine the prevalence of personality disorder in different cohorts, and then to determine whether this prevalence is associated with individual level sociodemographic factors as well as examining its association to neighbourhood-level deprivation.

In the following chapter (Chapter 2), I systematically reviewed literatures on personality disorder and social deprivation. Then I explored the prevalence and predictors of receiving a personality disorder diagnosis in early intervention in psychosis (EIP) services in rural England (Chapter 3). In the next chapter (Chapter 4), I tested the validity of a natural language processing (NLP) application within clinical data in a large inner city NHS Foundation Trust in North London. In Chapter 5, I examined the prevalence of personality disorder and its association with neighbourhood-level deprivation within this setting (Chapter 5). Then, in the following chapter (Chapter 6), I investigated the relationship between neighbourhood-level deprivation and two subsequent outcomes for people with personality disorder, namely mortality and the first acute psychiatric admission after personality disorder diagnosis. Finally, in Chapter 7&8, I replicated the studies that I carried out in North London (Chapter 5 & 6) using clinical data obtained from a different large inner city NHS Foundation Trust in South London.

In this thesis, I carried out seven different studies in order to fulfil these aims, including one systematic review (Chapter 2), one validation study (Chapter 4), and secondary data analyses using clinical data from deidentified electronic health records (Chapters 3, 5-8). The overall aims of the thesis were as follows:

1. To systematically review existing literature that reported the association between personality disorder and social deprivation
2. To explore prevalence and sociodemographic correlates of receiving a personality disorder diagnosis in EIP services
3. To examine prevalence of personality disorder s and its association with neighbourhood-level deprivation in secondary mental health services
4. To examine whether neighbourhood-level deprivation is associated with outcomes of personality disorders in secondary mental health services

Hence, the research questions and corresponding hypotheses in each chapter were as follows:

- **Chapter 2. Personality disorder and social deprivation – a systematic review**

1. Is there an association between risk of personality disorder and social deprivation, i.e., individual socioeconomic-status (education attainment, income level, and social class), neighbourhood-level deprivation and social isolation?
 2. Is there an association between outcomes of personality disorder and social deprivation, i.e., individual socioeconomic-status, neighbourhood-level deprivation and social isolation?
- **Chapter 3 Personality disorder in an EIP cohort in East Anglia area**
 1. What is the prevalence of comorbid personality disorder within EIP setting?
(Hypothesis 1(H1): The prevalence of personality disorder within EIP setting will be as high as 30%)
 2. Do the clinical and sociodemographic characteristics differ between people with and without comorbid personality disorder diagnoses within EIP setting?
(H2: The prevalence of comorbid personality disorder within EIP setting will increase with younger age at first contact, female sex, white British ethnicity, single or divorced marital status, and lower socioeconomic status (SES))
 3. Does living in more deprived or densely populated areas increase the prevalence of comorbid personality disorder in EIP setting?
(H3: The prevalence of comorbid personality disorder within EIP setting will be elevated when people live in more deprived areas or densely populated areas)
 - **Chapter 4. A preliminary work for identifying population at risk and a personality disorder cohort in Camden and Islington NHS Foundation Trust (C&I) using the Clinical Record Interactive Search (CRIS) data**
 1. Is the diagnosis of personality disorders gathered from open text-field via NLP in C&I CRIS valid when compared with the actual patient record?
 - **Chapter 5. Prevalence of personality disorder and its association with neighbourhood-level deprivation in secondary mental health services in North London**
 1. Does the frequency of personality disorder in clinical practice differ from research-based prevalence of personality disorder in general population?
(H1: The frequency of personality disorder in secondary mental health care is likely to be lower than previously reported personality disorder prevalence among general population).
 2. Does the frequency of personality disorder increase when people live in more deprived area?
(H2: The frequency of personality disorder will be higher in people who live in more deprived areas, based on recent findings by Walsh and colleagues)

3. Does the frequency of personality disorder increase when people live in more densely populated area?

(H3: The frequency of personality disorder will be higher in people who live in more densely populated areas)

▪ **Chapter 6. Neighbourhood-level deprivation and outcomes of personality disorder in secondary mental health services in North London**

1. Do people with personality disorder diagnosis living in more deprived neighbourhoods have a higher mortality rate?

(H1: People with personality disorder diagnosis living in more deprived neighbourhoods will have higher mortality rates compared to those who live in more affluent areas)

2. Do people with personality disorder diagnosis living in more densely populated areas have a higher mortality rate?

(H2: People with personality disorder diagnosis living in more densely populated areas will have higher mortality rates compared to those who live in less densely populated areas)

3. Do people with personality disorder diagnosis living in more deprived neighbourhoods have higher first admission rate to acute MH services after personality disorder diagnosis?

(H3: People with personality disorder diagnosis living in more deprived neighbourhoods will have higher rate of first admission after personality disorder diagnosis compared to those who live in more affluent areas)

4. Do people with personality disorder diagnosis living in more densely populated areas have higher first admission rate after personality disorder diagnosis?

(H4: People with personality disorder diagnosis living in more densely populated areas will have a higher first admission rate after personality disorder diagnosis compared to those who live in less densely populated areas)

▪ **Chapter 7. Prevalence of personality disorder and its association with neighbourhood-level deprivation in secondary mental health services in South London**

1. Does the frequency of personality disorder in clinical practice differ from research-based prevalence of personality disorder in general population?

(H1: The prevalence of personality disorder in a secondary mental health care will be lower than previously reported in the general population)

2. Does risk of having a personality disorder diagnosis increase when people live in more deprived area?

(H2: The frequency of personality disorder will be higher in people who live in more deprived areas).

3. Does the risk of having a record of a diagnosis of personality disorder increase when people live in more densely populated areas?

(H3: The frequency of personality disorder will be higher in people who live in more densely populated areas compared with sparsely populated areas).

▪ **Chapter 8. Neighbourhood-level deprivation and outcomes of personality disorder in secondary mental health services in South London**

1. Is there an association between neighbourhood-level deprivation and mortality for people diagnosed with personality disorder?

(H1: People with personality disorder who live in more deprived areas will have higher mortality rates compared with those who live in more affluent areas)

2. Is there an association between population density and mortality for people diagnosed with personality disorder?

(H2: People with personality disorder who live in more deprived areas will have higher mortality rates compared with those who live in more affluent areas)

3. Is there an association between neighbourhood-level deprivation and first psychiatric admission after a personality disorder diagnosis?

(H3: People with personality disorder who live in more densely populated areas will have higher readmission rates than those who live in more sparsely populated areas)

4. Is there an association between population density and subsequent psychiatric admission after a personality disorder diagnosis?

(H4: People with personality disorder who live in more densely populated areas will have higher admission rates than those who live in more sparsely populated areas)

Chapter 2 Personality disorder and social deprivation – a systematic review

2.1 Introduction

There have been a number of systematic reviews investigating the association between mental disorders and social deprivation, both at individual level or neighbourhood level (Cairns et al., 2017; Fryers et al., 2003; Karriker-Jaffe, 2011; Lund et al., 2010; O'Donoghue et al., 2016; Patel et al., 2018; Ribeiro et al., 2017; R. Richardson et al., 2015; Tibber et al., 2021). However, existing systematic reviews are often restricted in their inclusion in mental illnesses focusing on narrow range of illness such as common mental disorders (CMD), psychotic disorder, depression, self-harm, and substance use (Cairns et al., 2017; Fryers et al., 2003; Karriker-Jaffe, 2011; Lund et al., 2010; Patel et al., 2018; R. Richardson et al., 2015). Further, the focus of most of these systematic reviews has been primarily on the risk of mental illness rather than prognosis or downstream outcomes of mental illness. No systematic review published to date has sought to specifically examine the relationship between personality disorder and social deprivation. Although one systematic review investigated the risk factors associated with borderline personality disorder (BPD) (Stepp et al., 2016), this review not only limited its search to BPD, but also did not specifically consider 'social deprivation'. In this review, the authors found 39 studies that addressed a wide range of risk factors for subsequent BPD and four of them reported low socioeconomic status (SES) increased risk for subsequent BPD. While there is a paucity of systematic reviews on the relationship between personality disorder and social deprivation, epidemiological studies that looked into the association between personality disorder and social deprivation are less rare., e.g. (Walsh et al., 2013). However, these studies vary in terms of study population, type of social deprivation, type of personality disorder to name a few which make it difficult to draw valid insights or solid conclusions without a systematic review of the literature. Thus, systematically reviewing all relevant studies through comprehensive search is essential to improve our understanding of what is known so far about personality disorder and its relationship to social deprivation, and also to discuss implications for future research. Therefore, the aim of this review was to synthesize available evidence as to whether there was an association between frequency or outcomes in personality disorder and social deprivation as reported in previously published studies. As stated earlier, there are varied forms of social deprivation explored in different studies, and for this review, neighbourhood-level deprivation, individual SES including education, income and social class, and lastly social isolation were examined in relation to either frequency or outcomes of personality disorder.

I pursued the following research questions:

Frequency of personality disorder

- Is there association between frequency of personality disorder and individual socioeconomic status (education attainment, income level, and social class)?
- Is there association between frequency of personality disorder and neighbourhood level deprivation?
- Is there association between frequency of personality disorder and social isolation?

Outcomes of personality disorder

- Is there association between outcomes of personality disorder and individual SES?
- Is there association between outcomes of personality disorder and neighbourhood level deprivation?
- Is there association between outcomes of personality disorder and social isolation?

2.2 Method

My review protocol was registered with the international prospective register of systematic reviews (PROSPERO - registration number: CRD42017075306, https://www.crd.york.ac.uk/prospero/display_record.php?RecordID=75306). The protocol was designed to comply with the guidelines for the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA), and no amendments were made after registration.

Inclusion criteria - Studies were required to have addressed the association between frequency of developing personality disorder or prognosis in the outcomes of personality disorder and social deprivation using quantitative methods and measures. I searched for papers published from 1980 onwards, when the Diagnostic and Statistical Manual III (DSM-III) was introduced with its standardized definitions of symptom-based, categorical diseases. Neither language nor setting restrictions were applied.

Types of study: My review considered any type of observational studies for inclusion such as cohort studies, cross-sectional studies, ecological studies and case-control studies.

Participants: Participants in included studies were adolescents or adults with a personality disorder diagnosis with any recognised diagnostic criteria or a validated structured clinical interview.

Outcomes and exposure: The primary outcome in this systematic review was frequency of developing personality disorder, and the secondary outcome was prognosis of outcomes in people with personality disorder. Frequency of developing personality disorder included prevalence, incidence or odds, and there was no restriction of subtypes of personality disorder to be considered

if they belonged to either DSM or ICD classification system. I defined the outcomes included in this review as relapse, admission, functioning, physical health, quality of life, recovery, activities of daily living, disability, substance misuse, self-harm, suicide attempt, other mental health, or mortality. These outcomes were investigated in relation to social deprivation exposures which include neighbourhood poverty, socioeconomic factors (SES)/social class, and social isolation. Education and income were also included as potential measure of SES.

Search strategy and selection criteria - I conducted the search on the four electronic databases including Medline, EMBASE, PsycINFO, and Web of science from 1 January 1980 until 23 August 2017. An additional search was conducted for papers between 2018 and 2021 as shown in **Figure 2.1**. I conducted the search using both medical subject headings (MeSH terms) and key words within title and abstract. Search terms were adapted as required for different databases (For details, see Appendix 1). Searches were conducted covering three main areas: “personality disorder”, “risk (onset, prevalence, and incidence) or prognosis”, and “social deprivation”. Results from each key word within personality disorder and social deprivation were combined with ‘AND’ and ‘OR’. I screened potentially eligible studies through reading title and abstracts, and full texts of screened studies through title and abstract reading were explored for final decision for inclusion. Where two or more articles referred to the same study population by the same first author, the study providing the most robust or relevant reporting of the systematic review’s *a priori* primary outcome was selected. Although there was no restriction of language in the initial search, I decided not to consider papers published in other languages rather than English in the final stage of screening for current review due to language barrier and time constraints.

Data collections and extraction – I solely selected the papers and extracted the contained information from the studies. All important decisions were made through discussion with members of supervisory team, and I consulted my supervisors about studies with which I was ‘not sure’ whether to be included or not. I developed a structured template to record characteristics and results of each study included in this review. The data extracted were study title, author (s), published year, study setting/country, study type, case sample size, study population, personality disorder diagnosis/measure, type of social deprivation, frequency of personality disorder and prognosis in people with personality disorder in relation to social deprivation.

Quality assessment – I assessed the study quality according to the Newcastle Ottawa Scale (NOS), a widely used tool by Wells and colleagues (Wells et al., 2012) for assessing the quality of observational studies. This scale asks 9 items in 3 domains: selection of study group, comparability of groups, and validity of exposure or outcome (citation) (see Appendix 2). A maximum of one point is

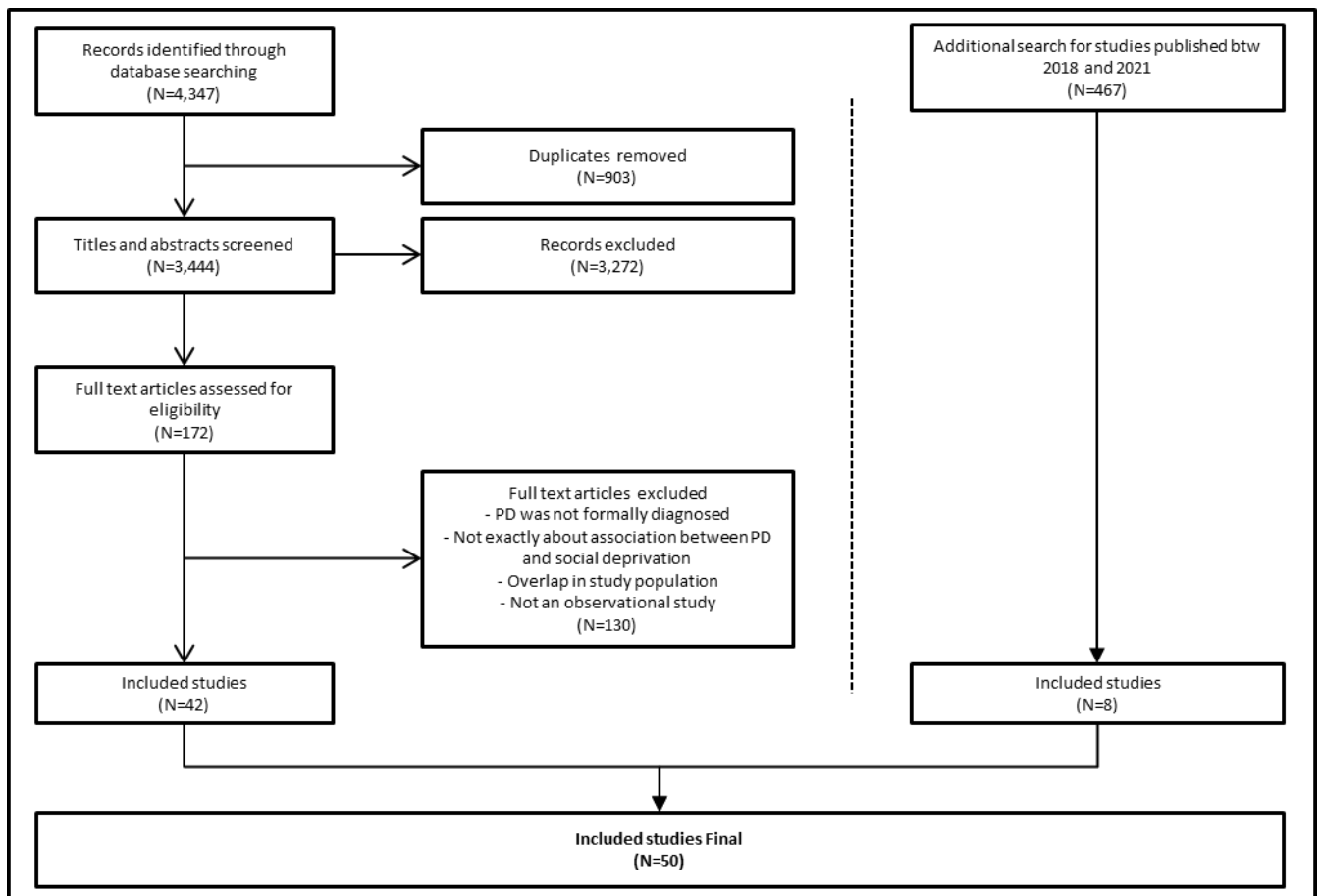
assigned for each item, and thus the NOS score ranges from zero to nine. Uncertainty about study quality was resolved through discussion among research team members.

2.3 Results

2.3.1 Overview of included studies

In all, I retrieved 4,347 papers in the initial search including 908 duplicates which were removed by electronic reference management software. Review of title and abstracts alone excluded 3,272 papers and 172 papers were selected for full text screening. The number of non-English studies excluded at the final stage was twelve, and eventually, 42 studies were included in the review (See **Table 2.2** for details). A total of 467 papers were retrieved for this period and after screening, eight additional studies were added to the final list.

Figure 2.1 Study search flow diagram



Of these studies, 23 (46%) studies were conducted in the US, four (8%) in the UK, three (6%) in Finland, two in Brazil, Canada, China, Denmark, Jamaica and Sweden and one each in Iran, Israel, Netherlands, New Zealand, Norway, Switzerland, and Turkey. The remaining study was conducted across 13 countries (Huang et al., 2009). With regards to the size of the case sample, eight (16%)

studies had a case sample which exceeded 1,000, fifteen (30%) studies between 100 and 1,000, and sixteen (32%) studies with a case less than 100. The remaining eleven (22%) studies did not specify the exact case sample size.

In terms of study design, there were twenty-seven (54%) cross-sectional studies, fifteen (30%) cohort studies, four (8%) case-control studies, and four (8%) ecological studies. Of these studies, 25 (50%) studies were sampled from the general population, eighteen (36%) studies from clinical settings, six (12%) studies used a mixed sample of general population and clinical samples, and one was from a military setting (Sayar et al., 2001).

Of the 50 included studies, 40 (80%) studies primarily examined the frequency of personality disorder, and ten (20%) studies examined the outcomes of personality disorder, in relation to social deprivation. The frequency of personality disorder was presented as prevalence or incidence, and outcomes were para-suicidal behaviour, suicide attempts, personality disorder symptoms, psychosocial outcomes, admission and re-admission rate or recovery in people with personality disorder.

As to the type of personality disorder, there were 24 (48%) studies on any type of personality disorder, fourteen (28%) studies on borderline personality disorder, seven (14%) studies on antisocial personality disorder, four (8%) studies on schizotypal personality disorder, two (4%) studies on paranoid personality disorder, and one (2%) each on dependent/avoidant/obsessive-compulsive personality disorder. There were two studies (McGurk et al., 2013; Walsh et al., 2013) which examined two or more specific types of personality disorder together.

A variety of methods were employed to assess personality disorder (See **Table 2.1** for details).

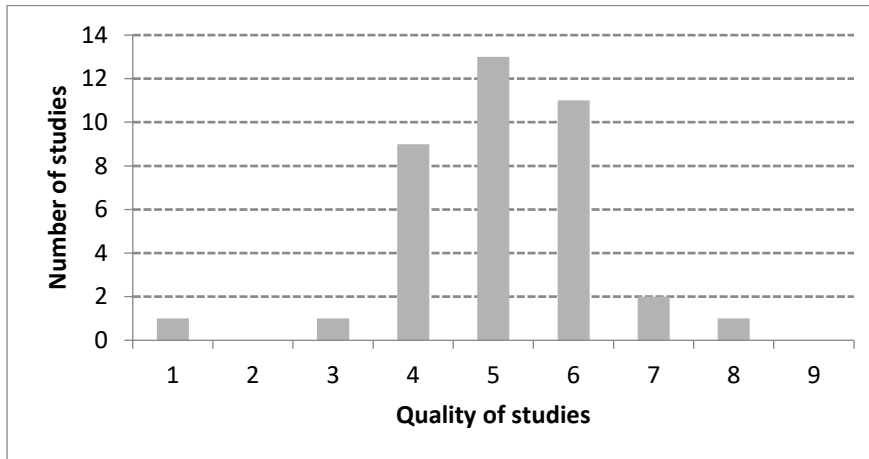
Table 2.1 Diagnostic measures of personality disorders used in the included studies

diagnostic measures	N (%) of studies
Structured Clinical Interview for DSM-III-R Personality disorders (SCID-II) or its translated versions	6 (12%)
ICD-9	5 (10%)
DSM-IV, or its translated versions	4 (8%)
DSM-III	3 (6%)
Alcohol Use Disorder and Associated Disabilities Interview Schedule-DSM-IV Version (AUDADIS-IV)	3 (6%)
Diagnostic Interview Schedule (DIS)	3 (6%)
ICD-10	2 (4%)
Structured Interview for DSM-IV Personality (SIDP-IV).	2 (4%)
Alcohol Use Disorder and Associated Disabilities Interview Schedule-DSM-IV Version (AUDADIS-V)	2 (4%)
ICD-9 & ICD-10	2 (4%)
International Personality disorder Examination (IPDE)	2 (4%)
IPDE, Diagnostic Interview for Borderline (DIB) & Revised Diagnostic Interview for Borderlines (DIB-R)	2 (4%)
Personality disorder Examination (PDE)	1 (2%)
Revised Diagnostic Interview for Borderlines (DIB-R)	1 (2%)
IPDE & Diagnostic Interview for Borderline (DIB)	1 (2%)
DSM-IV & Revised Diagnostic Interview for Borderlines (DIB-R)	1 (2%)
ICD-10 & Personality Assessment Schedule (PAS)	1 (2%)
Schedule for Affective Disorders and Schizophrenia (SADS)	1 (2%)
Assessment for DSM-IV Personality disorders questionnaire (ADP-IV)	1 (2%)
Personality Diagnostic Questionnaire -4+ (PDQ-4+)	1 (2%)
Standardized Assessment of Personality (SAP)	1 (2%)
Resident Assessment Instrument-Mental Health (RAI-MH)	1 (2%)
Jamaica Personality disorder Inventory (JPDI).	1 (2%)
ICD-10 & DSM-IV	1 (2%)
SCID, DIB-R & Diagnostic Interview for DSM-III-R Personality disorders (DIPD)	1 (2%)
ICD-8 & ICD-10	1 (2%)
Total	50 (100%)

With regard to the type of social deprivation measured in each study, there were 16 (32%) studies on individual SES/family SES, 24 (48%) studies on education, eight (16%) studies on neighbourhood-level deprivation, 16 (32%) studies on income/family income, three (6%) studies on social isolation, and of these, 15 (30%) studies examined two or more type of social deprivation. As stated earlier in Chapter 1, SES and social class are often used interchangeably in the literature, and thus, social class has been grouped together with SES in the present review.

With respect to the quality of studies, the mean quality was 5.08 out of 9 with a standard deviation of 1.24 (**Figure 2.2**). As there is currently no validated quality assessment tool for ecological studies, and the number of ecological studies included in this review was small (N=4), I did not conduct a quality assessment on these studies for this review (*See Appendix 2 for details*).

Figure 2.2 Quality of studies included



2.3.2 Frequency of personality disorder

2.3.2.1 Individual socioeconomic-status and personality disorder

In all, 40 studies examined the relationship between individual socioeconomic-status (SES) and frequency of personality disorder. Out of these studies, 17 were conducted in the US, two in Brazil, Canada, China, Denmark, Finland, Jamaica, Sweden and UK and one each in Iran, Israel, New Zealand, Norway, Switzerland, and Turkey. The remaining study was conducted across 13 countries. Fifteen studies reported on SES, 22 and 13 studies looked into education and income, respectively, and 15 studies reported more than one indicator of SES or together with other forms of social deprivation, such as neighbourhood-level deprivation or social isolation. For example, in a US study on antisocial personality disorder and antisocial behaviour among the general population which used data from the 2012-2013 National Epidemiologic Survey on Alcohol (Goldstein et al., 2017), the prevalence of antisocial personality disorder was found to be inversely associated with education and family income level.

Out of 15 studies reported on SES, 12 studies reported lower SES was associated with increased risk (incidence or prevalence) of personality disorder, and three studies reported there was not an association. Out of 22 studies on education, 15 studies reported lower level of education was associated with higher frequency of personality disorder and seven studies reported there was none. Out of 13 studies on income, seven studies reported there was an association between lower income and higher frequency of personality disorder, one study reported higher family income is

associated with increased frequency of personality disorder, and five studies reported there was no association.

2.3.2.2 *Neighbourhood level poverty and personality disorder*

Four studies investigated the association between frequency of personality disorder and neighbourhood disadvantage. Out of these studies, there were two cohort studies, one cross-sectional study, and one ecological study. Only one study examined a specific type of personality disorder (antisocial personality disorder) and the remaining three studies examined personality disorder in general. Each study was conducted in in Brazil, New Zealand, Sweden and US.

Overall, only one study reported there was an association between neighbourhood-level poverty and the frequency of personality disorder. For example, Newton-Howes and his colleagues (2021) reported rates of personality pathology increased with neighbourhood social deprivation, but only descriptive statistics (number and percentage) were provided (Giles Newton-Howes et al., 2021).

In contrast to this study, the three studies did not find an association between neighbourhood disadvantage and frequency of personality disorder. In a cross-sectional study conducted in Brazil (Santana et al., 2018), the authors found that living in socially-deprived neighbourhoods did not have any impact on personality pathology. A US cohort study reported that neither neighbourhood economic disadvantage during childhood nor longitudinal change neighbourhood affluence were predictors of adolescent antisocial personality disorder (Buu et al., 2009). Lastly, Malmström and colleagues (1999) examined the ecological relationship between psychiatric admissions and deprivation (using the "Care Need Index" (CNI)) in Malmö, Sweden, and found no significant association between first admission for personality disorder and CNI index (Malmström et al., 1999).

2.3.2.3 *Social isolation and personality disorder*

Two studies examined the relationship between social isolation and frequency of personality disorder, showing mixed results. Smith and Hirdes (2009) reported that risk of personality disorder were associated with higher odds for social isolation compared with those without personality disorder among elderly psychiatric patients (Smith & Hirdes, 2009). On the other hand, Javaras and colleagues (2017) reported there were no differences between community-based participants with and without BPD on social isolation. However, when they compared clinically-based and community-based participants with BPD, they found participants differed on social isolation, with clinically-based participants were more likely to spend more than half of their free time alone (Javaras et al., 2017).

2.3.3 Outcomes of personality disorder

Out of 50 studies included in my review, ten studies (Harrison et al., 1995; Koppel & McGuffin, 1999; Leppanen et al., 2016; Niesten et al., 2016; Paul H. & Laurel, 2012; Peen et al., 2001; Soloff, 2021; Soloff & Chiappetta, 2019; Walsh et al., 2013; Zanarini et al., 2018) investigated outcomes of personality disorder in relation to social deprivation. They included one study on SES (Soloff et al., 2012), one on social isolation (Leppanen et al., 2016), three studies on income (Niesten et al., 2016; Soloff, 2021; Soloff & Chiappetta, 2019), two on education (Soloff et al., 2012; Zanarini et al., 2018) and four on neighbourhood-level deprivation (Harrison et al., 1995; Koppel & McGuffin, 1999; Peen et al., 2001; Walsh et al., 2013). One study (Soloff et al., 2012) reported on more than one form of social deprivation. In a US cohort study with 10 years follow-up, the authors found people with BPD were four times more likely to be in lower income groups compared with an axis-II comparison subjects (Niesten et al., 2016). In another recent US cohort study, the authors reported that psychosocial outcomes were worse for people with BPD living in households with incomes at or below the poverty level (Soloff, 2021). Another US cohort study found people with BPD attempting suicide more likely to live in households with incomes below the federal poverty limit compared with those without suicide attempt after 10-year follow-up (Soloff & Chiappetta, 2019). In a cohort study carried out in the US with 20 years follow-up, the authors reported having a good vocational record (defined as working or going to school competently, consistently and on a full-time basis) was associated with excellent recovery of BPD (Global Assessment of Functioning score (GAF) of 71 or higher) (Zanarini et al., 2018). Leppanen and colleagues (2016) reported BPD patients with parasuicidal behaviour had higher mean scores (50.9, SD 39.8) in social isolation/alienation compared with the BPD patients without parasuicidal behaviour (28.7, SD 31.7) (Leppanen et al., 2016). Soloff and Chiappetta (2012) found that in people with BPD, people who had history of suicidal attempt differed from non-attempters in having lower SES and less education. Their risk of suicidal attempt was also increased by low SES over time at 6 years follow-up (Soloff et al., 2012).

Four studies including one cross-sectional study (Walsh et al., 2013) and three ecological studies (Harrison et al., 1995; Koppel & McGuffin, 1999; Peen et al., 2001) examined the association between neighbourhood-level deprivation and outcomes of personality disorder and reported mixed results. Walsh and colleagues (2013) reported that living in a lower socioeconomic-status neighbourhood was associated with more personality disorder symptoms among people diagnosed with personality disorder. In an ecological study, Peen and Dekker (2001) compared the first admission rates and re-admission rates for personality disorder with area-level deprivation in 79 Amsterdam neighbourhoods, and found no differences between area deprivation level and first admission rates as well as re-admission for personality disorder (Peen et al., 2001). Koppel and

McGuffin (1999) reported socioeconomic deprivation at the geographical level was inversely correlated with psychiatric admission for personality disorder (Koppel & McGuffin, 1999). Similarly, Harrison and colleagues (1995) investigated the correlation between psychiatric admission rates and neighbourhood disadvantage using a measure called “Underprivileged Area” score (UPA) in 19 districts in the North West Region of Britain; they reported no statistically significant correlation between admission rates for personality disorder and UPA (Harrison et al., 1995).

2.3.4 Type of personality disorder

There was considerable heterogeneity in the type of personality disorder studied in papers included in this review. Out of 50 studies, 24 (48%) studies examined any type of personality disorder diagnosis in relation to social deprivation. Among these, fourteen (28%) studies reported an inverse association between those with any type of personality disorder and social deprivation, seven (14%) studies found no association, and three (6%) studies reported mixed results. Among the fourteen (28%) studies on borderline personality disorder, 11 studies found an inverse association between those with borderline personality disorder and three studies report there was no association. Out of seven (14%) studies on antisocial personality disorder, six studies reported an inverse association while one study found no association. Among the four studies on schizotypal personality disorder, there were three studies an inverse association and one study with mixed results. Out of the two studies on paranoid personality disorder, one study reported an inverse association while the other study reported no association. Among the remaining two studies on dependent, avoidant/obsessive-compulsive personality disorder found a mixed association, and an inverse association, respectively.

2.4 Discussion

2.4.1 Summary of findings

The aim of this review was to present a systematic assessment of literature on any association between social deprivation and frequency of personality disorder, as well as the prognosis in people with personality disorder. On the basis of my inclusion and exclusion criteria, 50 studies were considered for inclusion. In all, I found 24 studies reporting there was an inverse association between social deprivation and frequency of personality disorder, one study with a positive association, and 16 studies with no relation between social deprivation and frequency of personality disorder. With regards to the outcomes of personality disorder, I found eight studies reporting an inverse association between social deprivation and outcomes of personality disorder and two studies with no association. The majority of studies reported on individual level of social deprivation than neighbourhood-level deprivation (N=8).

2.4.2 Meaning of findings

Although findings were heterogeneous, the overall balance of evidence suggested that worse social deprivation was associated with an increased risk of personality disorder as well as poorer prognosis in people with personality disorder. For example, prevalence of personality disorder was more likely to be higher among those with lower education or family income level at the time of diagnosis (Goldstein et al., 2017) or at 10 years of follow-up (Niesten et al., 2016). Also, lower neighbourhood-level deprivation was reported to be associated with more personality disorder symptoms among those with personality disorder diagnosis (Walsh et al., 2013). Also, all the studies that scored 7 or 8 out of total score 9 indicated an inverse association between social deprivation (individual income/education/ family income or neighbourhood-level deprivation). They included a cohort study (Niesten et al., 2016) and two cross-sectional studies (Goldstein et al., 2017; Walsh et al., 2013). Next, there was substantial heterogeneity among studies, and this heterogeneity was observed most distinctively in studies which examined individual SES. Among the three forms of social deprivation, the majority of studies (42 out of 50) only reported on individual SES, either on one individual indicator of SES or in combination with other indicators or other forms of social deprivation. And even within studies which examined SES, the results were varied as some studies looked at participant's individual SES whereas the others looked at family SES or that of the person's parents. The usual reason why SES was included in these studies included was probably because SES, education, or income is one of the factors that are routinely reported in studies even when they are not the focus of the studies. When more than one indicator of SES was examined, the results were not always consistent for each indicator. In some studies, each indicator had the same direction of association, whereas other studies showed differing results for each different indicator of SES, making it difficult to draw conclusions. For example, Leao and colleagues (2007) reported an association between an increased risk of being hospitalised for personality disorder and lower education or income level. But, in a study by Pulay and colleagues (2009), income had an adverse relationship with risk of personality disorder whereas there was no relationship found between frequency of personality disorder and education. This discrepancy in results between education, income or SES could be explained by different characteristics of each indicator. Education is accumulated assets acquired in school, and normally affects the likelihood of getting a job which is the source of income (Mirowsky & Ross, 2005). Therefore, their impact on the risk of personality disorder may not always be the same. There was also considerable heterogeneity in the type of personality disorder studied. It is noteworthy that seven studies out of ten studies on the outcomes of personality disorder in relation to social deprivation examined people with borderline personality disorder and all of them found an inverse association between borderline personality disorder and

social deprivation including individual income, education, and neighbourhood-level deprivation. This may suggest people with borderline personality disorder are more likely to experience worse outcomes when they are in more socially deprived position.

Additionally, more studies would be essential to confirm the direction of association between neighbourhood-level deprivation and personality disorder. There were eight studies that explored the association between neighbourhood-level deprivation and risk (N=4) or outcomes (N=4) of personality disorder, but half of these studies were ecological studies with their inherent problems in terms of determining causal associations. Further, the majority of studies reported the relative frequency of personality disorder, mostly the prevalence of personality disorder, and there were only ten studies that reported outcomes following the diagnosis of personality disorder. Personality disorder has detrimental effect on social and emotional functioning as well as well-being of people with personality disorder. Therefore, it would be important to have clear understanding about risk factors for outcomes in personality disorder in addition to risk of personality disorder. Lastly, there was a geographical disparity in number of studies on the association between personality disorder and social deprivation. Most studies were conducted in economically affluent countries such as North-Western Europe or US with almost half of studies having been conducted in US. Only a few studies were conducted in other parts of the world, such as Brazil, China, Iran and Jamaica. As quite a number of these studies point towards probable association between personality disorder and social deprivation, further research with the subjects from economically less-developed countries could validate their relationship between social deprivation and personality disorder.

2.4.3 Study limitations

This study had several limitations. First, there was a substantial heterogeneity among included studies in this review. The studies differed from each other in measurement of personality disorder, age range of people studied, case size, gender-distribution, data-type, and study setting. This heterogeneity only allowed a narrative analysis in this review and I was unable to perform a meta-analysis that could draw a quantitative summary estimate of the effect. Secondly, compared with the other two forms of social deprivation explored in this review, only one overarching search term was used for social isolation. Social isolation is somewhat different from the other factors which more concerned with economic characteristics whereas social isolation is about social contact be it objective or subjectively recorded. For this reason, it is possible my review might have overlooked some research on social isolation that could have been relevant in the literature searching process. Thirdly, grey and unpublished literature was not searched in my review, and also studies were confined to the ones published in English. This may have resulted in a failure in noticing relevant

studies or international biases. Fourth, in some studies, the association between personality disorder and social deprivation was not the main focus of their research, and in those studies, SES, income, education were reported as part of demographic information, and the cross-sectional distribution of them was merely reported with no statistical test involved. Finally, I was solely responsible for conducting this systematic review and there was no second-rater although I consulted my supervisors when making important decisions. Therefore, it is possible that bias may have been introduced during the review process.

2.5 Conclusions

This systematic review provides evidence that worse social deprivation was associated with an increased risk of personality disorder as well as poorer prognosis in people with personality disorder. There is a need for more robust research on the association between personality disorder and neighbourhood-level deprivation other than individual level of social deprivation. This review also highlights the need for more attention to outcomes of personality disorder in the study of its relationship to social deprivation.

Table 2.2 Summary of included studies

I. Studies on the risk of personality disorder

First Author	Pub. yr. ¹⁾	Country	Setting	Study design	Data period	PD Case (N)	Study pop. ²⁾ (N)	Age	Social deprivation	PD ³⁾ diagnosis	PD measure	Main findings	Quality
Elliott	2021	US	Community	X-sectional	2012-2013	1,758	36,309	18 or older	-Education -Income (family)	Borderline	AUDADIS-V	Educational attainment & family income is more likely to be lower in people with BPD ⁴⁾ than those without BPD -Education: Chi-squared test p<0.01* -Family income: Chi-squared test<0.01*	5
Newton-Howes	2021	New Zealand	Clinical	Cohort	2008-2017	8,884	294,612	18-64	Neighbourhood deprivation	Any PD	ICD-10AM; DSM-IV	Rates of personality pathology increased with social deprivation -No measure of effect	5
Blaney	2020	Canada	Community	Cohort	1984-2013	NS ⁵⁾	19,572	M ⁶⁾ 47.7	SES	Any PD	ICD-9-CM/10-CA	Lower SES was associated with an increased incidence of PDs among immune-mediated inflammatory diseases (IMID) patients -SES 1 st quintile (vs.5 th): IRR=2.39 (95% CI: 1.98-2.87), p<0.05	5
Hukulina	2020	Denmark	Community	Cohort	Born in 1980 to 2000 & f/u from 15 th birthday	24,000	1,051,265	NS	Income (family)	Any PD	ICD-8/ICD-10 (Danish version)	Parental income levels during childhood were inversely associated with later risks for developing PD -Family income 1 st quintile (vs.5 th): HR=1.78 (95% CI: 1.70-1.87)	6
Santana	2018	Brazil	Community	X-sectional	2005-2007	Prevalence 4.3% (≈127)	2,942	18 or older	-Education -Income -Neighbourhood deprivation	Any PD	IPDE	Education was inversely associated with Cluster C PDs -Education: OR=0.7; 95% CI: 0.5-0.9, p<0.05** No association between Income or neighbourhood deprivation and PDs -Income: OR=0.8 (95% CI: 0.5-1.4), p>0.05** -Neighbourhood deprivation (ND) level high (vs. No or low ND): OR=1.4 (95% CI: 0.5-4.0), p>0.05**	6
Goldstein	2017	US	Community	X-sectional	2012-2013	1,600	36,309	18 or older	-Education -Income (family)	Antisocial	AUDADIS-V	Prevalence of antisocial PD had an inverse association with education and family income -Education-level less than high school (vs. Postsecondary): OR=1.7 (95% CI: 1.37-2.05), p<0.05 -Family income <\$20,000 (vs. ≥\$70,000): OR=2.5 (95% CI: 2.02-3.13), p=0.05	7
Javaras	2017	US	Clinical & Community	X-sectional	2005-2009	164	1,127	Community with BPD: 36.9 (14.1) ⁷⁾ / Community no BPD: 28.9 (9.4)/ Clinical with BPD: 22.5 (4.1)	Education Social isolation	Borderline	DIPD-IV DIB-R	Community-based participants with and without BPD did not differ on educational status or social isolation - Education status college degree or beyond (vs. No high school degree): RR=0.62; 95% CI: 0.16-2.42, p=0.49 -Social isolation-spend less than half of free time alone (vs. More than half of free time alone): RR=0.70; 95% CI: 0.37-1.34, p=0.28	5

First Author	Pub. yr. ¹⁾	Country	Setting	Study design	Data period	PD Case (N)	Study pop. ²⁾ (N)	Age	Social deprivation	PD ³⁾ diagnosis	PD measure	Main findings	Quality
												People with BPD between community and clinical setting did not differ on education status or social isolation Education status college degree or beyond (vs. No high school degree): RR=0.86; 95% CI: 0.10-7.37, p=0.90 -Social isolation-spend less than half of free time alone (vs. More than half of free time alone): RR=0.40; 95% CI: 0.16-1.02, p=0.06	
Erickson	2016	US	Community	X-sectional	2004-2005	7,883	34,653	18 or older	Education	Any PD	AUDADIS-IV	No association between educational attainment and prevalence of PD -Effect size was provided as adjusted OR&95% CI, p>0.05**	5
Pare-Miron	2016	US	Community?	Cohort	2003-2012	989	8m	18-35	Income (family)	Borderline	ICD-9-CM	Women with BPD, compared with those without BPD, were more likely to have lower median household incomes -No measure of effect	4
Melca	2015	Brazil	Clinical	X-sectional	NS	24	110	18-70	Education	Borderline	SIDP-IV	OCD ⁸⁾ patients with BPD were more likely to have lower educational levels compared with those w/out BPD -Education: Chi-squared test p<0.05*	4
Raza	2014	US	Clinical	X-sectional *original: RCT	-	32	180	21-73	Income	Paranoid	SCID-II	No association between Income and paranoid PD diagnoses -Income: OR=0.98, p=0.61***	5
Tomko	2014	US	Community	X-sectional *original: longitudinal	2004-2005	1,030	34,481	18 or older	Education Income (family)	Borderline	AUDADIS-IV	No statistically significant difference between BPD group and non-BPD group with respect to education and family income -Chi-squared test: p>0.05**	6
Yang	2014	China	Clinical	X-sectional	2008	365	882	33.2 (±6.9)	Education	Antisocial	SCID-II (Chinese version)	People with less education are more likely to have ASPD among heroin dependent users -Education level high school (vs. Junior school): OR =0.61 (95% CI: 0.42-0.89), p=0.011	6
Greve	2013	Denmark	Community	Cohort	Over 29 years	336	23,641	29	Income (family)	Any PD	ICD-10	Family income at the child's birth is not significantly associated with admission rates for adult PD -First quartile family income (vs.4 th quartile): OR=1.18 (CI: 0.73-1.90) **	6
Hengartner	2013	Switzerland	Community	X-sectional	2010-2012	NS	511	20-41	Education	Any PD	ADP-IV	An inverse association between antisocial, borderline and histrionic PD and educational level -Antisocial PD: R ² =0.011, p<0.05 -Borderline PD: R ² =0.023, p<0.01 -Histrionic PD: R ² =0.013, p<0.05	6
Hickling	2013	Jamaica	Community	X-sectional	NS	624	1,506	18-64	Education Income Social class	Any PD	JPDI	An inverse association between prevalence of PD and education and social class, but a positive association between prevalence of PD and family income -Education: β coefficient=-0.079, t (1,1457) =-2.216, p<0.05 -Income: β coefficient=0.085, t (1,1457) =3.313, p<0.01	6

First Author	Pub. yr. ¹⁾	Country	Setting	Study design	Data period	PD Case (N)	Study pop. ²⁾ (N)	Age	Social deprivation	PD ³⁾ diagnosis	PD measure	Main findings	Quality
												-Social class: β coefficient=-0.083, t (1,1457) =-2.359, p<0.05	
McGurk	2013	US	Clinical & Community	X-sectional	NS	92	174	25 or older	Education	Schizotypal Paranoid	SIPD	People without schizotypal PD (SPD) or paranoid PD (PPD) had the most years of education compared with those with SPD only, PPD only and both SPD and PPD -F value: 3.61, p<0.05	4
Hickling	2011	Jamaica	Clinical	Case-control	1974-2007	351	702	18-69	SES	Any PD	DSM-IV	More than 50% of people with PD were from socioeconomic classes I and II -No measure of effect	4
Virtanen	2011	Finland	Community	Cohort	1997-2005	54	141,917	M 39 (10.6)	SES	Any PD	ICD-10-R	Compared with upper-grade non-manual workers, manual workers were more likely to have onset of PD -Manual workers (vs. upper-grade non-manual workers): HR=2.11 (95% CI: 1.02-4.38) **	6
Buu	2009	US	Community	Cohort	Over 15 years	NS	220	18-20	SES (family) Neighbourhood deprivation & longitudinal change	Antisocial	DIS-IV	Family SES, neighbourhood economic disadvantage during childhood, or neighbourhood becoming more affluent or less affluent did not predict the young adult's antisocial PD -Effect size was provided as Poisson regression coefficients, standard errors, p>0.05**	4
Huang Y.	2009	Multi.	Community	X-sectional	NS	≈1,291	21,162	-	Education Income	Any PD	IPDE	Cross-national prevalence of PD is significantly and inversely related to education, but not with income -Education: OR=0.8 (95% CI: 0.7-0.9), p<0.05 -Income: 0.9 (95%CI: 0.7-1.1), p>0.05**	6
Pulay	2009	US	Community	X-sectional *original: longitudinal	2004-2005	≈1,351	34,653	18 or older	Education Income	Schizotypal	AUDADIS-IV	Lower income groups more likely to have Schizotypal PD (SPD), but no association between SPD and education -Income level <\$20,000 (vs. ≥\$70,000): OR=3.1 (95% CI: 2.24-4.21), p<0.01 -Education level less than high school (vs. college or higher): OR=1.1 (95% CI: 0.82-1.44)	6
Smith	2009	Canada	Clinical	X-sectional	NS	≈53	848	65 or older	Social isolation	Any PD	RAI-MH	A diagnosis of PD were associated with higher odds for isolation compared with those people without PD among elderly psychiatric patients -Social isolation: OR=2.35 (95% CI: 1.20-4.62), p=0.01; HR=1.64 (95% CI: 1.04-2.59), p=0.03	5
Salehi	2008	Iran	Clinical	X-sectional	NS	299	368	29±9	Education	Any PD	DSM-IV (Persian translation)	People with lower levels of education were more likely to be afflicted by PD among substance dependent patients -No measure of effect	3
Huang X.	2007	China	Community	X-sectional	NS	NS	4,811	M:20.45 (1.62)	Income (family)	Any PD	PDQ-4+	Students from poor families showed significantly higher scores than those from average or wealthy families for each PD except paranoid and dependent PD -e.g., Borderline PD: F value: 8.085, p<0.01	1

First Author	Pub. yr. ¹⁾	Country	Setting	Study design	Data period	PD Case (N)	Study pop. ²⁾ (N)	Age	Social deprivation	PD ³⁾ diagnosis	PD measure	Main findings	Quality
Leão	2007	Sweden	Community	Cohort	1995-1998	NS	1.9m	16-34	Education Income	Any PD	ICD-9 ICD-10	Lower income and lower educational level were both associated with an increased risk of being hospitalised for PD -Income level lowest (vs. Highest): HR=2.28 (95% CI: 1.94-2.69)** -Education level <12 years (vs. ≥12 years): HR=2.16 (95% CI: 1.94-2.40) **	6
Dickey	2005	US	Community	Case-control	NS	104	214	18-55	Education SES (Parents/Own)	Schizotypal	SCID-I SCID-II	People with schizotypal PD (SPD) are more likely to be in lower SES and education level -SES: Anova F value=14.927, p<0.0005 -Education: Anova F value=17.825, p<0.005 The difference between SPD group and non-SPD group on parental SES approached statistical significance -Parental SES: Anova F value=3.812, p=0.052	5
Moran	2002	UK	Clinical	X-sectional	1997-1998	13	303	18-75	SES	Borderline	SAP	People with BPD were more likely to be in manual occupational class compared with non-PD people among primary care attenders -Manual (vs.non-manual): OR=3.23 (95% CI: 1.03-10.12), p<0.05	6
Sayar	2001	Turkey	Military	Case-control	NS	40	90	21-32	Education SES	Antisocial	DSM-IV	Antisocial PD group showed higher rates of lower education and SES than control group -Education: p=0.001 (Fisher's exact test) * -SES: p=0.001 (Fisher's exact test) *	5
Torgersen	2001	Norway	Community	X-sectional	NS	269	2,053	18-65	Education	Any PD	SIDP-R	Those with a high school education or less are more likely to have a PD -Education level high school or lower (vs. above high school): OR=1.38 (95% CI: 1.06-1.81), p<0.05	6
Devanand	2000	US	Clinical	X-sectional *original: RCT	NS	24	76	60 or older	SES	Any PD	SCID II	People with PD was more likely to be in lower SES than those without PD in an elderly sample with dysthymic disorder -SES: t=2.1, p<0.05	5
Malmstroem	1999	Sweden	Clinical	Ecological	1991-1994	NS	7,721	20-79	Neighbourhood deprivation	Any PD	ICD-9	No association between the neighbourhood affluence and psychiatric admission rates for first episode of PD -No measure of effect	NA ⁹⁾
Heikkinen	1997	Finland	Community	Case-control	1987-1988	56	229	15-65	Education	Any PD	DSM-III-R	No difference between PD group and non-PD group in education among suicide victims -Chi-squared test, p>0.05**	5
Reich	1996	US	Clinical	X-sectional	NS	12	171	59.8 (9.3)/ 57.7 (11.9)	Education SES	Dependent	PDE	The dependent PD group had significantly lower socioeconomic status than non-dependent PD group, but no significant difference in the years of education	5

