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Mental health service use in children at risk of significant harm: A record linkage study of a child protection register

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ABSTRACT

Children with experience of maltreatment, abuse or neglect have higher prevalence of poor mental health. In the United Kingdom, child protection services identify children at risk of significant harm on the Child Protection Register (CPR) and intervene to reduce risk. Prevalence and incidence of mental health service use among this population of children are not well understood. We analysed records from one Scottish Local Authority's CPR, linked to electronic health records for all children in the broader health board region aged 0–17 years. We described mental health service use among children with a CPR registration using measures of mental health prescribing and referrals to child and adolescent mental health services (CAMHS). We calculated age- and sex-specific incidence rates for comparison with the general population. Between 2012 and 2022, we found 1498 children with a CPR registration, with 69% successfully linked to their health records. 20% were registered before birth and median age at registration was 3 years. Incidence rates in all measures of mental health service use were higher in children with a CPR record across all ages (at outcome) and genders compared to the general population. The largest absolute difference was for boys aged 5–9 with a CPR record, who had 31.8 additional mental health prescriptions per 1000 person-years compared to the general population (50.4 vs. 18.6 prescriptions per 1000 person-years, IRR: 2.7). Girls aged 0–4 years with a CPR registration had the largest relative difference, with a rate of CAMHS referral 5.4 times higher than the general population (12.3 vs. 2.3 per 1000 person-years). Our reproducible record linkage of the CPR to health records reveals an increased risk of mental health service use during childhood. Our findings have relevance to public mental health surveillance, service prioritisation and wider policy aiming to reduce childhood exposure to risk of harm.

1. Background

Childhood experiences of maltreatment, abuse or neglect can have serious harmful effects on both physical and mental health (Mills et al., 2013; Vachon et al., 2015; Gardner et al., 2019; Lippard and Nemeroff, 2020), across the life course, (World Health Organisation, 2020; McKenna et al., 2021), in turn contributing to major and longstanding public health issues worldwide (Fegert and Stötzel, 2016). In response, governments around the world have implemented statutory frameworks and Child Protection Systems to fulfil their duty to reduce the risk of

harm (UNICEF, 1989). Despite a shared aim, care systems can differ dramatically and there is no internationally accepted standard definition of care systems to allow for direct international statistical comparison (Herczog et al., 2021).

In Scotland, and the rest of the United Kingdom, a Child Protection Register (CPR) is a confidential list of children (aged under 18) in a local authority area who have been identified as having suffered or is at risk of significant harm and are subject to a Child Protection Plan to protect and support them (Scottish Government, 2021). A child remains on the register until their risk of harm is sufficiently reduced that a Child

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Protection Plan is no longer required. If the child migrates to another local authority and remains at risk of harm they will be de-registered and may then receive a new CPR registration in the new local authority (Scottish Government, 2021). The most common reasons cited for children being added to the CPR in Scotland include concerns about the risk of harm due to domestic abuse, neglect, parental mental health problems or parental substance abuse (Scottish Government, 2022). There were 2050 child protection registrations across Scotland in 2022, with a rate of 22 per 10,000 children aged 0–15 years (Scottish Government, 2023a). The constituent parts of the United Kingdom operate under different legislative frameworks for reporting child protection statistics, making direct comparison difficult. As such, rates across the UK vary – in 2022 the rates per 10,000 children were 42 in England, 47 in Wales and 53 in Northern Ireland (Scottish Government, 2023a). Children appearing on the Child Protection Register may be subject to a range of child protection interventions or proceedings, such as being 'looked after' (i.e. where the local authority is responsible for their care) or cared for in kinship and other care setting, including their parental home (Scottish Government, 2021).

Epidemiological studies exploring mental health in children identified as being at risk of harm and with an intervention are relatively rare. Among the scarce evidence we do have, is a review and meta-analysis of 8 European and US studies (Bronsard et al., 2016) measuring the prevalence of a range of mental health disorders in children involved with child welfare (more broadly defined than, but inclusive of children on the child protection register) had heterogenous findings. Among Bronsard et al.'s (2016) findings were prevalence estimates of depressive disorders ranging between 3% and 38%, and estimates for ADHD ranging between 2% and 21%. Other research found that almost half of children with experience of child welfare services had clinically significant emotional or behavioural problems, as well as an increased likelihood of receiving mental health care (Burns et al., 2004). Another study found an increased risk of receiving a psychotropic prescription, hospital admission or emergency presentation for self-harm compared to children without interaction with social services (McKenna et al., 2023). A review of the use of linked administrative children's social care data in research found no previously published studies specifically exploring the mental health service use of children with a child protection registration in the United Kingdom (Allnatt et al., 2022), although there has been record linkage to self-reported measures (Zhang et al., 2020) and some international research (Green et al., 2020).