First Author	Pub. yr. ¹⁾	Country	Setting	Study design	Data period	PD Case (N)	Study pop. ²⁾ (N)	Age	Social deprivation	PD ³⁾ diagnosis	PD measure	Main findings	Quality
Tyrer	1994	UK	Clinical	X-sectional *original: RCT	1989-1990	50	100	16-65	Social class	Any PD	ICD-10 PAS	-SES: t=-4.2 (t-test), p=0.001 -Education: t=-1.1 (t-test), p=0.09 People in social classes IV or V (the two lowest) were more likely to have a PD -ICD-10 diagnosis: $\chi^2 = 4.3$, df=1, p<0.05 -PAS diagnosis: $\chi^2 = 6.6$, df=1, p<0.05	4
Regier	1993	US	Community	X-sectional	1980-1984	NS	18,571	18 or older	SES	Antisocial	DIS	One month prevalence of ASPD was more likely to be higher in the lowest SES group compare with the highest SES group -SES level the lowest (vs. the highest): OR=9.37, p<0.003***	6
Dohrenwend	1992	Israel	Community	X-sectional	NS	NS	4,914	24-33	Education	Antisocial	SADS	Antisocial PD was inversely related to education -No measure of effect	5
Cadoret	1990	US	Community	Cohort	NS	44	286	M24.3(±5.5)/	SES (adoptive home)	Antisocial	DSM-III	Risk of ASPD increased in adoptee from lower SES of adoptive home when the biologic parents had criminality or delinquency -SES level low (vs. High): OR=12.02, p<0.0025***	4
Swartz	1990	US	Community	X-sectional *original: longitudinal	1983-1984	24	1,541	19-55	Education SES	Borderline	DIS DIB	No difference between BPD group and all community respondents with respect to education and SES -Education: $\chi^2 = 1.16$, df=1, p>0.05** -SES: $\chi^2 = 5.33$, df=3, p>0.05**	4
Drake	1988	US	Community	Cohort	Over 30 years	83	369	47±2	Social class (Family SC in adolescence)	Any PD	DSM-III	No correlation between family social class in adolescence and adult PD (schizoid, schizotypal, histrionic, narcissistic, dependent, passive-aggressive) except avoidant PD -Family SES & avoidant PD: correlation=-0.09, p<0.05 -Family SES & other type of PDs: p>0.05**	5

¹⁾Pub.yr: published year; ²⁾ pop.: population; ³⁾ PD: personality disorder; ⁴⁾ BPD: borderline personality disorder; ⁵⁾ NS: not specified; ⁶⁾ M: mean, ⁷⁾ (): standard deviation; ⁸⁾ OCD: obsessive-compulsive disorder; ⁹⁾ NA: not applicable

*No effect size is available in the study; **No actual p value is available in the study; ***: No confidence interval is available in the study

II. Studies on the outcomes of personality disorder

First Author	Pub. yr. ¹⁾	Country	Setting	Study design	Data period	Case (N)	Study pop. ²⁾ (N)	Age	Social deprivation	PD ³⁾ diagnosis	PD measure	Main findings	Quality
Soloff	2021	US	Clinical & Community	Cohort	2-31 years depending on subjects	NS ⁵⁾	150	M38.1 years old	Income (family)	Borderline	IPDE DIB/DIB-R	People with poor psychosocial outcomes (GAS ⁶⁾ score ≤50) among people with BPD ⁴⁾ was more likely to have household incomes at or below the poverty level than those with good psychosocial outcomes (GAS score ≥70) at 2-31 years of f/up -Household income (<\$20,000): $\chi^2 = 8.25$, $df=1$, $p=0.004$	6
Soloff	2019	US	Clinical & Community	Cohort	M 14.4 years	NS	118	18-45	Income (family)	Borderline	IPDE DIB/DIB-R	People with BPD who attempted suicide tended to have household income below the federal poverty limit compared with those without suicide attempt after 10-year follow-up -Household income (<\$20,000): $\chi^2=7.2$, $df=1$, $p=0.007$	6
Zanarini	2018	US	Clinical	Case control *original: longitudinal	1992-1995	290	362	18-35	Education	Borderline	SCID DIB-R DIPD	Good Vocational Record (went to school competently, consistently, and on a full-time basis) in adulthood was associated with excellent recovery of BPD at 20 years of f/up -Good vocational record: HR=1.88 (95% CI: 1.18-2.99), $P=0.008$	5
Leppänen	2016	Finland	Clinical	X-sectional	2010-2011	60	60	M ⁶⁾ 32.4 (8.6) ⁷⁾	Social isolation	Borderline	SCID-II	The BPD patients with parasuicidal behaviour had higher mean scores in social isolation/alienation category of Early Maladaptive Schemas (EMS) compared with those without parasuicidal behaviour -Social isolation score: F-value (ANCOVA)=5.92, $p=0.018$	5
Nielsen	2016	US	Clinical	Cohort	1992-1995	264	327	18-35	Income	Borderline	DIB-R DSM-III-R	BPD patients were more likely to be in the low-income group compared with the axis II comparison subjects after 10-year follow-up -BPD (vs. axis II comparison subjects) over 16-year follow-up: OR=0.51 (95% CI: 0.35-0.75), $p=0.001$	7
Walsh	2013	US	Clinical & Community	X-sectional *original: longitudinal	over 2 years	335	335	18-45	Neighbourhood deprivation	Borderline Schizotypal Avoidant Obsessive-compulsive	DIPD-IV	Lower neighbourhood deprivation was associated with more PD symptoms in people with PD -Neighbour deprivation: β (Multiple regression) = -1.03, $p<0.01$ ***	8
Soloff	2012	US	Clinical & Community	Cohort	6 years	25	90	M29.1 (8.3)	Education SES	Borderline	IPDE DIB/DIB-R	People with BPD who attempted suicide were more likely to have lower SES and less education compared with those with no suicide attempt -SES level low: $\chi^2 = 4.51$, $p=0.03$ -Education level ≤high school: $\chi^2 = 4.51$, $p=0.03$ Risk of suicidal attempt was increased by low SES over time (at 6 years follow-up) among BPD patients -Low SES: RR=2.63 (95% CI: 1.05-6.57), $p=0.04$	5

First Author	Pub. yr. ¹⁾	Country	Setting	Study design	Data period	Case (N)	Study pop. ²⁾ (N)	Age	Social deprivation	PD ³⁾ diagnosis	PD measure	Main findings	Quality
Peen	2001	Netherlands	Clinical	Ecological	1992-1995	205	4,238	NS	Neighbourhood deprivation	Any PD	ICD-9	No significant association between area level deprivation and area-level admission rates & re-admission rates for PD -Admission rates: one-way ANOVA*, p>0.05** -Re-admission rates: Chi-squared test*, p>0.05**	NA ⁹⁾
Koppel	1999	UK	Clinical	Ecological	1990-1994	NS	11,296	NS	Neighbourhood-deprivation	Any PD	ICD-9	Social deprivation in geographical level was inversely correlated with psychiatric admission rates of people diagnosed with personality disorder -Neighbourhood deprivation indices: Carstairs (r=0.63), Jarman (r=0.67), and Townsend (r=0.68), p<0.001 for all three indices	NA
Harrison	1995	UK	Clinical	Ecological	1992-1993	590	≈2,6m	15-64	Neighbourhood deprivation	Any PD	ICD-9	No statistically significant correlation between first episode admission rates of PD and underprivileged area (UPA) score -Admission rates & UPA score: Pearson correlation (r)=0.39, p>0.05**	NA

¹⁾Pub.yr: published year; ²⁾ pop.: population; ³⁾ PD: personality disorder; ⁴⁾ BPD: borderline personality disorder; ⁵⁾ NS: not specified; ⁶⁾ M: mean; ⁷⁾ (): standard deviation; ⁸⁾GAS: global assessment scale; ⁹⁾ NA: not applicable

*No effect size is available in the study; **No actual p value is available in the study; ***: No confidence interval is available in the study

Chapter 3 Personality disorder in an Early Intervention in Psychosis cohort: Findings from the Social Epidemiology of Psychoses in East Anglia (SEPEA) study

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3.1 Introduction

It has been consistently suggested that people with personality disorder are at high risk of having a number of other psychiatric disorders such as mood disorder, anxiety disorder and substance use disorder to name a few (Lenzenweger et al., 2007; Paris, 2007). Although there is no consolidated consensus on the prevalence of comorbidity between personality disorder and psychosis, existing research suggests that it is not low (Newton-Howes, Tyrer, North, & Yang, 2008). For example, in a systematic review, Newton-Howes and colleagues suggested overall comorbidity between personality disorder and psychosis was 39.5% (95% CI 25.2%-55.8%), although the authors noted that this varied from 4.5% to 100% as a possible result of heterogeneity in country, study type, type of care setting and diagnostic tools for personality disorder used across studies (Newton-Howes, Tyrer, North, & Yang, 2008). Further, in the National Epidemiologic Survey on Alcohol and Related Conditions (NESARC), people with schizophrenia and other psychotic disorders showed high rates of various forms of co-occurring personality disorder (McMillan et al., 2009).

Both personality disorder and psychotic disorder are known to start developing at an early stage in life (Kessler et al., 2007; Paris, 2013). Young people with problems in personality functioning exhibit symptoms similar to those of psychosis such as hallucinations, potentially making the conditions difficult to distinguish at first presentation (McClellan et al., 1993). Comorbid personality disorder is associated with worse outcomes, such as increased relapse and readmission to hospital as well as more violent behaviours in people with psychosis (Moran et al., 2003; Stevenson et al., 2011). Existing studies which have estimated the prevalence of personality disorder in first episode psychosis (FEP) samples in EIP care have largely been based on small samples, which may have led to imprecise estimates of comorbidity. For example, in a study on forty-nine patients using an EIP

service, the prevalence of comorbid personality disorder was estimated to be 45% (Fornells-Ambrojo et al., 2015), while a further study estimated that 50% of a sample of fifty-five people with FEP met diagnostic criteria for two or more personality disorders (Simonsen et al., 2008). Large, population-based epidemiological data on this issue remains absent.

Furthermore, little is known about the possible predictors of comorbid personality disorder in such first episode psychosis samples, which may be helpful in informing both clinical practice and aetiology. At the individual level, personality disorder and psychosis may share phenomenological overlap, including relatively early onset, hallucinations, single relationship status and lower socioeconomic status (Baldwin et al., 2005; Jackson & Burgess, 2002; Goldstein et al., 2017). Interestingly, personality disorder prevalence appears to be higher for men in community settings, but higher for women in clinical settings (Coid et al., 2006; Tyrer et al., 2015). People of white ethnicity have higher prevalence than ethnic minority groups, in contrast to what is typically observed in FEP (Kirkbride, Hameed, Ankireddypalli, et al., 2017; McGilloway et al., 2010).

As indicated in earlier chapters, both psychosis and personality disorder appear to be associated with neighbourhood-level deprivation (Kirkbride, Hameed, Ankireddypalli, et al., 2017; Walsh et al., 2013). However, there is no epidemiological study investigating whether neighbourhood-level deprivation increased the risk of comorbid personality disorder and FEP within EIP sample. Given the importance of providing proper care for people who experience comorbid personality disorder with psychosis, and in order to allocate adequate resources to these issues, it is therefore necessary to characterise the prevalence and predictors of personality disorder more accurately within EIP cohorts.

Therefore, in the present study, I sought to estimate the prevalence of personality disorder documented in a large naturalistic cohort of people accepted for care in EIP services for FEP. I also investigated whether individual sociodemographic and clinical characteristics differed between people with and without personality disorder diagnoses in this context. Lastly, I examined whether neighbourhood-level social disadvantage was associated with prevalence of comorbid personality disorder. The research questions and hypotheses were as follows:

1. What is the prevalence of comorbid personality disorder within EIP setting?

(H1: The prevalence of personality disorder within EIP setting will be as high as 30%¹)

¹ This number was chosen because the lowest prevalence of PERSONALITY DISORDER in secondary mental health setting was reported to be 31%

2. Do the clinical and sociodemographic characteristics differ between people with and without comorbid personality disorder diagnoses within EIP setting?

(H2: The prevalence of comorbid personality disorder within EIP setting will increase with younger age at first contact, female sex, white British ethnicity, single or divorced marital status, and lower socioeconomic status (SES))

3. Does living in more deprived or densely populated areas increase the prevalence of comorbid personality disorder in EIP setting?

(H3: The prevalence of comorbid personality disorder within EIP setting will be elevated when people live in more deprived areas or densely populated areas)

3.2 Methods

3.2.1 Design and setting

I obtained data from the Social Epidemiology of Psychoses in East Anglia (SEPEA) study, originally designed to investigate variation in the incidence of psychotic disorders among people who were referred, accepted and fulfilled the criteria for FEP in six EIP services in rural England for 3.5 years (Kirkbride et al., 2017). Case ascertainment took place from 1 August 2009 to 31 January 2013 in the catchment area of the Cambridgeshire and Peterborough NHS Foundation Trust (CPFT), and from 28 September 2009 to 28 March 2013 in the Norfolk and Suffolk NHS Foundation Trust (NSFT).

3.2.2 Inclusion Criteria and Participants

Participants were included in the present study if they met the following inclusion criteria:

1. Acceptance to EIP services for a first referral of suspected psychosis
2. Aged between 16-35 years old in NSFT, or 17-35 years old in CPFT
3. Resident in the defined catchment area
4. No previous contacts with mental health services for psychotic symptoms, or previous treatment involving antipsychotic medication for more than 6 months.

3.2.3 Procedures

For all participants, sociodemographic data were collected at baseline. Clinical information was collected at two time points: 6 months after acceptance into EIP care and again at discharge from EIP services (up to 3 years of care); at these time points the clinicians responsible for care provided primary and secondary International Classification of Diseases, Tenth Revision (ICD-10) clinical

diagnoses. A primary search-based diagnosis was also obtained at each time point, using the Operational Criteria Checklist for Psychotic Illness and Affective Illness (OPCRIT) computerised algorithm. OPCRIT assessment involves rating ninety standardised clinical features and symptoms from all available case notes and information, which are entered into a computerized algorithm known to produce reliable and valid ICD-10 diagnoses for major psychotic and affective disorders based on rating of 90 signs and symptoms of disorder (Craddock et al., 1996; McGuffin et al., 1991). A panel of trained diagnosticians conducted OPCRIT assessments, with acceptable inter-rater reliability as previously reported (Kirkbride, Hameed, Ankireddypalli, et al., 2017).

Participants were classified as meeting research-based criteria for first episode psychosis if there was both clinical and research-based evidence of an ICD-10 psychotic disorder (F10-33) at either time point (6 months after acceptance into EIP care, or discharge from care); the exact diagnosis was based on their final OPCRIT assessment. Not all participants accepted into EIP care in this study met diagnosis criteria for FEP, and the prevalence of personality disorder diagnoses in both those with and without formal FEP in EIP setting were investigated.

3.2.4 Outcome variable

The main outcome in this study was a clinical diagnosis of ICD-10 personality disorder (F60.X) as a primary or secondary diagnosis at either time point during EIP care (6 months post-acceptance, or discharge).

3.2.5 Exposure variables

I considered FEP (yes/no) as a predictor of personality disorder. FEP was defined as a clinical diagnosis of an ICD-10 psychotic disorder (F10-33) at either time point, subsequently confirmed by a standardised research-based diagnosis using the OPCRIT assessment.

For all participants, demographic data were collected at acceptance, and included age (continuous), sex (male/female), ethnicity, marital status, individual and parental SES and country of birth at EIP acceptance. Age was defined as age-at-first-referral to EIP care. Ethnicity was self-ascribed to one of 18 categories in the 2011 census, recoded here as a binary variable (white British versus black and minority ethnic (BME) groups). Marital status was classified as married/civil partnership, divorced/dissolved/ separated or single. Occupational data on participants and their parents was classified into five (participants) or four (parents) categories according to the National Statistics Socio-Economic Classification guidelines (NS-SEC, 2010), as: professional/managerial, intermediate occupations (including small employers and self-employed), routine/manual, and people not in employment (including long-run unemployed, never worked, student, and otherwise unclassified). Parental SES was rated as the higher occupational group when data on both parents were available.

Next, participants were geo-coded to their small area of residence using postcode information for neighbourhood-level exposures on personality disorder risk. The “electoral wards” were used as the neighbourhood-level of analysis, with 530 wards in the SEPEA catchment area, containing a median population of 3,992 people (interquartile range (IQR): 2,426-5,935). Then information on population density and multiple deprivation were obtained based on these electoral wards. Population density was estimated based on the 2011 census population divided by area size in hectares (people per hectare (ppha)) and categorized into four equal-interval groups (0-4,000; 4,001-8,000; 8,001-12,000; and over 12,000 ppha). Multiple deprivation was defined as the proportion of households in each neighbourhood categorized as deprived on two or more of four indicators from the 2011 census such as employment, education, health, and living environment (Kirkbride et al., 2017), with four equal-interval scale categories (7.7%-18%, 18.1%-28%, 28.1%-38%, and 38.1%-47.1%).

I also included waiting time (in weeks) between referral and acceptance by EIP services (Kirkbride, Hameed, Wright, et al., 2017) and symptom dimensionality as potential predictors of personality disorder in my analyses. Symptom dimensions were derived from a factor analysis of OPCRIT items, as previously described (Solmi et al., 2018), for which I included scores on seven dimensions: mania, depressive symptoms, other delusions, psychomotor poverty and disorganisation, first rank delusions, paranoia and hallucinations.

3.2.6 Statistical analysis

First, I used descriptive statistics to calculate the mean, standard deviations, and frequencies of the variables, including the proportion of the EIP sample diagnosed with personality disorder. I used Chi-square (χ^2) tests or Fisher’s exact test (FET) (when one or more cell has small numbers), and independent t-tests or Wilcoxon Rank sum-tests (RST), as appropriate, to investigate univariable differences in personality disorder prevalence by sociodemographic and clinical characteristics. I then conducted multilevel logistic regression to examine the joint effects of these factors on personality disorder prevalence. I used Akaike’s Information Criterion (AIC) to determine entry order into a multivariable model, with lower AIC scores indicating better model fit, and employed a forward selection method to identify the best-fitting set of predictors associated with personality disorder. I used likelihood ratio tests (LRT) to determine the best-fitting model, with statistical significance set at $p < 0.05$. I conducted complete case analysis on the data, with minimal missing data in this sample; 39 (4.9%) participants were missing data on any exposure variable. Analyses were conducted in Stata version 14.

3.3 Results

3.3.1 Demographic and clinical characteristics

I identified 798 participants who met inclusion criteria, of whom 687 (86.1%) received a research-based diagnosis of FEP and 76 (9.5%) received a clinical personality disorder diagnosis (**Table 3.1**). Fifty-two of those diagnosed with FEP (7.5%) received a comorbid personality disorder diagnosis. The median age-at-first referral to EIP of people with and without any recorded personality disorder was 20.5 (IQR: 18.2-23.9) and 22.6 (IQR: 19.4-27.2) years old, respectively (RST: 3.4; $p < 0.01$). There were slightly more women (57.9%, $N=44$) than men (42.1%, $N=32$) with personality disorder, whereas two thirds (67.7%, $N=489$) of people without personality disorder were men (χ^2 test: 19.9; $p < 0.01$). Participants with personality disorder were also more likely to be white British (FET; $p < 0.01$), from low SES (individual SES: FET, $p=0.04$; parental SES: χ^2 test: 11.1, $p=0.01$), UK-born (FET; $p < 0.01$), and were less likely to be diagnosed with FEP (χ^2 test: 21.9; $p < 0.01$); they also had longer median waiting times between referral and acceptance to EIP (RST: -2.0; $p=0.04$). Participants with personality disorder differed on most psychopathology dimensions at initial assessment, and were rated as having more hallucinations, paranoia and depressive symptoms than those without personality disorder (**Table 3.1**), but fewer manic, negative and first rank delusional symptoms. There were no significant differences between participants with and without personality disorder in neighbourhood-level population density (χ^2 test: 2.4; $p=0.48$) or multiple deprivation (χ^2 test: 3.4; $p=0.34$).

Table 3.1 Demographic and clinical characteristics of people within EIP service

	Personality disorder diagnosis (n=76)		No personality disorder diagnosis (n=722)		statistic	
	n	(%) or (IQR [†])	n	(%) or (IQR)	test	p
Age (years)						
Median (IQR)	20.5	(18.2-23.9)	22.6	(19.4-27.2)	3.4 [†]	<0.01
Sex					19.9	<0.01
Female	44	(57.9)	233	(32.3)		
Male	32	(42.1)	489	(67.7)		
Ethnicity					‡	<0.01
White British	71	(93.4)	542	(75.1)		
BME	5	(6.6)	180	(25.0)		
Marital Status					‡	0.67
Married/Civil partnership	5	(6.6)	67	(9.4)		
Single	69	(90.8)	633	(88.7)		
Divorced/Dissolved/Separated	2	(2.6)	14	(2.0)		
Missing data	0		8			
Participant SES					‡	0.04
Professional & managerial	3	(4.0)	75	(10.4)		
Intermediate	4	(5.3)	87	(12.1)		
Routine	33	(43.4)	278	(38.5)		
Student	15	(19.7)	157	(21.8)		
LR unemployed or NW	21	(27.6)	125	(17.3)		
Parental SES					11.1	0.01

	Personality disorder diagnosis (n=76)		No personality disorder diagnosis (n=722)		statistic	
	n	(%) or (IQR¶)	n	(%) or (IQR)	test	p
Professional & managerial	10	(13.2)	222	(30.8)		
Intermediate	18	(23.7)	156	(21.6)		
Routine & manual	25	(32.9)	192	(26.6)		
Long-term unemployed, not working or student	23	(30.3)	152	(21.1)		
Country of birth					‡	<0.01
Born in UK	74	(97.4)	610	(84.5)		
Foreign born	2	(2.6)	112	(15.5)		
First Episode Psychosis (FEP)					21.9	<0.01
Yes	52	(68.4)	635	(88.0)		
No	24	(31.6)	87	(12.1)		
Waiting time (weeks)					-2.0†	0.04
Median (IQR)	2.29	(1.36-5.86)	2.14	(1-4.14)		
Symptoms of Psychosis (Median & IQR)						
Mania	-0.31	(-0.72-0.37)	-0.15	(-0.57-0.58)	1.9†	0.05
Depressive symptoms	0.52	(-0.45-1.15)	-0.05	(-0.84-0.70)	-3.4†	<0.01
Other delusions	-0.25	(-0.66-0.58)	-0.05	(-0.63-0.76)	0.8§	0.41
Psychomotor poverty & disorganisation	-0.29	(-0.89-0.31)	-0.01	(-0.54-0.63)	2.6†	<0.01
First rank delusions	-0.23	(-0.77-0.35)	-0.04	(-0.53-0.59)	2.3†	0.02
Paranoia	0.18	(-0.46-0.88)	-0.07	(-0.72-0.64)	-2.1§	0.04
Hallucinations	0.45	(-0.24-0.99)	-0.11	(-0.73-0.64)	-3.9§	<0.01
Population Density					2.4	0.48
0-4,000 ppha	29	(40.9)	315	(45.3)		
4,001-8,000 ppha	16	(22.5)	135	(19.4)		
8,001-12,000 ppha	18	(25.4)	137	(19.7)		
12,001-max ppha	8	(11.3)	109	(15.7)		
Missing data	5		26			
Multiple Deprivation					3.4	0.34
7.8-18%	16	(22.5)	172	(24.7)		
18.1-28%	26	(36.6)	312	(44.8)		
28.1-38%	22	(31.0)	164	(23.6)		
38.1-47.1%	7	(9.9)	48	(6.9)		
Missing data	5		26			

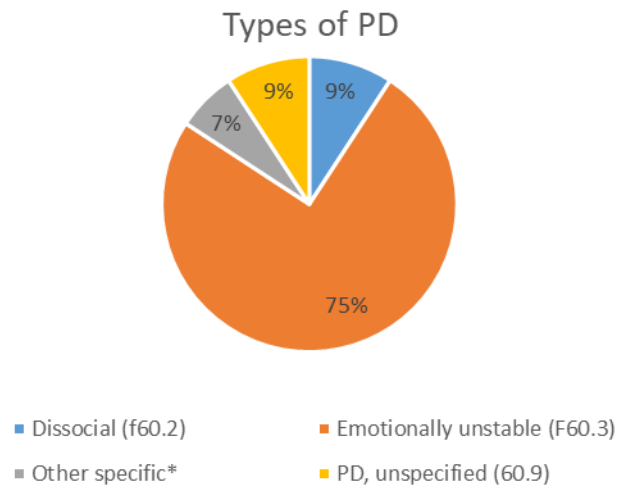
†: The Wilcoxon Rank-sum test; ‡: Fisher's exact test; §: The independent t-test; ¶: Interquartile range (IQR);

BME: black and minority ethnic; PPHA: people per hectare; SES: socioeconomic status

3.3.2 Sub-Types of personality disorder

The majority of participants with a personality disorder record (75%) received a diagnosis of 'emotionally unstable' personality disorder (75%; see **Figure 3.1**), followed by 'dissocial personality disorder' (9.2%) and 'unspecified personality disorder (9.2%)'. Due to the small sample size, I did not inspect these subtypes further in the present study.

Figure 3.1 Sub-types of personality disorder diagnosed (N=76) among participants (ICD-10)



*Due to small numbers, these groups were merged to avoid possible disclosure of individual participants, and included schizoid, anankastic, anxious, dependent personality disorders.

3.3.3 Missing data

Thirty-nine participants (4.9%) had missing data on either marital status or neighbourhood-factors (Supplemental **Table 3.2**). There were no significant differences between people with and without missing data, except that participants with missing data had lower individual and parental SES compared with those without missing data (both $p < 0.01$).

Table 3.2 Characteristics of the sample with and without missing data

	Without missing data (n=759)		With missing data (n=39)		statistic	
	n	(%) or (IQR)	n	(%) or (IQR)	test	p
Age (years)					RST	0.67
Median (IQR)	22.4	(19.3-27.0)	22.1	(19.9-24.5)		
Sex					ChiT	0.22
Female	267	(35.2)	10	(25.6)		
Male	492	(64.8)	29	(74.4)		
Ethnicity					ChiT	0.45
White British	585	(77.1)	28	(71.8)		
BME	174	(22.9)	11	(28.2)		
Marital Status					ChiT	0.13
Married/Couple	72	(9.5)	0	(0)		
Single	671	(88.4)	31	(100)		
Divorced/Dissolved/Separated	16	(2.1)	0	(0)		
Missing data			8			
Participant SES					FET	<0.01
Professional & managerial	77	(10.1)	1	(2.6)		
Intermediate	91	(12.0)	0	(0)		
Routine	295	(38.9)	16	(41.0)		
Student	164	(21.6)	8	(20.5)		
LR unemployed or NW	132	(17.4)	14	(35.9)		
Parental SES					FET	<0.01
Professional & managerial	228	(30.0)	4	(10.3)		

	Without missing data (n=759)		With missing data (n=39)		statistic	
	n	(%) or (IQR)	n	(%) or (IQR)	test	p
Intermediate	165	(21.7)	9	(23.1)		
Routine & manual	207	(27.3)	10	(25.6)		
Long-term unemployed, not working or student	159	(21.0)	16	(41.0)		
Country of birth					ChiT	0.25
Born in UK	653	(86.0)	31	(79.5)		
Foreign born	106	(14.0)	8	(20.5)		
First Episode Psychosis (FEP)					FET	0.64
Yes	652	(85.9)	35	(89.7)		
No	107	(14.1)	4	(10.3)		
Symptoms of Psychosis (median & IQR)						
Mania	-0.16	(-0.61-0.56)	-0.15	(-0.45-0.43)	RST	0.91
Depressive symptoms	0.00	(-0.79-0.78)	-0.28	(-1.16-0.51)	RST	0.10
Other delusions	-0.07	(-0.64-0.73)	-0.03	(-0.62-1.01)	RST	0.36
Psychomotor poverty & disorg.	-0.06	(-0.60-0.58)	0.30	(-0.53-0.80)	RST	0.11
First rank delusions	-0.08	(-0.56-0.56)	0.04	(-0.54-0.83)	RST	0.52
Paranoia	-0.04	(-0.69-0.66)	0.19	(-0.73-0.87)	RST	0.74
Hallucinations	-0.05	(-0.69-0.69)	-0.06	(-0.70-0.69)	RST	0.87
Population Density					FET	0.75
0-4,000 ppha	340	(44.8)	4	(50.0)		
4,001-8,000 ppha	149	(19.6)	2	(25.0)		
8,001-12,000 ppha	153	(20.2)	2	(25.0)		
12,001-max ppha	117	(15.4)	0	(0)		
Missing data			31			
Multiple Deprivation					FET	0.44
7.8-18%	186	(24.5)	2	(25.0)		
18.1-28%	336	(44.3)	2	(25.0)		
28.1-38%	183	(24.1)	3	(37.5)		
38.1-47.1%	54	(7.1)	1	(12.5)		
Missing data			31			

Abbreviations - RST: Rank-sum test; ChiT: Chi-square test; FET: Fisher's exact test; BME: black and minority ethnic; PPHA: people per hectare; SES: socioeconomic status

3.3.4 Sociodemographic and clinical features of people with personality disorder

In univariable modelling (**Table 3.3**), being younger, female, white British, of lower SES level (own, or parental), born in UK, having no FEP comorbidity, having longer waiting time before EIP acceptance and having symptoms of psychosis except other delusions were significantly associated with having a personality disorder diagnosis.

After multivariable modelling, receiving a personality disorder diagnosis was associated with sex, ethnicity, parental SES, FEP status, first rank delusions and hallucinations. Thus, personality disorder was more common amongst women (odds ratio (OR): 3.36; 95% CI: 1.97-5.73), participants with lower parental SES (OR per lower category: 1.43; 95% CI: 1.12-1.84), those without comorbid FEP (OR: 2.99; 95% CI: 1.61-5.52) and those experiencing more hallucinations (OR: 1.61; 95% CI: 1.23-2.12). personality disorder risk was weakly associated with age-at-referral (OR per year: 0.95; 95% CI: 0.89-1.00; p=0.059), which was retained in the model. Personality disorder risk was lower in the BME group (OR: 0.27; 95% CI: 0.11-0.71), and participants with more first rank delusions symptoms (OR:

0.74; 95% CI: 0.56-0.97). Although population density and multiple deprivation were not associated with personality disorder in univariable models (**Table 3.3**), I re-checked these variables in the final multivariable model given my *a priori* interest in these factors; however, neither variable improved the final model (LRT_{population density} p=0.40); (LRT_{multiple deprivation} p=0.89).

Table 3.3 Logistic regression models for predicting receiving a personality disorder diagnosis in the EIP service

Variable	OR†	Univariable model			Multivariable model		LRT¶ p-value
		95% CI‡	AIC§	OR	95% CI		
Age	0.92	(0.87-0.97)	467.1	0.95	(0.89-1.004)	0.059	
Sex			454.9			<0.01	
Male	1	-		1	-		
Female	3.18	(1.93-5.26)		3.36	(1.97-5.73)		
Ethnicity			463.1			<0.01	
White British	1	-		1	-		
BME	0.23	(0.09-0.60)		0.27	(0.11-0.71)		
Marital Status			477.0			0.67	
Married/Civil Partnership	1	-		1	-		
Single	1.57	(0.58-4.30)		1.26	(0.41-3.87)		
Divorced/Dissolved/Separated	2.16	(0.34-13.61)		2.62	(0.34-20.01)		
Participant SES			472.2			0.16	
Professional & managerial	1	-		1	-		
Intermediate	1.13	(0.24-5.37)		0.67	(0.14-3.30)		
Routine	3.12	(0.90-10.77)		1.78	(0.50-6.32)		
Student	2.45	(0.66-9.08)		0.98	(0.24-3.99)		
LR unemployed or NW	4.05	(1.11-14.74)		1.97	(0.52-7.53)		
Parental SES			467.3			0.01	
Professional & managerial	1	-		1	-		
Intermediate	3.00	(1.29-7.00)		2.68	(1.12-6.38)		
Routine	3.20	(1.42-7.19)		3.27	(1.42-7.56)		
Long-term unemployed, not working or student	3.57	(1.55-8.24)		3.44	(1.44-8.22)		
Parental SES - linear			467.1			<0.01	
1.43					(1.12-1.84)		
Country of birth			465.5			0.29	
Born in UK	1	-					
Foreign born	0.16	(0.04-0.69)		0.40	(0.07-2.35)		
Having FEP			461.0			<0.01	
Yes	1	-		1	-	-	
No	3.39	(1.87-6.16)		2.99	(1.61-5.52)		
Waiting time (weeks)	1.04	(1.01-1.07)	469.5	1.03	(0.997-1.06)	0.08	
Symptoms of Psychosis							
Mania	0.78	(0.60-1.01)	472.5	0.89	(0.66-1.21)	0.47	
Depressive symptoms	1.61	(1.22-2.12)	463.6	1.25	(0.94-1.66)	0.13	
Other delusions	0.88	(0.69-1.14)	475.1	0.92	(0.68-1.24)	0.59	
Psychomotor poverty & disorg.	0.69	(0.53-0.89)	467.7	0.85	(0.65-1.11)	0.22	
First rank delusions	0.68	(0.52-0.88)	467.2	0.74	(0.56-0.97)	0.03	
Paranoia	1.26	(0.97-1.63)	473.0	1.14	(0.83-1.58)	0.42	
Hallucinations	1.68	(1.28-2.20)	460.8	1.61	(1.23-2.12)	<0.01	
Population Density			477.9			0.90	
0-4,000 ppha	1	-		1	-		
4,001-8,000 ppha	1.36	(0.67-2.73)		1.31	(0.65-2.65)		
8,001-12,000 ppha	1.44	(0.72-2.88)		1.16	(0.58-2.32)		
12,001-max ppha	0.82	(0.34-1.99)		1.16	(0.47-2.82)		
Multiple Deprivation			476.9			0.38	
7.8-18%	1	-		1	-		
18.1-28%	0.90	(0.45-1.81)		0.74	(0.36-1.49)		
28.1-38%	1.51	(0.72-3.17)		1.04	(0.50-2.20)		
38.1-47.1%	1.65	(0.55-4.98)		1.70	(0.61-4.78)		

†: Odds ratio; ‡: Confidence interval; §: Akaike Information Criterion; ¶: Likelihood ratio test; BME: black and minority ethnic; PPHA: people per hectare; SES: socioeconomic status

3.4 Discussion

3.4.1 Main findings

To my best knowledge, this is the first study to have investigated the prevalence and correlates of recording of personality disorder diagnoses in a large, prospectively-collected sample in EIP services. While the overall prevalence of personality disorder diagnoses was lower than I expected, at about 10%, personality disorder diagnoses were more common for women and in those of white British ethnicity, as hypothesised. I also found that people with lower parental SES and those found not to meet research-based diagnostic criteria for FEP during their EIP care were more likely to receive a personality disorder diagnosis. Contrary to my expectations, there was no evidence of an association between prevalence of personality disorder and neighbourhood-level deprivation or population density in this sample. People reporting more hallucinations and fewer first-rank delusions, were more likely to receive personality disorder diagnosis, underlining overlapping phenomenological presentations at first referral to EIP services.

3.4.2 Meaning of findings

The findings in this study were partially consistent with previous studies. The prevalence of recording personality disorder in my study was much lower compared with the 45% prevalence in a study conducted in a similar EIP setting (Fornells-Ambrojo et al., 2015), or studies carried out in secondary mental health care settings, where personality disorder prevalence ranges from 31% to 92% (Beckwith, Moran, & Reilly, 2014; Keown, Holloway, & Kuipers, 2002; Newton-Howes et al., 2010; Ranger, Methuan, Rutter, Rao, & Tyrer, 2004). A number of possible reasons for this may exist. For example, the present study is based on people referred to EIP services due to suspected psychosis. When psychotic symptoms become prominent enough to warrant clinical attention, the sensitivity of personality disorder diagnosis could be weaker (Newton-Howes et al., 2008) or, alternatively, the likelihood that clinicians record a personality disorder diagnosis may be reduced. I may have also underestimated the true prevalence of personality disorder in my sample because, unlike previous studies (Beckwith et al., 2014; Fornells-Ambrojo et al., 2015; Keown et al., 2002; Giles Newton-Howes et al., 2010; Ranger et al., 2004), a structured instrument such as SCID-II was not used to define personality disorder in this study. Given the naturalistic design of the cohort in the present study, I was reliant on personality disorder diagnoses recorded during routine clinical practice. Further, while the sample in this study was based on precise epidemiological criteria, only those who were accepted into EIP care were assessed in this study; personality disorder prevalence may be higher amongst those referred to, but not accepted by EIP services, and may indicate that

these services are already effectively screening and triaging people who require onward referral to other specialist psychiatric services.

It is perhaps unsurprising that the absence of a FEP diagnosis increased the odds of receiving personality disorder diagnosis in clinical practice and is consistent with a small handful of people treated in EIP who, after extended evaluation, require onward referral to other specialist services. A similar result was reported in a recent study, indicating that participants at high-risk for psychosis were found to present to EIP services with more prominent personality traits and low transition to FEP at follow-up (Llewellyn-Jones et al., 2018). The associations I observed between personality disorder prevalence and symptom dimensions associated with psychosis (including hallucinations and first rank delusions) is novel and underlines the phenomenological overlap and difficulties that diagnosticians may face in evaluating participants with symptoms inherent to both personality disorder and FEP.

Participants receiving a personality disorder diagnosis in the sample in this study were more likely to be women, white British, and from lower SES groups, consistent with the previous literature (Goldstein et al., 2017; McGilloway et al., 2010; Saraiva Leao et al., 2005; Tyrer et al., 2015). While personality disorder diagnoses were more likely to be recorded for people of white British ethnicity accepted into EIP care for suspected psychosis, the present study does not provide information on the relative prevalence of personality disorder by ethnicity in the general population. People from BME backgrounds are over-represented in FEP samples, including those included in this study (Kirkbride et al., 2017), so other study designs are required to determine whether the incidence or prevalence of personality disorder varies by ethnicity.

Lastly, in contrast to my original hypothesis, I did not find associations between indicators of neighbourhood-level deprivation or population density and personality disorder. Nonetheless, it has been previously shown that participants in this sample are more likely to come from more deprived and densely-populated area than the general population (Kirkbride et al., 2017; Richardson, Hameed, Perez, Jones, & Kirkbride, 2018). Further, in the present study there was strong evidence that participants who received a personality disorder diagnosis in my sample were even more disadvantaged in terms of individual-level SES than those without personality disorder diagnosis. Together, these findings suggests that the personality disorder group in the sample in this study represents an extremely socially disadvantaged group.

3.4.3 Limitations

This study has some limitations. First, the original SEPEA study was designed to investigate the social epidemiology of psychotic disorders and not personality disorder as a primary outcome; thus, as

discussed above, I was reliant on personality disorder diagnoses made during clinical practice. Nonetheless, however, this may reflect the real-world assessment of personality disorder in clinical practice in EIP services. Further, diagnosis of personality disorder used in this analysis was made at 6 months after acceptance to EIP service or at discharge. Thus, it is not clear whether people with personality disorder had premorbid personality disorder before EIP or if they developed personality disorder symptoms after acceptance to EIP. Lastly, the setting of this study was in EIP services in rural England which may not be generalizable to other areas that have different characteristics, such as urban areas, and therefore, a further study may be needed to validate the findings on association between neighbourhood-level deprivation or population density and prevalence of personality disorder in EIP services.

3.4.4 Conclusion

In contrast to previous studies, I did not find high levels of personality disorder in a large, prospectively-collected cohort of people accepted into EIP services in England for suspected psychosis. This suggests that these services may be largely appropriately screening and triaging referrals to divert people with primary diagnoses of personality disorder. Nonetheless, participants receiving personality disorder diagnoses in my sample were less likely to receive a validated, research-based diagnosis of psychotic disorder while in EIP care, despite significant phenomenological overlap between the two groups. This symptomatic overlap highlights that difficulties in diagnostic assessment and categorisation, which may delay onward referral and treatment of personality-related problems. While careful assessment of personality disorder symptoms at referral may further help to signpost people to appropriate services, these problems only become apparent during longitudinal assessment in EIP care.

In an already socioeconomically disadvantaged EIP cohort, people with personality disorder reported more severe individual-level social disadvantage in terms of relationship status and occupational position, although I found no evidence to suggest people with personality disorder came from even more deprived or densely populated neighbourhoods at first referral than other groups referred to EIP care for suspected psychosis.

Chapter 4 Preliminary work to identify a personality disorder cohort in Camden and Islington NHS Foundation Trust (C&I) using the Clinical Record Interactive Search (CRIS) database

4.1 Introduction

In the upcoming chapters (Chapter 5-8), I examine the prevalence of personality disorders in secondary mental health care, and whether neighbourhood-level deprivation is associated with this prevalence and two outcomes (mortality and subsequent acute psychiatric admission) of personality disorder. I use Clinical Record Interactive Search (CRIS) data, derived from two large mental health services in inner-city London, namely Camden and Islington NHS Foundation Trust (C&I) and South London and Maudsley NHS Foundation Trust (SLaM). In this chapter, I first provide an overview of the CRIS database, and then I evaluate the validity of personality disorder diagnoses extracted via a natural language processing (NLP) application in C&I CRIS.

4.1.1 Electronic health records in mental health services

The World Health Organization (WHO) describes a psychiatric case register as “a patient-centred longitudinal record of contacts with a defined set of psychiatric services originating from a defined population” (WHO, 1983, cited in Stewart et al., 2009). The usefulness of case registers in mental health research has been demonstrated in recent years, given they provide extensive data regarding large number of participants (Byrne et al., 2005; Mortensen, 1995). Case register data from health care records not only provide high levels of statistical power and representative samples for research studies, but they also enable researchers to save time and money in the costly process of data collection compared to primary research studies (Gissler et al., 2000; Higgins & Howard, 2005). The benefits of routinely collected longitudinal data also includes comprehensiveness of the data compared with sample-based data and opportunities for time-trend analyses given the amount of follow-up time that is available in clinical records (Gissler et al., 2000; Kane et al., 2000).

Over the last decade, thanks to technological advances, electronic health records (EHRs) are gradually replacing paper clinical notes, both in physical health records and in mental health services (Robson & Timms, 2015), and in the UK, EHRs are much more common in mental health services and primary care services compared to acute physical care (Perera et al., 2016). EHRs have several advantage over paper versions. As large amounts of clinical information are recorded in an electronic format, they are less prone to loss, and easier to keep up to date. In a UK study involving survey and telephone interviews with the chief of information services at NHS Trusts throughout in

England, respondents perceived the benefits of EHRs to include patient safety, easier access to patient information, and efficiency in terms of time and human resource (Clarke et al., 2015). However, there have been some key challenges for using case register data in electronic format for research. First, there are important concerns regarding information governance and data protection when accessing and analysing data, especially free-text information and technical and procedural issues generating data as the source of raw data are not anonymised (Stewart et al., 2009). Second, large volumes of information in mental health records are written in text format rather than in a structured-checkbox form, as in contrast to most primary care records (Castillo et al., 2015; Perera et al., 2016; R. Stewart et al., 2009). This makes it more difficult to extract variables for research, for instance regarding diagnoses or mental health symptoms. Third, the datasets which are derived directly from EHRs are not provided in a format that is easy for researchers to analyse, and data extraction requires often statistical programs which many researchers are not familiar with (Stewart et al., 2009).

4.1.2 Development of the CRIS database

The Clinical Record Interactive Search (CRIS) was developed by the Biomedical Research Centre (BRC) in the South London and Maudsley NHS Foundation Trust (SLaM) in 2007-2008 (Perera et al., 2016; R. Stewart et al., 2009). CRIS is an application that renders de-identified routinely collected electronic health records accessible to researchers, and enables researchers to conduct secondary research (Fernandes et al., 2013). The dataset in CRIS contains unique ID numbers for each individual and some demographic variables such as date of birth, sex, ethnicity, and marital status. The ID number is constructed from the patient's unique NHS number and anonymized so that patient duplication can be avoided, while maintaining anonymity of clinical data (Stewart et al., 2009). Data in CRIS systems are derived in two ways, one from structured fields and the other from unstructured open text fields, and these two can be combined to address a variety of research questions in mental health (Stewart et al., 2009). Structured field data include dates and check boxes, and open text field data include clinical progress notes from consultations, written assessments and reports, and correspondence between professionals (Perera et al., 2016). Within mental health EHRs data, the most salient information may be included in text fields including multiple long free text entries in risk assessment notes, event notes and correspondence letters, potentially yielded over many years, rather than in structured-fields (Velupillai et al., 2018).

Data from open text fields are extracted using an application called natural language processing (NLP) which was developed in collaboration with the University of Sheffield. The NLP application employs Information Extraction (IE) techniques which convert unstructured text into structured

tables and General Architecture for Text Engineering (GATE), which is a widely used software for text engineering (Perera et al., 2016). It extracts information from clinical notes, for example: diagnosis, medication and cannabis use (Werbeloff et al., 2018). These NLP applications have been designed so that they are not confined to a simple keyword search, but also take into account the context of a word or phrase of interest, for instance excluding negative mentions of a term (Werbeloff et al., 2018). Despite its substantial potential to extract variables from clinical notes, NLP methods also have limitations in terms of their accuracy due to high degree of variability of the information clinicians enter into clinical text (Perera et al., 2016).

4.1.3 Camden and Islington NHS Foundation Trust (C&I)

Camden and Islington NHS Foundation Trust (C&I) is a large secondary mental health care provider in north London and delivers services to people living in two London Boroughs of Camden and Islington (**Figure 4.1**). They also provide substance misuse services in Westminster, and substance misuse services as well as psychological therapy services to residents of Kingston (www.candi.nhs.uk) who were not included in this study. The data was extracted by using the Clinical Record Interactive Search (CRIS) application system.

According to English Indices of Deprivation 2015 (Ministry of Housing Communities & Local government, 2015b) over 25% of LSOAs in Camden (36 LSOAs) fall within 20% most deprived LSOAs in England and borough of Camden ranks 69th out of 326 English districts in average rank of Index of Multiple Deprivation (IMD) where an area ranked 1 is the most deprived, and the area with a rank of 326 is the least deprived. However, in the same borough, there are also some areas (6 LSOAs) that are 20% least deprived areas in England which indicates that poverty is not evenly spread across the borough. In Islington, 54 LSOAs (44%) fall within 20% most deprived LSOAs in England, and there is only one LSOA that fall within 30% least deprived areas in England (Ministry of Housing Communities & Local government, 2015a). The Islington borough ranks 13th out of 326 English districts in average rank of IMD (Ministry of Housing Communities & Local government, 2015b). Additionally, Islington is the second highest most densely populated borough in London.

Figure 4.1 Map of Camden and Islington borough



4.1.4 C&I CRIS database

In C&I, EHRs have been in use since 2008 with the electronic patient record system called ‘Rio’ (Werbelloff et al., 2018). Extensive, longitudinal clinical records regarding the mental health of all patients who were ever in contact with the Trust are contained in an electronic record system called ‘Rio’, which was replaced with ‘CareNotes’ in 2015. The records included sociodemographic information, dates of important clinical events such as referrals and admission, medications, detailed clinical assessment and care plans (Werbelloff et al., 2018). The CRIS application developed by the SLaM BRC in 2008 was deployed to Camden and Islington NHS Foundation Trust (C&I) in 2013 along with three additional trusts, including Cambridgeshire and Peterborough NHS Foundation Trust, Oxford Health NHS Foundation Trust, and West London Mental Health NHS Trust, funded by National Institute for Health Research (NIHR) D-CRIS programme (Werbelloff et al., 2018). The C&I CRIS (<https://www.candi.nhs.uk/health-professionals/research/ci-research-database>) extracts information from Rio and CareNotes as far back as 2008 and employs the same security model as the one developed by SLaM. This was applied in C&I to adhere to the legal and ethical requirements for using patient data for research. As in SLaM, only authorized researchers are allowed access to the deidentified patient information extracted from the clinical EHRs to perform epidemiological research (Werbelloff et al., 2018).

4.1.5 Aims and research questions

In the following chapters (Chapters 5-8), I use data on personality disorder extracted from C&I CRIS and SLaM CRIS, both via ICD-10 structured field and NLP application. The validity of personality disorder diagnoses identified via NLP in SLaM CRIS has previously been demonstrated (Fok et al., 2014b), but no attempt has been made to assess this validity C&I CRIS data. For my thesis, it was important to establish whether data regarding personality disorders diagnoses from open text-fields in C&I CRIS was accurate before conducting further research using these diagnoses. Therefore, the principal aim of this chapter was to evaluate the validity of identified personality disorders diagnoses derived from open text-fields in C&I CRIS. The main research question was whether the diagnosis of personality disorders extracted automatically from open text-field via NLP in C&I CRIS was truly personality disorder diagnosis when compared with the information contained in the actual patient health records. More detailed methods specific to each study, including how I defined my cohorts and how the data were extracted from the CRIS system in both C&I and SLaM are described in Chapter 5 and 7.

4.2 Methods

4.2.1 Data extraction of people with personality disorder diagnoses from the CRIS system

I identified people with recordings of personality disorder diagnosis in two ways, from ICD-10 structured fields and NLP open text-fields. First, I identified people with recordings of personality disorders diagnoses from structured fields, by identifying those who had an ICD-10 code of F60.X (F60.0-F60.9). Next, I identified those with a recording of a personality disorders diagnosis in the free text fields of the clinical notes using the NLP diagnosis application. This used the search term 'F60.X (F60.0-F60.9)' and 'Personality disorder'. I applied this search criteria throughout all the free text clinical notes and documents in the Camden and Islington CRIS database. For the validation work I then manually screened the diagnoses extracted from free text to determine how many records identified by the NLP process would be eligible and ineligible to be included in a final cohort of people with a personality disorders diagnosis. I conducted the screening according to a pre-determined exclusion rule, in which people with organic personality disorder or people with schizotypal personality disorders (as my study is based on ICD-10 classification system and schizotypal type is categorized as psychotic disorder under ICD-10) were excluded.

4.2.2 Participants for validation

Participants for the validation were selected separately for tests of precision and recall (see Section 4.2.3 for definitions). For the *precision test*, 100 people who had a recording of personality disorders diagnosis sourced from the NLP application in C&I CRIS were randomly selected. For the *recall test*, 100 texts from any participant case notes in the CRIS database which contained mention of either 'personality disorder' or 'F60.x' were extracted from a further randomly selected sample of 100 people. Both random selections were made with a computer program designed by the C&I CRIS manager.

4.2.3 Procedure

The metrics widely employed for evaluating information extraction (IE) are 'precision' (equivalent to positive predictive value, PPV) and 'recall' (equivalent to sensitivity) (Perera et al., 2016). Precision refers to total number of documents retrieved that are relevant (i.e., truly identify someone with a diagnosis of personality disorder recorded in CRIS) divided by total number of documents that are retrieved. Recall refers to total number of documents retrieved that are relevant (i.e., which truly identify someone with a diagnosis of personality disorder and are identified by the NLP application) divided by total number of relevant documents in the database (i.e., which truly identify someone with a diagnosis of personality disorder in the CRIS database, identified by manually checking the sample) (Ting, 2011). These metrics have often been used to evaluate validity of various NLP applications in SLAM (Fernandes et al., 2013; Perera et al., 2016). Employing text mining within CRIS data involves a trade-off between precision and recall, and due to the longitudinal nature of EHR data, suboptimal recall can be compensated for with a focus on maximizing precision (Perera et al., 2016). The diagnosis of some psychiatric conditions extracted from free text using NLP in C&I have been validated. For example, the diagnosis of bipolar disorder was shown to have a 92% precision and 64% recall in validation set of 100 patients (Werbelloff et al., 2018). This may mean there could be about 8% of people who did not actually have bipolar disorder and some number of people with true bipolar disorder could have been missed in this cohort.

When deciding which participants met criteria for a personality disorder during the tests of precision and recall, I included those who had an indication of a personality disorder diagnosis in their case notes unless those notes included a clear statement that the participant did not have a personality disorder diagnosis. I used the following rules to decide whether people should be included in the personality disorders group (**Table 4.1**).

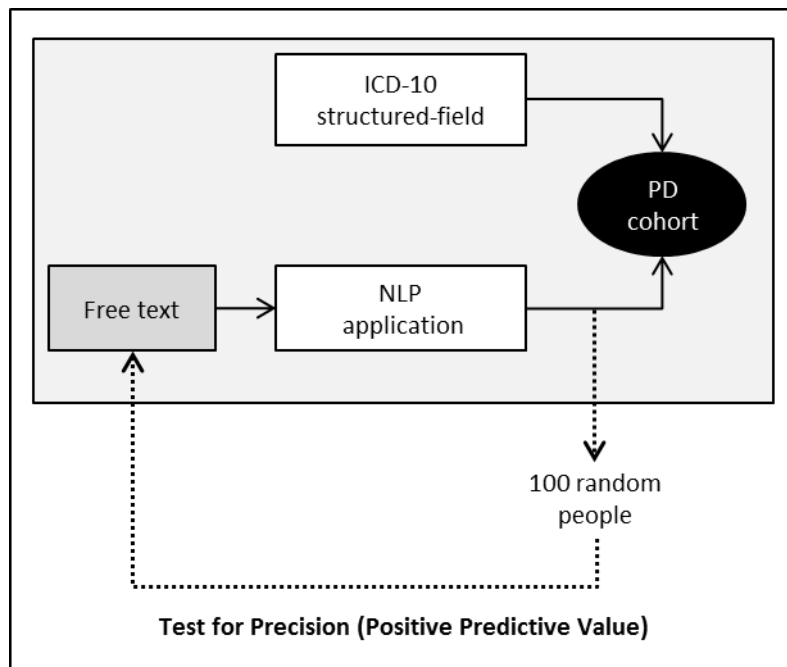
Table 4.1 Rules for deciding who should be included in the personality disorders group

Case	Description of cases	Include in the personality disorder diagnosis group?
1	People were formerly given a personality disorders diagnosis, but they currently “do not meet SCID-II threshold”	Yes
2	People who are “likely/appears to have personality disorders”, “possibly have personality disorders” or “have features of personality disorders”	Yes
3	“I(GP) have always wondered whether he had a personality disorder”	No
4	Self-report of a personality disorders diagnosis given elsewhere	Yes
5	Referred to a personality disorders service	Yes

4.2.3.1 Precision of the NLP application for personality disorder

For the precision test, I manually checked 100 randomly chosen people from my personality disorders cohort whose diagnosis was sourced from the NLP application in order to examine whether they truly had a personality disorders diagnosis in the original free-text case notes (**Figure 4.2**).

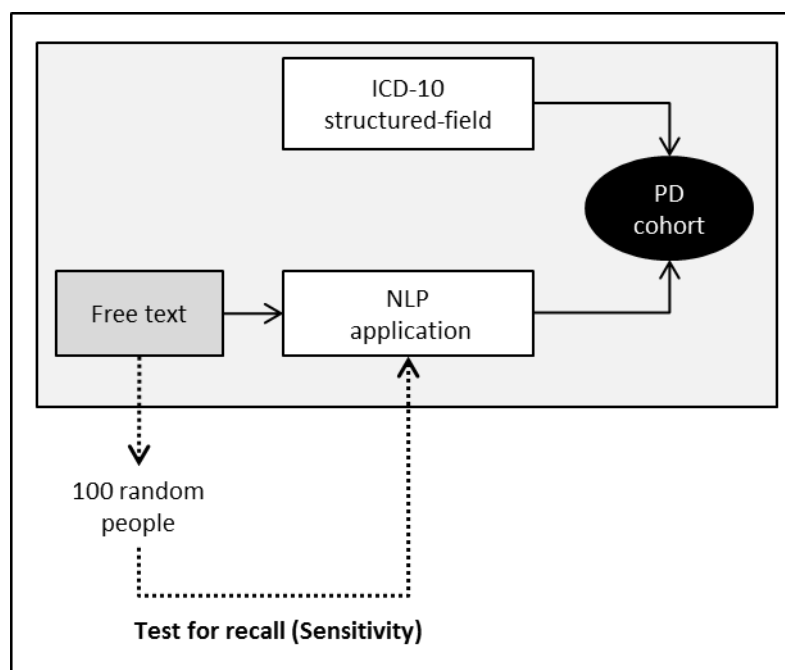
Figure 4.2 Flow diagram of test for precision



4.2.3.2 Recall of the NLP application for personality disorder

With regards to the recall test, 100 people whose free-text case notes contained a mention of 'personality disorder' or 'F60.x' were randomly selected and the relevant text regarding the diagnosis was extracted. Then I read this text to determine if there was indeed an indication of a personality disorders diagnosis. When there was an indication of a personality disorders diagnosis in the free text, I returned to the NLP application to see if this patient was correctly identified as having a personality disorders diagnosis to be included in the personality disorders cohort in our dataset (Figure 4.3).

Figure 4.3 Flow diagram of test for recall



4.3 Results

4.3.1 Demographic characteristics of the sample

For the precision test, all randomly selected 100 people were included in the test, and for the recall test, I found 63 people who were correctly identified as having a personality disorder diagnosis in the NLP application out of 100 randomly selected people with mention of personality disorder or F60.X, and only those 63 people were included in the recall test. The demographic characteristics of both samples are described in **Table 4.2**. The median age of the samples for the precision and recall test were 34.8 and 39.8 years old, respectively. The proportion of male and female was similar (χ^2 test: 0.24; $p=0.62$) in both test samples, and the largest ethnic group in both test samples was the White British group.

Table 4.2 Demographic characteristics of the test sample

	Precision test sample (N=100) N (%) or Median (IQR)	Recall test sample (N=63) N (%) or Median (IQR)
Age	34.8 (27.7-45.0)	39.8 (29.7-48.4)
Gender		
Male	50 (50%)	29 (46.0%)
Female	50 (50%)	34 (54.0%)
Ethnicity		
White British	44 (44%)	34 (54.0%)
White non-British	18 (18%)	13 (20.6%)
Black	8 (8%)	9 (14.3%)
Asian	6 (6%)	4 (6.3%)
Mixed	4 (4%)	1 (1.6%)
Other	5 (5%)	2 (3.2%)
Not known	15 (15%)	-

4.3.2 Precision (equivalent to positive predictive value) test

I identified 92 people out of 100 people who had a record of a personality disorders diagnosis in the original clinical documentation. This included people with self-reports of previous personality disorders diagnosis and people who had been referred to personality disorders services. I found eight people who did not have a record of a personality disorders diagnosis, and these included people whose notes stated that their partner or family had a personality disorder diagnosis (N=4) and people who, the clinical notes stated, did not meet the threshold for personality disorders (N=4) (Table 4.3). Thus, the precision was 92%.

Table 4.3 Details for Precision test result

Personality disorders diagnosis	N	Description
Yes	92	81 Definite evidence of a personality disorders diagnosis exists 6 Self-report of a previous personality disorders diagnosis 5 Referred to a specialist personality disorders service
No	8	4 Notes state that someone other than the patient has a personality disorders diagnosis - fiancé/partner (N=2), family member (N=2) 4 The clinical notes state that patient does not meet the threshold for personality disorders diagnosis - “We do not think patient's difficulties fit within a diagnosis of personality disorders” (N=1) - “Our current view is that these difficulties are in line with personality disorders traits yet would not meet the threshold of severity for a diagnosis of personality disorders” (N=1)

- “Symptoms not consistent to make a diagnosis of personality disorders” (N=1)
- “I do not feel she would meet the full criteria for a diagnosis of personality disorders” (N=1)

4.3.3 Recall (equivalent to sensitivity) test.

I found 63 people out of 100 people with clinical notes indicating they had a personality disorders diagnosis in the free text. Of these 63 people, the NLP application correctly identified 47 (75%) people as having a personality disorders diagnosis, whereas there were 16 (25%) people with a personality disorder diagnosis who were not identified by NLP application. Thus, the recall was 75% (Table 4.4).

Table 4.4 Details for Recall test result

Personality disorders diagnosis in free text	N	NLP correctly identified as having a personality disorders diagnosis		
			N	%
Yes	63	yes	47	75
		no	16	25
No	37	<i>Not relevant to test</i>		

4.4 Discussion

4.4.1 Main findings

I conducted a validation test of personality disorder diagnoses extracted from the NLP application in C&I CRIS using precision (PPV) and recall (sensitivity) techniques. This evaluation yielded 92% precision and 75% recall rates. This is the first study that has examined the validity of personality disorders diagnosis extracted from NLP in C&I CRIS, and precision was found to be high while the recall was of a moderate level.

4.4.2 Implication of findings

The precision rate of 92% in my personality disorder cohort extracted via NLP from C&I may mean that about 8% of people in the cohort would not truly have had personality disorder if they were identified by NLP alone. It is difficult to compare these results directly with those found in the SLaM CRIS, as the validity assessment for personality disorder diagnosis in SLaM CRIS did not adopt these precision and recall metrics. Instead, Fok and her colleagues (Fok et al., 2014b) examined the validity of personality disorder diagnoses from the SLaM CRIS database with 50 randomly selected cases

with or without personality disorder diagnosis from a severe mental illness (SMI) cohort as a part of a study examining the impact of co-morbid personality disorder on inpatient and community-based service use and risk of involuntary hospitalization amongst this cohort. During their validation assessment, a trained psychiatrist conducted a blind clinical rating of the case records for the presence or absence of personality disorder in these 50 case vignettes, and the rating results were compared with the CRIS diagnosis. The kappa coefficient for level of agreement was 0.72 ($p < 0.001$). However, the performance of the NLP applications in SLaM for other types of information including Mini-Mental State Exam (MMSE), diagnosis, smoking, education and medications has been previously demonstrated with a range of precision rates between 93%-97% and a range of recall rates between 59%-99% (Perera et al., 2016). Also, in a more recent report of a regularly updated NLP document, which contain details including the performance of NLP applications in SLaM, the precision and recall rates for different symptoms were within the ranges 77%-100% and 64%-100%, respectively (CRIS NLP service, 2020). In C&I CRIS, validation of NLP records extracted for bipolar disorder diagnoses also showed 92% for precision and 64% for recall (Werbelloff et al., 2018). Therefore, it is reasonable to suggest that the precision and recall rates for personality disorder diagnosis in my study are acceptable and permit me to proceed to conduct the studies using these diagnoses in my following chapters.

4.4.3 Limitations

Several limitations are worth noting. Firstly, I did not examine the validity of NLP extracted diagnosis for the whole sample. Although the subset sample chosen for this test was randomly selected, a large validation test for the personality disorder diagnoses would have strengthened the validity of the NLP algorithm for personality disorder diagnosis. Nonetheless, in performance tests of the NLP application for other diagnoses and measures in SLaM, the number of randomly selected subsamples did not exceed 100 in most studies (CRIS NLP service, 2020). Secondly, the recall rate in my study was 75%, which may mean that I will have missed some true cases of personality disorder in the following chapters. However, this may not necessarily be 25% because some of the missed cases of true personality disorder could have been picked up by the structured-field diagnostic fields, since the NLP extracted diagnoses were used to supplement the diagnoses of personality disorder extracted from these structured-field. Finally, I carried out the validation tests mostly on my own (except for the random selection of the subset sample and extraction of the data conducted by the C&I CRIS manager). This means that no interrater reliability measure could be derived, and this could be something that is addressed in future psychometric assessments of the NLP application for personality disorder diagnoses. I tried to reduce any uncertainty (and reliability issues) by consulting with my supervisors in the case of any ambiguous or marginal cases.

Chapter 5 Prevalence of personality disorders in secondary mental health care and its association with neighbourhood-level deprivation using C&I CRIS database

5.1 Introduction

In Chapter 4, I have overviewed the CRIS system in C&I and assessed the validity of personality disorder diagnosis obtained from the NLP application. In this chapter, I examine prevalence of personality disorder and whether it is associated with neighbourhood-level deprivation using the C&I CRIS database.

5.1.1 Frequency of personality disorder in the general population

There have been a number of studies reporting the frequency of personality disorder over the last two decades. The lifetime/point prevalence of personality disorders in the general population has been reported to be in the range of 4.4-21.2% (Coid et al., 2006; Dereboy, Güzel, Dereboy, Okyay, & Eskin, 2014; Ekselius, Tillfors, Furmark, & Fredrikson, 2001; H. Jackson & Burgess, 2000; Lenzenweger et al., 2007; Samuels, 2011; Samuels et al., 2002; Torgersen, Kringlen, & Cramer, 2001) (**Table 5.1**). There is a large variation in the reported prevalence of personality disorders across these studies and there might be several explanations for this variation. First, there are differences in the countries where the studies were conducted, and also whether participants resided in urban or rural environments. There were also differences in the demographic characteristics of the sample in each study, in sampling methods, in diagnostic assessment methods and in the time when the study was conducted. These differences could all have affected the different prevalence of personality disorders across the studies. Second, each study may have used a different diagnostic threshold to determine whether a person meets diagnostic criteria for personality disorders (Samuels, 2011). Thirdly, the self-rated methods which were used in some studies may have an influence on the prevalence of personality disorders. In a recent systematic review on the prevalence of personality disorders (Volkert et al., 2018), studies using self-rated assessment of the DSM-IV and ICD-10 Personality Questionnaire (DIP-Q) and the Structured Clinical Interview for DSM-IV AXIS-II Personality disorder (SCID-II) have reported higher prevalence, and prevalence based on expert-rated methods or clinical interviews resulted in lower prevalence findings.

Table 5.1 Previously reported prevalence of personality disorders in community settings

Authors	Country	Number & source of sample	Diagnosis	PD** assessment	Prevalence (type & %)
Jackson & Burgess (2000)	Australia	10,641/the National Survey of Mental Health and Wellbeing	ICD-10	IPDE*	Lifetime/ 6.5%
Torgersen et al (2001)	Norway	2,053/ a random sample from the National Register of Oslo	DSM-III-R	SIDP-R*	Point / 13.4%
Ekselius et al (2001)	Sweden	557/ random sample from a Swedish population-based registry	DSM-IV/ ICD-10	DIP-Q*	Point / 11.1% (DSM-IV), 11.0% (ICD-10)
Samuels et al (2002)	USA	742/ sample from Baltimore Epidemiological Catchment Area survey	DSM-IV/ ICD-10 combined	IPDE	Lifetime/ 9.0% (DSM-IV), 5.1% (ICD-10)
Coid et al (2006)	UK	626/sample from the British National Survey of Psychiatric Morbidity	DSM-IV	SCID-II*	Lifetime / 4.4%
Lenzenweger et al (2007)	USA	214/ sample from National Comorbidity Survey Replication	DSM-IV	IPDE	Lifetime/ 11.9%
Dereboy et al (2014)	Turkey	774/ sample from residents in a city of Aydin, Turkey	DSM-IV / ICD-10	DIP-Q (Turkish version)	Point / 20.0% (DSM-IV), 21.2% (ICD-10)

*IPDE: *International Personality disorder Examination*, SIDP-R: *The structured Interview for DSM-III-R*

Personality disorder, DIP-Q: *The DSM-IV and ICD-10 Personality Questionnaire*, SCID-II: *The Structured Clinical Interview for DSM-IV AXIS-II Personality disorder*

**PD: *Personality disorder*

These previous research studies have some limitations in common. First, these studies were cross-sectional studies examined at one time point rather than over a long period of time. Second, most of these studies included limited numbers of participants which rarely exceeded 1,000 people with the exception of the Australian study and Norwegian study. Third, they depended on the sample who were randomly chosen or recruited for research purposes rather than people who made a contact with psychiatric services for their mental health issues; these studies were specifically designed for research purposes as described in, rather than reflecting real life clinical settings as discussed in chapter two.

Although these primary research studies benefit from the fact that they used structured interviews which can take a substantial amount of time to deliver, their findings may not reflect the reality of

identifying personality disorder in routine clinical practice. For example, in clinical practice, less time is allocated for a single patient compared to primary research studies and furthermore people may not receive personality disorder diagnoses because there are long waiting lists for seeing specialist service who make the diagnoses (Flynn et al., 2019). Correspondingly, clinical diagnosis of personality disorders is mostly made by clinician's judgement based on patient's symptoms, mental state and history, and the assessments are far less likely to involve structured interviews due to time constraints, except perhaps in specialist personality disorder assessment clinics which use SCID-II. Also, clinicians are known to be reluctant to make a diagnosis of personality disorders in the clinical notes as it often entails stigma at least if they do not know the patient well, or unless the diagnosis seems very clear, as discussed in Chapter 1 (Paris, 2007). Further, people with personality disorders have been found to consult with mental health services much less frequently compared with those with other psychiatric illness such as psychotic disorder or depression (Andrews et al., 2001). Hence, it may be safe to hypothesise that the estimated prevalence in a clinical secondary care sample might be lower than that reported in primary research studies in **Table 5.1**.

5.1.2 Neighbourhood-level deprivation and the prevalence of personality disorders

Some evidence of associations between individual socio-demographic factors and the prevalence of personality disorders has been reported in a small number of previous studies, as discussed in Chapters 1 and 2 (Coid et al., 2006; H. J. Jackson & Burgess, 2002; McGilloy et al., 2010; Samuels et al., 2002; Tyrer et al., 2015). In clinical settings, people are more likely to receive a diagnosis of personality disorder if they are younger, female, white (British), are single/divorced/separated, or have a lower individual socioeconomic status (see chapter 1 and 2 for full details). However, as I have discussed in the literature review in Chapter 2, I only found eight papers that examined how neighbourhood-level deprivation is associated with personality disorder; three of them were published before 2000.

Two studies have reported there is a positive association with neighbourhood-level deprivation and personality disorder. For instance, a cross-sectional study (Walsh et al., 2013) with a sample of 335 adults found living in a lower socioeconomic-status neighbourhood was associated with more personality disorder symptoms among personality disorder individuals (Multiple regression coefficient: -1.03; $p < .01$). The sample in this study were drawn from a multi-site, longitudinal study of personality disorder, the Collaborative Longitudinal Personality disorder Study (CLPS), conducted in four urban sites in the US and were categorised according to four DSM-IV personality disorder diagnostic groups including avoidant, borderline, schizotypal and obsessive compulsive.

In another study (Koppel & McGuffin, 1999), which examined the ecological relationship between socioeconomic factors at a geographical level (electoral wards) and psychiatric admissions in a county of Wales using weekly admission data collected from all hospitals within the county, found socioeconomic deprivation at the geographical level was strongly correlated with increased psychiatric admissions for personality disorder ($r: 0.73$; $p < .05$). However, this study was not from a contemporary time period and the circumstances and indicators of deprivation may differ from those of today. For instance, 'car ownership' was one of the variables of deprivation indices used in this study, but it is not included in the domains of Index of multiple deprivation (IMD), the most widely used of the UK indices of Deprivation today.

Other studies have found no relationship between neighbourhood-level deprivation and personality disorder. For example, in an ecological study (Peen et al., 2001) conducted in the Netherlands, first admission rates for personality disorder were compared according to area-level deprivation in four categories in 79 Amsterdam neighbourhoods, and no significant differences between each deprivation categories and first admission rates for personality disorder were found.

In another study conducted in US (Buu et al., 2009), the authors examined the long-term effects of neighbourhood economic disadvantage during childhood (age 3-5) or neighbourhood becoming more or less affluent in the long-term (ages 3-17) on adolescent substance use and psychiatric symptomatology including antisocial personality disorder. This study used the data from a longitudinal study, the Michigan Longitudinal study, which originally recruited families where a parent had an alcohol use disorder alcoholic families with at least one 3-to-5 years old biological son in four-county areas in the US and 220 male children of those families were included in the analysis. They found neither neighbourhood economic disadvantage during childhood (Poisson regression coefficient: 0.03; $p=0.06$) nor the neighbourhood becoming more affluent (coefficient -0.08; $p=0.14$) or less affluent (coefficient -0.03; $p=0.12$) in the long-term predicted the diagnosis of adolescent antisocial personality disorder at ages 18-20. The findings of this study may be limited in their generalisability to the general population given the sample were people from families in Michigan with alcohol problems.

I also identified two additional ecological studies that investigated the relationship between psychiatric admission rates of people with personality disorder and neighbourhood-level deprivation, both of which were published in the 1990s. A British study (Harrison et al., 1995) explored the correlation between social deprivation and first episode of psychiatric in-patient admission rates of people with personality disorder in north west region of England and found no statistically significant correlation between them. In this study, only Pearson's r was reported, and no other statistical analyses were conducted to examine the association which makes the findings

more difficult to interpret. Similarly, a Swedish study (Malmström et al., 1999) examined the association between the neighbourhood affluence and psychiatric admission rates of first episode of personality disorder and found little difference between the prevalence of personality disorder among patients from the most affluent area (1.4%) compared with those from most deprived area (2.5%). In this study, personality disorder was not the main focus of research and no further significant examination on personality disorder was conducted. Also, only the distributions (%) of psychiatric diagnose in each area level were presented with no p-value or confidence intervals accompanied.

Population density is often used together with neighbourhood-level deprivation as a parameter of the urban environment. Some evidence has suggested that people who live in more densely populated areas are more like to have higher rates of psychiatric morbidity including schizophrenia (Vassos et al., 2012), psychosis/depression (Sundquist et al., 2004) and depression/anxiety (Walters et al., 2004). A US study examined the association between population density and mother-reported antisocial behaviours among youth, which can be a potential precursor for personality disorder. They found that youths who lived in more densely populated counties during ages 10-17 years reported significantly more 'delinquent behaviours' (Harden et al., 2009). However, apart from this, there is a general lack of research regarding the association between population density and personality disorder. When high population density is combined with poverty, the likelihood of conflicts among residents might become higher (Goldstone, 2002). Given that one of the main features of personality disorder is interpersonal problems, it is plausible to hypothesise that the risk of problems requiring clinical treatment will be elevated for people with personality disorder living in more densely populated areas. These circumstances may create more challenges for interacting with other people and deprivation may compound these pressures, particularly for people living in urban environments.

5.1.3 Aims and hypotheses

In summary, the evidence has demonstrated that there is a lack of studies on the prevalence of personality disorder that have used longitudinal clinical samples. There is a suggestion that the prevalence of personality disorder in clinical samples may be lower than reported in research studies which allowed relatively much more time to identify people with personality disorder amongst the general population. Also, only a small number of studies have examined whether neighbourhood-level deprivation is associated with the risk of personality disorder and most of them are older studies or used simple, unadjusted statistical approaches to assess any association.

Therefore, to address the gap in literature, I aimed to derive an estimate of ‘contact period prevalence of personality disorder diagnosis records’ (hereinafter, prevalence of personality disorder) over 8 years of follow up in a secondary mental health care. I used longitudinal electronic health register data collected in a NHS Foundation Trust in inner-city London, and population-level data for the same geographical area as the denominator. I aimed to adjust the estimates of the risk of having of personality disorder diagnosis in secondary mental health care setting for age, sex, and ethnic group distribution as well as the neighbourhood-level deprivation and population density.

The overall aims of this study were twofold:

1. To estimate the prevalence of a first diagnosis of personality disorder in secondary mental health care in population level.
2. To explore whether the prevalence of personality disorder is associated with neighbourhood-level deprivation and population density.

Hence, the research questions and corresponding hypotheses were as follows:

1. Does the frequency of personality disorder in clinical practice differ from research-based prevalence of personality disorder in the general population?

(H1: The frequency of personality disorder in secondary mental health care is likely to be lower than previously reported personality disorder prevalence among general population).

2. Does the frequency of personality disorder increase when people live in more deprived area?

(H2: The frequency of personality disorder will be higher in people who live in more deprived areas, based on recent findings by Walsh and colleagues (Walsh et al., 2013))

3. Does the frequency of personality disorder increase when people live in more densely populated area?

(H3: The frequency of personality disorder will be higher in people who live in more densely populated areas)

5.2 Methods

5.2.1 Design and setting

The data for this study were obtained from the Camden and Islington NHS Foundation Trust (C&I) and the data was extracted by using the Clinical Record Interactive Search (CRIS) application system. I have described more detailed information on C&I and the CRIS database in Chapter 4.

5.2.2 Participants

5.2.2.1 C&I CRIS sample

Inclusion criteria:

- People who presented to secondary mental health services at C&I between 2008-2016
- People who had a recorded diagnosis of personality disorder either in the ICD-10 structured field or text field (identified by NLP- see chapter 4).
- People who were 18 years old or older at the time of first recordings of personality disorder diagnosis in C&I
- People whose residential address was in Camden and Islington borough at the time of first recording of personality disorder diagnosis.

Exclusion criteria:

- Individuals who had a recorded diagnosis of organic personality disorder
- Individuals who had conditions classified as psychosis in ICD-10 (e.g. schizotypal personality disorder)

5.2.2.2 Population at risk

I estimated the population at risk in C&I using the 2011 Office for National Statistics (ONS) census data. The census is a count of all people and households (Office for National Statistics, n.d.) and describes the state of the whole nation, area by area (Rees et al., 2002). Census data is often used in research to define the denominator for a population. The UK Census has been conducted every 10 years since 1801 (Rees et al., 2002), and I used the census with available data closest to the time period of case ascertainment for my study which took place in 2011 (www.ons.gov.uk). I decided to stratify the census data by age, sex and ethnicity at MSOA level and used information provided in Table code DC2101EW. See below (5.2.3) for categorisation. Only people who were 18 years or older were included in this study.

5.2.3 Exposure variables

5.2.3.1 Demographic variables – age, sex, and ethnicity

I extracted demographic data including sex, age, ethnicity, and residential address at the time of first diagnosis of personality disorder for inclusion in my cohort. I defined age in C&I CRIS data as the age on the day a first personality disorder diagnosis was recorded in the electronic health record and calculated the age accordingly. In the census data, there were 15 age groups and I recategorized

them into 8 groups (18-19, 20-29, 30-39, 40-49, 50-59, 60-69, 70-79, 80 or over) both in CRIS data and census data. Sex was a binary variable of male or female. With regards to ethnicity, the lists of categories in CRIS data and the Census data were slightly different, with 17 ethnic groups in CRIS data after excluding ‘Not known’ and ‘Not recorded’, and 18 groups in the census data (with no ‘Not known’ or ‘Not recorded’ categories). As some of the categories were not directly comparable, they were re-categorized into 6 groups as follows: white British, white non-British, Black, Asian, mixed and any other ethnicity (Table 5.2).

Table 5.2 Ethnicity categories mapping

C&I CRIS (17 categories)	C&I Census (18 categories)	Regrouping (6)
<ul style="list-style-type: none"> ▪ White-British 	<ul style="list-style-type: none"> ▪ White: English/Welsh/Scottish/Northern Irish/British 	White British
<ul style="list-style-type: none"> ▪ White-Irish ▪ Any other White background 	<ul style="list-style-type: none"> ▪ White: Irish ▪ White: Gypsy or Irish traveller ▪ White: Other 	White-non British
<ul style="list-style-type: none"> ▪ Black or Black British – African ▪ Black or Black British – Caribbean ▪ Black or Black British – Any other Black background 	<ul style="list-style-type: none"> ▪ Black/African/Caribbean/Black British: African ▪ Black/African/Caribbean/Black British: Caribbean ▪ Black/African/Caribbean/Black British: Other Black 	Black
<ul style="list-style-type: none"> ▪ Asian or Asian British – Indian ▪ Asian or Asian British – Pakistani ▪ Asian or Asian British – Bangladeshi ▪ Chinese ▪ Asian or Asian British – any other Asian background 	<ul style="list-style-type: none"> ▪ Asian/Asian British: Indian ▪ Asian/Asian British: Pakistani ▪ Asian/Asian British: Bangladeshi ▪ Asian/Asian British: Chinese ▪ Asian/Asian British: Other Asian 	Asian
<ul style="list-style-type: none"> ▪ Mixed - White and Black African ▪ Mixed - White and Black Caribbean ▪ Mixed - White and Asian ▪ Mixed - Any other mixed background 	<ul style="list-style-type: none"> ▪ Mixed/multiple ethnic group: White and Black Caribbean ▪ Mixed/multiple ethnic group: White and Black African ▪ Mixed/multiple ethnic group: White and Asian ▪ Mixed/multiple ethnic group: Other Mixed 	Mixed
<ul style="list-style-type: none"> ▪ Other Ethnic Groups - Not stated ▪ Other Ethnic Groups - Any other ethnic 	<ul style="list-style-type: none"> ▪ Other ethnic group: Arab ▪ Other ethnic group: Any other ethnic group 	Other

5.2.3.2 Neighbourhood-level variables – neighbourhood deprivation and population density

The geographical areas of the data that I used in this chapter are Lower Layer Super Output Areas (LSOA) and Mid Layer Super Output Areas (MSOA). The minimum and maximum population for LSOAs is 1,000 and 3,000, and 5,000 to 15,000, for MSOAs. In the 2011 Census, there were 32,844 LSOAs and 6,791 MSOAs in England.

Information on residential neighbourhood was generated at LSOA level which was mapped from truncated postcode of patients' address at the time of the first personality disorder diagnosis at C&I. The ONS does not release the population data stratified by age, sex and ethnicity at areas lower than the MSOA level due to the potential for disclosure, whereas information on residential neighbourhood in the CRIS data are provided at LSOA level. Hence, I then used a conversion tool to map participants' LSOA to their corresponding MSOA, before linking their MSOA to their neighbourhood-level exposures described in the next section. I treated neighbourhood-level exposure as a continuous variable in the statistical analysis and also categorized them into quartiles in order to test for departure from linearity. Population density was used as a categorical variable with the four equal-interval groups.

Neighbourhood-level deprivation variables

Index of multiple deprivation (IMD)

The index of multiple deprivation (hereafter, IMD) is one of the most commonly used indices of deprivation in health research in the UK (Abel et al., 2016). It provides a combination of information on 37 variables in the following seven domains: income deprivation (22.5%), employment deprivation (22.5%), education, skills and training deprivation (13.5%), health deprivation and disability (13.5%), crime (9.3%), barriers to housing and services (9.3%), and lastly on living environment deprivation (9.3%) (Department for Communities and Local Government, 2015). Each country in the UK has their own version of IMD (Fairburn et al., 2016). In England, IMD measures relative deprivation for small areas called Lower-layer Super Output Areas (LSOA) and the greater the absolute IMD score is, the more deprived the area is. IMD scores are also presented in rank form and as deciles, based on the raw scores. For rank, every LSOA in England is ranked from 1 (most deprived) to 32,844 (least deprived), and for deciles, the 32,844 ranked LSOAs are divided into 10 equal groups, ranging from the most deprived 10% of neighbourhood of nationally and to the least deprived 10% of neighbourhood nationally. I did not use ranks or deciles of IMD in this chapter, and for each LSOA in catchment area of C&I, I estimated the MSOA mean score, weighted by the population size of each LSOA. The data were obtained from the latest release of English indices of deprivation 2015 provided by Ministry of housing, communities & local government.

Population density

Information on population density was also obtained from the total population recorded in the 2011 Census data, and data was available at the MSOA level. Population density was defined as number of persons per square kilometre and categorized into four groups with the same intervals (0-5,000; 5001-10,000; 10,001-15,000; and over 15,000 people per square kilometre).

5.2.3.3 Comorbid psychiatric diagnoses

I extracted information on the comorbid psychiatric diagnoses of those with personality disorder. They included substance use (ICD-10 code F10-19 Mental and behavioural disorders due to psychoactive substance use), severe mental illness (SMI) (F20-29 Schizophrenia, schizotypal and delusional disorders; F30 Manic episode; F31 Bipolar affective disorder) and common mental disease (CMD) (F32-48 Depressive episode; Recurrent depressive disorder; Persistent mood (affective) disorders; Other mood (affective) disorders; Unspecified mood (affective) disorders; Neurotic, stress-related and somatoform disorders). These comorbid psychiatric diagnoses were extracted from the ICD-10 structured field in the C&I CRIS dataset.

5.2.4 Outcome

Recordings of a personality disorder diagnosis: Information on diagnoses of personality disorder was extracted for the ICD-10 codes F60.0-F60.9 in the structured diagnosis field. This information was supplemented with data from free text notes using an NLP application (*See Chapter 4 for detailed information on the NLP application*) (Table 5.3).

Table 5.3 ICD-10 codes and diagnoses for personality disorder

Codes	diagnosis
F60.0	Paranoid personality disorder
F60.1	Schizoid personality disorder
F60.2	Dissocial personality disorder
F60.3	Emotionally unstable personality disorder <ul style="list-style-type: none">▪ Impulsive type▪ Borderline type
F60.4	Histrionic personality disorder
F60.5	Anankastic personality disorder
F60.6	Anxious (Avoidant)
F60.7	Dependent personality disorder
F60.8	Other specific personality disorder
F60.9	personality disorder, unspecified

5.2.5 Statistical analysis

First, I conducted descriptive statistics of demographic characteristics for people with personality disorder diagnosis, and I cross-tabulated with chi-squared tests to examine the frequencies and percentage of personality disorder diagnosis for each demographic variable. A complete case analysis was conducted, and people who had missing information in any of exposure variables including age, ethnicity, and neighbourhood of residence were excluded from the analysis.

Next, I used Poisson regression with the command 'xtpoisson' with personality disorder diagnosis, we the dependent variable. To derive the denominator for estimating prevalence, I used the 2011 UK census data stratified by age-sex-ethnicity. After combining CRIS data and population data, there were some strata where the number of cases both in the denominator and CRIS data was equal to zero. In those instances, I deleted those records since they contributed no useable information to the dataset. There was no strata where cases in CRIS data was larger than denominator.

The neighbourhood-level exposures, namely IMD scores and population density, were standardized computing z-scores (mean: 0, standard deviation: 1) and correlation between them was tested before conducting Poisson regression analysis in order to cure multicollinearity.

The models were fitted as follows: I used a forward-selection strategy to find the best fitting model. Initially fitted a null model to explore the variance of prevalence of personality disorder at the neighbourhood level. Then, I fitted univariable models for each exposure and a multivariable model with individual exposures. Lastly, I added neighbourhood-level exposures to the model to fit the final model. I assessed the model fit using likelihood ratio test (LRT) and retained exposures in the model if they improved the model fit. For each model, unadjusted risk ratios (RR) with 95% confidence intervals (95% Cis) were calculated. Further, additional models were fitted in order to examine whether there was a difference in any associations between neighbourhood-level deprivation and personality disorder in CRIS depending on the type of data source of personality disorder diagnosis, namely ICD-10 based structured field or NLP text-field.

In the final model, deviation from linearity of the continuous neighbourhood-level variables was tested by transforming continuous neighbourhood-level variables into categorical variables and comparing their Akaike Information Criterion (AIC) scores. Statistical analyses were performed using Stata version 16.

I conducted an additional sensitivity analysis to find out how comorbid psychiatric diagnoses may have affected on the association between neighbourhood-level deprivation and population density

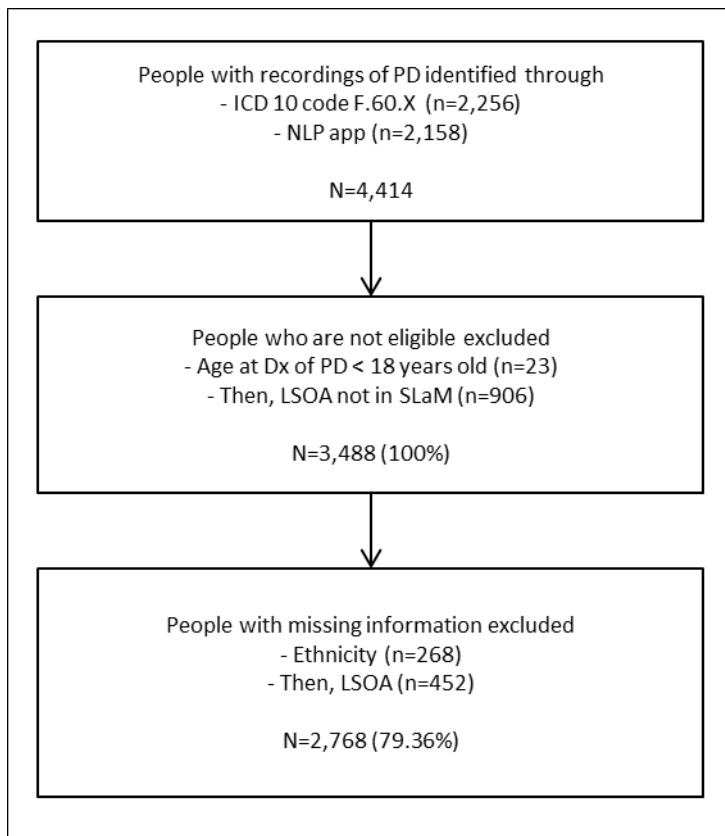
and the prevalence of personality disorder. I conducted two separate Poisson regression analyses – one for the people with comorbidities and the other for the people with no comorbidities.

5.3 Results

5.3.1 Personality disorder cohort identification

The number of people who had a recording of a personality disorder diagnosis in the CRIS system was 4,414 people and I excluded those who did not meet the inclusion criteria: being 18 years or older at the time of personality disorder diagnosis and having residential address in C&I. The number of people meeting eligibility criteria was 3,488 people and after excluding those with missing data the final complete case sample included 2,768 (79.4%) people. The process of identifying people with a personality disorder is described in **Figure 5.1** below.

Figure 5.1 Personality disorder cohort identification flow diagram



5.3.2 Number of people with personality disorder diagnosis records by data source

Overall, there were more people identified in ICD-10 structured field than open-text field. The difference in proportion of people with personality disorder diagnosis between ICD-10 structured field and open-text field in the whole cohort of people with personality disorder was 2.22% (**Table 5.4**). Among those who met inclusion criteria, the difference of proportion was 14.1% and in those who both met inclusion criteria and had no missing data, the difference was 17.64%.

Table 5.4 Frequency of personality disorder diagnosis records by each data source

	Total number of people with PD*		met eligibility criteria		Eligible & no missing	
	N	%	N	%	N	%
ICD-10 structure field (a)	2,256	(51.11)	1,992	(57.05)	1,628	(58.82)
Open text field (b)	2,158	(48.89)	1,498	(42.95)	1,140	(41.18)
Total	4,414	(100)	3,488	(100)	2,768	(100)
Difference (a-b)	98	(2.2)	494	(14.1)	488	(17.64)

*PD: personality disorder

5.3.3 Missing data

I identified 720 people (20.64%) with missing data in any of the exposure variables including age, ethnicity and residential neighbourhood. I found differences in the composition of sex ($p=.006$, **Table 5.5**). Both groups had more women than men, but the proportion of women was higher in those with complete data (60.48%) than those with missing data (54.86%). I found weak evidence ($p=0.060$) of difference in age distribution where the proportion of each age band was similar in two groups, with highest proportion in age band 20-29 (30.28%) in those with missing data and age band 30-39 (26.59%) in those with complete data. The composition of ethnicity between two groups also differed ($p=.001$). White British ethnicity had the largest proportion in both groups, but the proportion of white British was higher in people with complete data (53.36%) than those with missing data (46.02%).

Table 5.5 Descriptive characteristics of people with and without missing data among the sample with a CRIS record of personality disorder

	With missing data (n=720)		Without missing data (n=2,768)		p(χ^2 test)
	n	%	n	%	
Sex					0.006
Male	325	45.14	1,094	39.52	
Female	395	54.86	1,674	60.48	
Age					0.060
18-19	41	5.69	119	4.30	
20-29	218	30.28	713	25.76	
30-39	192	26.67	736	26.59	
40-49	144	20.00	667	24.10	
50-59	80	11.11	324	11.71	
60-69	23	3.19	121	4.37	
70-79	14	1.94	63	2.28	
80 or over	8	1.11	25	0.90	
Ethnicity					0.001
White British	208	46.02	1,477	53.36	
White non-British	118	26.11	614	22.18	
Black	44	9.73	269	9.72	
Asian	21	4.65	134	4.84	
Mixed	21	4.65	147	5.31	
Any other	40	8.85	127	4.59	

5.3.4 Contact period prevalence of personality disorder

The number of residents aged 18 or older in C&I neighbourhoods was 351,073, and there were 3,488 people who met the eligibility criteria of being aged 18 or older and with C&I postcode in C&I CRIS data. The prevalence of personality disorder diagnosis in C&I was calculated as 0.99% (95% CI: 0.96-1.02; **Table 5.6**).

Table 5.6 Prevalence of personality disorder in C&I

N of residents (age* ≥ 18)	N of people with personality disorder diagnosis	Prevalence	95% CI	Period
351,073	3,488	0.99	0.96-1.02	Jan.2008-Sep.2016

*Based on 2011 census data

5.3.5 Demographic characteristics of sample and population

The proportion of participants diagnosed with personality disorder who were women (60.48%) was much higher than in the population at risk in C&I (51.3%; $p < .001$; **Table 5.7**).

The distribution of age group also differed between people with personality disorder and population at risk ($p < .001$), especially in the age group of 40-49 with the biggest difference in proportion (7.7%). There was not much difference in the proportion between personality disorder sample and population at risk until age group 50-59, whereas the proportion became higher in population at risk in the age group of 60-69 or older.

As for ethnicity, the white British group was the largest single ethnic group both in personality disorder sample (53.36%) and population at risk (47.7%), and the white British group accounted for higher proportion of the personality disorder sample than that of the population at risk. In the other ethnic groups, the proportion between personality disorder sample and population at risk were similar except in Asian group where proportion in population at risk (12.6%) was much higher than in personality disorder sample (4.84%).

Table 5.7 Characteristics of people with a personality disorder (the complete case sample) in C&I & the population at risk in the boroughs of C&I

	People with personality disorder (N=2,768)		Population at risk in C&I (N=351,073)		P (χ^2 test)
	n	%	n	%	
sex					<.001
male	1,094	39.52	170,992	48.7	
female	1,674	60.48	180,081	51.3	
age					<.001
18-19	119	4.3	12,583	3.6	
20-29	713	25.76	97,983	27.9	
30-39	736	26.59	85,953	24.5	
40-49	667	24.10	57,664	16.4	
50-59	324	11.71	38,394	10.9	
60-69	121	4.37	29,184	8.3	
70-79	63	2.28	18,041	5.1	
80 or over	25	0.90	11,271	3.2	
Ethnicity					<.001
White British	1,477	53.36	167,424	47.7	
White non-British	614	22.18	81,910	23.3	
Black	269	9.72	29,987	8.5	
Asian	134	4.84	44,245	12.6	
Mixed	147	5.31	15,132	4.3	
Other	127	4.59	12,375	3.5	

5.3.6 Individual and neighbourhood-level associations with personality disorder in CRIS

In univariable modelling (**table 5.8**), I found personality disorder were more common in women (RR: 1.45; 95% CI: 1.35-1.57) compared with men. There was evidence that the age group 40-49 had an elevated risk of personality disorder (RR: 1.23; 95% CI: 1.01-1.49) compared with the youngest age group (18-19). However, many of other older age groups were less likely to have personality disorder diagnosis compared to age group 18-19 (age group 20-29, RR: 0.76; 95% CI: 0.63-0.93). With respect to ethnicity, white non-British (RR: 0.85; 95% CI: 0.78-0.94) and Asian ethnic group (RR: 0.33; 95% CI: 0.28-0.39) had a decreased risk of personality disorder compared to the white British group.

With respect to neighbourhood-level variables, IMD score in continuous form (RR: 1.29; 95% CI: 1.20-1.38) showed a positive association with personality disorder. However, no evidence of association between population density and personality disorder was observed.

Next, after adjusting for individual exposures (sex, age, and ethnicity), results remained very similar as in univariable modelling except for the age group 40-49 (RR: 1.18; 95% CI: 0.97-1.44) and Black ethnic group (RR: 0.81; 95% CI: 0.71-0.92).

Lastly, in the final best fitting model, adjusted for individual and neighbourhood-level deprivation and population density variables, women (RR: 1.52; 95% CI: 1.41-1.64) remained to have an elevated

risk of having a personality disorder compared to men. With respect to age group, many of older age groups (e.g. age group 20-29, RR: 0.75; 95% CI: 0.61-0.91) were less likely to have personality disorder compared with the youngest age group 18-19. As to ethnicity, the prevalence of personality disorder in people from other ethnic groups including white non-British, Black and Asian group was lower than the white British population in Camden and Islington. In the final model, I confirmed that the greater IMD score was, the greater the risk of having personality disorder diagnosis was (RR: 1.29; 95% CI: 1.20-1.39). I did not find any evidence of association between population density and personality disorder as in the univariable model.