To better understand the mental health service use and needs of children with a CPR registration, and to begin to design appropriate services or effective policy interventions to reduce harm, it is essential to accurately quantify the risk of mental health service use compared with the general population. We have demonstrated a reproducible approach to describe mental health service use in children at risk of significant harm and who were involved with child protection professionals. We linked information about children on the Aberdeen City Council Child Protection Register to their electronic health records, specifically for specialist outpatient child and adolescent mental health services (CAMHS) referrals and community mental health prescribing. We have the benefit of access to records for the total population living in the NHS Grampian health board (for health records) and in Aberdeen City Council (for CPR registrations) during the study period, which allows for direct comparison between children with a CPR registration and the general population.

2. Materials and methods

2.1. Study design

This is a population-based data linkage study.

2.2. Setting

The setting for our research is the Aberdeen City Council Local Authority area, located in the North East of Scotland. The 32 Scottish Local Authorities are the primary political and administrative units of local government. The 220,000 population of Aberdeen City Council area reside mostly in the City's urban settlement, with a small number of surrounding suburban towns and villages. In 2021, 18% (40,000) of the population of Aberdeen City Council was aged 17 years or under. Relative to the rest of Scotland, Aberdeen City is more affluent. By datazone small area geography, only 10% of the local authority is classified as being an area in the 20% most deprived in Scotland, which is a lower proportion than other mostly urban local authorities such as Edinburgh City (12%), Falkirk (16%), Dundee City (38%) and Glasgow City (44%) (Scottish Government, 2020a).

Aberdeen City Council is one of three local authorities which constitute the larger NHS Grampian health board area. For operational purposes, the NHS in Scotland is divided into 14 territorial health boards from which services are delivered. Aberdeenshire and Moray local authority areas had a combined population of 359,000 in 2021, of which 20% were aged 17 years or under (72,000). Most of the population in these areas reside in small towns, and there is a far smaller proportion of areas classed as in the 20% most deprived in Scotland (Aberdeenshire – 3% of datazones, Moray – 3%) (Scottish Government, 2020a).

2.3. Data sources

The Child Protection Register records a list of all children living in the area who are formally recognised as being at risk of significant harm and in need of intervention (Aberdeen City Council, 2022). We have access to the CPR for children resident in the Aberdeen City Council local authority area. The CPR is maintained and administered by social work professionals who enter details about the child and information related to their registration. Electronic health records are available for all children resident in the NHS Grampian region, made up of Aberdeen City, Aberdeenshire and Moray local authority areas. Child and Adolescent Mental Health Services (CAMHS) referral data is an NHS Grampian dataset used primarily to report official waiting list statistics nationally (NHS Grampian, 2022a). The Prescribing Information System (PIS) provides records for all medicines prescribed or dispensed outside of hospitals (NHS Grampian, 2022b). Rates have been calculated for outcomes using official mid-year population estimates for the NHS Grampian and Aberdeen City Council regions (National Records of Scotland, 2022).

2.4. Study population

The overall study population consisted of all children living in the NHS Grampian health board region, aged 0–17 years between the January 1, 2012 and December 31, 2022. Our study population was further split into two groups, 1) the primary group of interest, children who appeared with a CPR registration and 2) a comparator group, the general population.

1) **Children with a CPR registration:** individuals with a CPR registration start date in the Aberdeen City Council region between January 1, 2012 and December 31, 2022.
2) **General Population:** individuals aged between 0 and 17 years of age resident in NHS Grampian between January 1, 2012 and December 31, 2022, excluding those in 1).

Children with a CPR registration had no age-based inclusion criteria as many registrations occur before birth and are not made for individuals aged over 17. Any date of registration with a CPR registration within the study period was used to identify children with a CPR registration, regardless of whether any mental health outcome occurred

before, during or after the period of registration. The general population comparator group includes children resident in all 3 Local Authorities which constitute the NHS Grampian region, but not those children who had a registration on the CPR in Aberdeen City. We chose to include outcomes for the whole NHS Grampian region to ensure the highest level of accuracy in calculating outcome rates. Fig. 1 provides a representation of the overlap of these two populations, where children with a CPR registration are residents in the Aberdeen City Local Authority region, which is in turn part of the wider NHS Grampian region.