Table 5.8 Predictors for having a personality disorder diagnosis- results from Poisson regression

variables	Unadjusted model		Adjusted model ¹⁾		Final model ²⁾	
	RR (95% CI)	p	RR (95% CI)	p	RR (95% CI)	p
Sex						
Male	1		1		1	
Female	1.45 (1.35-1.57)	<.001	1.52 (1.38-1.61)	<.001	1.52 (1.41-1.64)	<.001
Age group						
18-19	1		1		1	
20-29	0.76 (0.63-0.93)	.007	0.75 (0.61-0.91)	.003	0.75 (0.61-0.91)	.003
30-39	0.92 (0.75-1.12)	.40	0.92 (0.76-1.12)	.40	0.92 (0.76-1.12)	.40
40-49	1.23 (1.01-1.49)	.04	1.18 (0.97-1.44)	.10	1.18 (0.97-1.44)	.10
50-59	0.89 (0.72-1.10)	.29	0.84 (0.68-1.04)	.11	0.84 (0.68-1.04)	.11
60-69	0.44 (0.34-0.57)	<.001	0.41 (0.32-0.53)	<.001	0.41 (0.32-0.53)	<.001
70-79	0.37 (0.27-0.50)	<.001	0.34 (0.25-0.46)	<.001	0.34 (0.25-0.46)	<.001
80 or over	0.24 (0.16-0.37)	<.001	0.21 (0.13-0.32)	<.001	0.21 (0.13-0.32)	<.001
Ethnic group						
White British	1		1		1	
White non-British	0.86 (0.78-0.94)	.001	0.81 (0.73-0.89)	<.001	0.81 (0.73-0.89)	<.001
Black	0.94 (0.82-1.07)	.34	0.81 (0.71-0.92)	.002	0.81 (0.71-0.92)	.002
Asian	0.33 (0.28-0.39)	<.001	0.30 (0.25-0.36)	<.001	0.30 (0.25-0.36)	<.001
Mixed	1.07 (0.90-1.26)	.46	0.95 (0.80-1.13)	.59	0.95 (0.80-1.13)	.59
Any other	1.13 (0.94-1.36)	.19	1.02 (0.85-1.22)	.84	1.02 (0.85-1.22)	.84
IMD score*	1.29 (1.20-1.38)	<.001			1.29 (1.20-1.39)	<.001
Population density						
0-5,000 ppsqkm**	1				1	
5,001-10,000 ppsqkm	1.29 (0.74-2.23)	.37			<i>1.20 (0.80-1.80)</i>	.37
10,001-15,000 ppsqkm	1.26 (0.76-2.07)	.37			<i>0.89 (0.61-1.29)</i>	.54
15,001-max ppsqkm	1.52 (0.92-2.52)	.10			<i>1.00 (0.68-1.46)</i>	.99

¹⁾Adjusted for sex, age, and ethnicity, ²⁾Adjusted for sex, age, ethnicity, and IMD score,

*: standardized score, **: people per square kilometre

5.3.7 Individual and neighbourhood-level associations with personality disorder in CRIS by data source

Next, in order to examine whether the association between personality disorder diagnosis and neighbourhood-level deprivation differed depending on the source of personality disorder diagnosis, i.e. whether they were from ICD-10 structured field or open text-field, I also conducted two separate Poisson analyses exactly in the same way I did with the combined data (**Table 5.9**). I found an association between neighbourhood-level deprivation and personality disorder diagnosis in each source of personality disorder diagnosis, as was in both sources combined. These congruent results may imply that people who live in more deprived areas are more likely to have a personality disorder diagnosis not only when their diagnosis was recorded in structured field but also in open text field where clinicians have more liberty to record a diagnosis. This result may support the validity of identifying diagnoses from clinical notes via NLP.

Table 5.9 Poisson regression analysis for each source of personality disorder diagnosis

variables	ICD-10 structured field (N=1,628)		Text field (N=1,140)		Both combined (N=2,768)	
	RR (95% CI)	p	RR (95% CI)	p	RR (95% CI)	p
Sex						
Male	1		1		1	
Female	1.93 (1.74-2.13)	<.001	1.10 (0.98-1.24)	.10	1.52 (1.41-1.64)	<.001
Age group						
18-19	1		1		1	
20-29	0.69 (0.54-0.87)	.002	0.85 (0.60-1.20)	.36	0.75 (0.61-0.91)	.003
30-39	0.82 (0.64-1.04)	.10	1.12 (0.79-1.58)	.53	0.92 (0.76-1.12)	.40
40-49	0.93 (0.73-1.18)	.53	1.71 (1.21-2.41)	.002	1.18 (0.97-1.44)	.10
50-59	0.58 (0.44-0.76)	<.001	1.41 (0.99-2.02)	.06	0.84 (0.68-1.04)	.11
60-69	0.29 (0.20-0.40)	<.001	0.68 (0.45-1.03)	.07	0.41 (0.32-0.53)	<.001
70-79	0.27 (0.19-0.41)	<.001	0.48 (0.29-0.80)	.004	0.34 (0.25-0.46)	<.001
80 or over	0.16 (0.09-0.28)	<.001	0.31 (0.16-0.61)	.001	0.21 (0.13-0.32)	<.001
Ethnic group						
White British	1		1		1	
White non-British	0.72 (0.63-0.81)	<.001	0.95 (0.82-1.10)	.46	0.81 (0.73-0.89)	<.001
Black	0.66 (0.55-0.79)	<.001	1.05 (0.87-1.28)	.62	0.81 (0.71-0.92)	.002
Asian	0.27 (0.21-0.34)	<.001	0.37 (0.29-0.49)	<.001	0.30 (0.25-0.36)	<.001
Mixed	0.94 (0.76-1.17)	.59	0.97 (0.73-1.28)	.82	0.95 (0.80-1.13)	.59
Any other	0.98 (0.77-1.24)	.87	1.08 (0.81-1.45)	.58	1.02 (0.85-1.22)	.84

IMD score*	1.29 (1.18-1.41)	<.001	1.27 (1.17-1.38)	<.001	1.29 (1.20-1.39)	<.001
Population density						
0-5,000 ppsqkm**		1		1		1
5,001-10,000 ppsqkm	1.01 (0.63-1.61)	.98	1.68 (1.02-2.78)	.04	1.20 (0.80-1.80)	.37
10,001-15,000 ppsqkm	0.75 (0.49-1.16)	.20	1.19 (0.74-1.92)	.47	0.89 (0.61-1.29)	.54
15,001-max ppsqkm	0.82 (0.52-1.280)	.39	1.37 (0.84-2.22)	.20	1.00 (0.68-1.46)	.99

*: standardized score

5.3.8 Departure from linearity

I found no evidence that the observed association between personality disorder diagnosis and neighbourhood-level deprivation in the final model showed a departure from linearity when I refitted the final model with categorical variables. The AIC scores of the final model with continuous neighbourhood-level deprivation was 6912.44, and 6922.22 for the final model when categorical neighbourhood-level deprivation was fitted.

5.3.9 Comorbid psychiatric diagnoses and neighbourhood-level deprivation and population density

I found 1,571 people with comorbid psychiatric diagnoses among those 2,768 people with personality disorder (**Table 5.10**). CMD (31.8%) was more common psychiatric comorbidity among those with personality disorder than SMI (21.7%) or substance use (19.5%).

Table 5.10 Comorbid psychiatric diagnoses

	Total (N, %)	The source of personality disorder diagnosis	
		ICD-10 structured field (N)	NLP application (N)
Substance use (F10-19)	539 (19.5%)	363	176
SMI* (F20-29, F30, F31)	600 (21.7%)	284	316
CMD** (F32-48)	886 (31.8%)	609	277

*SMI: severe mental illness, **CMD: common mental disorders

Finally, I conducted a sensitivity analysis to examine whether the association between neighbourhood-level deprivation and population density and personality disorder was affected when comorbid psychiatric diagnoses were accounted for. I conducted two separate Poisson analyses on two groups of people – one with comorbidities and the other without comorbidities (**Table 5.11**). I found that the association between neighbourhood-level deprivation and personality disorder was not affected by comorbid psychiatric diagnoses in both groups (RR: 1.22; 95% CI: 1.12-1.33, RR: 1.38;

95% CI: 1.27-1.50). There was still no evidence of association between population density and personality disorder when adjusted for comorbid psychiatric diagnoses.

Table 5.11 Effect of comorbid psychiatric diagnoses on the predictors of personality disorder

variables	People with comorbidities (N=1,571)		People without comorbidities (N=1,197)	
	RR (95% CI)	p	RR (95% CI)	p
Sex				
Male	1		1	
Female	1.38 (1.25-1.53)	<.001	1.73 (1.41-1.64)	<.001
Age group				
18-19	1		1	
20-29	0.84 (0.63-1.13)	.25	0.66 (0.61-0.91)	.002
30-39	1.16 (0.87-1.56)	.31	0.72 (0.76-1.12)	.01
40-49	1.66 (1.24-2.22)	.001	0.79 (0.97-1.44)	.08
50-59	1.18 (0.87-1.60)	.30	0.57 (0.68-1.04)	<.001
60-69	0.64 (0.45-0.91)	.01	0.22 (0.32-0.53)	<.001
70-79	0.52 (0.35-0.79)	.002	0.19 (0.25-0.46)	<.001
80 or over	0.26 (0.14-0.46)	<.001	0.16 (0.13-0.32)	<.001
Ethnic group				
White British	1		1	
White non-British	0.73 (0.64-0.83)	<.001	0.90 (0.78-1.04)	.14
Black	0.84 (0.71-0.997)	.05	0.76 (0.62-0.94)	.01
Asian	0.28 (0.22-0.36)	<.001	0.33 (0.26-0.43)	<.001
Mixed	1.07 (0.86-1.33)	.55	0.81 (0.62-1.07)	.14
Any other	0.98 (0.77-1.26)	.90	1.05 (0.80-1.39)	.71
IMD score*	1.22 (1.12-1.33)	<.001	1.38 (1.27-1.50)	<.001
Population density				
0-5,000 ppsqkm**	1		1	
5,001-10,000 ppsqkm	1.09 (0.63-1.61)	.70	<i>1.57 (0.90-2.72)</i>	.11
10,001-15,000 ppsqkm	0.73 (0.49-1.16)	.13	<i>1.29 (0.77-2.17)</i>	.33
15,001 – max ppsqkm	0.90 (0.52-1.280)	.61	<i>1.28 (0.75-2.17)</i>	.36

*: standardized score, **: people per square kilometre

5.4 Discussion

5.4.1 Summary of findings

The findings were partially consistent with the initial hypotheses. First, I found the prevalence of personality disorder diagnosis in a secondary mental health care in North London to be 0.99% (95% CI: 0.96-1.02) during 8 years of follow up between 2008 and 2016. This finding was consistent with the hypothesis that the prevalence of personality disorder using a clinical sample would be lower than the previously reported prevalence from studies based in community settings (4.4%-21.2%). I also found that there was evidence that people from more deprived neighbourhoods were more likely to have a personality disorder diagnosis compared with those from less deprived areas, as hypothesized. This relationship remained consistent when I separately analysed the data for each data source i.e., structured diagnostic fields and free text mentions of personality disorder. However, contrary to my hypothesis, I found no significant association between population density and the prevalence of personality disorder in secondary care. Further, women were more likely to have personality disorder diagnosis compared with men, and white British group had elevated risk of personality disorder diagnosis compared with those with white-non British, Black and Asian ethnicity. I also found that people who were 18-19 years old when they were first diagnosed with personality disorder were more likely to have personality disorder diagnosis compared with some older groups. The result of sensitivity analysis controlling for comorbid psychiatric diagnoses confirmed the findings that neighbourhood-level deprivation was a predictor for having a personality disorder, but population density was not associated with prevalence of personality disorder.

5.4.2 Implication of findings

5.4.2.1 Prevalence of personality disorder

The findings supported two out of my three hypotheses. First, my expectation that there would be a lower prevalence of personality disorder than previous reports was supported by the results in this study. The prevalence of personality disorder in the present study was much lower than previously reported prevalence of personality disorder in the general population as described earlier in the introduction of this chapter. There are various possible explanations for this discrepancy.

First, the major reason for this discrepancy may stem from the fact that I used a clinical diagnosis which was routinely collected during clinical practice in secondary mental health services, whereas previous studies used data collected mainly for research. Diagnosis of personality disorder is difficult and complex. It can require long hours and numbers of observations before clinicians feel confident to make a diagnosis of personality disorder. It is often only people with severe symptoms such as

repeated self-harm who are seen by secondary care service and receive treatment, and people with moderate symptoms which are close to the threshold for secondary care clinical services might not be referred to, or taken on, by specialist mental health clinicians. The majority of people with personality disorder who are seen in the NHS may be managed within primary care and only those who present with most significant distress or difficulties will be referred to secondary services (NIMH(E), 2003; Reich et al., 1990). Therefore, only those who met threshold for diagnosis of personality disorder will have a record of personality disorder diagnosis in the CRIS system, and people who meet the criteria for personality disorder but are not referred to the Trust would not be included in the analysis in this study. These may explain some of the lower prevalence of personality disorder in this study.

Second, the low prevalence might be explained by clinician's disinclination to make a personality disorder diagnosis. The clinician's decision to make a diagnosis will have consequences in terms of future treatment and possibly stigma so they might try to avoid unnecessary errors or over-diagnosis. Clinicians are known to be reluctant to make a diagnosis of personality disorder because it is considered to entail stigma for the people diagnosed with personality disorder and people with personality disorder diagnosis are sometimes considered to be problematic patients (Paris, 2007). The lower prevalence of diagnoses of personality disorder may reflect the fact that clinicians did not want to label patients unless their pathology is severe, or it may harm the person with personality disorder or people around them. Personality disorder is a relatively common mental disorder, but it is rarely very severe, and therefore it is more likely to go undiagnosed (Giles Newton-Howes et al., 2010). Further, personality disorder is known to associated with a number of comorbidities such as psychosis and bipolar and when someone has two conditions including personality disorder, it may be more likely that clinicians will choose to enter the other condition rather than personality disorder if it entails less stigma or if the other condition is more prominent. In a study conducted with a sample of 102 lay people in which they completed a vignette-identification task, participants showed lowest sympathy rating toward people with personality disorder compared to people with depression or schizophrenia (Furnham et al., 2015).

Also, clinicians often have to rely solely on the evidence from routine clinical evaluations in making a diagnosis of personality disorder as assessment of personality disorder through structured interview requires much more time, and thus the results of diagnosis may be affected by assessment methods used in assessing diagnosis. This was demonstrated in one research study which clinicians were less likely to diagnose borderline personality disorder when they conducted routine unstructured clinical evaluations in comparison to other group of clinicians who were presented detailed information from semi-structured interviews on top of their clinical evaluation (Zimmerman & Mattia, 1999).

Also, another study (Westen, 1997) observed a divergence between clinicians and researchers in making a diagnosis of personality disorder in which clinicians found listening to patient's narratives on their interpersonal interactions in real life and observing interpersonal behaviours during treatment more useful in making a diagnosis of personality disorder than questions derived from various diagnostic methods.

5.4.2.2 *Neighbourhood-level deprivation/population density and personality disorder*

I found personality disorder diagnosis were associated with higher neighbourhood-level deprivation. This association might be looked at in relation to two classic theories on poverty and mental health (Dohrenwend et al., 1992), which are proposed as the social causation and social selection/drift mechanisms. The social causation theory proposes the adverse social and economic conditions of poverty such as financial stress and adverse life events increases psychiatric disorders (Dohrenwend et al., 1992; Lund & Cois, 2018). We might be able to link this to early childhood development and the relationship between child and their parents/caregivers. One of the most well-known predictors for personality disorder is abuse in any form, sexual, physical or verbal, during childhood and (Luntz & Widom, 1994; Tyrka et al., 2010; Waxman et al., 2014). People who live in deprived neighbourhoods are more likely to be poor, and it is likely that economic disadvantage imposes increased stress on these populations. When they are parents with children, these stresses may increase the risk of harsh parenting and weaken parents' emotional ability to meet their children's needs (Aber et al., 1997; Murali & Oyebode, 2004) which may inhibit them from forming a secure attachment with their children. A secure relationship between primary carer, mostly parents, and their children early in life affects development of personality, and when children grew up in an insecure attachment environment they are more likely to show unstable personality traits as adults (Young et al., 2019). Further, children growing up in a high-poverty communities may be at elevated risk of harmful socioeconomic consequences of poverty such as crime and violence, arrest, substance use (Drake & Rank, 2009). Thus, personality difficulties may become more common or more often manifested among those who grew-up in extremely poor neighbourhood, which would lead them to more detection and referrals for care. The social causation theory could also be applied to the effect of living environment on individuals' wellbeing who live in it. Physical features of neighbourhoods such as quality of housing, access to basic resources, and safe living conditions are important determinants of well-being (Cutrona et al., 2006). When these basic conditions of well-being are not met, people are exposed to increased stress. People living in poor neighbourhood have less access to resources and have limited social support which would induce further stress on them. Stress has been shown to increase negative evaluations about other people and people with personality disorder have been shown to have higher negative emotions when stress was induced

(Deckers et al., 2015). One of the main elements of personality disorder is problems in interpersonal relations and this vulnerability of people with personality disorder against stress might worsen the symptoms of personality disorder when people with personality disorder living in poor neighbourhood encounter interpersonal disputes, as personality stems from the interaction of a person and his/her environment (Salling & Harvey, 1981).

On the other hand, however, the social selection/drift theory proposes a converse idea that people with psychiatric disorders drift down in social class status or fail to rise out of low social class and move into more deprived areas after the onset of the illness (Dohrenwend et al., 1992; Fox, 1990; Lapouse et al., 1956; Sariaslan et al., 2016). This drift hypothesis might also apply to people with personality disorder. People with personality disorder might move into more deprived area because of their disability and symptoms, reduced economic productivity and employment stability, and increased stigma induced by the clinical features of their illness or because they need local authority housing which might be located in more deprived areas.

Lastly, another possible explanation for the association between personality disorder diagnosis and neighbourhood-level deprivation might be that clinicians might be exposed to the bias that they are more likely to diagnose people with personality disorder if they are from poor neighbourhood than those from less deprived area when they present similar symptoms. As discussed in the introduction, personality disorder is a mental disorder which is more difficult to diagnose and requires much time and thought before clinicians reach diagnosis. Clinicians often have to make rapid decisions about their patients either due to seeing them in a medical emergency setting or because they have to see many patients in a limited time (J. G. Klein, 2005), and during this process of decision making, it is possible that a bias can happen. For example, it was reported that psychiatrists can be prone to confirmation bias, which is a tendency to confirm a favoured hypothesis, and this tendency may lead to poorer diagnostic accuracy (Mendel et al., 2011). So, it is possible that diagnosis of personality disorder is more likely to be made on people from poorer neighbourhood if the clinicians are influenced by this hypothesis that people from poor area are more likely to have personality disorder. Another potential bias may be representativeness heuristics, which is assuming that something belongs to a certain category if it seems similar to other things in that category (J. G. Klein, 2005). When patients come from poorer neighbourhoods with presenting symptoms that are most common among people with personality disorder such as self-harm or antisocial behaviours, clinicians may be more likely to be susceptible to the idea that these people may be afflicted by personality disorder and more likely to assign this diagnosis. However, evidences of bias in mental health is sparse and I only found a small number of studies which raised an issue of possible bias

against ethnicity and class in mental health (Blow et al., 2004; Kugelmass, 2016; Merino et al., 2018; Snowden, 2003).

With regards to population density, when adjusted for individual demographic variables and neighbourhood-level deprivation, population density was not associated with personality disorder as in univariable analysis, and this might indicate people with personality disorder are more likely to be affected by factors of poverty rather than how densely the area is populated.

5.4.2.3 Correlates of personality disorder

I found women were more likely to have personality disorder compare with men in Camden and Islington population and this is partially consistent with previous reports as the prevalence of personality disorder in each sex differs across studies and types of personality disorder (Coid et al., 2006; Ekselius et al., 2001; Grant et al., 2008; H. J. Jackson & Burgess, 2002; Lenzenweger et al., 2007; Samuels et al., 2002; Torgersen et al., 2001; Torvik et al., 2015). Prevalence of personality disorder is higher in women in clinical services, presumably because more women than men are seeking help with presenting repeated self-harming behaviour (Tyrer et al., 2015), but I found no concrete result on the gender difference in prevalence of personality disorder in population-based studies.

With regards to ethnicity, personality disorder was more common in people of white British ethnicity compared to people with White non-British, Black, Asian ethnic group, and this was also consistent with prior studies. A systematic review that examined studies on personality disorder and race/ethnicity found a significant difference between black and white ethnic groups (OR: 0.48; 95% CI: 0.25-0.92) (McGilloway et al., 2010). Also, in the SEPEA study in chapter 3, the prevalence of personality disorder was more common in white British people compared to black and minority (BME) ethnic group. However, there was large difference ($p < .001$; **Table 5.5**) in the proportion of ethnicity composition between people with missing data and those without, especially in white British ethnic group (7.84% larger in without missing data), and it is possible this might have affected the relationship between personality disorder and ethnicity.

5.4.3 Strengths and limitations

To my best knowledge, this is the first study that has investigated the prevalence of personality disorder in a large prospective cohort of people in secondary mental health services in inner city London. Previous studies on prevalence of personality disorder are based on data obtained for research purposes, and there have been no reports of prevalence of personality disorder with data drawn from routine clinical practice covering an entire secondary mental health system over a long period of time serving a defined population. Also, by using the CRIS data, I was able to include not

only those with diagnosis records in ICD-10 structured-field but also those with diagnosis written in the clinical notes extracted via NLP application. Using data collected from clinical practice, however, is also a limitation in this study. As discussed earlier, diagnosing personality disorder is complex, and it is not uncommon that clinicians make personality disorder diagnosis without using a structured interview such as SCID-II due to time constraints. Also, there is no clear-cut distinguishing symptomology between each of the types of personality disorder and these symptomologies also overlap much with other mental disorders including depression, anxiety and even some psychotic disorders. Hence, diagnosing personality disorder often relies on clinician's subjective judgement and it is not always clear who gets diagnosis of personality disorder and who does not. This may allow bias induced by different tendencies of clinicians and no inter-rater reliability was tested. So, I cannot exclude the possibility of underestimation of personality disorder in the sample. However, I tried to overcome this limitation by examining data from both structured field and open-text field in the CRIS data. The number of people who had personality disorder diagnosis in the open-text field was almost equivalent as those in structured field, and they could have been overlooked if I extracted the data only from the structured field. Clinicians in mental health services record much information in open text field rather than structured field (Perera et al., 2016) and this may be more true for personality disorder which clinicians are not inclined to make a diagnosis for reasons discussed earlier. I also replicated the Poisson regression that I did with the data from the combined source to check the validity of the findings across data sources, and the association between personality disorder and neighbourhood-level deprivation observed in combined dataset remained consistent when I analysed the data from each data source separately.

Second, as discussed earlier, the data in this study were drawn from routinely collected administrative and clinical record rather than from a study specifically designed for research purposes. Therefore, they either do not contain or may have missed important variables related to information on individual socioeconomic status such as income, education, or marital status, which could have had an impact as a confounding variable on the association between prevalence of personality disorder and neighbourhood-level deprivation. Such data on individual SES are not routinely available for most people using clinical services.

With regards to the neighbourhood-level variables, I used the address at the time of first diagnosis of personality disorder, and it is difficult to know how long a person has lived at that address. So, it is not possible to identify whether someone with a personality disorder had previously lived in less deprived area may have moved into poor neighbourhood just before being diagnosed with personality disorder, or vice versa. I might be able to overcome this issue by comparing the address of participants at their first personality disorder diagnosis with their prior address and examine

whether there has been any change in their deprivation score. Social drift theory may suggest there would be deterioration in deprivation level while social causation theory would suggest there would not be much change in the deprivation level. Also, it is possible some of the addresses provided might not be their genuine address, but the address of their family and friends, especially considering many people with personality disorder are reported to be homeless as discussed earlier. This may limit the certainty of the findings of association between prevalence of personality disorder and neighbourhood-level deprivation in this study.

Further, the IMD scores, which I used to measure the level of neighbourhood deprivation, may not be the optimal variable for assessing the deprivation of an individual's area of residence. Although it is widely used in health research and has various advantages as an indicator of deprivation, it is also criticised for having ecological fallacy (Fairburn et al., 2016). Under area-based indicator of deprivation such as IMD, it is assumed that all people who live in the same neighbourhood have same experience in all the domains of IMD when it is possible that this is actually not true.

Additionally, people with recordings of personality disorder diagnosis in CRIS data are the people who had access to the different level of pathways into care, and therefore, it is possible that those with personality disorder symptoms in the community who were not in contact with the secondary service are not included in the prevalence in this study either because they did not seek help or their symptoms were not severe enough to be detected by secondary services. Also, people who were only treated in the primary care or private services would not have been included in this study. So, it is possible all these people not included in this study could have affected the low prevalence of personality disorder in the present study. However, this may also suggest my findings are valid in relation to personality disorder that is severe enough to warrant secondary mental health care.

In terms of methodological perspective, 20.1% of sample had missing information in their age, ethnicity or address of residence, and I chose to conduct a complete case analysis. Although complete case analysis is the most commonly used method when analysing data with missing information (Pigott, 2001), this method may also introduce bias in estimating the parameters unless data are missing complete at random (MCAR) or the sample is large enough (Kang, 2013). Although, this study has a large sample size, the data are far from MCAR. Therefore, the way I handled the missing data could have biased the result of this analysis. However, this might also reflect the difficulties encountered when using clinically collected data which often entail a large quantity of missing data.

Along these lines, there was a large quantity of people whose data in residential neighbourhood were missing, and this number was much larger than those with missing data in the other exposure

variable, ethnicity. This might corroborate earlier reports that people with personality disorder are more likely to have no fixed abode (Adlam & Scanlon, 2005; Herzberg, 1984), and it may not be that those residential information is missing, but that many numbers of people with personality disorder genuinely do not have address of residence.

Lastly, the sample was drawn from a NHS Foundation Trust in London, which is an urbanized, ethnically diverse and culturally heterogeneous mega city. Thus, it may not be generalizable to other cohort with a composition of different neighbourhood-level characteristics which are being rural or not having a large variety of ethnicity or culture.

5.5 Conclusion

I examined contact period prevalence of personality disorder in a secondary care clinical mental health Trust in UK and found the frequency of personality disorders to be much lower than those previously reported in research studies. The difference in the prevalence between present study and previous studies may indicate that there are people with symptoms of personality disorder but not receiving care from secondary care mental health service. Hence, appropriate care and treatment may not be provided to those people in the Boroughs I studied. I also identified that personality disorder was more prevalent in people from deprived neighbourhood compared to those from wealthier areas. This may highlight the adverse effect of social inequality on presentations of personality disorder (or the social disadvantage associated with experiencing personality disorder). It may also suggest that disadvantaged background of these people may be one of the factors which influence their pathways into care or diagnosis they receive.

Chapter 6 Neighbourhood-level deprivation and outcomes of personality disorder using C&I CRIS data

6.1 Introduction

In this chapter, I examine whether neighbourhood-level deprivation and population density are associated with measures of prognosis of personality disorder including mortality and subsequent acute psychiatric admission after personality disorder diagnosis using clinical data obtained from a secondary mental health service in north London.

6.1.1 Personality disorder and mortality

As I have briefly discussed in chapter one, there is little research examining long-term clinical outcomes such as mortality, medication or subsequent psychiatric admission among people with personality disorder. One of the outcomes that have been studied is mortality. Previous studies have reported people with personality disorder are more like to have high mortality from both natural and unnatural causes with a standardised mortality ratios (SMRs) in the range of 3.7-6.1 for women, and 3.5-5.0 for men, respectively (C. Björkenstam et al., 2015; E. Björkenstam et al., 2015; Fok et al., 2012). For instance, a UK study which examined life expectancy of people with personality disorder diagnosis using a large psychiatric case register in South London found people with personality disorder diagnosis had a shorter life expectancy, with 17.7 years in men and 18.7 years in women, respectively, compared with the general population; the overall standardised mortality ratios (SMRs) for people with personality disorder diagnosis was 4.2 (95% CI: 3.03-5.64) (Fok et al., 2012). Also, two Swedish national register studies which examined causes of mortality in personality disorder found that people with personality disorder diagnoses had increased mortality risk compared with the general population in both in-patient settings with all-cause SMRs of 6.1 (95% CI: 5.8-6.4) for women and 5.0 (95% CI: 4.7-5.2) for men (Björkenstam et al., 2015), and outpatient settings with all-cause SMRs of 3.7 (95% CI: 3.3-4.1) for women and 3.8 (95% CI: 3.4-4.2) for men, respectively (C. Björkenstam et al., 2015). Another study which used national psychiatric registers from Denmark, Finland and Sweden to examine excess mortality among 270,770 psychiatric patients found that people with personality disorder diagnosis had reduced life expectancy ranged between 13.0 and 21.9 years for men, and 14.5 and 20.0 years for women, respectively, in comparison with the general population (Nordentoft et al., 2013). Further, in a Danish population-based study, the authors examined the association between mental illness and death by unnatural causes including homicide, suicide and accident among 72,208 psychiatric patients; the study suggested that people with personality disorder were at increased risk of dying by unnatural causes along with other psychiatric

illnesses (Hiroeh et al., 2001). During this period, 17,892 (25%) people died from unnatural causes, and 2,532 (3.51%) people had personality disorder diagnosis at their first admission. Of these unnatural deaths among people with personality disorder, 33 (1.30%) were by homicide, 2,016 (79.62%) by suicide, and 483 (19.08%) by accident. The SMRs in women and men with a personality disorder diagnosis, respectively, were: 536 (95% CI: 311-922) and 782 (95% CI: 499-1,226) for homicide, 1,198 (95% CI: 1,128 – 1,272) and 1,568 (1,471 – 1,672) for suicide, and 406 (95% CI: 361-455) and 465 (95% CI: 404-535) for accident.

Many studies regarding mortality in people with personality disorder have focussed on borderline personality disorder (BPD). For example, a Danish study followed 10,545 subjects with a personality disorder diagnosis for a mean time of 7.98 years using a nationwide psychiatric register, and found the SMR of patients with BPD was 8.3 (95% CI 7.6-9.1) compared with the general population (Kjær et al., 2018). Also, a meta-analysis of eight studies on BPD reported that people with BPD had higher suicides rates in comparison with the general population (Pompili et al., 2005). In this study, the number of suicides were calculated as suicides x 100,000/number of patients in the study x follow up, and the mean of suicides in people with BPD was 898 (Standard deviation (SD)=660) and 16.6 in the general population (SD=6). Further, a recent US prospective cohort study suggested that people with BPD were at elevated risk of dying prematurely from suicide or other causes (Temes et al., 2019). In this study, a cohort of 290 adults with BPD and 72 comparison subjects with personality disorder who were recruited during their inpatient admission between 1992 and 1995 were followed and reassessed every two years for over 24 years and 19.9% of people with BPD were found to have died prematurely, by suicide (5.9%) and by non-suicide cause (14.0%), respectively.

6.1.2 Personality disorder and readmission to acute mental health care

Another outcome of personality disorder that has been investigated is readmission, although once again there are not many published studies. In terms of risk factors for admission, a Spanish study examined a total of 11,578 visits to a psychiatric emergency unit in Barcelona and reported that factors associated with the decision to hospitalize people with BPD included high risk of suicide (10.33; 95% CI: 6.38–16.71), danger to others (OR: 2.55; 95% CI: 1.59–4.11), severity of symptoms (OR: 3.58; 95% CI: 1.67–6.40), difficulty with self-care (OR: 5.14; 95% CI: 2.54–10.39), and non-compliance with treatment (OR: 4.50; 95% CI: 1.89–10.69) (Pascual et al., 2007). As for readmission, in a large prospective cohort study of 7,000 subjects conducted in Norway, the authors explored predictors of frequency and time to readmission to the acute psychiatric department at a university hospital among people with a BPD diagnosis using Health of the Nation Outcome Scale (HoNOS) scores. They found that the frequency of readmission in people with a diagnosis of BPD was

predicted by higher score on self-harming behaviour ($B=0.13$; $P=0.005$) and time to admission was associated with higher score on symptoms of depression (HR: 1.18; 95% CI: 1.04-1.35), and hallucinations and delusions (HR: 1.13; 95% CI: 1.01-1.26) (Furnes et al., 2019).

The evidence regarding the association between personality disorder diagnosis and readmission is mixed. For example, a retrospective Finnish study of 64 subjects with diagnosis of personality disorder and non-psychotic illness over 5 years of follow-up found that diagnosis of personality disorder at first admission was not associated with readmission ($p=0.7$) (Korkeila et al., 1995). However, this study lacked detailed information on statistical analyses except mentioning the use of a log-linear model and an associated p-value. On the other hand, in a Canadian study of young people (mean age 17.73 years old, SD 1.20) admitted to psychiatric hospitals, young people with personality disorder were more likely to stay longer ($\beta = .05$; $t = 2.35$; 95% CI: 0.02-0.22) and to be readmitted (Exp(B): 2.02; 95% CI: 1.58-2.59) when compared with those without personality disorder diagnosis (Stewart et al., 2014). Also, a UK study examined predictors of early readmission with 7,891 sample from an electronic psychiatric patient records in South London, and found that people with a personality disorder diagnosis had an increased risk of readmission in the 90 days after hospital discharge (OR: 1.57; 95% CI: 1.17-2.09) relative to those diagnosed with schizophrenia (Tulloch et al., 2016).

6.1.3 Neighbourhood-level social deprivation and its association with outcomes in people with personality disorder

Both neighbourhood-level deprivation and population density have been reported to be inversely related to mortality rates in the general population. For example, a Dutch study that examined the relationship between neighbourhood socioeconomic status and all-cause mortality found that people living in neighbourhoods with a higher percentage of persons with unemployment/disability (OR: 1.78; 95% CI: 1.26-2.52) and persons who reported severe financial problems (OR: 1.47; 95% CI: 1.07-2.02) were more likely to have a higher mortality risk compared with those living in areas with lowest percentage of unemployment/disability and severe financial problems (Bosma et al., 2001). Also, evidence suggests that higher population density is related to higher mortality and predictors of increased mortality included motor vehicle accidents (Clark, 2003; Gedeberg et al., 2010), elevated urban stress and smoking (Beenackers et al., 2018) and health disparities between neighbourhoods (Nakaya et al., 2014). However, there is a lack of research on how neighbourhood-level deprivation or population density were associated with the risk of mortality among people diagnosed with mental health problems including personality disorder. Similarly, to my knowledge, previous research on the association between neighbourhood-level social deprivation and the

readmission rates of people with personality disorder after personality disorder diagnosis is also sparse.

6.1.4 Aims and research questions

Our understanding on prevalence of personality disorder is growing, albeit slowly, but knowledge on the clinical outcomes of personality disorder such as mortality and hospitalization after personality disorder diagnosis is still very limited, especially in relation to neighbourhood-level factors such as deprivation and population density, as discussed above. Therefore, to address these gaps in knowledge, in the present study, I aimed to examine, first, whether there was association between neighbourhood-level deprivation and population density and mortality rates among people with personality disorder diagnosis in secondary mental health care. Second, I aimed to examine the association between these neighbourhood-level factors and subsequent admission to hospital after a first diagnosis of personality disorder.

This study seeks to address the following research questions, with corresponding hypotheses:

1. Do people with personality disorder diagnosis living in more deprived neighbourhoods have a higher mortality rate?
(Hypothesis 1(H1): *People with personality disorder diagnosis living in more deprived neighbourhoods will have higher mortality rates compared with those who live in more affluent areas*)
2. Do people with personality disorder diagnosis living in more densely populated areas have a higher mortality rate?
(H2: *People with personality disorder diagnosis living in more densely populated areas will have higher mortality rates compared with those who live in less densely populated areas*)
3. Do people with personality disorder diagnosis living in more deprived neighbourhoods have higher subsequent admission rate to acute mental health services after personality disorder diagnosis?
(H3: *People with personality disorder diagnosis living in more deprived neighbourhoods will have higher rate of first admission after personality disorder diagnosis compared with those who live in more affluent areas*)
4. Do people with personality disorder diagnosis living in more densely populated areas have higher subsequent admission rate after personality disorder diagnosis?
(H4: *People with personality disorder diagnosis living in more densely populated areas will have a higher first admission rate after personality disorder diagnosis compared with those who live in less densely populated areas*)

6.2 Methods

As the outcomes of this study were mortality and subsequent admission after personality disorder diagnosis, I describe the outcomes separately, but the remainder of the methods are described together since they are the same for both of these outcomes.

6.2.1 Study design and setting

This study was a retrospective cohort study that followed people with personality disorder diagnosis records over 9 years from 2008 to September 2016 in Camden and Islington NHS Foundation Trust (C&I) in North London. I have discussed the detailed information regarding the Camden and Islington catchment areas and C&I in Chapter 4.

6.2.2 Sample

The data for this study were drawn from the C&I CRIS data. As described in Chapter 5, I included people who met the inclusion criteria of being under the care of C&I between 2008 and 2016, having recordings of personality disorder diagnosis in C&I CRIS system, being 18 years old or older at the time of personality disorder diagnosis and residing in Camden and Islington catchment areas at the time of their first personality disorder diagnosis in the personality disorder cohort. Those who had a recorded diagnosis of organic personality disorder, and conditions classified as psychosis in ICD-10 (e.g. schizotypal personality disorder) were excluded.

6.2.3 Exposures

6.2.3.1 Neighbourhood-level covariates – primary exposures

The two primary exposures were neighbourhood-level deprivation and population density. I used the Index of Multiple Deprivation (IMD) score at lower layer super output areas (LSOA) level as a measure of neighbourhood-level deprivation, and the population density was defined as the number of persons per square kilometre. I have previously described both IMD score and population density, and how they were categorized into groups, in Chapter 5. Both IMD score and population density were initially stratified into 4 categories.

6.2.3.2 Individual-level covariates

I included the following Individual level covariates. Age at the first record of a personality disorder diagnosis, sex and ethnicity. Detailed definitions of these variables are described in Chapter 5 (the prevalence study). I also included an ‘admission at baseline’ variable, defined as having a record of admission (Inpatient admission to hospital, crisis house or crisis teams in C&I) on the same day as personality disorder diagnosis.

6.2.3.3 Comorbid psychiatric diagnoses

For those with personality disorder diagnoses in the C&I CRIS dataset, their comorbid psychiatric diagnoses based on ICD-10 classification including substance use, SMI and CMD were also extracted. I have provided more detailed description of each comorbid diagnosis in the previous chapter (Chapter 5).

6.2.4 Outcomes

The main outcomes in my study were mortality and the first admission after personality disorder diagnosis. For mortality, in all NHS trusts, patients are given a NHS number and are registered on the 'Spine', a national electronic database of NHS patient demographic details (<https://digital.nhs.uk/services/spine>). A patient's death is also recorded on the Spine and records of deceased patients are routinely sent back to C&I electronic health records based on their NHS number. Data on death records extracting during the follow-up period for the personality disorder cohort (2008-September 2016). I excluded those who had their death recorded before or concurrently with their first personality disorder diagnosis.

Next, I defined the readmission outcome as the first acute psychiatric admission after their first personality disorder diagnosis. This included inpatient admission to hospital, crisis house or admission to crisis teams in C&I. The information on admission were obtained from the C&I CRIS data during the same follow-up period (2008-September 2016). In addition, I also generated another 'admission' outcome which included 'admission at baseline' as well as the first admission after personality disorder diagnosis.

6.2.5 Statistical analyses

All analyses were conducted with Stata, version 16. I used descriptive statistics to summarise and compare outcomes (mortality and admission) in people with personality disorder by their primary exposures and confounder variables. I used appropriate statistical tests including chi-squared tests. For those whom had missing information on ethnicity or LSOA in which they were residing in, I used a complete case analysis to handle this missing data. I inspected whether those with missing data differed to those without it in Chapter 5.

Next, Cox regression models were used to examine associations with mortality. Age, sex, ethnicity, neighbourhood-level deprivation and population density were entered as exposure variables. In modelling age, a time-varying covariate, current age, in which age had been split into different observations with one-year intervals, was used in order to reflect the phenomenon that mortality risk changes over time. Univariable and multivariable Cox regression analyses were conducted, and

hazard ratio and 95% confidence interval were calculated. I defined the follow-up time as the number of days from the date of first diagnosis of personality disorder until either the date of death or the date of last observation (30th September 2016). AIC scores for each exposure were calculated to find out the best fitting model.

6.3 Results

6.3.1 Mortality

6.3.1.1 *Sample characteristics*

From an initial sample of 4,414 people with a recorded diagnosis of personality disorder, 3,488 met inclusion criteria for this study (**Figure 6.1**). Of these, I excluded 720 people with missing data on ethnicity or LSOA and 13 people with inaccurate dates of death or first personality disorder diagnoses. From the complete case sample of 2755, 163 people were reported to have died over the follow-up period (5.92%). Sociodemographic differences between those who died and remained alive in this cohort are shown in **Table 6.1**. As shown, the median age of participants with personality disorder at the time of personality disorder diagnosis in the sample was 37.66 years old (IQR: 28.21-47.05). The age distribution of those who died differed from those who remained alive (Chi-square p -value<.001; **Table 6.1**), with the age group 30-39 and 40-49 having the highest proportion in people with death records while the age group 20-29 took up the highest proportion among people without death records. In terms of sex differences, more men died than women while there were more women than men in people with no death records (p <.001). As to ethnicity, people who died differed from those who did not (p =0.01), with those who died being concentrated in White British and white-non British ethnic groups. I found no statistically significant differences between people with death records and those without both in IMD score and population density.

Figure 6.1 Flowchart of identifying mortality cohort

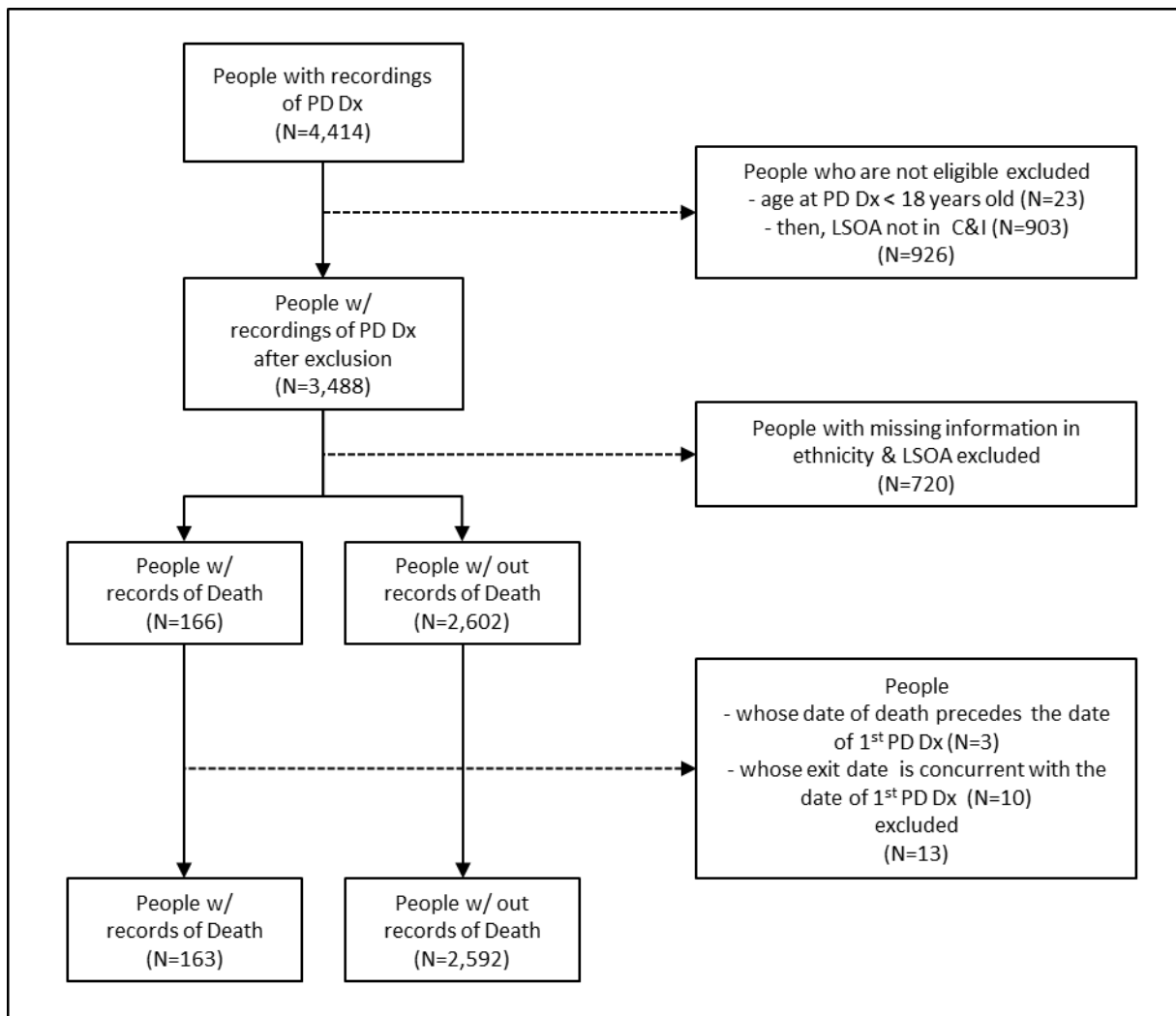


Table 6.1 Characteristics of people with & without death record

	Death record (N=163) N (%)	No death record (N=2,592) N (%)	Total (N=2,755) N (%)	χ^2 test (p-value)
Age at personality disorder diagnosis				<0.001
18-19	2 (1.23)	117 (4.51)	119 (4.32)	
20-29	10 (6.13)	701 (27.04)	711 (25.81)	
30-39	41 (25.15)	693 (26.74)	734 (26.64)	
40-49	38 (23.31)	627 (24.19)	665 (24.14)	
50-59	30 (18.40)	290 (11.19)	320 (11.62)	
60-69	15 (9.20)	104 (4.01)	119 (4.32)	
70-79	16 (9.82)	46 (1.77)	62 (2.25)	
80 or over	11 (6.75)	14 (0.54)	25 (0.91)	
Sex				<0.001
Male	95 (58.28)	993 (38.31)	1,088 (39.49)	
Female	68 (41.72)	1,599 (61.69)	1,667 (60.51)	
Ethnicity				0.01
White-British	96 (58.90)	1,377 (53.13)	1,473 (53.47)	
White-non British	44 (26.99)	566 (21.84)	610 (22.14)	
Black	10 (6.13)	257 (9.92)	267 (9.69)	
Asian	9 (5.52)	125 (4.82)	134 (4.86)	
Mixed	3 (1.84)	144 (5.56)	147 (5.34)	
Other	1 (0.61)	123 (4.75)	124 (4.50)	
IMD score				0.26
Least deprived	48 (29.45)	641 (24.73)	689 (25.01)	
25 th – 50 th	37 (22.70)	662 (25.54)	699 (25.37)	
50 th – 75 th	33 (20.25)	654 (25.23)	687 (24.94)	
Most deprived	45 (27.61)	635 (24.50)	680 (24.68)	
Population density				0.54
0-12,500 ppsqkm*	50 (30.67)	704 (27.16)	754 (27.37)	
12,501-25,000 ppsqkm	104 (63.80)	1,779 (68.63)	1,883 (68.35)	
25,001-37,500 ppsqkm	9 (5.52)	106 (4.09)	115 (4.17)	
37,501– max ppsqkm	0 (0.00)	3 (0.12)	3 (0.11)	

*ppsqkm: people per square kilometre

6.3.1.2 Mortality rate

People were followed for a total of 12,922.552 person-years and 163 people had died by the end of the follow-up. Therefore, the crude mortality rate was calculated as 12.61 per 1,000 person-years. When looked at by each exposure, firstly, in terms of age group, the oldest age group 80 or over had the highest mortality rate (1,448.46 per 1,000 person-years; 95% CI: 802.16-2,615.50), with the

mortality rate tending to be higher in older age groups (**Table 6.2**). Men had higher mortality rates (18.17 per 1,000 person-years; 95% CI: 14.86-22.21) compared with women. In terms of ethnicity, white British (14.16 per 1,000 person-years; 95% CI: 11.60-17.30), white-non British (14.61 per 1,000 person-years; 95% CI: 10.88-19.64) and Asian (14.89 per 1,000 person-years; 95% CI: 7.75-28.62) ethnic groups had the highest mortality rates. There was little difference in the mortality rates between the four subgroups of IMD score and population density.

Table 6.2 Mortality rate by exposure

variables	mortality rate (per 1,000 person-years)	95% CI
Age group		
18-19	45.89	11.48 – 183.48
20-29	31.67	17.04 – 58.87
30-39	103.97	76.56 – 141.21
40-49	118.80	86.45 – 163.27
50-59	217.73	152.24 – 311.41
60-69	304.00	183.27 – 504.25
70-79	665.62	407.78 – 1,086.50
80 or over	1,448.46	802.16 – 2,615.50
Sex		
Male	18.17	14.86 – 22.21
Female	8.84	6.97 – 11.21
Ethnicity		
White British	14.16	11.60 – 17.30
White-non British	14.61	10.88 – 19.64
Black	7.21	3.88 – 13.41
Asian	14.89	7.75 – 28.62
Mixed	4.57	1.47 – 14.17
Other	2.05	0.29 – 14.57
IMD score		
Least deprived (<25 th pctl ¹ .)	15.10	11.38 – 20.04
25 th – 50 th	11.46	8.30 – 15.82
50 th – 75 th	10.10	7.18 – 14.21
Most deprived (≥75 th pctl ¹ .)	13.85	10.34 – 18.55
Population density		
0-12,500 ppsqkm*	13.87	10.51 – 18.30
12,501-25,000 ppsqkm	11.49	9.50 – 13.90
25,001-37,500 ppsqkm	16.80	8.74 – 32.28
37,501 – max ppsqkm	0.00	-

*ppsqkm: people per square kilometre

6.3.1.3 Predictors of mortality

In univariable modelling (**Table 6.3**), people living in neighbourhoods with deprivation in the 50th and 75th percentile of deprivation in Camden and Islington had a lower rate of mortality at a trend-level (HR 0.66; 95% CI 0.43 – 1.04; p=0.07) compared with people living in the least deprived quartile. I

found no evidence of changes in mortality for people with personality disorder living in more densely populated areas relative to the least densely populated. Additionally, I found the older age group had a higher rate of mortality (HR: 1.06; 95% CI: 1.05-1.07) compared with the younger age group. Women had a decreased rate of mortality (HR: 0.49; 95% CI: 0.36-0.67) than men.

In the fully adjusted model with individual and neighbourhood-level variables (**Table 6.3**), I found no evidence of an association between either neighbourhood-level deprivation or population density and mortality. I found that current age and sex were the only variables which remained significantly associated with mortality when fully adjusted. The older age group (HR: 1.06; 95% CI: 1.05-1.07) had a higher rate of mortality than younger age group and women had a decreased rate of mortality (HR: 0.54; 95% CI: 0.40-0.74) compared with men.

Table 6.3 Predictors of mortality in people with personality disorder

variables	Univariable		Multivariable		
	HR (95% CI)	p	AIC	HR (95% CI)	p
Current age	1.06 (1.05-1.07)	<0.001	2,214.87	1.06 (1.05-1.07)	<0.001
Sex					
Male	Ref		2,307.33	Ref	
Female	0.49 (0.36-0.67)	<0.001		0.54 (0.40-0.74)	<0.001
Ethnicity (6 groups)			2,319.21		
White-British	Ref				
White-Non British	1.03 (0.72-1.48)	0.86			
Black	0.52 (0.27-0.995)	0.05			
Asian	1.07 (0.54-2.11)	0.85			
Mixed	0.32 (0.10-1.02)	0.06			
Any other	0.14 (0.02-1.03)	0.05			
IMD score (4 groups)			2,328.39		
Least deprived (<25 th pctl ¹ .)	Ref			Ref	
25 th -50 th	0.76 (0.50-1.17)	0.22		<i>0.83 (0.54-1.27)</i>	<i>0.38</i>
50 th -75 th	0.66 (0.43-1.04)	0.07		<i>0.81 (0.52-1.27)</i>	<i>0.36</i>
Most deprived (≥75 th pctl ¹ .)	0.91 (0.61-1.37)	0.66		<i>0.97 (0.64-1.48)</i>	<i>0.89</i>
Population density (4 groups)			2,327.96		
0-12,500 ppsqkm ²	Ref			Ref	
12,501-25,000 ppsqkm	0.81 (0.58-1.13)	0.22		<i>0.84 (0.59-1.19)</i>	<i>0.33</i>
25,001-37,500 ppsqkm	1.16 (0.57-2.36)	0.69		<i>1.10 (0.54-2.27)</i>	<i>0.79</i>
37,501 – max ppsqkm	0.00 (-)	-		0.00 (-)	-

*Only current age and sex were statistically significant in the final model. Non-significant values for IMD score and population density are shown after adjustment of current age and sex and did not improve model fit over the final model; ¹Percentile, ²ppsqkm: people per square kilometre

6.3.1.4 Comorbid psychiatric diagnoses and mortality of people with personality disorder

In the sensitivity analysis, I found there was no evidence of association between neighbourhood-level or population density and mortality of people with personality disorder when comorbid psychiatric diagnoses were added in the fully adjusted model (**Table 6.4**). Also, in the final model, people with SMI (HR: 0.49; 95% CI 0.33-0.74) and CMD (HR 0.48; 95% CI: 0.33-0.71) were less likely to die than those with no SMI or CMD.

Table 6.4 Effect of comorbid psychiatric diagnoses on mortality of people with personality disorder

variables	Univariable		Multivariable		
	HR (95% CI)	p	AIC	HR (95% CI)	p
Current age	1.06 (1.05-1.07)	<0.001	2,214.87	1.06 (1.05-1.07)	<0.001
Sex					
Male	Ref		2,307.33	Ref	
Female	0.49 (0.36-0.66)	<0.001		0.57 (0.41-0.77)	<0.001
Ethnicity (6 groups)			2,319.21		
White-British	Ref				
White-Non British	1.03 (0.72-1.48)	0.86			
Black	0.52 (0.27-0.995)	0.05			
Asian	1.07 (0.54-2.11)	0.85			
Mixed	0.32 (0.10-1.02)	0.06			
Any other	0.14 (0.02-1.03)	0.05			
Comorbid psychiatric diagnoses					
Substance use (F10-19)	0.82 (0.55-1.22)	0.33	2,327.36		
SMI (F20-29, F30, F31)	0.63 (0.42-0.95)	0.03	2,323.00	0.49 (0.33-0.74)	0.001
CMD (F32-48)	0.64 (0.44-0.94)	0.02	2,322.66	0.48 (0.33-0.71)	<0.001
IMD score (4 groups)			2,328.39		
Least deprived (<25 th pctl ¹ .)	Ref			Ref	
25 th -50 th	0.76 (0.50-1.17)	0.22		0.81 (0.52-1.24)	0.33
50 th -75 th	0.66 (0.43-1.04)	0.07		0.78 (0.50-1.22)	0.27
Most deprived (≥75 th pctl ¹ .)	0.91 (0.61-1.37)	0.66		0.93 (0.61-1.42)	0.75
Population density (4 groups)			2,327.96		
0-12,500 ppsqkm ²	Ref			Ref	
12,501-25,000 ppsqkm	0.81 (0.58-1.13)	0.22		0.85 (0.60-1.20)	0.35
25,001-37,500 ppsqkm	1.16 (0.57-2.36)	0.69		1.11 (0.54-2.29)	0.77
37,501 – max ppsqkm	0.00 (-)	-		0.00 (-)	-

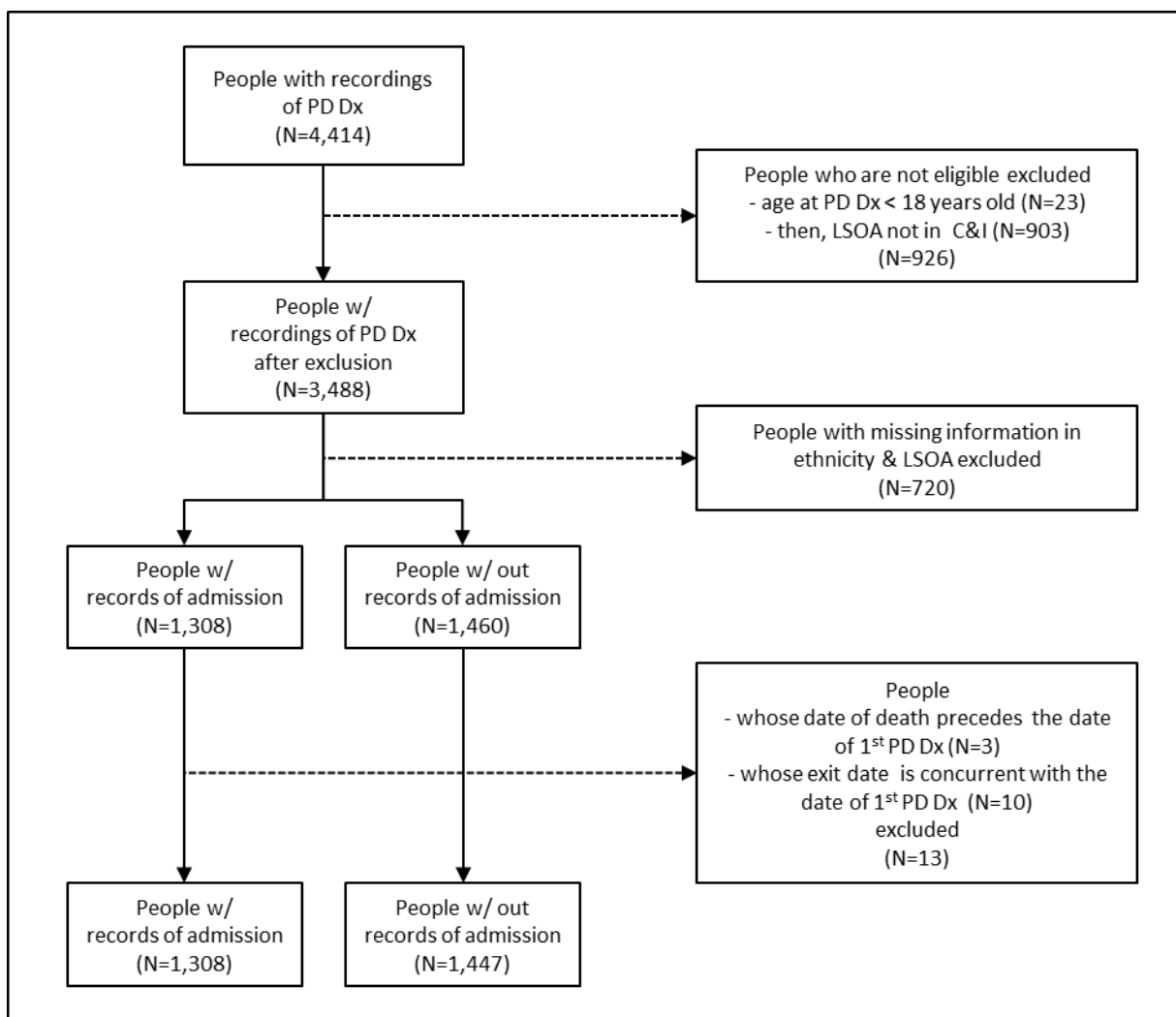
*Only current age, sex, SMI and CMD were statistically significant in the final model. Non-significant values for IMD score and population density are shown after adjustment of current age, sex, SMI and CMD and did not improve model fit over the final model.; ¹Percentile, ²ppsqkm: people per square kilometre

6.3.2 First admission after personality disorder diagnosis

6.3.2.1 Sample characteristics

I described the process of identifying people with the first admission records after personality disorder diagnosis in **Figure 6.2**. As in the mortality cohort, I found three people whose date of death preceded the personality disorder diagnosis date which was presumably an administrative error while recording the data. I also found ten people whose personality disorder diagnosis date were recorded on the last day of follow-up period, which was used as an exit date in the cox regression analysis. After excluding those 13 people, I identified a final number of 1,308 people with a record of the first acute admission after their personality disorder diagnosis.

Figure 6.2 Flowchart of identifying admission cohort



I found no statistically significant difference of IMD score between people with admission records and those without ($p=0.32$; **Table 6.5**) and population density ($p=0.58$). Further, the age distribution of those who had a record of subsequent admission after personality disorder diagnosis differed from those who did not (Chi-square p -value <0.001). In both parties, the age groups 20-29, 30-39 and 40-49 constituted around 70% of the sample. The age group 30-39 had the largest proportion in both parties, but the proportion was higher in people admitted (29.05%) than in those not admitted

(26.64%). People with and without admission records also differed in the composition of sex ($p < 0.001$). There were more women than men in both groups, but the difference of proportion between men and women were much larger in people admitted (27.98%) than those not admitted (14.72%). With respect to ethnicity, white-British ethnic group had the largest proportion followed by white-non British and black ethnic group in both cohorts. However, the proportion of white-non British was larger in people with no admission record while proportion of black ethnic group was bigger in people with admission records.

Table 6.5 Characteristics of people with & without a record of the subsequent admission

	admission record (N=1,308)	No admission record (N=1,447)	Total (N=2,755)	χ^2 test (p-value)
	N (%)	N (%)	N (%)	
Age at personality disorder diagnosis				<.001
18-19	72 (5.50)	47 (3.25)	119 (4.32)	
20-29	326 (24.92)	385 (26.61)	711 (25.81)	
30-39	380 (29.05)	354 (24.46)	734 (26.64)	
40-49	319 (24.39)	346 (23.91)	665 (24.14)	
50-59	129 (9.86)	191 (13.20)	320 (11.62)	
60-69	58 (4.43)	61 (4.22)	119 (4.32)	
70-79	20 (1.53)	42 (2.90)	62 (2.25)	
80 or over	4 (0.31)	21 (1.45)	25 (0.91)	
Sex				<.001
Male	471 (36.01)	617 (42.64)	1,088 (39.49)	
Female	837 (63.99)	830 (57.36)	1,667 (60.51)	
Ethnicity				<.001
White-British	725 (55.43)	748 (51.69)	1,473 (53.47)	
White-non British	250 (19.11)	360 (24.88)	610 (22.14)	
Black	151 (11.54)	116 (8.02)	267 (9.69)	
Asian	55 (4.20)	79 (5.46)	134 (4.86)	
Mixed	70 (5.35)	77 (5.32)	147 (5.34)	
Other	57 (4.36)	67 (4.63)	124 (4.50)	
IMD score				0.32
Least deprived	339 (25.92)	350 (24.19)	689 (25.01)	
25 th – 50 th	330 (25.23)	369 (25.50)	699 (25.37)	
50 th – 75 th	307 (23.47)	380 (26.26)	687 (24.94)	
Most deprived	332 (25.38)	348 (24.05)	680 (24.68)	
Population density				0.58
0-12,500 ppsqkm*	372 (28.44)	382 (26.40)	754 (27.37)	
12,501-25,000 ppsqkm	879 (67.20)	1,004 (69.38)	1,883 (68.35)	
25,001-37,500 ppsqkm	55 (4.20)	60 (4.15)	115 (4.17)	
37,501 – max ppsqkm	2 (0.15)	1 (0.07)	3 (0.11)	

*ppsqkm: people per square kilometre

6.3.2.2 Crude admission rates

As to neighbourhood-level variables, the least deprived group had the highest admission rate (189.26 per 1,000 person-years; 95% CI: 170.15 – 210.52) and the most densely populated areas had the highest admission rate (627.58 per 1,000 person-years; 95% CI: 156.96 – 2,509.33). In terms of age group, I found the youngest age group 18-19 had the highest admission rate (349.59 per 1,000 person-years; 95% CI: 277.49-440.43; **Table 6.6**) followed by age group 60-69 (213.24 per 1,000 person-years; 95% CI: 164.86-275.83). Women had a higher admission rate (195.60 per 1,000 person-years; 95% CI: 182.79-209.31) than men (139.19 per 1,000 person-years; 95% CI: 127.17 – 152.35). The Black ethnic group had the highest admission rate (207.23 per 1,000 person-years; 95% CI: 176.68 – 243.06) followed by people in the “Other” ethnic group (200.43 per 1,000 person-years; 95% CI: 154.60 – 259.84).

Table 6.6 Admission rate by exposures

Variables	Admission rates (per 1000 person-years)	95% CI
Age group		
18-19	349.59	277.49 – 440.43
20-29	172.99	155.20 – 192.83
30-39	170.63	154.31 – 188.68
40-49	164.95	147.81 – 184.09
50-59	142.69	120.07 – 169.56
60-69	213.24	164.86 – 275.83
70-79	119.72	77.24 – 185.56
80 or over	58.41	21.92 – 155.64
Sex		
Male	139.19	127.17 – 152.35
Female	195.60	182.79 – 209.31
Ethnicity		
White British	188.60	175.36 – 202.84
White-non British	122.79	108.48 – 139.00
Black	207.23	176.68 – 243.06
Asian	141.46	108.61 – 184.26
Mixed	183.69	145.33 – 232.18
Other	200.43	154.60 – 259.84
IMD score		
Least deprived (<25 th percentile)	189.26	170.15 – 210.52
25 th – 50 th	171.87	154.29 – 191.45
50 th – 75 th	149.91	134.04 – 167.65
Most deprived (≥75 th percentile)	174.39	156.60 – 194.19
Population density		
0-12,500 ppsqkm*	181.77	164.20 – 201.21
12,501-25,000 ppsqkm	165.53	154.94 – 176.84
25,001-37,500 ppsqkm	181.48	139.34 – 236.38
37,501 – max ppsqkm	627.58	156.96 – 2509.33

*ppsqkm: people per square kilometre

6.3.2.3 Predictors of subsequent acute psychiatric admission after personality disorder diagnosis

In univariable modelling (**Table 6.7**), I found the second most deprived neighbourhood quartile had a significantly lower rate of admission (HR: 0.84; 95% CI: 0.72-0.98) compared with the least deprived neighbourhood when I divided the neighbourhood variable into 4 groups. I did not find any evidence of association between population density and subsequent admission when population density were categorized into 4 groups. With regards to age distribution, I found older people had a lower rate of readmission (HR: 0.99; 95% CI: 0.989-0.997) than those with younger current age. Women had elevated rate of admission (HR: 1.28; 95% CI: 1.14-1.43) compared with men. With regards to ethnicity, white-non British group had a decreased rate of admission (HR: 0.75; 95% CI: 0.65-0.86) and Asian group showed a trend-level negative association with admission (HR: 0.78; 95% CI: 0.59-1.03) compared with white-British ethnic group.

Lastly, in the final best-fitting model where I adjusted for individual and neighbourhood-level variables (Multivariable 1; **Table 6.7**), older people still had a decreased rate of admission (HR: 0.99; 95% CI: 0.990-0.998) compared with the younger group. Women also remained to have an elevated rate of admission (HR: 1.25; 95% CI: 1.11-1.40) than men. As to ethnicity, I also found white-non British group had a lower rate of admission (HR: 0.76; 95% CI: 0.65-0.87) in comparison with white-British group.

When further tested for the effect of admission at baseline (Multivariable 2; **Table 6.7**), I found the current age was no longer statistically significantly associated with readmission, but remained to be at trend-level (HR: 0.996; 95% CI: 0.99-1.00). Women still had an elevated rate of admission (HR: 1.28; 95% CI: 1.14-1.44) compared with men and white-non British ethnic group showed a decreased rate of admission (HR: 0.77; 95% CI: 0.67-0.89) than white-British. When I accounted for admission at baseline, I found a record of admission at baseline was associated with a higher rate of admission after personality disorder diagnosis (HR: 2.72; 95% CI: 2.39-3.10).

Table 6.7 Predictors of admission in people with recordings of personality disorder diagnosis

variables	Univariable		AIC	Multivariable 1 ¹⁾		Multivariable 2 ²⁾	
	HR (95% CI)	p		HR (95% CI)	p	HR (95% CI)	p
Current age	0.99 (0.989-0.997)	<0.001		0.99 (0.990-0.998)	0.009	0.996 (0.99-1.00)	0.074
Sex							
Male	Ref			Ref		Ref	
Female	1.28 (1.14-1.43)	<0.001		1.25 (1.11-1.40)	<0.001	1.28 (1.14-1.44)	<0.001
Ethnicity (6 groups)			19,316.32				
White-British	Ref			Ref		Ref	
White-non British	0.75 (0.65-0.86)	<0.001		0.76 (0.65-0.87)	<0.001	0.77 (0.67-0.89)	<0.001
Black	1.11(0.93-1.32)	0.26		1.07 (0.90-1.27)	0.46	1.10 (0.92-1.31)	0.31
Asian	0.78 (0.59-1.03)	0.08		0.77 (0.59-1.02)	0.07	0.79 (0.60-1.04)	0.10
Mixed	0.98 (0.76-1.25)	0.84		0.91 (0.71-1.17)	0.46	0.87 (0.68-1.11)	0.27
Any other	1.00 (0.76-1.31)	0.998		0.97 (0.74-1.27)	0.81	1.00 (0.77-1.31)	0.98
IMD score (4 groups)			19,329.77				
Least deprived (<25 th pctl ³⁾ .)	Ref			Ref		Ref	
25 th -50 th	0.90 (0.78-1.05)	0.18		0.90 (0.77-1.05)	0.18	0.89 (0.76-1.04)	0.14
50 th -75 th	0.84 (0.72-0.98)	0.03		0.83 (0.71-0.97)	0.02	0.84 (0.71-0.98)	0.03
Most deprived (≥75 th pctl ³⁾ .)	0.95 (0.81-1.10)	0.47		0.98 (0.84-1.14)	0.79	0.98 (0.84-1.14)	0.76
Population density (4 groups)			19,332.95				
0-12,500 ppsqkm*	Ref			Ref		Ref	
12,501-25,000 ppsqkm	0.92 (0.85-1.15)	0.21		0.92 (0.81-1.04)	0.19	0.96 (0.85-1.10)	0.56
25,001-37,500 ppsqkm	0.99 (0.75-1.02)	0.96		1.01 (0.751-34)-	0.97	1.11 (0.83-1.48)	0.49
37,501 – max ppsqkm	1.70 (0.74-1.01)	0.46		1.59 (0.39-6.40)	1.14	1.97 (0.49-7.95)	0.34
Admission at baseline							
No admission at baseline						Ref	
Admission at baseline						2.72 (2.39-3.10)	<0.001

*Only current age, sex, and ethnicity were statistically significant in the final model (Multivariable 1). Non-significant values for IMD score and population density are shown after adjustment of current age, sex and ethnicity and did not improve model fit over the final model. I took the same approach for displaying the result of Multivariable 2.

¹⁾Adjusted for individual (current age, sex, ethnicity) and neighbourhood-level (IMD score and population density) covariates, ²⁾ Adjusted for individual, neighbourhood-level covariates and admission at baseline, ³⁾Percentile.

6.3.2.4 Comorbid psychiatric diagnoses and subsequent admission of people with personality disorder

In the additional sensitivity analyses where comorbid psychiatric diagnoses were added in the fully adjusted model, I found no evidence of association between neighbourhood-level deprivation or

population density and subsequent admission of people with personality disorder (**Table 6.8**). In the final model, people with each comorbid psychiatric diagnosis (Substance use - HR: 1.78; 95% CI: 1.68-2.13, SMI – HR: 2.22; 95% CI: 1.80-2.28, CMD – HR: 1.63; 95% CI: 1.38-1.73) had an elevated rate of subsequent admission after their first diagnosis of personality disorder.

Table 6.8 Effect of comorbid psychiatric diagnoses on subsequent admission of people with personality disorder

variables	Univariable		Multivariable		
	HR (95% CI)	p	AIC	HR (95% CI)	p
Current age	0.99 (0.988-0.997)	<0.001	19,318.54	0.99 (0.986-0.995)	<0.001
Sex			19,312.36		
Male	Ref			Ref	
Female	1.28 (1.14-1.43)	<0.001		1.45 (1.29-1.64)	<0.001
Ethnicity (6 groups)			19,316.32		
White-British	Ref			Ref	
White-Non British	0.75 (0.65-0.86)	<0.001		0.80 (0.69-0.92)	0.002
Black	1.11 (0.93-1.32)	0.26		0.99 (0.83-1.18)	0.87
Asian	0.78 (0.59-1.03)	0.08		0.82 (0.62-1.08)	0.15
Mixed	0.98 (0.76-1.25)	0.84		0.83 (0.64-1.06)	0.13
Any other	1.00 (0.76-1.31)	0.998		0.96 (0.73-1.26)	0.77
Comorbid psychiatric diagnoses					
Substance use (F10-19)	1.89 (1.68-2.13)	<0.001	19,234.35	1.78 (1.68-2.13)	<0.001
SMI (F20-29, F30, F31)	2.03 (1.80-2.28)	<0.001	19,202.2	2.22 (1.80-2.28)	<0.001
CMD (F32-48)	1.55 (1.38-1.73)	<0.001	19,275.31	1.63 (1.38-1.73)	<0.001
IMD score			19,329.77		
Least deprived (<25 th pctl ¹ .)	Ref			Ref	
25 th -50 th	0.90 (0.78-1.05)	0.18		0.92 (0.79-1.08)	0.31
50 th -75 th	0.84 (0.72-0.98)	0.03		0.86 (0.74-1.01)	0.07
Most deprived (≥75 th pctl ¹ .)	0.95 (0.81-1.10)	0.47		0.98 (0.84-1.14)	0.78
Population density			19,332.95		
0-12,500 ppsqkm*	Ref			Ref	
12,501-25,000 ppsqkm	0.92 (0.82-1.04)	0.21		0.91 (0.80-1.03)	0.13
25,001-37,500 ppsqkm	0.99 (0.75-1.32)	0.96		1.05 (0.78-1.40)	0.76
37,501 – max ppsqkm	1.70 (0.42-6.81)	0.46		2.64 (0.66-10.67)	0.17

*Only current age, sex, ethnicity, and comorbid psychiatric diagnoses were statistically significant in the final model. Non-significant values for IMD score and population density are shown after adjustment of current age, sex, ethnicity, and comorbid psychiatric diagnoses and did not improve model fit over the final model.

6.4 Discussion

6.4.1 Summary of findings

Contrary to my initial hypotheses, I found no evidence that living in more deprived area was associated with either mortality or first admission after personality disorder diagnosis in a clinical sample treated in a large mental health trust in two boroughs of North London. I also did not find any association between population density and mortality or first admission in the same cohort. Older age group at the time of first diagnosis personality disorder and being male were positively associated with mortality rate, whereas older age group at the time of first personality disorder diagnosis and women had a decreased rate of subsequent acute admission.

6.4.2 Meaning of findings

6.4.2.1 Mortality

Although there is good evidence regarding neighbourhood-level deprivation and mortality links in the general population, I did not find any evidence that mortality of people with personality disorder varied by neighbourhood-level deprivation in this study. The result remained consistent in the sensitivity analysis where comorbid psychiatric diagnoses were adjusted. One of the possible explanations could be that catchment areas of C&I are already very urbanised and deprived and I may be looking at one end of the spectrum. So, it is possible the association would be present if I repeated the analyses on the national level. Another possible explanation may be that people with personality disorder in C&I all live in the most deprived parts.

The cause of death is not recorded in the current data in this study, so it is not clear whether people with death records in this study had died with natural or unnatural cause. Therefore, it is hard to establish how each predictor impacted the mortality rate of people with personality disorder diagnosis in this sample. One possible way worth to try may be to look at the pattern of cause of death in the general population in Camden and Islington area and compare this with the result of this analysis to overcome the lack of information in terms of cause of death in this study. According to the 'Public Health Intelligence Profile' published by Camden and Islington's Public Health Intelligence team in 2017 (Team, 2017), the total number of deaths (yearly average) among C&I residents during 2013-2015 was 2,173. The majority of people had a cause of death related to physical illnesses such as cancer (668/30.7%), cardiovascular diseases (551/24.6%), respiratory disease (284/13.1%), digestive diseases (112/5.2%), and infectious and parasitic diseases (34/1.6%). Other causes included dementia (148/6.8%), and other illnesses including diseases of nervous

system (268/ 12.3%). The remaining causes were external causes which included accidents and other external causes (68/3.1%) and suicide and undetermined injury (40/1.8%).

In terms of neighbourhood-level deprivation, I did not find any association with neighbourhood-level deprivation and mortality in people who died. As discussed earlier in the introduction, neighbourhood-level SES has an inverse relationship with mortality rate in the general population, and the fact that the finding in this study is not consistent with previous literature on the general population may mean that there are some other factors which prevent the people with personality disorder diagnosis living in the most deprived neighbourhoods from dying. One of possible reasons may include mobility of people who are living in most deprived neighbourhoods. People who are living in low-income areas are known to move more frequently for voluntary or involuntary reasons (Phinney, 2013) and residential information of people from most deprived areas in this study may not have been properly reflected during their frequent moving. In fact, according to the 'Camden profile' (London Borough of Camden, 2020), Camden has the 5th largest population 'churn' in the UK. Also, we cannot overlook the possibility that second least deprived neighbourhood had a higher HR compared to the reference group (the least deprived neighbourhood) merely due to chance, especially with the small number of deaths. Although the variable of IMD scores were further stratified into two groups and examined in order to overcome the shortcomings of small number of mortalities, I did not find any significant association both in univariable and multivariable analysis.

As for population density, my results did not support the initial hypothesis of this study. I did not find any association between population density and mortality of people with personality disorder, and the additional analyses controlling for comorbid psychiatric diagnoses confirmed this finding. It is difficult to contextualise this finding as there is no published evidence on the relation of mortality and population density among people with personality disorder. Also, it is important to recognise that Camden and Islington is a densely populated area overall. For example, while Camden is the 8th smallest borough in London with occupying only 1.4% by area, it ranks the 6th highest by population density in the year of mid-2018 (London Borough of Camden, 2020), and Islington has the highest population density in the entire UK according to ONS report (Office for National Statistics, 2011). So there may not be enough variation in population density in the catchment areas of C&I to be able to discern an association. However, there are a few points that might to consider. It is possible that social isolation or loneliness might have impacted the increased risk of death of people with personality disorder diagnosis who are living in less densely populated area. Considering people with personality disorder have higher rate of suicidal attempts (Paris, 2019) and suicidal ideation is increased by degrees of loneliness (Stravynski & Boyer, 2001), high density of population may have prevented people from feeling suicidal. Another possibility is that there could be disparity of

community care among neighbourhoods and areas with high population density may pay more attention to residents who live in the neighbourhood than areas with low population density.

The results also suggested the older the current age at the time of first diagnosis of personality disorder became, the faster the time to mortality was, and this would not be unexpected if most people with death records have died due to natural causes.

As to sex, a Norwegian study found that women were more likely to die due to suicide compared with the general population whereas men had higher risk of death of natural causes than the general population (Høyve et al., 2016). It is not clear what the nature of the causes of death in the present study was and it is hard to conclude the association between mortality and having male sex. One possible explanation might be that men are more often diagnosed with antisocial personality disorder than women (Corbitt & Widiger, 1995) and men are more likely to manifest features of antisocial personality disorder compared to women (Klonsky et al., 2002). Further, previous research showed that men with antisocial personality disorder are more likely to be engaged in illegal and violent actions than women with antisocial personality disorder (Alegria et al., 2013). This may provide an explanation why men had higher rate of mortality rate than women in this study.

It may be noteworthy that in the sensitivity analysis, the final model suggested that people with SMI and CMD were less likely to die, and no association with substance use was observed. This result is inconsistent with earlier literature although there are only a small number of studies which investigated clinical predictors of personality disorder outcomes. A Norwegian study reported that comorbid substance use and SMI were associated with higher mortality among people with personality disorder compared with the general population (Høyve et al., 2016). Also, a UK study suggested there is an association between alcohol and drug use among people with personality disorder (Fok et al., 2014a). The reasons for the negative association between comorbid SMI and CMD and mortality of people with personality disorder found in this study is difficult to explain. Further studies may be required since comorbidity was not the main scope of this study and there may be many other factors that should be considered together to unpick this finding.

6.4.2.2 First acute psychiatric admission after personality disorder diagnosis

As in the case of mortality, the reason for admission was not specified in the CRIS records. Therefore, it is possible the admission was caused by other comorbidities rather than personality disorder alone, especially considering that personality disorder is known to coexist with other mental illnesses including schizophrenia, depression, anxiety and substance abuse (Hayward & Moran, 2008). I also demonstrated there is phenomenological overlap between personality disorder and psychotic disorder in Chapter 3. Hence, there may be a limitation in understanding how

neighbourhood-level social deprivation is related to the rate of first admission after personality disorder diagnosis.

The fact that people were admitted to either of psychiatric ward, crisis house or crisis teams means that their conditions have deteriorated to the level which needed a professional care and attention. Therefore, the finding that people who were older at the time of personality disorder diagnosis had longer time to the subsequent admission after personality disorder diagnosis may suggest that people are less likely to present risk factors of admission such as suicidal risk, self-harm or danger to other people or their symptoms become less severe as they get older.

Women had higher rate of first admission after personality disorder diagnosis and this may be understood in relation to the previous finding that women with personality disorder are more associated with death due to suicide compared with the general population (Høye et al., 2016) and one of the predictors of psychiatric admission of people with personality disorder was high risk of suicide (Pascual et al., 2007). Also, there is a recognised gender gap in mental health service use whereby men make less visits to psychiatric services (Pattyn et al., 2015) which may explain the higher rate of first admission after personality disorder diagnosis among women in the present study.

Existing evidence from the general population suggested neighbourhood-level socioeconomic characteristics are associated with hospital admission. For example, a population-based Swedish study found that people living in more deprived areas were more likely to be hospitalized for mental disorder (Sundquist & Ahlen, 2006). However, outcome in this study was the first admission, and not readmission. So it might be difficult to understand the finding on the relationship between neighbourhood-level deprivation and the subsequent admission after personality disorder diagnosis in this study in relation to earlier literature.

In terms of population density, I did not find any previous study that examined personality disorder and readmission, and only found a research on population density and hospital admission among people with psychosis. A German study has examined 33, 813 psychiatric admissions in a rural catchment area for the years of 2006-2009, and reported that the rate of hospital admission were negatively associated with population density both in people with diagnosis of schizophrenia and affective disorder combined (IRR 0.997; $p < 0.001$) and those with affective disorders (IRR 0.996; $p < 0.001$) (Losert et al., 2012). However, this study only counted the first admission rather than readmission and was conducted in a rural catchment area whereas the setting of present study was urbanised inner-city areas.

It is not surprising the admission at baseline predicted faster time to the first admission after personality disorder diagnosis (HR: 2.72; 95% CI: 2.39-3.10) in the additional multivariable analysis. As discussed in introduction, the decision to hospitalize people with personality disorder is affected by risk of suicide and severe symptoms, among others (Pascual et al., 2007), and the fact that people were admitted at baseline indicate that they might already have presented with these symptoms at the time of personality disorder diagnosis. Therefore, the previous finding that time to readmission was associated symptoms of depression, hallucinations and delusions (Furnes et al., 2019) may support the finding in this study that admission at baseline is associated with a shorter time to first admission after personality disorder diagnosis in this study.

6.4.2.3 Strengths and limitations

Although, to my knowledge, this is the first study that tested the association between routinely recorded clinical diagnosis of personality disorder and recorded outcomes of personality disorder including mortality and the first admission after the diagnosis of personality disorder in a large secondary mental health care, there are several limitations that need to be acknowledged. First, as previously discussed in the prevalence study in chapter 5, the data used in this study were drawn from routine electronic health records and were not specifically collected for research purposes. Hence, it introduces some issues such as not having information on individual SES that could have impacted the association between mortality/first admission and neighbourhood-level deprivation as a confounding factor. There was also some missing data for covariates leading to people being excluded from the analysis, and hence, may have biased the result. Second, the data on death records contained no information on causes of death, and thus, it was difficult to extend the implications of findings to more meaningful level. Future studies would benefit from linkage of the CRIS data to ONS mortality data through which information on the cause of death will be acquired. Third, with regards to readmission, there was no information on why they were admitted, and it was hard to know whether the readmission was directly related to personality disorder or due to comorbidities. The relationship between neighbourhood-level social factors and the first admission after personality disorder diagnosis might have shown a different result if it was examined together with the cause of admission. Fourth, the C&I CRIS data only includes what would routinely be recorded as part of someone's care at C&I. So, if someone resided in catchment areas of Camden or Islington, and later moved away, the care they received elsewhere after moving away would not be recorded in C&I CRIS. Therefore, if people had moved away and came back to C&I, it is possible that the subsequent acute psychiatric admission after personality disorder diagnosis recorded in C&I CRIS may not be the actual first acute psychiatric admission after personality disorder diagnosis. Fifth, as previously discussed in the prevalence study in Chapter 5, the duration of residence of people with

personality disorder in the address used in this study cannot be established, and it is possible that the address of people with personality disorder diagnoses used in this study may not be their genuine current address, but someone else's, such as a family member or friends considering the high prevalence of personality disorder among homeless people (Fazel et al., 2008; Martens, 2001). Lastly, the catchment of areas of Camden and Islington are urbanised and mostly deprived and therefore, the result of this study may not be generalisable to settings beyond C&I.

6.4.2.4 Conclusions

I found no evidence that neighbourhood-level deprivation was associated with mortality or the subsequent acute psychiatric admission after diagnosis of personality disorder among people with personality disorder diagnosis. I also did not find any association between population density and mortality or the readmission after personality disorder diagnosis. This may suggest neighbourhood-level deprivation and population density have little effect on the prognosis of personality disorder once people received a personality disorder diagnosis. Alternatively, given this study took place in a highly urban and deprived area relative to the rest of England, it could be that typical social gradients in mortality and subsequent acute psychiatric admission that I originally hypothesised to exist were not relevant beyond certain thresholds of deprivation and population density. Further research, however, on the relationship between neighbourhood-level deprivation and population density and mortality or the subsequent acute psychiatric admission after personality disorder diagnosis in consideration of the causes of mortality or admission, discrete type of personality disorder as well as more geographic areas would be needed to strengthen the findings of this study.

Chapter 7 Prevalence of personality disorders in secondary mental health care and its association with neighbourhood-level deprivation using SLaM CRIS data: A replication study in a different London Foundation Trust

7.1 Introduction

In chapter 5, I examined the contact period prevalence of personality disorder in Camden and Islington NHS Foundation trust (C&I), and its association with neighbourhood-level deprivation. In that study, I found the prevalence of personality disorder was 0.99% (95% CI 0.96-1.02). As discussed, previous studies have suggested that the point prevalence of personality disorder is in a range of 4.4-21.2% in general population as discussed in chapter 5 (Coid et al., 2006; Dereboy, Güzel, Dereboy, Okyay, & Eskin, 2014; Ekselius, Tillfors, Furmark, & Fredrikson, 2001; H. Jackson & Burgess, 2000; Mark F Lenzenweger et al., 2007; Samuels, 2011; Samuels et al., 2002; Torgersen, Kringlen, & Cramer, 2001). I also found that people who live in more deprived neighbourhoods were more likely to have a personality disorder diagnosis.

This study was important in order to establish that the prevalence of personality disorder is lower in clinical settings compared with those reported in population based research-purpose studies, and that personality disorder diagnosis are associated with neighbourhood-level deprivation. However, the finding in this study was novel and it is important to be replicated and validated in order to assess the generalizability of the result. Also, the data used in the C&I study were collected between 2008-2016 and another study with more recently collected data would be able to assess the generalizability and validity of the findings from my C&I study.

I chose The South London and Maudsley National Health Service (NHS) Foundation Trust (SLaM) CRIS data for the replication study. Conducting the replication study with the SLaM CRIS data confers several benefits. Firstly, the SLaM CRIS data uses the same platform as the C&I CRIS data so it was possible to maintain consistency of method between two studies as the data will be obtained via same framework, the structured field with ICD-10 codes and text free NLP application. Secondly, SLaM provides services for a larger population compared with C&I so a larger sample could be identified which would afford greater statistical power. Third, as SLaM shares similar urban environment in inner city London as C&I, I expected the characteristics of participants would not be significantly different from each other. Lastly, obtaining data including more recently collected data is possible which would strengthen the generalizability of the study.

The structure of population in C&I and SLaM is presented in **Table 7.1**. The age structure ($p < .001$) and ethnicity structure ($< .001$) differed while the distribution by sex between the populations in C&I (male 48.7%;) and SLaM (male 48.7%) was similar ($p = 0.58$) (**Table 7.1**).

Table 7.1 Population structure in C&I and SLaM

	C&I		SLaM		P (χ^2 test)
	n	%	n	%	
Age group					<.001
18-19	12,583	3.58	28,130	2.93	
20-29	97,983	27.91	231,189	24.12	
30-39	85,953	24.48	230,010	23.99	
40-49	57,664	16.43	185,064	19.30	
50-59	38,394	10.94	123,360	12.87	
60-69	29,184	8.31	77,943	8.13	
70-79	18,041	5.14	51,093	5.33	
80 or over	11,271	3.21	31,892	3.33	
Sex					0.58
Male	170,992	48.71	466,407	48.65	
Female	180,081	51.29	492,274	51.35	
Ethnic group					<.001
White British	167,424	47.69	434,946	45.37	
White non-British	81,910	23.33	139,477	14.55	
Black	29,987	8.54	209,379	21.84	
Asian	44,245	12.60	105,732	11.03	
Mixed	15,132	4.31	45,569	4.75	
Any other	12,375	3.52	23,578	2.46	

(source: 2011 UK Census data)

Therefore, the aim of this study was to (1) replicate the study in Chapter 5 regarding the prevalence of C&I CRIS personality disorder prevalence and (2) examine whether prevalence of personality disorder is associated with neighbourhood-level deprivation at the population level.

This current study seeks to address the following research questions and hypotheses.

1. Does the frequency of personality disorder in clinical practice differ from research-based prevalence of personality disorder in general population?
(*H1: The prevalence of personality disorder in a secondary mental health care will be lower than previously reported in the general population*)

2. Does risk of having a personality disorder diagnosis increase when people live in more deprived area?
(H2: *The frequency of personality disorder will be higher in people who live in more deprived areas,*).
3. Does the risk of having a record of as diagnosis of personality disorder increase when people live in more densely populated area?
(H3: *The frequency of personality disorder will be higher in people who live in more densely populated areas compared with sparsely populated areas*).

7.2 Methods

As the aim of this study was to replicate the research conducted in chapter 5 with C&I CRIS data, the methodology in this study was very similar to that applied in chapter 5. The study in chapter 5 included people with recordings of personality disorder diagnosis who presented in C&I, a secondary mental health care service in inner city London and this replication study included people with recordings of personality disorder diagnosis who presented in SLaM, also a large inner city secondary mental health care service in south London. The catchment areas in both Trusts do not overlap (**Figure 7.1**). In **Figure 7.1**, C&I catchment areas are those marked in royal blue colour while catchment areas belong to SLaM are in navy colour.

Figure 7.1 C&I and SLaM catchment areas



7.2.1 Design and setting

This study was a secondary analysis of the clinical data provided by The South London and Maudsley National Health Service (NHS) Foundation Trust (SLaM) Biomedical Research Centre (BRC) case register and the data was extracted using the Clinical Record Interactive Search (CRIS) application system. SLaM provides NHS mental health services in four London boroughs of Lambeth, Southwark, Lewisham and Croydon to about 2 million local population (www.slam.nhs.uk).

According to the English Indices of Deprivation 2015 briefing published by Greater London Authority (Greater Authority London, 2016), the three boroughs of Lambeth (22nd), Southwark (23rd), and Lewisham (26th) ranked within the top 50 of the 326 local authorities in England in average rank of deprivation. In the same statistics, Croydon, Camden and Islington ranked 91st, 69th and 13th, respectively.

7.2.2 Participants

7.2.2.1 CRIS sample

The participants consisted of people who met the following criteria:

- People who received care at SLaM between April 2008 and March 2020
- People who had a recording of a personality disorder diagnosis either as an ICD-10 structured field or via identification in unstructured text fields (i.e. clinical notes) through NLP (For NLP, see chapter 4)
- People who were 18 years old or older at the time of first personality disorder diagnosis in SLaM
- People whose residential address was in one of the four boroughs (Lambeth, Southwark, Lewisham and Croydon) at the time of first personality disorder diagnosis in the SLaM case register

Personality disorder diagnoses included those with ICD-10 F60.0-F60.9 code, as well as a mention of personality disorder in the clinical unstructured notes found via NLP in the same way as in chapter 5 (**Table 7.2**). Individuals who had organic personality disorder or conditions classified as psychosis in ICD-10 (e.g. schizotypal personality disorder) were excluded.

Table 7.2 ICD-10 codes and diagnoses for personality disorder

Codes	diagnosis
F60.0	Paranoid personality disorder
F60.1	Schizoid personality disorder
F60.2	Dissocial personality disorder
F60.3	Emotionally unstable personality disorder <ul style="list-style-type: none">▪ Impulsive type▪ Borderline type
F60.4	Histrionic personality disorder
F60.5	Anankastic personality disorder
F60.6	Anxious (Avoidant)
F60.7	Dependent personality disorder
F60.8	Other specific personality disorder
F60.9	personality disorder, unspecified

7.2.2.2 Population at risk

I estimated the population at risk in C&I using the 2011 Office for National Statistics (ONS) census data and stratified the data by age, sex and ethnicity at MSOA level (Table code DC2101EW) as I did in C&I study in Chapter 5. Only those who were 18 years or older were included in this study.

7.2.3 Outcomes

Recordings of personality disorder diagnosis: The first recordings of personality disorder diagnosis between April 2008 and March 2020 of people who contacted the SLaM NHS Foundation Trust was obtained from both the ICD-10 diagnosis structured field and free text via NLP application as in the C&I CRIS prevalence study in chapter 5. personality disorder diagnoses included ICD-10 F60.0-F60.9 coded diagnosis as well as generic personality disorder (F60). Refer back to 7.2.2.1 for exclusion criteria and personality disorder diagnosis.

7.2.4 Exposures

7.2.4.1 Demographic variables

I used the same demographic exposures as in chapter 5 on the C&I CRIS personality disorder prevalence including age, sex and ethnicity. Age was defined as the age on the day of first personality disorder diagnosis in C&I. In the C&I CRIS, sex was composed of two values, male and female, but the SLaM CRIS included additional values such as 'not known', 'not specified' and 'other'. Only those who identified as male or female were included in the analysis, as this was a replication study of the C&I CRIS personality disorder prevalence study. In the population data, sex was

classified as either male or female. As for ethnicity, there were 16 categories after excluding ‘not stated’ and ‘not known’ in the SLaM data, which I re-categorized into 6 groups including white-British, white non-British, Black, Asian, Mixed and Any other ethnicity in order to comply with the first study that used the C&I CRIS data (**Table 7.3**). In the population data, ethnicity initially comprised 18 categories and was re-grouped into 6 categories in the same way as in the SLaM CRIS data (**Table 7.3**). IMD score and population density were chosen as neighbourhood-level variables in line with the C&I study in Chapter 5.

Table 7.3 Ethnicity categories mapping

SLaM CRIS (16 categories)	SLaM Census (18 categories)	Regrouping (6)
▪ White British	▪ White: English/Welsh/Scottish/Northern Irish/British	White British
▪ White Irish	▪ White: Irish	White-non British
▪ Any other White background	▪ White: Gypsy or Irish traveller ▪ White: Other	
▪ Caribbean	▪ Black/African/Caribbean/Black British: Caribbean	Black
▪ African	▪ Black/African/Caribbean/Black British: African	
▪ Any other Black background	▪ Black/African/Caribbean/Black British: Other Black	
▪ Indian	▪ Asian/Asian British: Indian	Asian
▪ Pakistan	▪ Asian/Asian British: Pakistani	
▪ Bangladeshi	▪ Asian/Asian British: Bangladeshi	
▪ Chinese	▪ Asian/Asian British: Chinese	
▪ Any other Asian background	▪ Asian/Asian British: Other Asian	
▪ White and Black Caribbean	▪ Mixed/multiple ethnic group: White and Black Caribbean	Mixed
▪ White and Black African	▪ Mixed/multiple ethnic group: White and Black African	
▪ White and Asian	▪ Mixed/multiple ethnic group: White and Asian	
▪ Any other Mixed background	▪ Mixed/multiple ethnic group: Other Mixed	
▪ Any other ethnic group	▪ Other ethnic group: Arab ▪ Other ethnic group: Any other ethnic group	Other

7.2.4.2 Neighbourhood-level variables

I chose IMD score and population density as neighbourhood-level exposures and used the same measure as in the chapter 5 on the C&I CRIS personality disorder prevalence. Both variables were used as continuous variables and standardized in order to reduce multicollinearity.

IMD score: As in chapter 5, I used IMD score as a measurement for neighbourhood deprivation and obtained information on IMD score in this study from the English Indices of Deprivation 2015 published by Department for Communities and Local Government which was the mid-point of SLaM case ascertainment. IMD score is a set of measures of deprivation for lower-layer super output areas across England and comprises 7 domains of deprivation including income deprivation (22.5%),

employment deprivation (22.5%), education, skills and training deprivation (13.5%), health deprivation and disability (13.5%), crime (9.3%), barriers to housing and services (9.3%), and living environment deprivation (9.3%). In this dataset, the IMD scores were provided at LSOA level while the 2011 Census data (the population data) were provided at MSOA level.

Population density: I obtained Information on population density from the '2011 Census: population and household estimates for Wards and Output Areas in England and Wales' published by the Office for National Statistics. Population density in this table had been defined as number of persons per square kilometre and provided at the MSOA level. Population density was categorized into four equal-interval groups as previously described (Chapter 5 &6)

7.2.5 Statistical analysis

As this study was a replication study, the same statistical methodology as in chapter 5 was used. Stata version 16 was used for statistical analyses. I estimated the contact period prevalence of personality disorder and 95% confidence intervals (CI).

As the observation period in the replication study was not the same as the first study, I estimated the period prevalence in this study in two ways: One with the original period that the SLAM CRIS data for personality disorder were collected (April 2008 – Mar 2020), and the other with the same period as the C&I prevalence study (Jan 2008 – Sep 2016).

Descriptive statistics of participants were computed and the χ^2 test was used to explore the difference between people with personality disorder diagnosis records and the population. I used a complete case analysis with a list-wise deletion method, and people with missing information in exposure variables including age, sex, ethnicity and LSOA was excluded in the analysis.

I used multilevel Poisson regression model to test the association between prevalence of personality disorder diagnosis and exposures, as the outcome variable was count data (Colin et al., 1998). As I combined the CRIS data with the population data based on their MSOA code, age, sex and ethnicity, there were some strata where the numerator (CRIS cases) was larger than denominator (population data) or denominator was equal to zero. When both the denominator and CRIS cases were equal to zero, I deleted these rows since it was considered not to contribute any usable information to the dataset. When the denominator was smaller than CRIS cases, I assigned the denominator the median value of the strata to which the denominator belonged to.

I started the regression model building with examining univariable associations between each exposure and outcome in which unadjusted risk ratio (RR) with the 95 % CI for each exposure were calculated. Then the models were fitted with individual-level demographic risk factors including age,

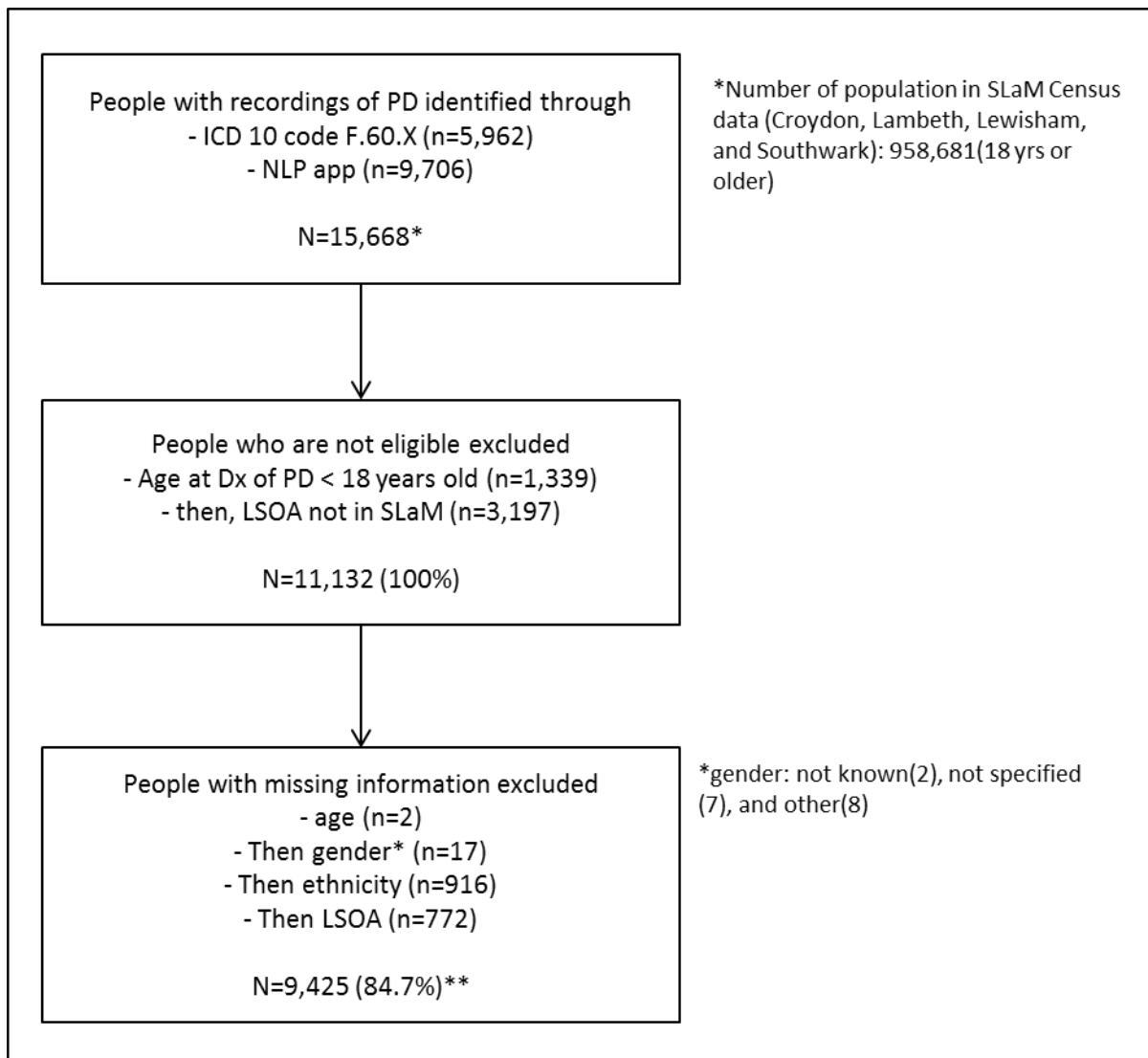
sex and ethnicity. In the final stage, models were fitted with both individual-level and neighbourhood-level exposures. Models were tested with likelihood ratio test (LRT)

7.3 Results

7.3.1 Cohort identification

The Flow diagram of cohort identification is presented in **Figure 7.2**. I initially identified 15,668 people who had records of personality disorder diagnosis either in structured ICD-10 code or text-free NLP application. Those who were younger than 18 years old at the time of First diagnosis of personality disorder or whose LSOA does not belong to SLaM catchment areas were excluded in the first step. Next, people who had any missing information in age, gender, ethnicity and LSOA were excluded resulting in the final cohort of 9,425 people.

Figure 7.2 Flow diagram of SLaM CRIS personality disorder cohort identification



7.3.2 Missing data

I identified 1,707 people (15.3%) with missing data in exposure variables such as age, sex, ethnicity and LSOA. I found differences in age distribution ($p < 0.001$; **Table 7.4**). In both groups, the age band 20-29 had the highest proportion, but the proportion was higher in those with missing data (39.9%) than those with complete data (32.2%). Both groups also differed in the composition of sex ($p < 0.001$). Both groups had more women than men, but the proportion of women was higher in those with complete data (61.0%) than those with missing data (52.4%). I also found differences in the composition of ethnicity (< 0.001). Although white British ethnicity made up the highest proportion with similar proportion, 57.0% and 57.8% in both groups, the second highest proportion was in white non-British (15.5%) in those with missing data while Black ethnicity (16.1%) had the second highest proportion in those with complete data.

Table 7.4 Characteristics of people with and without missing data

	Missing (n=1,707)		No missing (n=9,425)		P (χ^2 test)
	n	%	n	%	
Age group					<.001
18-19	80	4.7	525	5.6	
20-29	680	39.9	3,032	32.2	
30-39	466	27.3	2,379	25.2	
40-49	280	16.4	1,834	19.5	
50-59	144	8.4	1,063	11.3	
60-69	40	2.3	361	3.8	
70-79	12	0.7	147	1.6	
80 or over	3	0.2	84	0.9	
Sex					<.001
Male	805	47.6	3,680	39.0	
Female	885	52.4	5,691	61.0	
Ethnic group					<.001
White British	446	57.0	5,445	57.8	
White non-British	121	15.5	904	9.6	
Black	112	14.3	1,514	16.1	
Asian	26	3.3	357	3.8	
Mixed	27	3.5	407	4.3	
Any other	50	6.4	798	8.5	

7.3.3 Contact period prevalence

Table 7.5 presents the contact period prevalence of personality disorder (hereinafter, prevalence of personality disorder) in SLaM in comparison with C&I. The prevalence of personality disorder was found to be 1.16 (95% CI: 1.14 – 1.18) during the period of April 2008 – March 2020 which was the whole period of data collection. When the period was restricted to the same as that in C&I (2008-2016), the prevalence was found to be 0.76 (95% CI: 0.74-0.78). For comparison, in the C&I study, the prevalence of personality disorder was 0.99% (95% CI: 0.96-1.02).

Table 7.5 Contact period prevalence of personality disorder in SLaM and C&I

FT*	N of residents** (age*** ≥ 18)	N of people with personality disorder	Prevalence (%)	CI (95%)	Period
SLaM	958,681	11,132	1.16	1.14-1.18	Apr. 2008 – Mar. 2020
		7,270	0.76	0.74-0.78	Apr.2008 – Sep.2016
C&I	351,073	3,488	0.99	0.96-1.02	Jan. 2008 – Sep.2016

*FT: NHS Foundation Trust

**Based on 2011 Census data

***age on the day of first personality disorder diagnosis

7.3.4 Characteristics of people with personality disorder diagnosis and the population at risk

The proportion of participants diagnosed with personality disorder who were women (61.0%) was much higher than in the population at-risk in C&I (51.3%; $p < 0.001$; **Table 7.6**). The age distribution also differed between people with personality disorder and the population at risk. The proportions of age group 18-19 (5.6%) and 20-29 (32.2%) in the CRIS personality disorder sample were larger than those of population at risk with 18-19 (2.9%) and 20-29 (24.1%), respectively. The age groups of 30-39 (25.2% vs 24.0%) and 40-49 (19.5% vs 19.3%) showed similar proportion. This pattern was opposite in the older age groups of 50 years and older with higher proportion in the population at risk compared with people with personality disorder: 50-59 (11.3% vs 12.9), 60-69 (3.8% vs 8.1%), 70-79 (1.6% vs 5.3%). The age group which had the biggest difference was 20-29, with 8.1% between people with personality disorder and population at risk. In terms of ethnicity, the white British group were the largest single ethnic group in both CRIS personality disorder sample (57.8%) and population

at risk (45.4%) and showed the biggest difference of proportion with 12.4% between CRIS personality disorder sample and population at risk.

Table 7.6 Demographic characteristics of people with a record of personality disorder diagnosis at SLaM & population at risk in boroughs of SLaM

Variables	People with personality disorder diagnosis records (N=9,425)		Population at risk (N=958,681)		P (χ^2 test)
	n	%	n	%	
Sex					<.001
Male	3,680	39.0	466,407	48.7	
female	5,691	61.0	492,274	51.3	
age					<.001
18-19	525	5.6	28,130	2.9	
20-29	3,032	32.2	231,189	24.1	
30-39	2,379	25.2	230,010	24.0	
40-49	1,834	19.5	185,064	19.3	
50-59	1,063	11.3	123,360	12.9	
60-69	361	3.8	77,943	8.1	
70-79	147	1.6	51,093	5.3	
80 or over	84	0.9	31,892	3.3	
Ethnicity					<.001
White British	5,445	57.8	434,946	45.4	
White non-British	904	9.6	139,477	14.5	
Black	1,514	16.1	209,379	21.8	
Asian	357	3.8	102,735	11.0	
Mixed	407	4.3	45,569	4.8	
Any Other	798	8.5	23,578	2.5	

7.3.5 Univariable and multivariable analysis

In the univariable modelling (**Table 7.7**), IMD score (RR: 1.27; 95% CI: 1.22-1.33) and all the subgroups of the population density (e.g. subgroup 5,001-10,000 ppsqkm - RR: 1.46; 95% CI: 1.25-1.71) was found to be positively associated with the prevalence of personality disorder. Women (RR: 1.48; 95% CI: 1.42-1.54) showed elevated risk of having a personality disorder diagnosis compared with men. Compared with the youngest age group (18-19 years old), all the other older age groups were less likely to have a personality disorder diagnosis (e.g., age group 20-29 RR: 0.72; 95% CI: 0.66-0.80). With regards to ethnicity, compared with the white British ethnic group, white non-British (RR: 0.50; 95% CI: 0.46-0.53), Black (RR: 0.51; 95% CI: 0.48-0.54), Asian (RR: 0.25; 95% CI: 0.23-0.28) and Mixed (RR: 0.65; 95% CI: 0.59-0.72) ethnic groups were less likely to have a personality disorder diagnosis record. However, any other ethnic group (RR: 2.49; 95% CI: 2.31-2.68) showed elevated risk of having a personality disorder diagnosis record in comparison with the white British group.

Table 7.7 Risk ratio of significant variables associated with recordings of personality disorder diagnosis in univariable and multivariable analysis

	UV		MV1 ¹⁾		MV2 ²⁾	
	RR (95% CI)	p	RR (95% CI)	p	RR (95% CI)	p
Sex						
Male	1		1		1	
Female	1.48 (1.42-1.54)	<.001	1.56 (1.50-1.63)	<.001	1.56 (1.50-1.63)	<.001
Age group						
18-19	1		1		1	
20-29	0.72 (0.66-0.80)	<.001	0.71 (0.65-0.78)	<.001	0.71 (0.65-0.78)	<.001
30-39	0.57 (0.52-0.62)	<.001	0.57 (0.52-0.63)	<.001	0.57 (0.52-0.63)	<.001
40-49	0.54 (0.49-0.59)	<.001	0.53 (0.48-0.58)	<.001	0.53 (0.48-0.58)	<.001
50-59	0.47 (0.43-0.53)	<.001	0.44 (0.39-0.49)	<.001	0.44 (0.40-0.49)	<.001
60-69	0.26 (0.23-0.30)	<.001	0.22 (0.20-0.26)	<.001	0.23 (0.20-0.26)	<.001
70-79	0.16 (0.13-0.19)	<.001	0.14 (0.12-0.17)	<.001	0.14 (0.12-0.17)	<.001
80 or over	0.14 (0.12-0.18)	<.001	0.11 (0.09-0.14)	<.001	0.11 (0.09-0.14)	<.001
Ethnic group						
White British	1		1		1	
White non-British	0.50 (0.46-0.53)	<.001	0.44 (0.41-0.48)	<.001	0.44 (0.41-0.47)	<.001
Black	0.51 (0.48-0.54)	<.001	0.45 (0.43-0.48)	<.001	0.45 (0.42-0.47)	<.001
Asian	0.25 (0.23-0.28)	<.001	0.22 (0.20-0.25)	<.001	0.22 (0.20-0.25)	<.001
Mixed	0.65 (0.59-0.72)	<.001	0.53 (0.48-0.58)	<.001	0.53 (0.47-0.58)	<.001
Any other	2.49 (2.31-2.68)	<.001	2.18 (2.03-2.36)	<.001	2.16 (2.00-2.33)	<.001
IMD score*	1.27 (1.22-1.33)	<.001			1.30 (1.25-1.37)	<.001
Population Density*						
0-5,000 ppsqkm**	1				1	
5,001-10,000 ppsqkm	1.46 (1.25-1.71)	<.001			1.16 (1.01-1.32)	.03
10,001-15,000 ppsqkm	1.44 (1.23-1.70)	<.001			1.05 (0.91-1.21)	.49
15,001 – max ppsqkm	1.36 (1.13-1.65)	.001			0.88 (0.74-1.04)	.13

*: Standardized score, **: people per square metre

¹⁾ Adjusted for individual (age, sex, ethnicity) variables, ²⁾Fully adjusted for individual and neighbourhood-level (IMD score and population density) variables

Next, when Individual level characteristics were adjusted in the Poisson regression model, the association between each individual variable found in the univariable modelling remained the same. women (RR: 1.56; 95% CI: 1.50-1.63) and youngest age group (18-19) were more prone to have personality disorder after controlling for other confounding variables. Regarding ethnicity, all ethnic groups were less likely to have personality disorder diagnosis compared to the reference group (white British) except for any other ethnic group (RR: 2.18; 95% CI: 2.03-2.36) which was shown to have an increased risk of having personality disorder diagnosis.

Lastly, when fully adjusted with individual and neighbourhood-level variables (**Table 7.7**), IMD score (RR: 1.30; 95% CI: 1.25-1.37) remained to be positively associated with prevalence of personality disorder diagnosis. Although all the subgroups of the population density showed a statistically significant positive association with records of personality disorder diagnosis in the univariable modelling, the association was no more apparent except the subgroup (5,001-10,000 ppsqkm – RR: 1.16; 95% CI: 1.01-1.32) when fully adjusted. Women (RR: 1.56; 95% CI: 1.50-1.63) remained at elevated risk of personality disorder as in univariable modelling. In terms of age group, in comparison with the youngest age group (18-19), all other age groups remained to be negatively associated with personality disorder diagnosis as in univariable (e.g., age group 20-29 RR: 0.71; 95% CI: 0.65-0.78). With respect to ethnicity, white non-British (RR: 0.44; 95% CI: 0.41-0.47), Black (RR: 0.45; 95% CI: 0.42-0.47), Asian (RR: 0.22; 95% CI: 0.20-0.25) and Mixed (RR: 0.53; 95% CI: 0.47-0.58) ethnic groups were less likely to have personality disorder diagnosis compared with reference group (white British ethnic group). On the contrary, Any other ethnic groups (RR: 2.16; 95% CI: 2.00-2.33) showed increased risk of having a personality disorder diagnosis compared with the white British ethnicity.

7.4 Discussion

7.4.1 summary of findings

The findings were partially consistent with the initial hypotheses. First, the contact period prevalence of personality disorder in a large secondary mental health care service in South London was to be found to be 1.16 (95% CI: 1.14-1.18) during the period between April 2008 and March 2020, and 0.76 (95% CI: 0.74-0.78) during April 2008 and September 2016 both of which are lower than previously reported prevalence of personality disorder in community setting (4.4%-13.4%). Secondly, there was evidence that neighbourhood-level deprivation increased the risk of having a personality disorder diagnosis as hypothesized. However, no clear association between population density and personality disorder was observed. In terms of individual variables, I found that female

sex, white British ethnicity, youngest age group increased the risk of having a personality disorder diagnosis.

7.4.2 Similarities between findings from C&I and SLaM

As expected, and in keeping with the findings in the first study, I found the contact period prevalence of personality disorder in SLaM was lower than those reported in previous community studies. I found the prevalence of personality disorder between C&I (0.99; 95% CI: 0.96-1.02 for the period of 2008 and 2016) and SLaM (1.16; 95% CI: 1.14-1.18 for the period of 2008 and 2020; 0.76; 95% CI: 0.74-0.78 for the period of 2008 and 2016) was not to be much different, with being close to 1%. Considering the prevalence in this study is cumulative period prevalence, it is not surprising the prevalence of personality disorder in SLaM during the period of April 2008 and March 2020 (1.16; 95% CI: 1.14-1.18) was bigger than the prevalence examined during 2008 and 2016 (0.76; 95% CI: 0.74-0.78). With the 0.76% prevalence for 8 years, average annual prevalence is calculated as about 0.095%. Therefore, 0.4% increase in prevalence over 4 years could be expected and prevalence of 1.16% during the period of 2008 and 2020 may be explained if assumed that the number of people diagnosed with personality disorder does not change significantly over time.

Next, in the multivariable Poisson regression models fully adjusted with individual and neighbourhood variables (**Table 7.8**), both studies confirmed that people living in more deprived neighbourhoods are more likely to receive a personality disorder diagnosis. Possible reasons behind this relatively low prevalence of personality disorder and the relationship with the neighbourhood-level deprivation have already been discussed in chapter 5. Another plausible explanation is that people from less deprived areas may seek private practice rather than NHS services because first they want to avoid perceived stigma associated with personality disorder and pursue service discreetly and second, they can afford the cost. Hence, even if people who live in less deprived areas have a diagnosis of personality disorder, their diagnosis would not have been recorded in the CRIS data. The association between neighbourhood-level deprivation and personality disorder that I found in the SLaM replication study confirmed the findings from C&I study in Chapter 5. This may strengthen the evidence that there may be a possibly causal role for neighbourhood-level deprivation on the prevalence of personality disorder, although it is hard to exclude reverse causality, and suggest the finding did not arise due to chance.

In terms of individual demographic variables, both studies showed that female sex increased the risk of having a personality disorder diagnosis. The results were also consistent for age distribution. People who were aged 18 or 19 on the first day of personality disorder diagnosis, were more likely to have personality disorder diagnosis compared with those in age group of 20-29, and 60 or older.

Regarding ethnicity, the white British ethnic group was more prone to have personality disorder diagnosis than white non-British, Black and Asian groups in both studies.

Table 7.8 Risk ratios of individual and neighbourhood-level variables associated with personality disorder in Poisson regression models

variables	C&I study		SLaM (replication) study	
	RR (95% CI)	p	RR (95% CI)	P
Sex				
Male	1		1	
Female	1.52 (1.41-1.64)	<.001	1.56 (1.50-1.63)	<.001
Age group				
18-19	1		1	
20-29	0.75 (0.61-0.91)	.003	0.71 (0.65-0.78)	<.001
30-39	0.92 (0.76-1.12)	.40	0.57 (0.52-0.63)	<.001
40-49	1.18 (0.97-1.44)	.10	0.53 (0.48-0.58)	<.001
50-59	0.84 (0.68-1.04)	.11	0.44 (0.40-0.49)	<.001
60-69	0.41 (0.32-0.53)	<.001	0.23 (0.20-0.26)	<.001
70-79	0.34 (0.25-0.46)	<.001	0.14 (0.12-0.17)	<.001
80 or over	0.21 (0.13-0.32)	<.001	0.11 (0.09-0.14)	<.001
Ethnic group				
White British	1		1	
White non-British	0.81 (0.73-0.89)	<.001	0.44 (0.41-0.47)	<.001
Black	0.81 (0.71-0.92)	.002	0.45 (0.42-0.47)	<.001
Asian	0.30 (0.25-0.36)	<.001	0.22 (0.20-0.25)	<.001
Mixed	0.95 (0.80-1.13)	.59	0.53 (0.47-0.58)	<.001
Any other	1.02 (0.85-1.22)	.84	2.16 (2.00-2.33)	<.001
IMD score*	1.29 (1.20-1.39)	<.001	1.30 (1.25-1.37)	<.001
Population Density**				
Least densely populated	1		1	
2 nd least densely populated	<i>1.20 (0.80-1.80)</i>	.37	1.16 (1.01-1.32)	.03
2 nd most densely populated	<i>0.89 (0.61-1.29)</i>	.54	1.05 (0.91-1.21)	.49
Most densely populated	<i>1.00 (0.68-1.46)</i>	.99	0.88 (0.74-1.04)	.13

*: standardized score

**As the range of population density defined as people per square kilometre was different in each study, I presented the population density as above.

7.4.3 Differences between the two studies

First, in the SLaM replication study, people who were 18-19 years old were more likely to have a personality disorder diagnosis compared with all older age group whereas no association was found in some age groups (30-39, 40-49, and 50-59) in the C&I study. This may be due to chance as the power in C&I was not big. Also, there was a positive association between Any other ethnic group and personality disorder diagnosis records in the SLaM study whereas no association was found in the C&I study. The proportion of this ethnic group with personality disorder was much larger in SLaM CRIS (8.6%) compared to C&I CRIS (4.6%), but it was difficult to explore further about the possible reason behind the different association between studies as there was no sub-category given in this particular ethnic group.

The relationship between personality disorder and population density also differed in each study. A partial positive association between the subgroup (50,001-10,000 ppsqkm) of population density and personality disorder was observed in SLaM while there was no significant association found in the first study. Both SLaM and C&I serve people living in highly densely populated areas and there was no clear association between population density and prevalence of personality except a partial association found in a population density subgroup in SLaM. The median population density at MSOA level was measured as 140.3 (persons per hectare (p/h), IQR: 120.65-176.55) IN C&I, and 92.4 (p/h, IQR: 73.9-104.9) in SLaM in 2011 UK Census, and three boroughs of Lambeth (113 p/h), Southwark (100 p/h) and Lewisham (78 p/h) in SLaM and both boroughs of Camden (101 p/h) and Islington (139 p/h) in C&I were included among the 20 most densely populated local authorities in England and Wales in the same Census data (Office for national statistics). Although evidence for an effect of population density on personality disorder is inconclusive, urban living has continuously been reported to be associated with poorer mental health (Peen et al., 2010) and a population based cohort study conducted in Denmark (Vassos et al., 2016) found birth in large cities was associated with increased risk for developing psychiatric illness including personality disorder. So, the partial association between personality disorder diagnosis and a subgroup of population density found in the replication study is consistent with earlier literature. Although both studies share densely populated urban setting in a capital city of England, various factors including culture, social support from the community and family level factors may have influenced the discrepancy between the two studies and further examination would be needed to explain the reason behind.

7.4.4 Strengths and limitations

To my best knowledge, this study is the first study that analysed a large sample of people with records of personality disorder diagnosis in a clinical setting together with the C&I personality

disorder prevalence study in chapter 5. The replication using the same methodology and data obtained from the same platform may help to provide greater validity to the findings of the first study in C&I. However, this study also has multiple limitations which are similar with those found in the C&I study. Firstly, this study is based on data obtained in clinical setting, and given limited time allowed for each patient, not everyone is assessed with structured diagnosis tool such as SCID-II before a diagnosis of personality disorder has been made. Many of those diagnoses made based on clinician's judgement. So, one may question the accuracy of diagnosis and inconsistency of assessment measures.

Second, this study is based on recorded personality disorder diagnoses of people who received services or treatments at the NHS Foundation Trust. Only people with certain symptoms or problems would be contacting NHS services or referred and those with mild symptoms or who have no intention of seeking services are not included when calculating the prevalence in this study. Some people may choose to seek private services rather than NHS service when it comes to mental health issues due to stigma and these cohort of people were not included in this service. So it is possible that the prevalence here is underestimated.

Next, the addresses of people with personality disorder diagnosis used in this study are based on their self-report, and it is difficult to verify whether they are their genuine address. It is possible that they could have borrowed the addresses from their friends or relatives. Also, the duration of their residency in those addresses is hard to confirm. They may have just moved in from a neighbourhood which had a different deprivation level or did not live in those addresses for long enough for their neighbourhood they live in to be able to affect their lifestyle. In fact, it is not known how much time should be spent for living environment to have an impact on risk of developing or presenting personality disorder symptoms.

Further, there were some missing data in some variables, especially demographic variables. It must be considered that the data used in this study were collected for and during clinical practice, rather than for research purpose, and therefore, the data obtained did not contain exhaustive information of every single participant in spite of its large sample size. The demographic information is mostly based on self-report, and it is possible some may have deliberately chosen to leave out their demographic information or did so by mistake. These missing data may have influenced the estimations considering the different characteristics between people with missing data and those without as discussed in 7.3.2.

Next, the length of data collection period was not homogeneous between population data and CRIS data. The population data were from 2011 census which was taken on March 2011 whereas the CRIS

data in this study contained recordings between April 2008 and March 2020. Although the 2011 census data is the most recent data that provide combined information on age, sex and ethnicity, this discrepancy of time period between two datasets may have affected the study result.

Further, the data sets used in this study lack individual socioeconomic information. It has been reported that association between neighbourhood-level deprivation and psychiatric disorders tended to weaken or disappear when adjusted for individual (Lofors et al., 2006; O'Donoghue et al., 2016; Walters et al., 2004). Although the effect of individual socioeconomic status on the relationship between personality disorder and area-level deprivation has not examined yet, the estimation could have been affected if information on individual socioeconomic status was available.

Lastly, I used the classification of personality disorders in this study generically and did not examine discrete types of personality disorder to maintain consistency with the C&I CRIS prevalence study. In the first C&I study, I did not examine discrete types of personality disorder because there were many people who had diagnoses of multiple types of personality disorder or generic type of personality disorder diagnosis in the free-text clinical notes, and I chose not to pursue analysis of individual types of personality disorder in the replication study in order to avoid complexity in the scope of present study. However, more in-depth examination of prevalence of each specific type of personality disorder diagnosis and their association with neighbourhood-level deprivation in the further study will add more insights on the findings in this study considering each type of personality disorder presents different symptoms and features under current ICD-10 classification.

7.4.5 Conclusion

The contact period prevalence of personality disorder recordings in a large NHS Foundation Trust in south London was examined as a replication study. The findings verified the conclusion of the first study in chapter 5 that prevalence of personality disorder diagnosis records in based on clinical records obtained in secondary mental health services is lower than those previously reported studies conducted for research purpose. Further, the replication study also confirmed that people from poor neighbourhood were more likely to have a personality disorder diagnosis compared to those living in less deprived areas as found in the first study.

Chapter 8 Neighbourhood-level deprivation and outcomes of personality disorder using CRIS data: a replication study in another London NHS Foundation Trust

8.1 Introduction

In Chapter 6, I examined the association between neighbourhood level social-environmental factors, including deprivation and population density, and two outcomes following personality disorder, mortality and readmission, in the catchment area of Camden and Islington NHS Foundation Trust (C&I). In this Chapter, I replicate that analysis in another part of London, namely the catchment area of the South London and Maudsley NHS Trust (SLaM). In C&I, I found no evidence of associations between neighbourhood-level deprivation and population density on either mortality or subsequent acute psychiatric admission. As discussed in Chapter 6, to my knowledge, there is no study that looked at the relationship between social-environmental factors at neighbourhood-level and mortality or readmission of people with personality disorder and, therefore, the results found in Chapter 6 need to be validated by a replication study. In Chapter 7, I have described the similarities and differences between the catchment areas of these two NHS Foundation Trusts and replicated the C&I personality disorder prevalence study using SLaM CRIS data. Hence, I decided to replicate this work in another similar cohort using the same methodology to determine if the results from Chapter 6 were generalisable to other parts of London.

In the present chapter, I aim to, firstly, replicate the outcomes study conducted in Chapter 6 and secondly, to examine whether there is any association between neighbourhood-level social-environmental factors including neighbourhood-level deprivation and population density and prognosis of people with personality disorder such as mortality or readmission after their personality disorder diagnosis.

I set out the research questions and corresponding hypotheses as follows:

1. Mortality
 - a. Is there an association between neighbourhood-level deprivation and mortality for people diagnosed with personality disorder?
(H1: People with personality disorder who live in more deprived areas will have higher mortality rates compared with those who live in more affluent areas)

- b. Is there an association between population density and morality for people diagnosed with personality disorder?
(H2: People with personality disorder who live in more deprived areas will have higher mortality rates compared with those who live in more affluent areas)

2. Readmission

- a. Is there an association between neighbourhood-level deprivation and first psychiatric admission after a personality disorder diagnosis?
(H3: People with personality disorder who live in more densely populated areas will have higher readmission rates than those who live in more sparsely populated areas)

- b. Is there an association between population density and subsequent psychiatric admission after a personality disorder diagnosis?
(H4: people with personality disorder who live in more densely populated areas will have higher admission rates than those who live in more sparsely populated areas)

8.2 Methods

8.2.1 Design and setting

I used clinical data provided by The South London and Maudsley National Health Service (NHS) Foundation Trust (SLaM) Biomedical Research Centre (BRC) case register, which I extracted using the Clinical Record Interactive Search (CRIS) application system for this retrospective cohort study. I have described the details of SLaM and its catchment area in Chapter 7. Participants included people who were treated from April 2008 and March 2020 in SLaM and had a recorded personality disorder diagnosis in either an ICD-10 structured field or text field in the CRIS database. Participants who met eligibility criteria of being 18 years or older and residing in the SLaM catchment area at the time of personality disorder diagnosis were only included in the personality disorder cohort. I excluded those who had a diagnosis of organic personality disorder and conditions classified as psychosis in ICD-10 and detailed the ICD-10 codes of F60 for personality disorder in Chapter 7.

8.2.2 Outcomes

The primary outcomes in this study were all-cause mortality and the first acute psychiatric admission after personality disorder diagnosis as in the first (C&I) study. In all NHS trusts, a NHS number is given to all patients and registered on the 'Spine', a national electronic database of NHS patient demographic details (NHS, n.d.). A patient's death is recorded on the Spine and records of deceased patients are routinely sent back to SLaM electronic health records based on their NHS number. Data

on death records were extracted during the follow-up period for the personality disorder cohort (April 2008-March 2020). I excluded those who had their death recorded before or concurrently with their first personality disorder diagnosis.

Next, I defined the readmission outcome as the first acute psychiatric admission after their first record of a personality disorder diagnosis, as recorded in the CRIS database. Although this included inpatient admissions to hospital, crisis houses or admission to crisis teams in C&I, only information on inpatient admission to hospital and crisis teams were included in this study, as SLaM does not provide crisis house care. Information on readmissions were obtained from the SLaM CRIS data during the same follow-up period as for mortality (April 2008-March 2020).

8.2.3 Exposures

The two primary exposures were neighbourhood-level deprivation and population density. I used the index of multiple deprivation (IMD) score at lower layer super output areas (LSOA) level as a measure of neighbourhood-level deprivation and the population density was defined as the number of persons per hectare. I have described the detailed information on both IMD score and population density and how they were categorized into groups in Chapter 6 and 7. Both IMD score and population density were stratified into 4 categories, quartiles and four equal-interval groups, respectively as previously described.

8.2.4 Covariates

I included Individual-level covariates, including age at the first record of a personality disorder diagnosis, sex and ethnicity as in C&I prognosis study. I have discussed the detailed definitions of these variables in Chapter 7 (the SLaM prevalence study).

8.2.5 Statistical analysis

As this study was a replication study, I maintained the same statistical methodology that I used in Chapter 6. Firstly, I generated descriptive statistics of participants using χ^2 test and examined differences between those participants with outcomes (in mortality and readmission) and those without. There were people with missing information in age, sex, ethnicity or LSOA, and I took a complete case analysis method to deal with them. I inspected whether those with missing data differed from those included to assess how this could affect the result by comparing of those with complete data and those with missing data using Chi-squared test.

Next, I investigated whether main exposures, neighbourhood-level deprivation and population density, were associated with outcomes of personality disorder (mortality and readmission) using Cox proportional hazard regression. Age, sex, and ethnicity were used as covariates. I split age with a

one-year interval and generated current age, a time-varying covariate given that status of outcomes of personality disorder change over time. I conducted univariable and multivariable Cox regression analysis and unadjusted and adjusted hazard ratios (HR) with 95% confidence intervals were estimated. I used Akaike's Information Criterion (AIC) scores for each exposure and covariate and likelihood ratio test (LRT) to find the best fitting model. For mortality, I defined the follow-up time as the number of years from the date of first personality disorder diagnosis until either the date of death or a censoring date (31st March 2020) and for readmission, until either the date of the first admission or the censoring date. I also censored people who were not admitted with their date of death (if they died) in the analysis of readmission, since their date of death would have come before the censoring date and so they stopped being followed up. I used Stata version 16 for all analyses.

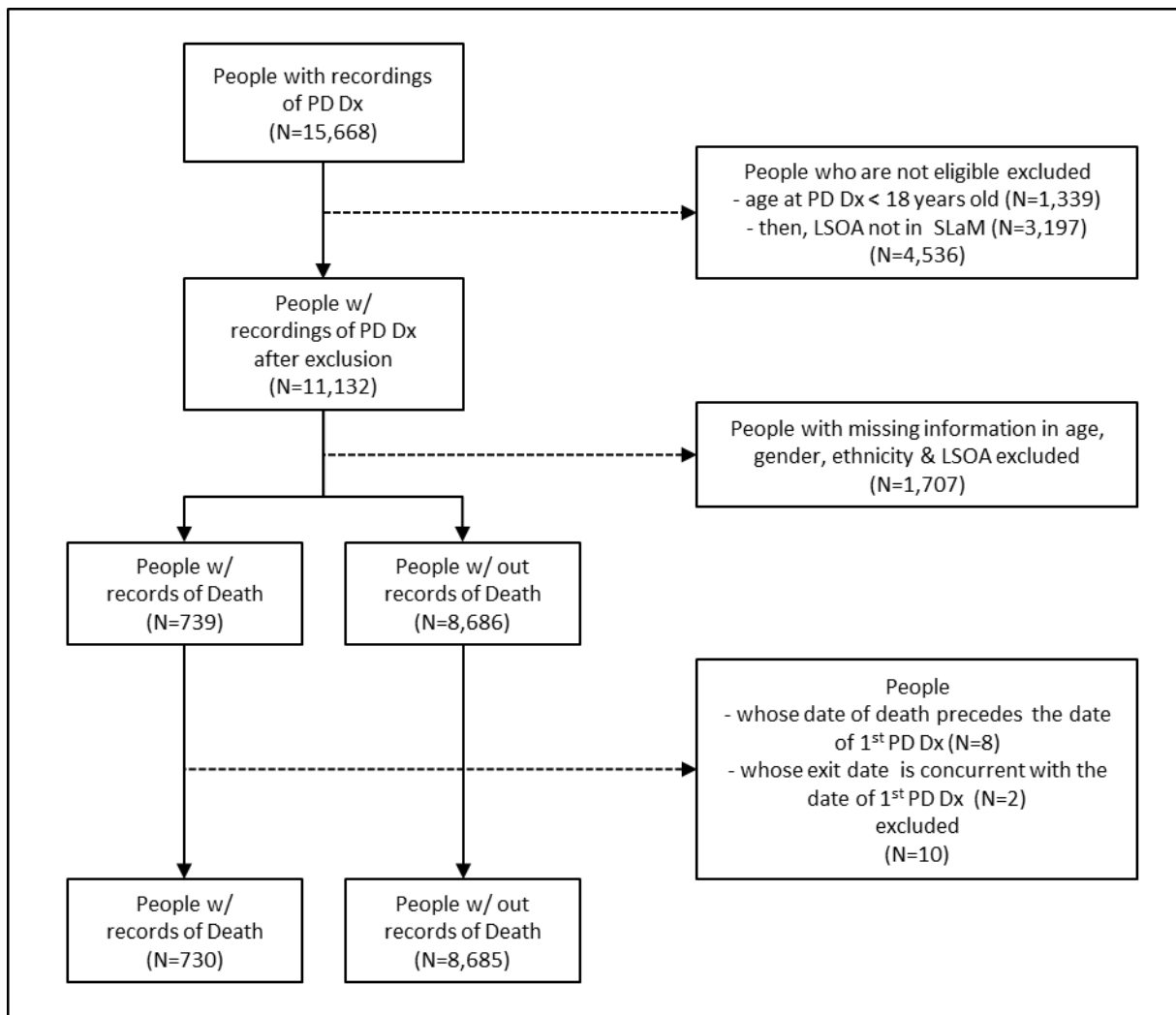
8.3 Results

8.3.1 Part I. Mortality

8.3.1.1 *Sample characteristics*

As described in **Figure 8.1** and consistent with the C&I outcomes study, I excluded those who were younger than 18 years old (N=1,339) or whose LSOA was not in SLaM (N=3,197) at the time of personality disorder diagnosis. Then, I also excluded people with missing information in age, gender, ethnicity and LSOA (N=1,707). Through these processes, I identified 739 people who have died and 8,686 people who have not. Of these, I found eight people whose date of death preceded their personality disorder diagnosis date, which I conjectured to be a result of administrative error during recording. I also found 2 people whose personality disorder diagnosis date was concurrent with their exit date, which meant that they did not contribute any follow-up time to the study. After excluding these 10 people, I identified the final number of 730 people with death records and 8,685 people without death records.

Figure 8.1 Flowchart of identifying mortality cohort



The median age of participants with personality disorder at the time of the personality disorder diagnosis in the sample was 34.36 years old (IQR: 25.94-45.80). The age distribution of people who died differed from those who remained alive (Chi-square p -value<.001; **Table 8.1**), with the age group 40-49 having the highest proportion (21.51%) in people who died whereas the age group 20-29 took up the highest proportion among people without death records. In terms of sex differences, people with and without death records also differed (p <.001). Also, there was a higher proportion of men (53.15%) in the sample who died while there were more women (60.99%) in those who did not die. In terms of ethnicity, people who died differed from those who did not (p <.001). Although the White British ethnic group were the highest proportion in both groups, this was larger in people who died (72.47%) compared with those who did not (56.52%). I found no statistically significant differences between people with death records and those without both in terms of IMD score and population density (**Table 8.1**).

Table 8.1 Characteristics of people with & without death record

	Death record (N=730) N (%)	No death record (N=8,685) N (%)	Total (N=9,415) N (%)	χ^2 test (p-value)
Age at personality disorder diagnosis				<0.001
18-19	6 (0.82)	519 (5.98)	525 (5.58)	
20-29	101 (13.84)	2,930 (33.74)	3,031 (32.19)	
30-39	126 (17.26)	2,250 (25.91)	2,376 (25.24)	
40-49	157 (21.51)	1,675 (19.29)	1,832 (19.46)	
50-59	126 (17.26)	935 (10.77)	1,061 (11.27)	
60-69	88 (12.05)	272 (3.13)	360 (3.82)	
70-79	72 (9.86)	74 (0.85)	146 (1.55)	
80 or over	54 (7.40)	30 (0.35)	84 (0.89)	
Sex				<0.001
Male	388 (53.15)	3,285 (37.82)	3,673 (39.01)	
Female	342 (46.85)	5,400 (62.18)	5,742 (60.99)	
Ethnicity				<0.001
White-British	529 (72.47)	4,909 (56.52)	5,438 (57.76)	
White-non British	64 (8.77)	840 (9.67)	904 (9.60)	
Black	65 (8.90)	1,449 (16.68)	1,514 (16.08)	
Asian	22 (3.01)	335 (3.86)	357 (3.79)	
Mixed	19 (2.60)	387 (4.46)	406 (4.31)	
Other	31 (4.25)	765 (8.81)	796 (8.45)	
IMD score				0.66
Least deprived	99 (13.56)	1,282 (14.76)	1,381 (14.67)	
25 th – 50 th	186 (25.48)	2,058 (23.70)	2,244 (23.83)	
50 th – 75 th	221 (30.27)	2,665 (30.69)	2,886 (30.65)	
Most deprived	224 (30.68)	2,680 (30.86)	2,904 (30.84)	
Population density				0.41
0-8,750 ppsqkm*	264 (36.16)	3,024 (34.82)	3,288 (34.92)	
8,751-17,500 ppsqkm	389 (53.29)	4,867 (56.04)	5,256 (55.83)	
17,501-26,250 ppsqkm	65 (8.90)	683 (7.86)	748 (7.94)	
26,251-max ppsqkm	12 (1.64)	111 (1.28)	123 (1.31)	

*people per square kilometre

8.3.1.2 Crude mortality rate

People were followed for a total of 59,348.56 person-years and 730 people had died by the end of the follow-up. Therefore, crude mortality rate was calculated as 12.30 per 1,000 person-years. In terms of age group, the older the age group was, the higher mortality rate was; with the oldest age group of 80 or over having the highest mortality rate (200 per 1,000 person-years; 95% CI: 160-260). Men had higher mortality rate (16.02 per 1,000 person-years; 95% CI: 14.50-17.70) compared with women (9.74 per 1,000 person-years; 95% CI: 8.76-10.82). In terms of ethnicity, the White British (15.01 per 1,000 person-years; 95% CI: 13.79-16.35) ethnic group showed the highest mortality rate. There was not much difference between mortality rates across the four groups of IMD score (min.

11.97 & max. 13.02 per 1,000 person-years) and population density (min. 11.60 & max.14.70 per 1,000 person-years).

Table 8.2 Mortality rate by exposure

variables	mortality rate (per 1,000 person-years)	95% CI
Age group		
18-19	1.98	0.89–4.41
20-29	5.67	4.66–6.89
30-39	7.76	6.52– 9.24
40-49	11.71	10.02–13.70
50-59	20.45	17.17–24.35
60-69	46.44	37.68–57.23
70-79	130	110– 170
80 or over	200	160– 260
Sex		
Male	16.02	14.50–17.70
Female	9.74	8.76–10.82
Ethnicity		
White British	15.01	13.79–16.35
White-non British	10.96	8.58–14.00
Black	6.65	5.21–8.47
Asian	11.25	7.41–17.09
Mixed	7.86	5.01–12.32
Other	7.53	5.29–10.70
IMD score		
Least deprived (<25 th percentile)	12.16	9.98–14.80
25 th – 50 th	13.02	11.28–15.04
50 th – 75 th	11.97	10.49–13.66
Most deprived (≥ 75 th percentile)	12.13	10.65–13.83
Population density		
0-8,750 ppsqkm*	13.23	11.73–14.93
8,751-17,500 ppsqkm	11.60	10.50–12.81
17,501-26,250 ppsqkm	12.90	10.11–16.45
26,251-max ppsqkm	14.70	8.35–25.88

*ppsqkm: people per square kilometre

8.3.1.3 Predictors of mortality

In univariable modelling (**Table 8.3**), I did not find any statistically significant association between neighbourhood-level deprivation or population density and mortality rate of people with personality disorder diagnosis. I found older age was associated with a higher rate of mortality (HR: 1.06; 95% CI: 1.04-1.08) compared with younger age. Women had a decreased rate of mortality (HR: 0.61; 95% CI: 0.53-0.71) than men. In terms of ethnicity, all ethnic groups except Asian group showed a lower mortality rate compared with the White British ethnic group.

Next, in the fully adjusted model with individual and neighbourhood-level variables (**Table 8.3**), I found no evidence of an association between either of the neighbourhood-level variables and mortality. I found being older (HR: 1.07; 95% CI: 1.05-1.09) remained associated with a higher rate of mortality than younger age, and women had a decreased mortality rate (HR: 0.60; 95% CI: 0.52-0.70) compared with men. The lower mortality rate for each ethnic group except the Asian group compared to white British ethnic group also remained in the fully adjusted model.

Table 8.3 Predictors of mortality in people with recordings of personality disorder diagnosis

variables	Univariable		Multivariable		
	HR (95% CI)	p	AIC	HR (95% CI)	p
Current age	1.06 (1.04-1.08)	<0.001	12,150.90	1.07 (1.05-1.09)	<0.001
Sex					
Male	Ref		12,133.49	Ref	
Female	0.61 (0.53-0.71)	<0.001		0.60 (0.52-0.70)	<0.001
Ethnicity (6 groups)			12,124.42		
White-British	Ref			Ref	
White-Non British	0.74 (0.57-0.95)	0.02		0.73 (0.56-0.95)	0.02
Black	0.45 (0.35-0.58)	<0.001		0.44 (0.34-0.57)	<0.001
Asian	0.76 (0.50-1.17)	0.21		0.74 (0.48-1.14)	0.17
Mixed	0.54 (0.34-0.85)	0.008		0.55 (0.35-0.87)	0.01
Any other	0.53 (0.37-0.76)	0.001		0.48 (0.34-0.70)	<0.001
IMD score (4 groups)			12,180.44		
Least deprived (<25 th percentile)	Ref			Ref	
25 th -50 th	0.93 (0.76-1.15)	0.50		0.99 (0.80-1.22)	0.91
50 th -75 th	0.96 (0.78-1.19)	0.74		0.98 (0.80-1.21)	0.87
Most deprived (≥75 th percentile)	0.996 (0.81-1.22)	0.97		1.04 (0.85-1.29)	0.68
Population density (4 groups)			12,177.78		
0-8,750 ppsqkm**	Ref			Ref	
8,751-17,500 ppsqkm	0.88 (0.80-1.23)	0.10		0.93 (0.79-1.09)	0.38
17,501-26,250 ppsqkm	0.97 (0.75-1.15)	0.82		1.03 (0.78-1.36)	0.82
26,251-max ppsqkm	1.11 (0.76-1.17)	0.73		1.27 (0.71-2.28)	0.42

* Only current age, sex and ethnicity were statistically significant in the final model. Non-significant values for IMD score and population density are shown after adjustment of current age, sex and ethnicity did not improve model fit over the final model.; **people per square kilometre

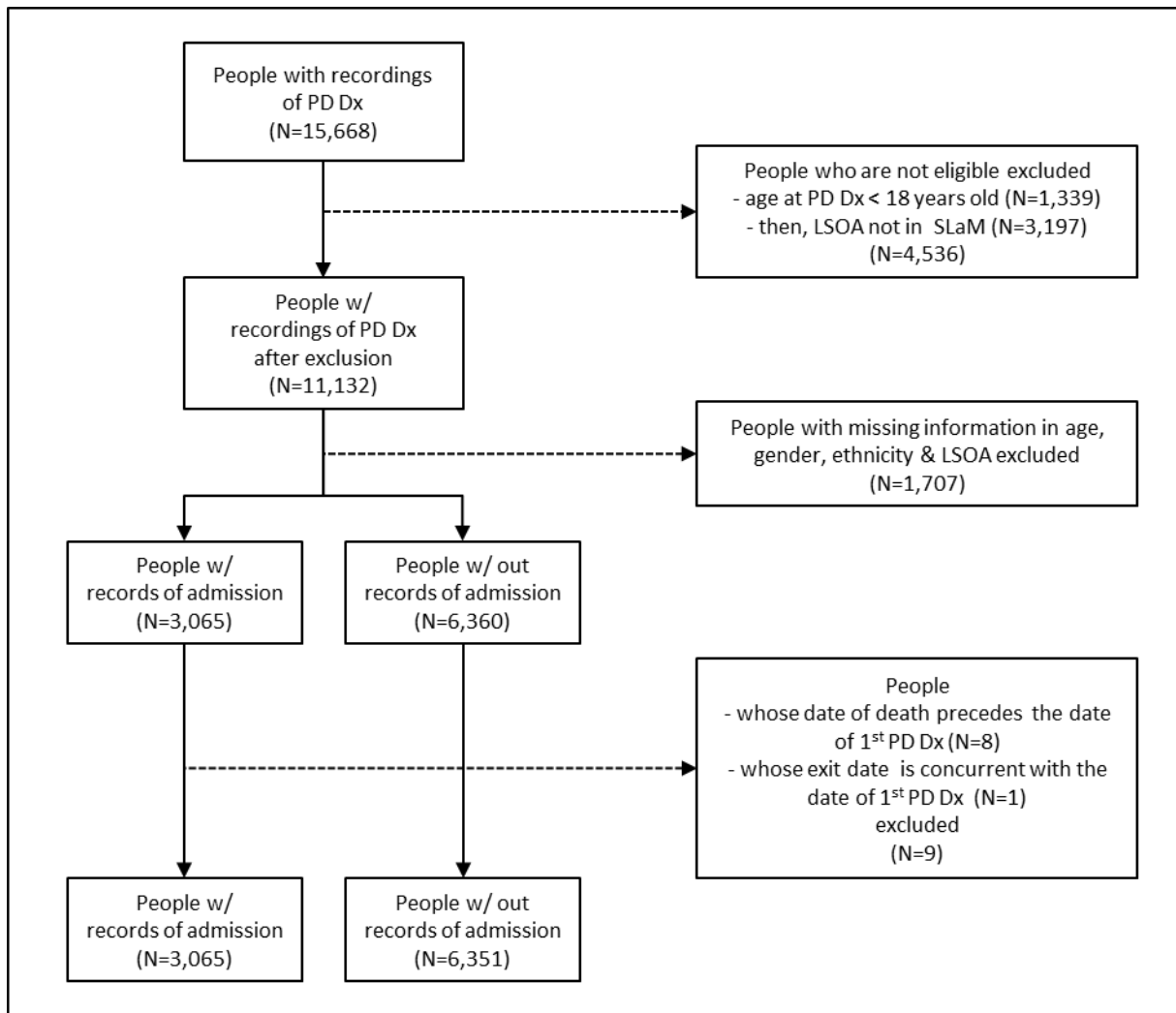
8.3.2 Part II. first acute psychiatric admission after personality disorder diagnosis

8.3.2.1 Sample characteristics

I described the process of identifying people with the first admission records after personality disorder diagnosis in **Figure 8.2**. The initial number of people with personality disorder diagnosis was 15,668 and the I followed the same process before identifying people with admission records and those without. Then, I excluded 9 people whose date of death preceded the personality disorder diagnosis date or whose personality disorder diagnosis were recorded on the last day of follow-up period, which was used as an exit date in the cox regression analysis. I identified the final number of

3,065 people with a record of the subsequent acute psychiatric admission after personality disorder diagnosis and 6,351 people without admission records.

Figure 8.2 Flowchart of identifying admission cohort



The age distribution of those who had a record of first admission after personality disorder diagnosis differed from those who did not have records of admission with age group 20-29 making up the highest proportion in both parties (Chi-square p-value<0.001; **Table 8.4**). People with and without admission records also differed in the composition of sex (p<0.001) and ethnicity (p<0.001). There were more women than men, but the difference of proportion between men and women were much larger among those admitted (27.98%) compared with those not admitted (14.72%). As for ethnicity, the White British ethnic group had the largest proportion followed by Black and White-non British ethnic group. However, the proportion of the Black ethnic group was bigger in people admitted (20.33%) compared with those not admitted (14.03%), while the White-non British ethnic group made up similar proportion (9.07% vs 9.86%) in both parties.

I also found a trend-level (p=0.07) difference in IMD score quartiles between people admitted and those not admitted. The least deprived area had slightly smaller proportion (13.34%) among people

with a record of admission compared with those without admission records (15.30%), whereas all the other areas in people with admission records showed slightly bigger proportion than in those without admission records. I did not find any statistically significant difference of population density between people admitted and those not admitted ($p=0.69$).

Table 8.4 Characteristics of people with & without a record of first acute psychiatric admission after personality disorder diagnosis

	admission record (N=3,065)	No admission record (N=6,351)	Total (N=9,416)	χ^2 test (p-value)
	N (%)	N (%)	N (%)	
Age at personality disorder diagnosis				<.001
18-19	174 (5.68)	351 (5.53)	525 (5.58)	
20-29	961 (31.35)	2,070 (32.59)	3,031 (32.19)	
30-39	835 (27.24)	1,542 (24.28)	2,377 (25.24)	
40-49	632 (20.62)	1,200 (18.89)	1,832 (19.46)	
50-59	287 (9.36)	774 (12.19)	1,061 (11.27)	
60-69	111 (3.62)	249 (3.92)	360 (3.82)	
70-79	46 (1.50)	100 (1.57)	146 (1.55)	
80 or over	19 (0.62)	65 (1.02)	84 (0.89)	
Sex				<.001
Male	1,308 (42.68)	2,366 (37.25)	3,674 (39.02)	
Female	1,757 (57.32)	3,985 (57.36)	5,742 (60.98)	
Ethnicity				<.001
White-British	1,759 (57.39)	3,680 (57.94)	5,439 (57.76)	
White-non British	278 (9.07)	626 (9.86)	904 (9.60)	
Black	623 (20.33)	891 (14.03)	1,514 (16.08)	
Asian	118 (3.85)	239 (3.76)	357 (3.79)	
Mixed	125 (4.08)	281 (4.42)	406 (4.31)	
Other	162 (5.29)	634 (9.98)	796 (8.45)	
IMD score				0.07
Least deprived	409 (13.34)	972 (15.30)	1,381 (14.67)	
25 th – 50 th	733 (23.92)	1,511 (23.79)	2,244 (23.83)	
50 th – 75 th	970 (31.65)	1,916 (30.17)	2,886 (30.65)	
Most deprived	953 (31.09)	1,952 (30.74)	2,905 (30.85)	
Population density				0.69
0-8,750 ppsqkm*	1,059 (34.55)	2,230 (35.11)	3,289 (34.93)	
8,751-17,500 ppsqkm	1,707 (55.69)	3,549 (55.88)	5,256 (55.82)	
17,501-26,250 ppsqkm	257 (8.38)	491 (7.73)	748 (7.94)	
26,251-max ppsqkm	42 (1.37)	81 (1.28)	123 (1.31)	

*ppsqkm: people per square kilometre

8.3.2.2 Crude admission rates

I examined the crude admission rate by each exposure (**Table 8.5**). As for neighbourhood-level variables, I did not find much variance in admission rates across either subgroups of IMD score (min. 70.61 & max. 78.25 per 1,000 person-years) or population density (min. 73.84 & max.77.21 per 1,000 person-years). In terms of age group, the age group 70-79 had the highest admission rate (113.62 per 1,000 person-years; 95% CI: 85.11-151.69), followed by age group 80 or over (89.82 per 1,000 person-years; 95% CI: 57.29-140.82) and age group 18-19 (85.21 per 1,000 person-years; 95% CI: 73.44-98.86). Men showed a slightly higher admission rate (80.10 per 1,000 person-years; 95% CI: 75.87-84.55) than women (72.02 per 1,000 person-years; 95% CI: 68.73-75.46). The Black ethnic group had the highest admission rate (105.54 per 1,000 person-72.79 – 104.42).

Table 8.5 Admission rate by exposure

variables	Admission rate (per 1,000 person-years)	95% CI
Age group (at personality disorder diagnosis)		
18-19	85.21	73.44–98.86
20-29	77.47	72.72–82.52
30-39	78.60	73.44–84.12
40-49	69.68	64.46–75.33
50-59	62.71	55.86–70.41
60-69	79.55	66.05–95.81
70-79	113.62	85.11–151.69
80 or over	89.82	57.29–140.82
Sex		
Male	80.10	75.87-84.55
Female	72.02	68.73-75.46
Ethnicity		
White British	72.39	69.08-75.85
White-non British	69.15	61.48-77.77
Black	105.54	97.57-114.16
Asian	87.19	72.79-104.42
Mixed	71.28	59.81-84.93
Other	47.67	40.86-55.60
IMD score		
Least deprived (<25 th percentile)	70.61	64.08-77.79
25 th – 50 th	74.51	69.30-80.10
50 th – 75 th	78.25	73.48-83.33
Most deprived (≥75 th percentile)	75.03	70.41-79.95
Population density		
0-8,750 ppsqkm*	77.21	72.69-82.00
8,751-17,500 ppsqkm	74.27	70.83-77.88
17,501-26,250 ppsqkm	73.84	65.34-83.44
26,251-max ppsqkm	76.60	56.61-103.64

*ppsqkm: people per square kilometre

8.3.2.3 Predictors of admission

In univariable modelling (**Table 8.6**), I found the second most deprived neighbourhood quartile had an increased rate of admission (HR: 1.12; 95% CI: 1.00-1.26) compared with the least deprived neighbourhood. However, when I re-categorized neighbourhoods into a binary classification (least deprived (<25 percentile) vs. more deprived (25th-100th percentile)), this association did not remain (p=0.09). I did not find any evidence of association between population density and admission rate.

I found people with older current age had a lower rate of admission (HR: 0.96; 95% CI: 0.95-0.97) than those with younger current age. Women had a decreased rate of admission (HR: 0.87; 95% CI: 0.81-0.93) compared with men. With regards to ethnicity, Black ethnic group had an elevated rate of admission (HR: 1.37; 95% CI: 1.25-1.50) while the “Any other” ethnic group had a negative association with admission (HR: 0.78; 95% CI: 0.59-1.03) compared with White British ethnic group.

Lastly, in the final best fitting model where I adjusted for individual and neighbourhood-level variables (Multivariable; **Table 8.6**), I did not find evidence of association between either of neighbourhood-level variables and admission. I found older current age group remained associated with a decreased rate of admission (HR: 0.97; 95% CI: 0.96-0.97) compared with younger age. Women also remained to have a lower rate of admission (HR: 0.89; 95% CI: 0.83-0.96) than men. As to ethnicity, I also found Black group with a higher rate of admission (HR: 1.38; 95% CI: 1.26-1.52) and the “Any other” ethnic group with lower rate of admission (HR: 0.66; 95% CI: 0.56-0.78) in comparison with white-British group.

Table 8.6 Predictors of admission in people with a personality disorder diagnosis

variables	Univariable		Multivariable 1 ¹		
	HR (95% CI)	p	AIC	HR (95% CI)	p
Current age	0.96 (0.95-0.97)	<0.001	53,338.29	0.97 (0.96-0.97)	<0.001
Sex			53,402.56		
Male	Ref			Ref	
Female	0.87 (0.81-0.93)	<0.001		0.89 (0.83-0.96)	0.002
Ethnicity (6 groups)			53,325.11		
White-British	Ref			Ref	
White-non British	0.95 (0.83-1.07)	0.40		0.96 (0.84-1.09)	0.50
Black	1.37 (1.25-1.50)	<.001		1.38 (1.26-1.52)	<.001
Asian	1.12 (0.93-1.35)	0.25		1.15 (0.96-1.39)	0.13
Mixed	0.95 (0.79-1.14)	0.57		0.99 (0.83-1.19)	0.91
Any other	0.62 (0.53-0.73)	<.001		0.66 (0.56-0.78)	<.001
IMD score (4 groups)			53,417.62		
Least deprived (<25 th pctl ² .)	Ref			Ref	
25 th -50 th	1.08 (0.96-1.22)	0.22		1.06 (0.94-1.20)	0.36
50 th -75 th	1.12 (1.00-1.26)	0.06		1.09 (0.96-1.22)	0.18
Most deprived (≥75 th pctl ² .)	1.08 (0.96-1.21)	0.19		1.05 (0.94-1.19)	0.38

Population density (4 groups)		53,420.86		
0-8,750 ppsqkm*	Ref		Ref	
8,751-17,500 ppsqkm	0.98 (0.91-1.06)	0.57	0.95 (0.88-1.03)	0.25
17,501-26,250 ppsqkm	1.00 (0.88-1.15)	0.95	0.98 (0.85-1.12)	0.76
26,251-max ppsqkm	1.01 (0.74-1.37)	0.96	1.02 (0.75-1.39)	0.90

*Only current age, sex, and ethnicity were statistically significant in the final model (Multivariable 1). Non-significant values for IMD score (4 groups) and population density (4 groups) are shown after adjustment of current age, sex and ethnicity and did not improve model fit over the final model, **people per square kilometre

¹Adjusted for individual (current age, sex, ethnicity) and neighbourhood-level (IMD score and population density) covariates, ²Percentile.

8.4 Discussion

8.4.1 Summary of findings in this study

I have examined the association between neighbourhood-level variables including neighbourhood-level deprivation and population density and outcomes of personality disorder including mortality and the subsequent admission after personality disorder diagnosis. None of the findings were consistent with the hypotheses. Neither neighbourhood-level deprivation nor population density were associated with mortality of people who have had a personality disorder diagnosis. I also did not find evidence of association between neighbourhood-level deprivation nor population density and readmission of people with personality disorder diagnosis.

8.4.2 Similarities between the C&I study and replication study

8.4.2.1 Mortality

In both studies, my hypotheses concerning the link between neighbourhood-level deprivation and mortality of people with personality disorder diagnosis were not supported by the data in either South London (this chapter) or Camden and Islington (Chapter 6). Although no existing literature specified the relationship between neighbourhood-level deprivation and mortality in people with personality disorder, previous literature has demonstrated that there is an association between neighbourhood-level socioeconomic status and all-cause mortality in general (Davey Smith et al., 1998; Waitzman & Smith, 1998). However, this association did not extend to people with personality disorder in either of my studies. Similarly, while no previous study examined how population density was linked to mortality among people with personality disorder, it was reported that higher population density was associated with increased mortality in the general population (Beenackers et al., 2018).

I found older current age were associated with higher mortality rate in both studies, and this may indicate current age had much actual impact on mortality of people with personality disorder. This result is consistent with findings in existing literature that older age is a risk factor for mortality among people with mental health or physical health problems (Brown et al., 2010; Cai et al., 2020;

Kobayashi et al., 2016). Previous studies found people with personality disorder are more likely to die due to unnatural causes such as suicide and accidental death (Arsenault-Lapierre et al., 2004; Cailhol et al., 2017; Crump et al., 2013) and this may be relevant to the findings in this study as well. However, as no information on the cause of death was available in the present study, I could not explore further on this aspect.

Both studies also shared similar result on gender difference of mortality rate that women had a decreased rate of mortality compared to men and this is in line with previous literature on gender gap on all-cause mortality among general population (Barford et al., 2006; Gjonça et al., 2005; Oksuzyan et al., 2010).

Table 8.7 Predictors of mortality among people with personality disorder diagnosis

variables	C&I study		Replication (SLaM) study	
	HR (95% CI)	p	HR (95% CI)	p
Current age	1.06 (1.05-1.07)	<0.001	1.07 (1.05-1.09)	<0.001
Sex				
Male	Ref		Ref	
Female	0.54 (0.40-0.74)	<0.001	0.60 (0.52-0.70)	<0.001
Ethnicity (6 groups)				
White-British			Ref	
White-Non British			0.73 (0.56-0.95)	0.02
Black			0.44 (0.34-0.57)	<0.001
Asian			0.74 (0.48-1.14)	0.17
Mixed			0.55 (0.35-0.87)	0.01
Any other			0.48 (0.34-0.70)	<0.001
IMD score (4 groups)				
Least deprived (<25 th percentile)	Ref		Ref	
25 th -50 th	0.83 (0.54-1.27)	0.38	0.99 (0.80-1.22)	0.91
50 th -75 th	0.81 (0.52-1.27)	0.36	0.98 (0.80-1.21)	0.87
Most deprived(≥75 th percentile)	0.97 (0.64-1.48)	0.89	1.04 (0.85-1.29)	0.68
Population density (4 groups)				
Least densely populated	Ref		Ref	
2 nd least densely populated	0.84 (0.59-1.19)	0.33	0.93 (0.79-1.09)	0.38
2 nd most densely populated	1.10 (0.54-2.27)	0.79	1.03 (0.78-1.36)	0.82
Most densely populated	0.00 (-)	-	1.27 (0.71-2.28)	0.42

*Only current age and sex, and current age, sex and ethnicity were statistically significant in the final model of the C&I study and replication study, respectively. Non-significant values for IMD score and population density are shown after adjustment of current age, sex and ethnicity did not improve model fit over the final model.

**As the range of population density defined as people per square kilometre was different in each study, I presented the population density as above.

8.4.2.2 Admission

Similarly, in both studies, I did not find any association between neighbourhood-level deprivation or population density and subsequent psychiatric admission following an index personality disorder diagnosis (**Table 8.8**). I did not find any study that discussed specifically about association between neighbourhood-level deprivation and readmission for personality disorder. However, there are some literature that discussed on the relationship between neighbourhood-level deprivation and psychiatric readmission more broadly and they presented mixed reports. For example, a UK study with participants from C&I and SLaM examined predictors of readmission to acute mental health services in each NHS Trust and did not find any evidence of significant association between neighbourhood-level deprivation and readmission to acute psychiatric services (Werbeloff et al., 2017). This supports my findings on relationship between neighbourhood-level deprivation and readmission. On the contrary, another study found that people from more deprived areas were more likely to be admitted to inpatient psychiatric services after emergency mental health assessments (Brooker et al., 2007), which is not in line with the findings on neighbourhood-level deprivation and readmission in both of my studies. However, the literature in the area of population density and acute psychiatric admission is sparse, which makes it difficult to assess the generalisability of the result that I found in both studies beyond urbanised inner-city setting.

Although older current age was associated with lower risk of admission in both studies, the hazard ratios in both studies were close to 1. This may suggest the risk of admission is almost similar over time among people with personality disorder. Although older age was found to be associated with increased readmission to acute psychiatric services in C&I and SLaM in an earlier literature (Werbeloff et al., 2017), this study was not on a personality disorder sample. Another possible explanation for this discrepancy may be the self-harm and suicidal behaviour commonly presented in people with personality disorder (Black et al., 2004; Krysiniska et al., 2006; Paris, 2005) which may increase the likelihood of being assessed in the emergency mental health services and admitted to acute psychiatric services regardless of current age.

Table 8.8 Predictors of admission in people with recordings of personality disorder diagnosis

variables	C&I study		Replication (SLaM) study	
	HR (95% CI)	p	HR (95% CI)	p
Current age	0.99 (0.990-0.998)	0.009	0.97 (0.96-0.97)	<.001
Sex				
Male	Ref		Ref	
Female	1.25 (1.11-1.40)	<0.001	0.89 (0.83-0.96)	0.002
Ethnicity (6 groups)				
White-British	Ref		Ref	
White-non British	0.76 (0.65-0.87)	<0.001	0.96 (0.84-1.09)	0.50
Black	1.07 (0.90-1.27)	0.46	1.38 (1.26-1.52)	<.001
Asian	0.77 (0.59-1.02)	0.07	1.15 (0.96-1.39)	0.13
Mixed	0.91 (0.71-1.17)	0.46	0.99 (0.83-1.19)	0.91
Any other	0.97 (0.74-1.27)	0.81	0.66 (0.56-0.78)	<.001
IMD score (4 groups)				
Least deprived (<25 th percentile)	Ref		Ref	
25 th -50 th	0.90 (0.77-1.05)	0.18	1.06 (0.94-1.20)	0.36
50 th -75 th	0.83 (0.71-0.97)	0.02	1.09 (0.96-1.22)	0.18
Most deprived (≥75 th percentile)	0.98 (0.84-1.14)	0.79	1.05 (0.94-1.19)	0.38
Population density (4 groups)				
Least densely populated	Ref		Ref	
2 nd least densely populated	0.92 (0.81-1.04)	0.19	0.95 (0.88-1.03)	0.25
2 nd most densely populated	1.01 (0.751-1.34)	0.97	0.98 (0.85-1.12)	0.76
Most densely populated	1.59 (0.39-6.40)	1.14	1.02 (0.75-1.39)	0.90

*Only current age, sex, and ethnicity were statistically significant in the final model of both studies. Non-significant values for IMD score and population density are shown after adjustment of current age, sex and ethnicity and did not improve model fit over the final model.

**As the range of population density defined as people per square kilometre was different in each study, I presented the population density as above.

8.4.3 Differences between the two studies

8.4.3.1 Mortality

Contrary to the C&I study (Chapter 6), where ethnicity was not found to be associated with risk of mortality, the replication study in this chapter indicated that all ethnicities had a lower risk of mortality except the Asian group, compared with the White British group in the final model (**Table**

8.7). As the cause of mortality was not specified, it is difficult to establish what generated the difference between each Trust. One possible explanation for this discrepancy is that the number of people with mortality in C&I was 163, while SLaM had 730 people with death records. This may have reduced the power for detecting an effect in the C&I study.

8.4.3.2 Admission

Although ethnicity was shown to be linked to admission rate in both studies, the detailed findings were not the same (**Table 8.8**). In the C&I study, white-non British ethnicity had a lower risk of admission compared with white-British ethnicity, whereas in the SLaM replication study, black ethnicity showed an increased risk of admission and any other ethnicity had a decreased risk of admission compared with white-British ethnicity. One of the possible reasons for this disparity might be the differences of the proportion in ethnic distribution between each sample. In the C&I sample, the second largest ethnicity was white-non British while the Black ethnicity took up the second largest proportion in SLaM sample. However, this still does not explain why the direction of association differs in each trust.

Next, it is noteworthy that each study showed different results on gender differences in readmission. Contrary to the C&I study where women had a higher risk of admission than men, I found men had an increased risk of readmission in the SLaM replication study. In the population structure of the catchment areas, C&I and SLaM did not differ in terms of gender distribution, with 49% male and 51% female in both trusts according to 2011 UK census data illustrated in Chapter 7.

An additional consideration is how I defined the outcome 'admission'. In the C&I study, the original dataset contained information on whether people were admitted at baseline as well as after the diagnosis of personality disorder. However, in the SLaM study, I only requested data to be extracted for the first admission 'after' the personality disorder diagnosis, not baseline admission. Therefore, I could not repeat the C&I supplementary analysis including baseline admission in the SLaM dataset

8.4.4 Strengths and limitations

This study, to my best knowledge, is the first that has examined how neighbourhood-level social-environmental factors are associated with outcomes of personality disorder, including mortality and admission in a large secondary care in inner-city London along with the first (C&I) study. Also, the cohort in this study benefits from a large sample of more than 9,000 people who had a record of secondary care clinical diagnosis personality disorder, which is even larger than my first (C&I) study. I have described several limitations of study on the outcomes of personality disorder caused by using

clinical data collected in secondary mental health care in Chapter 6 and as they also apply to this study, I am not going to reiterate them here.

8.4.5 Conclusion

In this study, I replicated the C&I personality disorder outcomes study that I conducted in Chapter 6. Consistent with the first study, I found no evidence that neighbourhood-level deprivation affected mortality or admission for people subsequent to a personality disorder diagnosis. Similarly, I did not find any significant association between population density and mortality or admission of people with personality disorder diagnosis. These findings may indicate neighbourhood-level social environmental factor such as neighbourhood-level deprivation or population density has little effect on the prognosis of personality disorder once personality disorder has been diagnosed. However, there is a need for a further study with diverse outcomes that have not been examined in this study.

Chapter 9 Discussion

In this chapter, I first summarize the main findings from this thesis (Section 9.1) and discuss implications of these findings (Section 9.2). Next, I address broad strengths and limitations of overall thesis (Section 9.3). Finally, I explore implications for clinical practice and public health (Section 9.4) and potential future research (Section 9.5) before addressing overarching conclusions of this thesis (Section 9.6).

9.1 Summary of main findings

In this thesis, I started by conducting a systematic review of the association between personality disorder (both prevalence and outcomes) and social deprivation (Chapter 2). In this review, I found that there was a need for more robust research on the association between personality disorder and neighbourhood-level deprivation, and more attention required to investigate the association between outcomes of personality disorder and social deprivation. Therefore, in the following chapters, and informed by the findings from my systematic review, I conducted three retrospective cohort studies using data obtained from three different mental health services on the prevalence of personality disorders in clinical mental health settings and association with neighbourhood-level deprivation (Chapter 3,5&7). In the first study (Chapter 3), I examined the prevalence of comorbid personality disorder among people who were accepted in six Early Intervention for Psychosis services in East Anglia and its association with living in more deprived neighbourhoods. I also examined this association for all people diagnosed with personality disorder in secondary mental health care settings in more urban settings in North and South London (Chapter 5 and 7 respectively). Prior to conducting these studies, I assessed the validity of personality disorder diagnoses extracted via a natural language processing (NLP) application captured in routine electronic health records in Camden and Islington NHS Trust (Chapter 4). Lastly, in two studies using the electronic health records data from North and South London, I also explored whether neighbourhood-level deprivation was associated with outcomes following personality disorder diagnosis (Chapter 6&8) including mortality and acute psychiatric admission. Combining evidence from rural (Chapter 3) and urban (Chapters 4-8) settings, and by replicating findings from one secondary mental health Trust in North London (Chapters 5, 7) in a second Trust in South London (Chapters 6,8), I was able to replicate my work in methodologically similar designs. The studies collectively suggest that prevalence of personality disorder in clinical settings is much lower than that had been reported in the previous studies in the general population and may implicate personality disorder may need to be identified more often in clinical practice than it is at present. The findings also informed that people from more deprived areas are more likely to have personality

disorder diagnosis in an urbanized environment setting whereas there was no evidence of association between outcomes of personality disorder and neighbourhood-level deprivation. In the following section, I provide greater detail summarising the results from each chapter.

Firstly, in Chapter 2, I conducted a systematic review on the association between social deprivation and personality disorder. I identified 50 papers on this topic, published between 1980 and 2021. However, the evidence was not conclusive and a need for more robust research on the association between personality disorder and varied forms of social deprivation including neighbourhood-level deprivation was highlighted. Out of 50 included studies, I found 38 studies on individual socioeconomic status and eight studies on neighbourhood-level deprivation of which three studies were published before 2000. This review also suggested more attention to be paid on subsequent outcomes of personality disorder in relation to social deprivation. I found six studies that examined association between outcomes of personality disorder and social deprivation.

Given these gaps in the literature, I conducted three retrospective cohort studies to examine the relationship between neighbourhood-level deprivation and personality disorder using clinical samples. First, I investigated the sociodemographic and clinical characteristics of people with comorbid personality disorder referred to Early Intervention in Psychosis (EIP) in an epidemiological study in East Anglia known as the SEPEA study (Chapter 3). I did not find any evidence of an association between prevalence of comorbid personality disorder and neighbourhood-level deprivation or population density in this sample. While the overall prevalence of personality disorder was lower in this clinical sample of people being treated for first episode psychosis than I expected, at about 10%, personality disorder risk was more common for women and in those of white British ethnicity, as hypothesised. I also found that people with lower parental socioeconomic status and those found not to meet research-based diagnostic criteria for FEP during their EIP care were more likely to receive a personality disorder diagnosis.

Before moving on to next two studies using clinical record interactive search (CRIS) data, I explored the validity of personality disorder diagnoses identified in open text-field data recorded in case notes via a natural language processing (NLP) application in Camden and Islington NHS Foundation Trust (C&I) CRIS, as they have not previously been tested to identify personality disorder (Chapter 4). I used precision and recall metrics to test the validity and found them to be 92% and 75%, respectively, which I decided to be good enough to continue my analysis using these data extracted via NLP application.

Next, I investigated the prevalence of personality disorder diagnosed in a secondary mental health care in North London (C&I) during 8 years of follow up between 2008 and 2016. I also examined

whether neighbourhood-level deprivation and population density were associated with the prevalence of personality disorder (Chapter 5). I hypothesized prevalence of personality disorder in this study will be lower than previously reported in the general population. I also hypothesized people from more deprived and more densely populated areas would have higher prevalence of personality disorder than those living in more affluent and rural areas. I found the prevalence of personality disorder to be 0.99% (95% CI: 0.96-1.02), much lower than in the general population (4.4-13.4%) in accordance with my initial hypothesis. I also found that people from more deprived neighbourhoods were more likely to have a personality disorder diagnosis compared with those from more affluent neighbourhoods (risk ratio (RR): 1.29; 95% CI: 1.20-1.39). However, contrary to my initial hypothesis, there was no evidence of association between population density and prevalence of personality disorder. The prevalence of personality disorder was higher in women, people from white British ethnic groups, and those who were 18-19 years old at the time of first personality disorder diagnosis.

In the next chapter (Chapter 6), I examined how neighbourhood-level deprivation and population density affected the outcomes of personality disorder in the same C&I CRIS cohort – mortality and subsequent acute psychiatric admission after personality disorder diagnosis. I hypothesized people from more deprived areas would have higher mortality and admission rates compared with those living in less deprived areas. I also hypothesized people living in more densely populated areas would have higher mortality and admission rates than those from less densely populated areas. The findings for both outcomes were not consistent with my hypotheses. I found no effect of neighbourhood-level deprivation on either mortality or admission. Similarly, I did not find any evidence that either mortality or admission rates were associated with population density.

Lastly, I replicated the studies I had conducted in Chapter 5 and 6 (C&I study) with CRIS data obtained from another large secondary mental health care in South London (South London and Maudsley NHS Foundation Trust; SLaM) during 12 years between 2008 and 2020, in order to assess validity and replicability of the findings (chapter 7 & chapter 8). In line with the C&I study, the prevalence of personality disorder was lower than those previously reported in community settings, with 1.16% (95% CI: 1.14-1.18) for 12 years of follow-up period and 0.76% (95% CI: 0.74-0.78) for the same period as the C&I study. Further, I found the prevalence of diagnosed personality disorder was higher in more deprived areas as in C&I study. As in the C&I study, there was no clear association between population density and prevalence of personality disorder. With regards to the outcomes of personality disorder, like in C&I, I did not find any evidence of association between neighbourhood-level deprivation or population density and either mortality or readmission rates.

9.2 Meaning of the findings

9.2.1 Prevalence of personality disorder

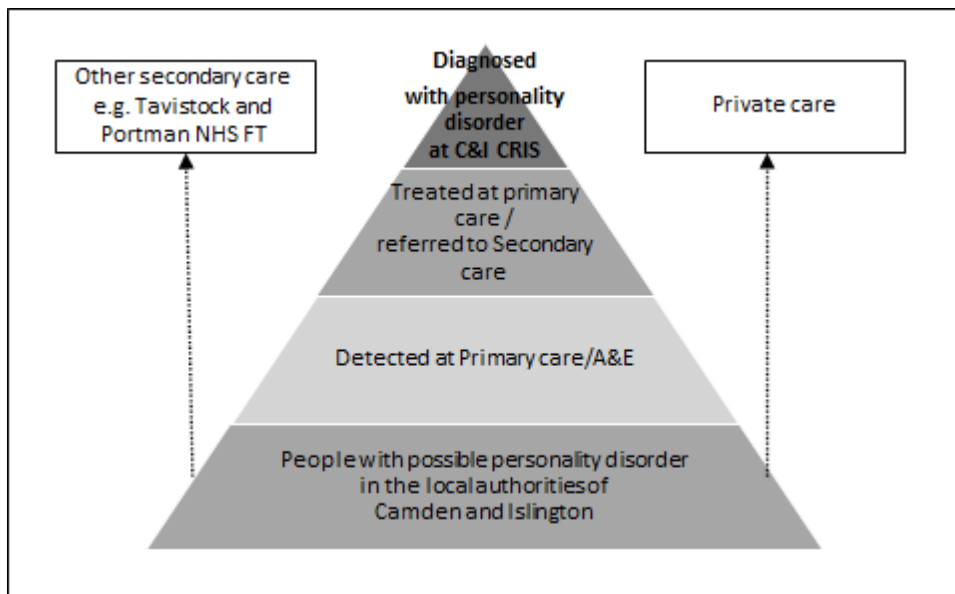
I found low levels of diagnoses of personality disorder in a large, prospectively collected cohort of people accepted into EIP services in England for suspected psychosis (Chapter 3). This result may suggest that screening and triaging referrals for first episode psychosis are already adequately made by Early Intervention in Psychosis services. However, some phenomenological overlap between personality disorder and psychotic disorder may inhibit accurate diagnostic assessment, treatment and onward referral, and careful assessment of personality disorder symptoms at referral may further help to signpost people to appropriate services.

In light of this result in chapter 3, I expanded my exploration of prevalence of personality disorder to a more general setting covering all secondary mental health care services in the Camden and Islington NHS Foundation Trust in Chapter 5. Although I had expected the prevalence of personality disorder in clinical practice would be lower than amongst those presented in the earlier literature in the general population (Coid et al., 2006; Dereboy, Güzel, Dereboy, Okyay, & Eskin, 2014; Ekselius, Tillfors, Furmark, & Fredrikson, 2001; H. Jackson & Burgess, 2000; Mark F Lenzenweger et al., 2007; Samuels, 2011; Samuels et al., 2002; Torgersen, Kringlen, & Cramer, 2001), the discrepancies between prevalence found in my study (0.99%; 95% CI: 0.96-1.02) and those from previous literature (4.4%-13.4%) were not small. By replicating the C&I study with SLaM CRIS data in chapter 7, I demonstrated the lower prevalence of personality disorder in secondary mental health care services (at least in central London) was similarly lower compared with the previous findings for the general population.

The large discrepancy of personality disorder prevalence between my findings and the earlier literature requires additional consideration of the possible reasons behind it. Firstly, making a diagnosis personality disorder is often a long clinical process due to the complex nature of personality disorder, requiring multiple interviews over time in order to formally confirm the diagnosis. There are often other comorbid conditions among people with personality disorder, including anxiety, psychosis and substance misuse (Hayward & Moran, 2008; Giles Newton-Howes et al., 2010; Quirk et al., 2017). In addition, there are several different types of personality disorder with no clear distinction between each subtype, and there is often an overlap of symptoms between each of the diagnostic categories. There is continuing debate and discussion about how to classify and assess personality disorder (Tyrer et al., 2015). Although a major change in classification of personality disorder has been proposed in the 11th revision of International Classification of Mental and Behavioural Disorders (ICD-11) and the fifth edition of the Diagnostic and Statistical Manual of

Mental Disorders (DSM-V), they have not come into effect in clinical practice yet. The changes emphasise the severity of personality disorder as a continuum rather than categorising subtypes. Currently ICD-10 and DSM-IV classifications are still in use in clinical practice. Under ICD-10, there are 9 categories of personality disorder (World Health Organization, 1992) and 10 categories in the DSM-IV (American Psychiatric Association, 2000). Each type of personality disorder is described with distinct symptomology which overlap with each other. Each type of personality disorder can have slightly different recommended treatments. For example, the two most common types of personality disorder found in the UK are borderline personality disorder (“emotionally unstable personality disorder” in ICD-10) and antisocial personality disorder (“dissocial personality disorder” in ICD-10). The National Institute for Health and Care Excellence (NICE) describes separate pathways for each of these two types of personality disorder (www.pathways.nice.org.uk). According to the pathway for borderline personality disorder, people with repeated self-harm, persistent risk-taking behaviour or pronounced affective instability are usually identified in primary care and referred to community mental health services, crisis management team or inpatient services depending on their state of distress. In the case of antisocial personality disorder, people are often identified in both primary care and in secondary care services including drug and alcohol services or community services such as the probation service. They are then referred to an appropriate mental health service such as forensic service or general mental health services on the basis of the symptoms manifested. So only those who presented with the most significant distress or burdensome problems will be referred to secondary care (NIMH(E), 2003; Reich et al., 1990), and thus, only those who meet threshold for diagnosis of personality disorder will have a recording of personality disorder diagnosis in the CRIS system. For example, I have illustrated the possible pathway for the people with personality disorder in C&I on the way to be included in CRIS data (**Figure 9.1**) and it shows what process people go through to be included in the CRIS personality disorder cohort. People have to be detected first at primary care or A&E, and then ultimately need to be diagnosed with personality disorder by a secondary mental health care team. So it is possible that people whose symptoms met the criteria for personality disorder diagnosis, but were not detected or not referred to the secondary care would not be included in the analysis in this study, and this may explain some of the lower prevalence of personality disorder in this study. Alternatively, it is possible people pursued other secondary care or private care which made them not to be recorded in C&I CRIS as well.

Figure 9.1 Potential pathway to personality disorder diagnosis in C&I CRIS



Secondly, the absence of quick and reliable instruments to assessing personality disorder also makes assessment of personality disorder difficult (Tyrrer et al., 2015). There are quite a few measures for personality disorder. Some instruments measure all subtypes of personality disorder and some measure one specific type of personality disorder such as borderline personality disorder. The form of instruments also varies. Some involve structured research diagnostic interviews, some rating instruments are for use by clinicians, some are self-assessment questionnaires, and others involve peer-report questionnaires (Friedman et al., 2007; Furnham et al., 2014). One study which reviewed the various instruments to assess personality disorder found 22 different assessment tools for all types of personality disorder, as well as 46 tools for specific subtypes of personality disorder (Furnham et al., 2014). Most of these instruments included large numbers of items and required specialized training in order to administer the interview. Hence, it takes a long time to complete them, which may be prohibitive in general clinical settings. For example, the Structured Clinical Interview for DSM-IV Personality disorders (SCID-II), one of the most widely used measures, is comprised of an initial self-report screening questionnaire with 113 items and a subsequent interview conducted by trained clinicians. The interview itself lasts a minimum of 30 minutes (First et al., 1995). As clinical judgement is required in the administration and scoring of the SCID-II, interviewers need to be fully aware of the DSM nosology and have experience in diagnostic interviewing (Blanchard & Brown, 1998).

Thirdly, the diagnosis of personality disorder may entail stigma and can be perceived as pejorative (Campbell, Clarke, Massey, & Lakeman, 2020; Foye et al., 2021). Clinicians' decisions over a diagnosis in mental health services will have consequences in terms of future treatment and possibly stigma so

they might try to avoid unnecessary errors or over-diagnosis. Clinicians are known to be disinclined to make a diagnosis of personality disorder, as it is perceived to be stigmatizing for those diagnosed with personality disorder and people with personality disorder diagnosis are sometimes considered to be problematic patients (Paris, 2007). Clinicians also often have limited time allocated to each patient, and thus they often have to solely depend on the evidence from routine clinical evaluations when making a personality disorder diagnosis as assessing personality disorder with structured interviews requires much more time. So being aware of stigma associated with personality disorder diagnoses might make clinicians become reluctant to make a personality disorder diagnosis, and this may contribute the lower prevalence of personality disorder diagnoses made in the clinical settings as observed in my thesis.

Finally, along the line of stigma associated with personality disorder, London is a city of cultural diversity, and each culture has different perspectives toward mental health problems. In many cultures, mental health problems are perceived as shameful (Hampton & Sharp, 2014), and stigma around mental illness acts as a barrier when accessing mental health services (Gopalkrishnan, 2018). This may affect their attitude toward help-seeking, and less people may become treated for their mental health problems including personality disorder. This may be one possible explanation of the lower rates of diagnosed personality disorder amongst ethnic minority groups in my studies (Chapter 5&7).

9.2.2 Neighbourhood-level deprivation and prevalence of personality disorder

In the SEPEA study (chapter 3), I did not find any evidence of association between neighbourhood-level-deprivation and personality disorder among people accepted in EIP services, but, in the CRIS study in chapter 5 &7, I found people living in more deprived areas were more likely to have personality disorder in secondary care services in inner London. The discrepancy may come from the differences of settings between SEPEA study and CRIS study such as rural-urban gradient or EIPs versus generic secondary care.

A possible explanation for the association between neighbourhood-level deprivation and personality disorder may be found in terms of two classic theories on socioeconomic status and mental health (Dohrenwend et al., 1992): social causation and social selection/drift hypotheses. The social causation theory proposes that the adverse social and economic conditions of poverty, such as financial stress and adverse life events increases psychiatric disorders (Dohrenwend et al., 1992; Lund & Cois, 2018). People living in deprived neighbourhood are more likely to be poor, and under economic deprivation, stress is heightened (Schanzenbach, Mumford, Nunn, & Bauer, 2016). These stresses may affect the quality of parenting and weaken parents' emotional ability to meet their

children's needs (Aber et al., 1997; Murali & Oyeboode, 2004), which may hinder them to form a secure attachment with their children. Secure relationship between parents and their children early in life plays an important role in development of personality, and children who grow up with a lack of secure attachment with their parents are more likely to show unstable personality traits as adults (Young et al., 2019). Furthermore, adverse conditions in early life increase risk of harmful socioeconomic consequences of poverty such as crime and violence, arrest, substance use (Drake & Rank, 2009). Financial distress also makes it difficult to provide children a friendly learning environment at home due to overcrowding or unhealthy conditions when education plays a key role in building emotional resilience for risk of mental disorders (World Health Organization (WHO), 2014). Thus, personality difficulties may become more common or more often manifested among those who grew-up in economically deprived areas, which would lead them to more detection and referrals for care.

On the contrary, the social selection/drift theory proposes the converse idea that people with mental illnesses are at increased risk of drifting down in social class status or remain in low social class and move to or remain in more deprived areas after the onset of the illness (Dohrenwend et al., 1992; Fox, 1990; Lapouse et al., 1956; Sariaslan et al., 2016). This drift hypothesis might also apply to personality disorder, insofar as people with personality disorder might move into more deprived area because of their disability and symptoms, reduced economic productivity and loss of employment, and increased stigma induced by the clinical features of their illness.

Another plausible explanation may be that people from less deprived areas may seek private practice rather than NHS services for personality disorder treatment because they want to avoid perceived stigma associated with personality disorder and pursue alternative treatment available. Hence, even if people who live in less deprived areas have a diagnosis of personality disorder, their diagnosis would not have been recorded in the CRIS data.

9.2.2.1 Inverse care law and personality disorder

The association between neighbourhood-level deprivation and the prevalence of personality disorder may be related to what Hart coined the 'Inverse Care law' in the early 1970s. (Hart, 1971). In this paper, Hart argued that "the availability of good medical care tends to vary inversely with the need of the population served" and emphasized inequality in health care provision implying that people who are most in need of healthcare are less likely to receive it. Although the NHS has sought to reduce inequity in health care since his publication (The Lancet, 2021), evidence suggests that the inverse care law may still be relevant. For example, in a UK qualitative study which explored GP's experiences in the referral of patients of cardiology services, participants stated that patients living

in deprived areas who have worse health literacy and were less confident were less likely to ask for referrals when compared with affluent patients who were more likely to be vocal in demanding referrals (Walton et al., 2018). Health literacy is defined as 'the degree to which individuals have the capacity to obtain, process, and understand basic health information and services needed to make appropriate health decisions' (Ratzan & Parker, 2000). Health literacy is associated with limited financial and social resources as well as worse health status and outcomes (Gibney et al., 2020; Roberts, 2015). For example, in a cross-sectional survey of 1,046 sample from Stoke-on-Trent in England, lower education and lower income were found to be associated with limited health literacy (Protheroe et al., 2017). Also, in another study which measured health literacy in eight EU member states (Sørensen et al., 2015), financial deprivation was found to be the strongest predictor of low health literacy, followed by social status and education, suggesting the existence of a social gradient for health literacy. A systematic review also reported people with mental health problems are more likely to have lower health literacy compared with the general population (Degan et al., 2021). Low health literacy may affect help-seeking behaviour, and people with low health literacy may hesitate to seek help from the healthcare services even when experiencing symptoms of disorder.

The inverse care law may also be affected by the behaviours and attitudes of health providers. For example, a qualitative study from the UK (Chew-Graham et al., 2002) explored the attitudes of GPs in north-west England toward management of patients with depression, and views of GPs from deprived areas were compared with those serving more affluent populations. It was found that GPs serving in more deprived areas were more likely to have pessimistic views on treating and managing depression, whilst GPs from more affluent areas tended to have optimistic and positive view toward treatment of depression; the authors suggested that the inverse care law was in effect in the primary care management of patients with depression. Considering people with personality disorder are often perceived by mental health staff as being difficult to interact with (Hersh, 2008; Lewis & Appleby, 1988; Newton-howes et al., 2008), the findings from this qualitative study on depression may also be relevant to personality disorder. Another barrier that people with personality disorder encounter when accessing mental health services is long waiting times. For example, in a UK qualitative study (French et al., 2019), GPs stated that patients with personality disorder have to endure particularly long time, often far exceeding the waiting times by other mental health patients. A recent study on waiting times before receiving hospital treatment suggested social gradients may exist in waiting times. (Macdonald et al., 2020). In this study, people living in the most deprived areas were nearly as twice as likely to wait over a year for hospital treatment compared with those living in the most affluent areas. Further, people with personality disorder are more likely to be homeless with no stable address (Adlam & Scanlon, 2005; Herzberg, 1984) and this may make it

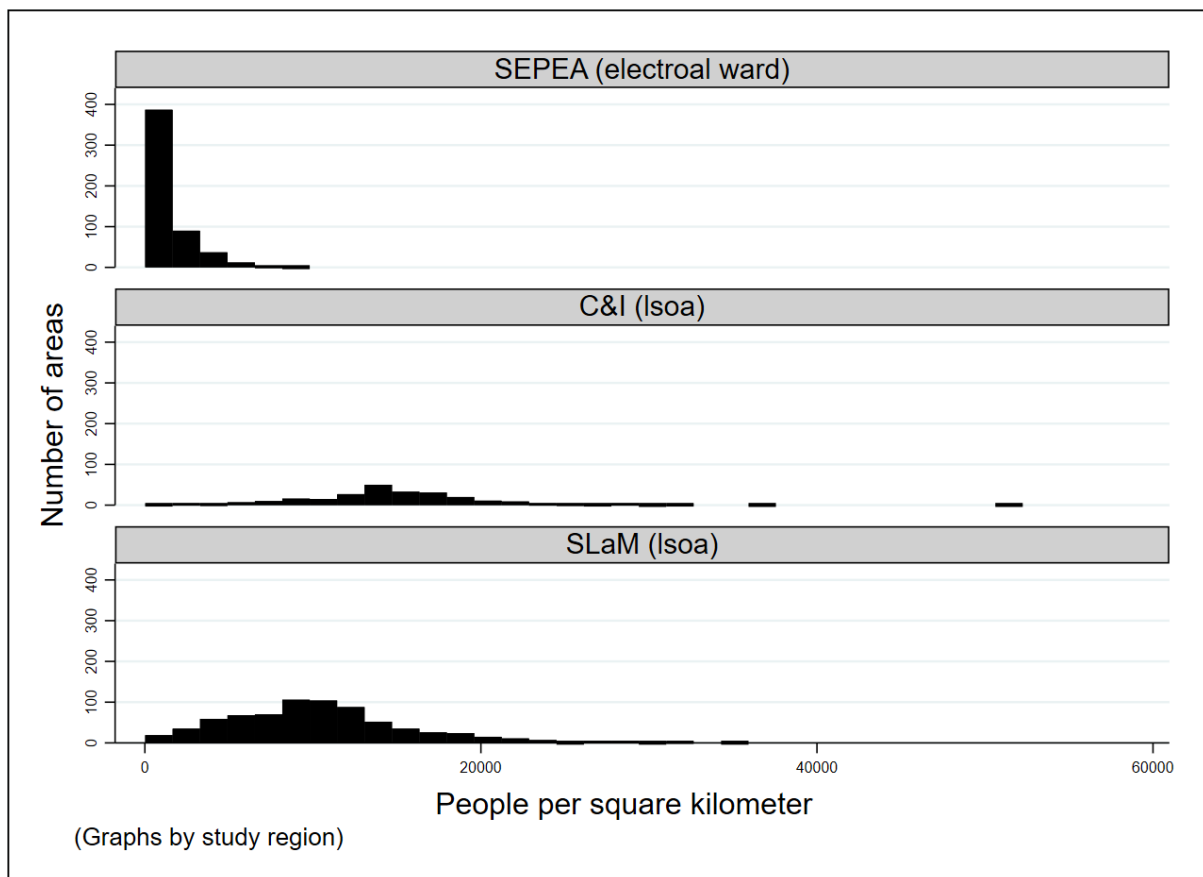
difficult for them to make an appointment needed and to access the adequate social support and treatment. Considering all these challenges that people with personality disorder may have to face, the inverse care law may be relevant to personality disorder. However, the findings in my study did not necessarily support this – people living in more deprived areas were more likely to have personality disorder diagnosis than those living in more affluent areas. My finding suggested that there is a strong gradient between deprivation and higher prevalence of PD. If the inverse care law exists, then it suggests this gradient may be even steeper than I observed, because the inverse care law would mean some people in the more deprived areas did not receive assessment or treatment. The prevalence of diagnosed personality disorder is not equivalent to population prevalence, and it is very possible there are people in the community who meet diagnostic criteria but have not been detected or diagnosed, as I discussed in the previous section on prevalence of personality disorder. This may also implicate the inevitable limitation of using secondary care data. Further, it is also possible that some people who can afford the additional cost might have sought alternative services available other than NHS secondary mental health care maybe because they wanted to avoid the entailed stigma, or their waiting time was shorter. With regards to outcomes (mortality and subsequent admission) of personality disorder, however, I found no evidence of association with neighbourhood-level deprivation. It is possible the inverse care law meant people in most need of admission (those in more deprived, lower literacy areas) were least likely to seek help after a diagnosis, and so the inverse care law might have blocked a possible association between neighbourhood-level deprivation and admission in this study. But it seems inverse care law should apply for prevalence, where I still found an effect of deprivation. It is also unlikely that the inverse care law affected mortality outcomes in my study, since mortality is always routinely recorded on the population.

9.2.3 Population density and prevalence of personality disorder

I did not find any association between population density and prevalence of comorbid personality disorder among people accepted in six Early Intervention for Psychosis services in East Anglia in the SEPEA study (Chapter 3). There was also no clear association between population density and prevalence of personality disorder both in C&I and SLaM CRIS study. The catchment areas included in the SEPEA study were mostly rural, while both SLaM and C&I serve people living in highly densely populated areas of London. According to 2011 UK Census, the median population density at MSOA level in C&I was 140.3 (persons per hectare (p/h), IQR: 120.65-176.55), and 92.4 (p/h, IQR: 73.9-104.9) in SLaM. Three boroughs of Lambeth (113 p/h), Southwark (100 p/h) and Lewisham (78 p/h) in SLaM and both boroughs of Camden (101 p/h) and Islington (139 p/h) in C&I were ranked among the 20 most densely populated local authorities in England and Wales in the same Census data

(Office for national statistics). Figure 9.2 includes histograms comparing population density across three regions examined in this thesis to illustrate the differences across the different studies in my thesis. This shows that, as expected, the population density in the region of the SEPEA study is much lower than the London based studies. The population density distributions in the London regions of both CRIS studies show much higher levels of population density. It should be noted that the units of neighbourhood-level are different in the SEPEA study (which used electoral ward) and both CRIS studies (which used LSOAs).

Figure 9.2 Histograms comparing population density variation across neighbourhoods in the SEPEA and CRIS studies



Previous literature suggested that there is an association between population density and risk of psychiatric illnesses, although little research specifically on personality disorder has been conducted. For example, urban living has continuously been reported to be associated with poorer mental health (Peen et al., 2010), and a population-based Danish cohort study found birth in large cities was associated with increased risk for developing psychiatric illness including personality disorder (Vassos et al., 2016). Another Danish study suggested the high levels of residential green space during childhood was associated with lower risk of developing any psychiatric illness during adulthood (Engemann et al., 2019). In spite of sharing densely populated urban settings in the

capital city of England, various factors including culture, social support from the community and family level factors may have influenced the discrepancy between prevalence in the C&I and SLaM studies. A further examination of clinical data from other settings, including more rural areas, may be helpful to determine the inconclusive relationship between population density and prevalence of personality disorder found in this research.

9.2.4 Neighbourhood-level deprivation and mortality/subsequent acute psychiatric admission of people with personality disorder

In general, existing research evidence suggests that neighbourhood-level socioeconomic status is associated with all-cause mortality in the general population (Davey Smith et al., 1998; Waitzman & Smith, 1998), but there is a lack of literature on this relationship for people with personality disorder. In both of my studies, I found no evidence of any association between neighbourhood-level deprivation and mortality for people following a personality disorder diagnosis about 12 years. Although it is difficult to discuss the meaning of my findings given the absence of other studies on this topic, it is worth considering the possible reasons for the absence of such an effect in my samples. First, it may be that there is no true effect of neighbourhood-level deprivation on the mortality of people with personality disorder. Secondly, my sample may not have been big enough or old enough and follow up period was long enough to observe an effect. Lastly, there may be an effect but as the residential areas of my sample was very urbanised and deprived.

With regards to subsequent acute psychiatric admission after personality disorder diagnosis, I also found no evidence of any associations between neighbourhood-level deprivation and admission. While no previous study has examined neighbourhood-level deprivation in relation to admission for people following a personality disorder diagnosis, there are studies which reported on the relationship between neighbourhood-level deprivation and admission. For example, a UK study with participants from C&I and SLaM examined predictors of readmission to acute mental health services including crisis house, crisis team, and in-patient ward in each NHS Trust, and found no evidence of a statistically significant association between neighbourhood-level deprivation and readmission to acute psychiatric services (Werbelloff et al., 2017). This was consistent with my findings on the relationship between neighbourhood-level deprivation and admission for personality disorder. However, another UK study using a sample obtained from the Sheffield emergency mental health assessment team found that people from more deprived areas were more likely to be admitted to inpatient psychiatric services after emergency mental health assessments (Brooker et al., 2007). In addition to their geographic locations, these two studies also differed in terms of their sample size (17,666 vs 375) and measures of social deprivation (IMD score vs Townsend index score), and

neither study specified the proportion of people with each diagnosis, so there is a limitation to extent the findings in these studies to people with personality disorder.

9.2.5 Personality disorder and ethnicity

I found personality disorder prevalence was lower in the BME group (OR: 0.27; 95% CI: 0.11-0.71) compared with the White British in the SEPEA study (Chapter 3), an observation which I also found in both CRIS prevalence studies (chapter 5&7) with respect to the prevalence of personality disorder diagnosed in secondary mental health care. Given the substantial rural-urban gradient and differences in type of services from which the samples were taken between SEPEA study and CRIS study, the results suggested a consistent finding that the White British group had higher prevalence of personality disorder diagnosis compared with other ethnic groups. The lower prevalence of personality disorder in ethnic minority groups compared with the White British groups has been noted before. For example, in a cross-sectional survey of in-patient data collected in north-west England from 2007 to 2009 (Raffi & Malik, 2010), the majority of people diagnosed with personality disorder (91.6%) were White British patients while BME patients only accounted for 8.4%. Another UK study which examined the in-patient admission rate for personality disorder in East London from 2007 and 2013 reported similar results (Hossain et al., 2018). In this study, the prevalence of personality disorder was much less in all ethnic minority groups compared with the White British population (17%), except for mixed ethnic group where the sample size was too small. There was little variation in personality disorder rates among the different BME ethnic groups. Further, a systematic review reported that people of Black ethnicity had a lower prevalence of personality disorder than people of white ethnicities (McGilloway et al., 2010). However, a UK study reported personality disorder in Black and other ethnic minorities was at least as prevalent as in White people in the UK in the general population (Crawford et al., 2012).

There are possible explanations which may account for different rates of personality disorder in different ethnic groups. First, it may suggest that clinicians are predisposed to diagnostic bias; diagnosis of personality disorder may be given more to the White British ethnic group than Black and other ethnic minority groups in clinical settings. Especially, borderline personality disorder (BPD) has been commonly considered as an illness of White females (Newhill et al., 2009). Research suggested the diagnosis of personality disorder is prone to cross-cultural judgment bias. For example, in a UK study which used a case-vignette method, the authors examined whether cross-cultural clinical judgment bias was present in forensic psychiatrists, and found White participants were more likely to receive a personality disorder diagnosis than Black Caribbean participants, and in particular, antisocial personality disorder (Mikton & Grounds, 2007). Research has also suggested people are

racially biased when judging other people's emotional expressions (Halberstadt et al., 2022; Hugenberg, 2005).

Second, it is possible that the ethnic density effect may have played a role in explaining the differences I observed. The ethnic density effect is an observed phenomenon that occurs when people of racial/ethnic minority living in areas with more individuals of the same or similar ethnicities appear to experience better health outcomes; a positive effect of ethnic density on mental health has been consistently found for other psychiatric disorders, particularly psychoses (Bécares et al., 2018; Shaw et al., 2012). London is the most ethnically diverse region in the UK, and the catchment areas in both CRIS studies have high percentage of ethnically diverse groups. For example, the catchment of SLaM has one of the largest black Caribbean and black African communities in the UK (Das-Munshi et al., 2017). It was reported that ethnic density protects people from suicidal ideation or self-harm (Bécares et al., 2018; Neeleman & Wessely, 1999), which are important symptoms of personality disorder. Ethnic density in neighbourhood-level may also act as a buffer against experience of discrimination and provide social support (Bécares et al., 2009). I did not include ethnic density as a measure in my thesis as this was not the main focus of my work, but it is important that this is addressed in the future research.

Third, cultural impact might have played a part in different rates of personality disorder in different ethnic groups. In some cultures, stigma toward mental health problems is more prominent, and people from these cultural backgrounds may find it hard to seek help from mental health services. In a qualitative study from the UK on the perceived barriers toward accessing mental health services in black and minority ethnic groups, participants suggested the consequences of stigma attached to mental health is not only limited to the person with mental illness but also the standing of the whole family in the community (Memon et al., 2016). This negative attitude toward people with personality disorder and their families in this ethnic minority groups may affect their help seeking behaviour and results in lower prevalence of personality disorder in the ethnic minority groups than their White counterparts.

It is also possible there is cross-cultural bias in the diagnostic process of personality disorder. The clinical entities of personality disorder classification assume the perspective of an individual within Western cultures which are characterized as individualistic, and endorsing independence and autonomy of individuals while other cultures are more collectivistic, and encourage interdependence and cooperation within society (Mulder, 2012). In line with the notion of cultural impact, there may be an effect of difference as to how emotions are manifest in different cultural/ethnic groups. One of the main symptomology of BPD is emotional instability, also called affective dysregulation, and people with BPD often experience a range of intensive negative

emotions such as rage, sorrow, shame, panic, terror and loneliness (NHS, 2019). Evidence suggests that there is ethnic variation in expressing and recognising emotion. For example, in an US study (Consedine & Magai, 2002) with 755 multi-ethnic older adults in community setting, authors examined differences in emotion expression – ten trait emotions and level of emotion expressed during conflict- among different ethnic groups. They found there were significant differences by ethnicity. White Americans reported more negative emotions and less of the positive emotions than their African American counterparts. They also reported more use of emotional tactics during conflict compared with African Americans.

Lastly, immigrant status may also be related to this ethnic variance of personality disorder diagnosis rate. London has a high proportion of migrants populations, making up over 30% of resident population and even greater proportion over 40% in inner London (Gidley & Jayaweera, 2010), to which all the boroughs in both CRIS studies belong to. A growing literature suggests the existence of the so-called ‘immigrant health paradox’: that foreign-born have better health-related outcomes than both native-born groups from the same race or ethnicity and the White majority population (Luthra, Nandi, & Benzeval, 2020; Teruya & Bazargan-Hejazi, 2013). This association has also been reported in relation to mental health, such as psychosis (Cantor-Graae & Selten, 2005; Castillejos et al., 2018). Previous studies of personality disorder have also found this effect. For example, a US study found that the prevalence of personality disorder among first-generation immigrants was significantly less than that of native-born Americans (Salas-Wright, Kagotho, & Vaughn, 2014). Similarly, another US study (Pascual et al., 2008) which compared the likelihood of being diagnosed with BPD in a tertiary psychiatric emergency service over 4 years found that in the psychiatric emergency service BPD was diagnosed less frequently in the immigrant group compared with the indigenous group. Although the reason behind the lower rates of personality disorder among immigrant groups is not yet certain, one possible explanation may be the language barrier among immigrant groups. In a systematic review of 18 studies from the United states, Australia, Canada, and the Netherlands (Ohtani et al., 2015), it was suggested that there was an association between limited language proficiency and underutilization of psychiatric services, regardless of where the research was conducted.

Additionally, my findings on the link between ethnicity and outcomes following a personality disorder diagnosis were inconclusive. In respect to mortality, ethnicity was not found to be associated with the risk of mortality in C&I, while all ethnicities except Asian had a lower risk of mortality compared with the white British ethnicity in SLaM. Although, it is difficult to infer what caused the difference between each Trust, one possible explanation might be the difference in the number of people who have died in each cohort. The number of people with mortality in C&I was

163 while SLaM had 730 people with death records, and when they were allocated to each ethnicity, the relatively small number of people in C&I may have reduced the power for detecting an effect.

Regarding time to admission following a personality disorder diagnosis, I found admission rates were associated with some of the ethnic groups in both C&I and SLaM, and in both studies, the reference groups was the White British group. In the C&I study, white-non British ethnicity had a lower risk of admission, whereas in the SLaM study, black ethnicity showed an increased risk of admission and any other ethnicity had a decreased risk of admission compared with the reference group. One of the possible reasons for this difference between two studies might be the differences of the proportion in ethnic distribution between each sample. In both studies, the largest ethnic group was the white British, whereas the second largest ethnicity was white-non British in C&I and the Black ethnicity in SLaM sample. However, this still does not explain why the direction of association differed in each study.

9.3 Strengths and limitations of this research

This research contributes to existing knowledge, in that the SEPEA study and two CRIS studies, as far as I am aware, are the first studies that have been used to examine the relationship between neighbourhood-level deprivation or population density and personality disorder and its outcomes based on data obtained from a clinical sample. The SEPEA study (chapter 3) investigated the prevalence and correlates of comorbid personality disorder in a large, prospectively-collected sample in EIP services for first episode psychosis. Similarly, in the C&I (Chapters 5&6) and SLaM studies (Chapters 7&8), I had a large representative sample of people with personality disorder diagnosis (C&I: 3,488 people; SLaM: 11,132 people). These clinical samples are different from the general population samples from earlier literature in that they are the people who have presented the most severe type of personality disorder to be diagnosed and real-life clinical samples identified in NHS Foundation Trusts. Furthermore, clinical data has advantage that data is routinely and prospectively collected by clinicians. However, there are also several limitations that need to be addressed and in the following section, I discuss overall limitations of this research that need to be acknowledged, focusing on chance, bias and confounding.

9.3.1 The role of chance in my results

In the SEPEA study (Chapter 3), the number of people with personality disorder was 76 and they were re-categorized into different sub-groups for the analysis. During this process, there were cases where the number of people in some of the sub-groups was less than 5, which could have caused the results of the sub-group analysis to be that of type II error (false negative).

Similarly, in the C&I study (chapter 6), the total number of people who died were fairly small to be categorized into different age and ethnic groups for analysis. They were stratified into 8 different age groups and six ethnic groups, which led to very small number of people in some of the sub-groups. For example, there were two people who died in age group 18-19, three people in mixed ethnic group and one person in other ethnic group, which might have induced type II error as they lacked statistical power to reject the null hypotheses.

In Chapters 7 and 8, I replicated the C&I study (Chapter 5&6) in another large secondary care cohort in London in order to test whether the results in C&I study was a result of chance. Some of the results did replicate: the prevalence of personality disorder in another secondary mental health service (SLaM) was similar to that of C&I study, and neighbourhood-level deprivation was associated with this personality disorder prevalence. Also, I did not find any evidence of an association between neighbourhood-level deprivation and population density and mortality or the subsequent acute psychiatric admission after personality disorder diagnosis, all of which may suggest the result was not a chance finding.

9.3.2 Bias

It is possible that the findings in this research are subject to selection bias. The samples in the C&I and SLaM studies were of people who had access to secondary mental health care and treated by these services because their symptoms were severe enough to come to the attention of service. If people have decided not to seek the care of the service or to choose private services may not have been included in my sample of people with personality disorder diagnosis.

Additionally, the possibility of information bias cannot be ruled out. In dealing with missing information in each study (Chapters 3, 5-8), I used a complete case analysis and excluded those who had missing information on the main exposures or covariates of age, sex and ethnicity. It is possible that a bias was introduced during this process affecting the results of each study. Another risk of information bias may be that residential information of people with personality disorder recorded may not be their genuine address at the time of first presentation for personality disorder. Earlier evidence suggested that there is a link between personality disorder and homelessness (Bassuk, Rubin, & Lauriat, 1986; Fazel et al., 2008) and residential information on the CRIS data depend on self-report. Therefore, it is possible that the address recorded in the CRIS data may belong to their family or friends (i.e., if they were staying with them temporarily), or be a temporary address such as a shelter or other place of refuge, rather than a valid residential address corresponding to the exposure environment of people with personality disorder themselves.

Next, another potential source of threat to validity is the issue of generalizability. Both C&I and SLaM are two large secondary mental health service providers in inner London, and the catchment areas of boroughs where C&I and SLaM provide services belong to are amongst the most deprived areas in England (**Table 9.1**). For instance, three (Lambeth 22nd; Southwark 23rd; Lewisham 26th) of four boroughs in SLaM and one (Islington 13th) of two boroughs in C&I ranked within the top 50 out of 326 local authorities (Ministry of Housing Communities & Local government, 2015b), with the two remaining boroughs ranking within 100 (Camden 69th; Croydon 91st). Also, as both C&I and SLaM are located in inner city London, the population density in these areas is also relatively higher than many of other areas in England. For example, according to the mid-year population estimates for UK and its constituent countries (Office for National Statistics, 2019), London boroughs accounted for the 20 most densely populated areas in England and all boroughs except Croydon in C&I and SLaM were included in these 20 boroughs. London is the largest city in England with multicultural and ethnic diversity. Therefore, the characteristics of neighbourhoods in my research may differ from those in other areas in England that have different composition of deprivation, population density, cultural or ethnic background or level of urbanicity and thus findings in this research may not be generalisable at national level.

Table 9.1 Neighbourhood-level deprivation and population density in the catchment areas of C&I, SLaM and England

	C&I	SLaM	England
Neighbourhood-level deprivation (IMD score) rank*	<ul style="list-style-type: none"> ▪ Camden: 69th ▪ Islington: 13th 	<ul style="list-style-type: none"> ▪ Lambeth: 22nd ▪ Southwark: 23rd ▪ Lewisham: 26th ▪ Croydon: 91st 	Total number of local authorities in England: 326
Population density (people per square meter)**	<ul style="list-style-type: none"> ▪ Camden: 12,399 ▪ Islington: 16,319 	<ul style="list-style-type: none"> ▪ Lambeth: 12,162 ▪ Southwark: 11,041 ▪ Lewisham: 8,702 ▪ Croydon: 4,471 	432

*English Indices of Deprivation 2015; **Population estimates for the UK, England and Wales, Scotland and Northern Ireland: mid-2019

Further, I have used IMD score as an exposure to measure neighbourhood-level deprivation, and it is possible this may have introduced ecological bias (or fallacy). Although IMD scores have been well-validated and most widely used as a measure of relative deprivation at area level (MHCLG, 2019), they do not capture individual features and experiences of people living in those areas which cannot be covered by seven domains of IMD score (income, employment, skills and training, crime, barriers

to housing and services, and living environment). With this measure, people living in the same areas are assumed to have the same experience of deprivation when deprivation is actually subjective and dependent on situation (Burke & Jones, 2019).

Lastly, there was not much variance in deprivation among areas within C&I and SLaM, as described earlier. In the outcomes studies (Chapters 6&8), I stratified neighbourhood-level deprivation and population density into four groups. In the C&I outcomes studies, the number of people who died was 163, which may have been too small to have sufficient statistical power to detect variation by neighbourhood level population density or deprivation. This may have led me to incorrectly accept the null hypotheses. Nonetheless, replication of this finding in the larger SLaM cohort, suggests there may little association between area-level socioenvironmental factors and mortality in these two inner city areas, particularly where all participants are – on average – already exposed to considerably more disadvantage and urbanicity than elsewhere in England.

9.3.3 Confounding

I have included potential confounding factors including age, sex and ethnicity in the analysis in order to overcome the possible effect of confounding throughout all the chapters. However, due to the intrinsic nature of the clinical data in chapters 5-8, I could not obtain relevant and important information on individual socioeconomic status such as income or education.

9.4 Implications for clinical practice and public health

In this section, I aim to address the implications of my results for clinical practice and public health. In this research, I found the prevalence of personality disorder was significantly lower in clinical settings than compared with those estimates found in the general community population. It may not necessarily mean that number of people with personality disorder in clinical settings was actually low. Rather, it may suggest there may be people who are not under proper care of services either because they intentionally chose not to seek care, could not access the pathways to the care or were not at the clinical threshold for receiving secondary mental health care in terms of their risk profile. For example, in a qualitative study undertaken in the UK with six focus groups composed of 45 clinicians in mental health services and online survey of 131 service users, participants identified the absence of a coherent personality disorder pathway as one of the main concerns (Flynn et al., 2019) among others. In the same study, service users also responded that they perceived a lack of understanding of the personality disorder diagnosis from the staff and need for trainings to improve clinician's attitude toward personality disorder. Another possible reasons for this low prevalence of personality disorder may be that treatment of personality disorder depend more on therapies such as psychotherapy and dialectical behavioural therapy, and access to these therapies is often difficult,

albeit effective (NIMHE, 2003). Thus, people with personality disorder may be discouraged from seeking help via NHS services. Further, the NHS guideline specifies that drug treatment for BPD should be considered with care and drug treatment including antipsychotics should not be used to individuals with BPD and for mid-term or long-term treatment for these people (NICE, 2009). More pathways for the people with personality disorder to easily access the care of the NHS system may need to be sought so that people with different level of severity can be treated.

Also, my findings suggested that people from more deprived areas are more likely to be diagnosed with personality disorder in clinical settings than those from more affluent areas. This may suggest that the policymakers and those who build interventions for people with personality disorder need to consider targeting improving more the deprived areas. Individuals living in more deprived areas experience more crime, live in less pleasant housings, and more likely to be unemployed which may lead them to have less capacity to seek adequate help and psychiatric services.

NICE guideline recommends not making a diagnosis of BPD or antisocial personality disorder for individuals before they become 18 years or over (National Institute for Health and Care Excellence (NICE), 2015), but features of personality disorder may begin and may become identifiable earlier in adolescence. For example, evidence suggested that general aggression emerging in early adolescence predicted antisocial personality disorder in young adulthood in a population-based sample (Whipp et al., 2019). As EIPs have demonstrated their efficacy both clinically and economically for people with traits of psychotic disorder (Singh, 2018), young people with traits of antisocial personality disorder may benefit from early interventions provided during childhood which may help them to learn engaging and prevent them from developing personality disorder in later life.

Furthermore, in the outcomes studies (Chapters 6&8), the proportion of people who have had subsequent admission after personality disorder diagnosis among people with personality disorder was fairly high both in C&I and SLaM with 47.48% and 32.55%, respectively, and the rate of subsequent admission after personality disorder diagnosis was found to be higher in the 18-19 age group compared to older age groups both in C&I and SLaM and. This may be a source of substantial burden to individuals and the society. The quality of life of individuals with personality disorder will be deteriorated and increase government's spending on such as treatment and care of people with personality disorder and loss in productivity at workplace.

One underlying problem for all phenomena involving personality disorder may be that personality disorder comes with negative labelling. personality disorder has been constantly reported to be associated with stigma and exclusion from professional care (Rains et al., 2021). In recognition of the

negative clinical connotations that are often associated with a clinical label of ‘personality disorder’, there has been an initiative that advocates changing the term personality disorder into ‘complex emotional needs (CEN)’, among some stakeholders including clinicians, academics and service users (Foye et al., 2021; Rains et al., 2021). People with personality disorder in general experience difficulties in social interaction, and a study found that people with BPD have a much higher prevalence of ‘gelotophobia’, which is the fear of being laughed at in comparison with a reference group (Brück, Derstroff, & Wildgruber, 2018). Additionally, more interventions for raising awareness of personality disorder, such as campaigns may need to be developed as public knowledge on personality disorder is limited and people with personality disorder are perceived as misbehaving intentionally rather than going through an illness (Sheehan, Niewegłowski, & Corrigan, 2016). Stigma not only leads to the deterioration of social acceptance of people with diagnosable mental health conditions, but also affects chances of employability (Lai, Hong, & Chee, 2000). This may contribute to the positive association between neighbourhood-level deprivation and personality disorder.

9.5 Implications for future research

I recommend that further research be undertaken in the following areas. First, personality disorder in this study was examined as an umbrella term, and I chose not to examine individual types of personality disorder for several reasons. For example, in the C&I study, discrete types of personality disorder were not examined because there were many people who had diagnoses of multiple types of personality disorder, or whose clinical diagnosis recorded in free-text did not involve any specific type of personality disorder. I chose not to pursue analysis of individual types of personality disorder in order to avoid complexity in the scope of the study, and I applied the same criteria for the SLAM study. However, more in-depth examination of prevalence of each specific type of personality disorder diagnosis and their association with neighbourhood-level deprivation in further studies could add more insights on the findings in this study considering each type of personality disorder presents different symptoms and features under current ICD-10 classification. Secondly, in line with the introduction of new classification of personality disorder in ICD-11, a further study based on different degrees of severity of personality disorder is needed to account for the varying symptoms and presentations of personality disorder. Under currently practice with ICD-10 classification, severity of personality disorder is not considered and people with mild or moderate symptoms and those with severe symptoms are treated as a group. I envisage studying people with personality disorder based on their severity will provide an insight for understanding the social deprivation and personality disorder, especially in relation to the outcomes of personality disorder. Third, the follow up period for this research (2008-2016) was not the most recent in the case of C&I study as the data were only available until a point before I started this research; adding recent data may enable to

uncover potential association between neighbourhood-level deprivation or population density and subsequent outcomes of personality disorder by allowing longer follow-up time. Fourth, as I discussed earlier in the limitations section, the settings of both my C&I or SLAM studies were in inner city London NHS Trusts, and do not represent all clinical settings in England. It is therefore difficult to generalize my findings beyond these settings, which were disproportionately more deprived and urban than England as a whole. Therefore, a further study looking into areas with different characteristics, for example, CRIS data obtained from rural areas would provide more generalisability for the findings in this study. Similarly, the findings of my study on people with comorbid personality disorder in EIPs conducted in Chapter 3 could be strengthened if another study in different areas is carried out. Fifth, although I initially considered including more outcomes of personality disorder, such as medications prescribed or Health of the Nation Outcome Scales (HoNOS) score which is a set of dozen scales measuring mental health-related problems in four different domains including behaviour, symptoms, impairment, and social functioning (Twomey et al., 2016), I decided not to include them in the scope of this research for practical reasons. In the initial search, I found the number and types of medications prescribed to people with personality disorder were extensive, and it would not have been feasible to include them in this research as it would have required more time than was available in my PhD to investigate these issues. As for the HoNOS score, only a small number of people with personality disorder had information on HoNOS score and therefore I had to give up using HoNOS score, although this score could have provided useful information on items such as self-harm, substance-use and physical health. A further study examining these outcomes would provide further insights into understanding the prognosis of people with personality disorder, especially when studies on the outcomes of personality disorder is scarce. Sixth, it would be important in a future study to examine the cause of death in relation to the neighbourhood-level deprivation or population density by linking the mortality data from ONS to the CRIS data. I did not include this work in the scope of my research due to time constraints, but sub-group analysis based on the cause of death in examining its association between neighbourhood-level deprivation or population density could provide more definitive evidence on the effect of these neighbourhood-level variables to the mortality of people with personality disorder. However, I would still need a greater sample given the small number of deaths in my sample. Additionally, I examined acute psychiatric admissions in general, and did not carry out a sub-analysis for types of admission, i.e., in-patient wards, crisis teams and crisis house. As each type of admission serves different purpose, it may provide insights if they were looked at individually. I also did not have information on what caused people's subsequent acute psychiatric admission. For example, it could have been self-harm or overdose, and it would be a great help to understand the association between neighbourhood-

level deprivation and subsequent admission. Lastly, if feasible, a future study could produce a greater degree of accuracy on the findings if information on individual SES could be procured.

9.5.1 Feedback from personality disorder clinicians

While I was doing this research, I had occasions where I could present my findings and discuss their implications with interested parties in the Camden and Islington NHS Foundation Trust. One of them was the C&I CRIS board meeting and the other was a journal club at C&I. The former included people from diverse backgrounds including clinicians, administrators and lay persons who are responsible for overseeing and making decisions involving C&I CRIS data. I was able to share the output of my study to these board members and I learned that I should be able to present the findings of my study not only to those who have academic knowledge and skills, but also to those who do not have an academic background in research. The C&I journal club was composed of people all of whom have first-hand experience with people with personality disorder including psychiatrists, psychologists, nurses and social workers, and were well aware of the stigma arising from being diagnosed with personality disorder. Through these opportunities and their feedback, I was able to discuss many aspects of my findings on people with personality disorder and as well as having a chance to introduce what I have studied with the C&I CRIS data (**Table 9.2**). Especially in the C&I journal club, I found many aspects of my findings were consistent with their experiences. For example, it was agreed that personality disorder diagnosis entails much stigma and people with personality disorder do not come to secondary mental health services as they fear stigma. Also, I got an insight for developing my thoughts during the discussion. For instance, it was suggested that people with personality disorders may be less likely to seek help from the service since interventions for personality disorders are often delivered via therapeutic relationships with clinicians or psychological therapy in long-term rather than medication, hence presenting no immediate effect for treating personality disorders.

Table 9.2 Summary of presentations at C&I CRIS board meeting and C&I journal club

Contents	Audience	Agendas
C&I CRIS board meeting		
10 minutes presentation including Q&A	Academics, clinicians, CRIS administrative staff, and lay persons	<ul style="list-style-type: none"> - Presentation of C&I prevalence study - Discussion about the findings
C&I Journal club		
One hour-long presentation and discussion	Psychiatrists, psychologists, nurses, and social workers	<ul style="list-style-type: none"> - Presentation of C&I prevalence study - Discussion about the findings <ul style="list-style-type: none"> • Why do you think the prevalence in your study is so low? • Ppersonality disorder diagnosis entails stigma. People with personality disorder do not come to secondary care much • Chaotic people move a lot and are often homeless • White female with personality disorder is affected by more cultural perspective? • Personality disorder has therapeutic relationship/psychological therapy rather than medication • Religious/cultural/racial effects on the low prevalence of personality disorder? • Black young men: story/history is missing in the way that could lead into personality disorder diagnosis and instead lead to psychosis • Personality disorder: may have something to do with postnatal depression & attachment? • Bipolar diagnosis/eating disorder/ personality disorder may be middle class diagnosis • How did you divide the area for neighbourhood-level deprivation? • Personality disorder may be often dealt within community • Have you studied other area than C&I? What was the prevalence there? • What was hypothesis for association between personality disorder and ethnic group?

9.5.2 Service users, carers and public perspectives

As I briefly discussed in the introduction in Chapter 1, there has been a constant debate around the classification of personality disorder, mainly due to its categorical approach and not being assessed in the form of severity in spite of its heterogeneous symptoms and severity (Mulder, 2021; Tyrer et al., 2011, 2015). As a result, the ICD-11 has introduced a model of five personality disorder domains which abolished all categories of personality disorder except for a general description with a

dimension of severity (Mulder, 2021). In addition to the classification of personality disorder, there is also an ethical debate around the conceptual basis of personality disorder that personality disorder diagnosis is that it is stigmatising and associated with gender bias (Campbell et al., 2020; P. Klein et al., 2021; Ussher, 2013). It is well known people with personality disorder diagnosis often experience stigmatising attitudes, not only among the community, but also among mental health professionals (Hersh, 2008; Lewis & Appleby, 1988; Newton-howes et al., 2008). Carers of people with personality disorder also reported that they experience a range of challenges such as exclusion and discrimination when they attempt to get support from mental health services and higher burden and grief compared with carers of people with other serious mental illnesses (Bailey & Grenyer, 2014; Barr et al., 2020; Lawn & McMahon, 2015). People with personality disorder diagnosis or their carers have not been extensively included in research on personality disorder. On the notion of this lack of involvement of service users or carers, efforts have been made to incorporate service users' or carers' views in research. For example, in recognition of the negative clinical connotations that are often associated with a clinical label of 'personality disorder', there has been an initiative that advocates changing the term personality disorder into 'complex emotional needs (CEN)', among some stakeholders including clinicians, academics and service users (Foye et al., 2021; Rains et al., 2021). Also, a consensus statement (Lamb et al., 2018) was authored and signed by people with lived experience of personality disorder and mental health professionals from a wide range of disciplines in the UK to highlight the general consensus of opinions of people with lived and professional experience. The statement described challenges faced by people with personality disorder and set out recommendations for improving treatment and support. Further, in the wake of increasing awareness about challenges people with personality disorder carry, the National Institute for Mental Health for England (NIMH(E)) published a landmark policy implementation guidance, 'Personality disorder: No Longer a Diagnosis of Exclusion (NIMH(E), 2003), for the development of services for those with personality disorder in 2003. Since its publication, there has been a lot of interest on the required services for people with personality disorder, and subsequent guidance on treatment for personality disorder from the National Institute of Health Care and Excellence (NICE) was also published (NICE, 2009). In a recent position statement published by Royal College of Psychiatrists (Royal College of Psychiatrists, 2020), recommendations on best implementing services for persons with personality disorder were made and they included timely and accurate diagnosis, staff support and inclusion of people with lived experience as a part of workforce (Harding, 2020).

Although patient and public involvement (PPI) perspective was not within the scope of my study, inclusion of lived experience of service users or carers would have provided valuable implications behind the findings of this research, especially the lower prevalence of personality disorder in the

clinical sample in this research compared with the prevalence found in the general population in earlier studies. A future study on perceived barriers toward accessing personality disorder service involving service users and carers would provide balanced implications on findings from this study along with the feedback from personality disorder clinicians described in 9.5.1. This could be carried out by conducting a focus group or a qualitative study by inviting those who have accessed community mental health services in C&I or SLaM. Further, I could also present and disseminate the findings of this study to the data science PPI group at UCL and engage with other research PPI group such as NIHR Mental Health Policy Research Unit.

9.6 Conclusion

Social deprivation at neighbourhood-level is one important factor that contributes to inequality among people with mental health difficulties. In this thesis, I sought to establish whether neighbourhood-level deprivation was associated with the prevalence of personality disorder diagnosed in clinical settings and subsequent outcomes including mortality and acute psychiatric admission. In the systematic review, I demonstrated a lack of evidence in the literature on social deprivation and personality disorder. In light of this, I examined the prevalence of people with personality disorder in EIPs and whether neighbourhood-level deprivation or population density affected those with personality disorder accepted in an EIP. In further studies in the more general setting of secondary care in two inner London NHS Foundation trusts, I found the prevalence of personality disorder was much lower than those reported in previous literature on community settings. Importantly, my findings highlighted that people living more deprived area were more likely to have a personality disorder diagnosis in secondary mental health care than those from more affluent neighbourhoods. This finding replicated across another separate setting in inner London. However, outcomes of personality disorder, including mortality or subsequent acute psychiatric admission after a personality disorder diagnosis, were not associated with neighbourhood-level deprivation or population density.

This research extends our knowledge of the relationship between neighbourhood-level deprivation and development of personality disorder and may suggest neighbourhood-level deprivation and population density have little effect on the prognosis of personality disorder once people were to receive personality disorder diagnosis in very urban areas. Lower prevalence of personality disorder in clinical settings compared with community settings may be partially explained by the fact that people who were included in this research were those whose symptoms were severe enough to be detected, had access to the care and were diagnosed and these may indicate there are still people who chose not to seek help, pursue alternative services or were not detected by services as their

symptoms did not meet the threshold for diagnosis. Further studies using data that cover neighbourhoods with different characteristics would still be needed to examine the generalisability of my findings at a broader national level. Additional studies on the relationship between neighbourhood-level deprivation and population density and mortality or the subsequent admission after personality disorder diagnosis are also needed to more accurately determine the relationship between neighbourhood-level deprivation or population density and outcomes of personality disorder.

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Appendix 1. Search strategy for systematic review

Medline

No	Search	Items found	Remarks
1	exp Personality Disorders/	39510	
2	personality disorder*.mp ¹⁾ .	43104	
3	paranoid personality.mp.	383	
4	schizoid personality.mp.	703	
5	Schizotypal personality.mp.	2882	
6	antisocial personality.mp.	10229	
7	dissocial personality.mp.	51	
8	borderline personality.mp.	8005	
9	emotionally unstable personality.mp.	45	
10	histrionic personality.mp.	638	
11	narcissistic personality.mp.	637	
12	obsessive compulsive personality.mp.	405	
13	anankastic personality.mp.	20	
14	avoidant personality.mp.	435	
15	anxious personality.mp.	80	
16	dependent personality.mp.	414	
17	1 or 2 or 3 or 4 or 5 or 6 or 7 or 8 or 9 or 10 or 11 or 12 or 13 or 14 or 15 or 16	47247	PD
18	onset.mp.	446331	
19	Incidence/	229891	
20	incidence*.mp.	767016	
21	rate.mp.	2048317	
22	Prevalence/	249045	
23	prevalen*.mp.	699989	
24	Risk/	115353	
25	risk.mp.	2140433	
26	18 or 19 or 20 or 21 or 22 or 23 or 24 or 25	4906472	Onset
27	Prognosis/	451993	
28	prognosis.mp.	644731	
29	Treatment Outcome/	839411	
30	treatment outcome*.mp.	863834	
31	outcome*.mp.	2027661	
32	exp Recurrence/	172506	
33	recurrence*.mp.	450468	
34	relapse*.mp.	141885	
35	exp Hospitalization/	204877	
36	hospitali?ation.mp.	179244	
37	admission*.mp.	196231	
38	functioning.mp.	155883	
39	Physical health.mp.	16328	
40	"Quality of Life"/	159702	
41	quality of life.mp.	280715	
42	recover*.mp.	607292	
43	"Activities of Daily Living"/	59632	
44	activities of daily living.mp.	70450	
45	disabilit*.mp.	235708	
46	symptom*.mp.	999251	
47	substance abuse.mp.	48215	

No	Search	Items found	Remarks
48	exp Suicide/	57240	
49	suicid*.mp.	84455	
50	suicid* attempt*.mp.	23072	
51	mental health/	30146	
52	mental disorders/	153560	
53	(mental adj2 (health or disorder*)).mp.	303180	
54	Mortality/	39513	
55	mortalit*.mp.	677350	
56	(self adj2 (injur* or mutil* or harm)).mp.	14845	
57	27 or 28 or 29 or 30 or 31 or 32 or 33 or 34 or 35 or 36 or 37 or 38 or 39 or 40 or 41 or 42 or 43 or 44 or 45 or 46 or 47 or 48 or 49 or 50 or 51 or 52 or 53 or 54 or 55 or 56	5151177	Prognosis
58	26 or 57	8122051	Onset or Prognosis
59	17 and 58	28612	Onset or prognosis of PD
60	Social Isolation/ or exp Socioeconomic Factors/	420850	
61	socioeconomic*.mp.	190514	
62	socio economic*.mp.	27147	
63	social class.mp.	41963	
64	poverty.mp.	51312	
65	(soci* adj2 (depriv* or isolat*)).mp.	20144	Social deprivation
66	60 or 61 or 62 or 63 or 64 or 65	486565	
67	59 and 66	2315	
68	limit 67 to yr="1980 - 2017"	1721	Final
69	limit 68 to medline	1691	Final

Embase

No	Search	Items found	Remarks
1	exp personality disorder/	53671	
2	personality disorder*.mp.	44068	
3	paranoid personality.mp.	639	
4	schizoid personality.mp.	270	
5	Schizotypal personality.mp.	2985	
6	antisocial personality.mp.	4268	
7	dissocial personality.mp.	88	
8	borderline personality.mp.	7621	
9	emotionally unstable personality.mp.	68	
10	histrionic personality.mp.	948	
11	narcissistic personality.mp.	724	
12	obsessive compulsive personality.mp.	489	
13	anankastic personality.mp.	27	
14	avoidant personality.mp.	1205	
15	anxious personality.mp.	100	
16	dependent personality.mp.	4234	
17	1 or 2 or 3 or 4 or 5 or 6 or 7 or 8 or 9 or 10 or 11 or 12 or 13 or 14 or 15 or 16	58540	PD
18	onset.mp.	581593	
19	Incidence/	279570	
20	incidence*.mp.	982392	
21	rate.mp.	2607227	
22	prevalence/	549669	
23	prevalen*.mp.	952785	

No	Search	Items found	Remarks
24	risk/	496679	
25	risk.mp.	3012667	
26	18 or 19 or 20 or 21 or 22 or 23 or 24 or 25	6443376	Onset
27	prognosis/	516818	
28	prognosis.mp.	751404	
29	Treatment Outcome/	754725	
30	treatment outcome*.mp.	779224	
31	outcome*.mp.	2568971	
32	exp recurrent disease/	155581	
33	recurrence*.mp.	463925	
34	relapse*.mp.	244848	
35	exp hospitalization/	285374	
36	hospitali?ation.mp.	359772	
37	admission*.mp.	362890	
38	functioning.mp.	195207	
39	physical health.mp.	20195	
40	"quality of life"/	363220	
41	quality of life.mp.	449464	
42	recover*.mp.	694622	
43	daily life activity/	72406	
44	activities of daily living.mp.	30104	
45	disabilit*.mp.	260324	
46	symptom*.mp.	1452656	
47	substance abuse.mp.	62215	
48	exp suicide/ or exp suicide attempt/	67864	
49	suicid*.mp.	108157	
50	suicid* attempt*.mp.	28736	
51	mental health/	102709	
52	mental disease/	199868	
53	(mental adj2 (health or disease)).mp.	379541	
54	mortality/	670449	
55	mortalit*.mp.	1172897	
56	(self adj2 (injur* or mutil* or harm)).mp.	12701	
57	27 or 28 or 29 or 30 or 31 or 32 or 33 or 34 or 35 or 36 or 37 or 38 or 39 or 40 or 41 or 42 or 43 or 44 or 45 or 46 or 47 or 48 or 49 or 50 or 51 or 52 or 53 or 54 or 55 or 56	6711750	Prognosis
58	26 or 57	10372123	Onset or Prognosis
59	17 and 58	39339	Onset or prognosis of PD
60	exp social isolation/	19723	
61	exp socioeconomics/	322281	
62	socioeconomic*.mp.	182170	
63	socio economic*.mp.	34064	
64	social class.mp.	32907	
65	poverty.mp.	46955	
66	(soci* adj2 (depriv* or isolat*)).mp.	25587	
67	60 or 61 or 62 or 63 or 64 or 65 or 66	429228	Social deprivation
68	59 and 67	2045	
69	limit 68 to yr="1980 - 2017"	1879	
70	limit 69 to embase	1313	Final

PsychINFO

No	Search	Items found	Remarks
1	exp Personality Disorders/	31887	
2	personality disorder*.mp.	39356	
3	paranoid personality.mp.	546	
4	schizoid personality.mp.	957	
5	Schizotypal personality.mp.	2378	
6	antisocial personality.mp.	6521	
7	dissocial personality.mp.	59	
8	borderline personality.mp.	10461	
9	emotionally unstable personality.mp.	56	
10	histrionic personality.mp.	655	
11	narcissistic personality.mp.	3354	
12	obsessive compulsive personality.mp.	930	
13	anankastic personality.mp.	14	
14	avoidant personality.mp.	782	
15	anxious personality.mp.	78	
16	dependent personality.mp.	586	
17	1 or 2 or 3 or 4 or 5 or 6 or 7 or 8 or 9 or 10 or 11 or 12 or 13 or 14 or 15 or 16	48849	PD
18	onset.mp.	89510	
19	incidence*.mp.	47073	
20	rate.mp.	178360	
21	prevalen*.mp.	122584	
22	risk.mp.	312357	
23	18 or 19 or 20 or 21 or 22	638243	Onset
24	PROGNOSIS/	8324	
25	prognosis.mp.	19869	
26	exp Treatment Outcomes/	34621	
27	treatment outcome*.mp.	39546	
28	outcome*.mp.	341997	
29	recurrence*	8148	
30	"Relapse (Disorders)"/	6235	
31	relapse*.mp.	25123	
32	exp HOSPITALIZATION/	20755	
33	hospitali?ation.mp.	28873	
34	admission*.mp.	35362	
35	functioning.mp.	132367	
36	Physical health.mp.	17823	
37	exp "Quality of Life"/	36422	
38	quality of life.mp.	63579	
39	exp "RECOVERY (DISORDERS)"/	11041	
40	recover*.mp.	73835	
41	exp "Activities of Daily Living"/	5317	
42	activities of daily living.mp.	13736	
43	exp DISABILITIES/	62638	
44	disabilit*.mp.	128034	
45	exp SYMPTOMS/	210039	
46	symptom*.mp.	312059	
47	Drug Abuse/	43431	
48	drug abuse.mp.	53391	
49	substance abuse.mp.	32740	
50	exp SUICIDE/	25051	
51	suicid*.mp.	57541	

No	Search	Items found	Remarks
52	suicid* attempt*.mp.	11867	
53	Mental health/	53943	
54	Mental disorders/	76443	
55	(mental adj2 (health or disorder*))	271138	
56	"Death and Dying"/	27746	
57	death.mp.	85714	
58	dying.mp.	33322	
59	mortalit*.mp.	35573	
60	(self adj2 (injur* or mutil* or harm)).mp.	11579	
61	24 or 25 or 26 or 27 or 28 or 29 or 30 or 31 or 32 or 33 or 34 or 35 or 36 or 37 or 38 or 39 or 40 or 41 or 42 or 43 or 44 or 45 or 46 or 47 or 48 or 49 or 50 or 51 or 52 or 53 or 54 or 55 or 56 or 57 or 58 or 59 or 60	1302560	Prognosis
62	23 or 61	1626997	Onset or Prognosis
63	17 and 62	30700	Onset or prognosis of PD
64	exp Social Deprivation/	7623	
65	(soci* adj2 (depriv* or isolat*)).mp.	13579	
66	exp Socioeconomic Status/	45564	
67	socioeconomic*.mp.	53728	
68	socio economic*.mp.	12087	
69	social class.mp.	13165	
70	poverty.mp.	20861	
71	64 or 65 or 66 or 67 or 68 or 69 or 70	113143	Social deprivation
72	63 and 71	601	
73	limit 72 to yr="1980 - 2017"	557	Final

Web of Science

No	Search	Items found	Remarks
1	personality disorder		
2	paranoid personality		
3	schizoid personality		
4	Schizotypal personality		
5	antisocial personality		
6	dissocial personality		
7	borderline personality		
8	emotionally unstable personality		
9	histrionic personality		
10	narcissistic personality		
11	obsessive compulsive personality		
12	anankastic personality		
13	avoidant personality		
14	anxious personality		
15	dependent personality		
16	1 or 2 or 3 or 4 or 5 or 6 or 7 or 8 or 9 or 10 or 11 or 12 or 13 or 14 or 15	50183	PD
17	onset.mp		
18	incidence*		
19	Rate		
20	prevalen*		
21	Risk		
22	17or 18 or 19 or 20 or 21	6732036	Onset

No	Search	Items found	Remarks
23	Prognosis		
24	treatment outcome*		
25	outcome*		
26	recurrence*		
27	relapse*		
28	Hospitalisation		
29	admission*		
30	Functioning		
31	Physical health		
32	quality of life		
33	recover*		
34	activities of daily living		
35	disabilit*		
36	symptom*		
37	substance abuse		
38	suicid*		
39	suicid* attempt*		
40	Mental health		
41	Mental disorder*		
42	(mental near/2 (health or disorder*))		
43	mortalit*		
44	(self near/2 (injur* or mutil* or harm))		
45	23 or 24 or 25 or 26 or 27 or 28 or 29 or 30 or 31 or 32 or 33 or 34 or 35 or 36 or 37 or 38 or 39 or 40 or 41 or 42 or 43 or 44	7896309	Prognosis
46	22 or 45	12311033	Onset or Prognosis
47	16 and 46	35933	Onset or prognosis of PD
48	socioeconomic*		
49	socio economic*		
50	social class		
51	Poverty		
52	(soci* adj2 (depriv* or isolat*))		Social deprivation
53	48 or 49 or 50 or 51 or 52	241812	
54	47 and 53	786	

Appendix 2. Quality assessment of included studies

Cohort study

1st Author	P. year	Representativeness of the exposed cohort	selection of the non-exposed cohort	ascertainment of exposure	demonstration that outcome of interest was not present at start of study	comparability of cohort on design/analysis	assessment of outcome	was f/u long enough for outcomes to occur	adequacy of f/u of cohorts	Total
Blaney	2020	1	0	1	1	1	1	0	0	5
Buu	2009	1	0	1	0	1	1	0	0	4
Cadoret	1990	1	0	1	0	1	1	0	0	4
Drake	1988	1	0	1	0	0	1	1	1	5
Greve	2013	1	0	1	0	1	1	1	1	6
Hakulinen	2020	1	0	1	0	1	1	1	1	6
Leão	2007	1	0	1	0	1	1	1	1	6
Niesten	2016	1	1	1	0	1	1	1	1	7
Newton-Howes	2021	1	0	1	0	0	1	1	1	5
Pare-Miron	2016	1	1	1	0	0	1	0	0	4
Soloff	2021	1	0	1	0	1	1	1	1	6
Soloff	2019	1	0	1	0	1	1	1	1	6
Soloff	2012	1	0	1	0	0	1	1	1	5
Virtanen	2011	1	0	1	0	1	1	1	1	6

Case-control study

1st Author	P. year	case definition adequacy	representativeness of the cases	selection of controls	definition of controls	comparability of cases and controls on design/analysis	ascertainment of exposure	same method of ascertainment for case and controls	non-response rate	Total
Dickey	2005	1	0	1	1	0	1	1	0	5
Heikkinen	1997	1	0	0	1	1	1	1	0	5
Hickling	2011	1	0	0	1	0	1	1	0	4
Sayar	2001	1	0	1	1	0	1	1	0	5
Zanarini	2018	1	1	0	1	0	1	1	0	5

Cross-sectional study

1st Author	P. year	representativeness of sample	sample size	non-respondents	ascertainment of exposure	control for confounders	assessment of outcome	statistical test	Total
Devanand	2000	1	0	1	1	0	1	1	5
Dohrenwend	1992	1	1	0	1	0	2	0	5
Elliott	2021	1	1	0	1	0	2	0	5
Erikson	2016	1	0	0	1	1	1	1	5
Goldstein	2017	1	1	1	1	1	1	1	7
Hengartner	2013	1	0	0	2	1	1	1	6
Hickling	2013	1	0	0	1	1	2	1	6
Huang Y.	2009	1	0	0	1	1	2	1	6
Huang X.	2007	1	0	0	0	0	0	0	1
Javaras	2017	1	0	0	1	1	1	1	5
Leppänen	2016	1	1	1	0	0	1	1	5
McGurk	2013	1	0	0	1	0	1	1	4
Melca	2015	1	0	0	1	0	2	0	4
Moran	2002	1	0	0	1	1	2	1	6
Pulay	2009	1	0	0	1	1	2	1	6
Raza	2014	1	0	0	1	1	1	1	5
Regier	1993	1	0	0	1	1	2	1	6
Reich	1996	1	0	1	1	0	1	1	5
Salehi	2008	1	0	0	1	0	1	0	3
Santan	2018	1	1	0	1	1	1	1	6
Smith	2009	1	1	0	2	0	1	0	5
Swartz	1990	1	0	0	1	0	1	1	4
Tomko	2014	1	1	0	1	0	2	1	6
Torgersen	2001	1	0	1	1	1	2	0	6
Tyrer	1994	1	0	0	0	0	2	1	4
Walsh	2013	1	0	1	2	1	2	1	8
Yang	2014	1	0	0	1	1	2	1	6