2.5. Data linkage

The lack of a common unique identifier across the CPR and electronic health records required us to conduct a deterministic record linkage using the Community Health Index (Public Health Scotland, 2022) population register as a reference dataset. Full details of the record linkage process and results are provided in Appendix A, section 1. To summarise, records were matched based on a sequential process of 'high quality' or 'lower quality' combinations of matching criteria, i.e. first name, surname, date of birth and postcode. We demonstrate a reproducible and repeatable method of linkage between administrative social work and healthcare datasets where a common unique identifier is absent.

Data linkage and management were conducted by Grampian Data Safe Haven (DaSH) (O'Sullivan and Wilde, 2023) staff on a secure server using accredited procedures to collect, link and pseudonymise patient-level records. Access to de-identified records was allowed through the Trusted Research Environment (TRE) for only named and approved researchers and outputs in the form of aggregate summary data, tables or figures were subject to disclosure control procedures to reduce the risk of identifiable information being shared.

2.6. Variables

2.6.1. Exposure and outcomes

The exposure of interest was a binary indicator of whether an individual had received a new CPR registration (or not) during the study period (January 1, 2012–December 31, 2022).

The outcomes measured in our study are indicators of mental health service use, which included recorded referrals to specialist outpatient Child and Adolescent Mental Health Services (CAMHS) and prescriptions of a medication used to treat mental health disorders or neurodevelopmental conditions during the study period.
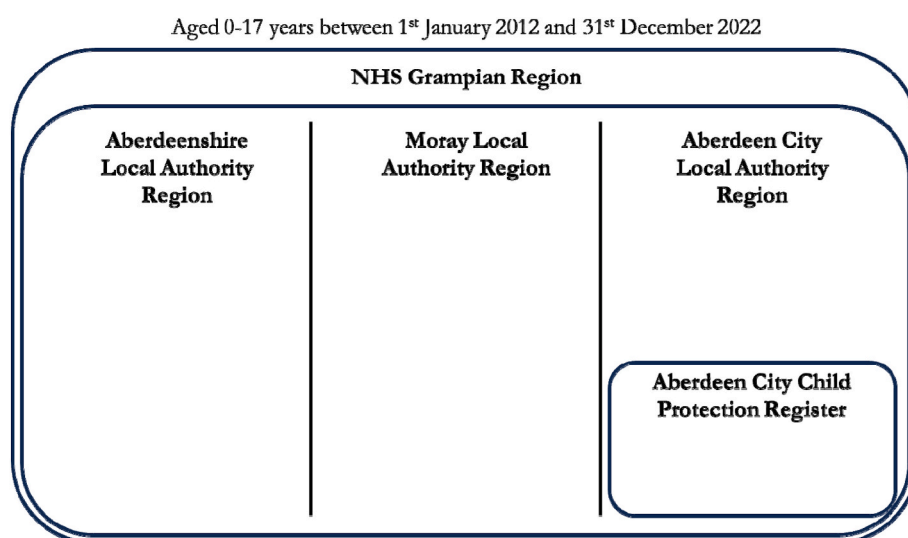
In general usage, CAMHS describes a collection of mental health support services provided to children. The referral records available to us relate only to specialist outpatient CAMHS, which is a service for children and young people with more severe, complex and persistent disorders, including neurodevelopmental conditions such as Attention Deficit Hyperactivity Disorder (ADHD) (Scottish Government, 2020b). Date of referral within the study period was used to identify individuals with this outcome.

Mental health-related prescriptions have been identified by the British National Formulary (BNF) item code recorded in PIS, or by item name where no item code was available. Medications in the following BNF sections have been included: 4.1) Hypnotics and Anxiolytics, 4.2) Drugs used in psychoses and related disorders, 4.3) Antidepressant drugs, 4.4) Central nervous system stimulants and drugs used for ADHD, and 4.10) Drugs used in substance dependence (Joint Formulary Committee, 2022). These classes of medication align with the classification of mental health medications applied elsewhere (Public Health Scotland, 2021; Ball et al., 2023). A full list of included medications can be found in Appendix A, Table S1. Prescribing outcomes have been measured for all classes combined as well as for treatments of ADHD (4.4) and antidepressants (4.3) separately.

2.7. Statistical methods

We described the social and demographic characteristics of the entire population with a CPR registration, including summaries of age, sex, length of time on the register over the entire study and by year. We calculated annual mean length of time (in days) spent on the register based on registration and de-registration dates. Length of time is calculated overall and by year of registration. We have described the prevalence of mental health service use among children with a CPR registration, as measured by our proxy prescribing and referral outcomes.

We calculated age- and sex-specific incidence rates of mental health service use for both Children with a CPR registration and the General Population. Year of age, at the time of outcome, has been grouped into four categories (0–4 years, 5–9, 10–14 and 15–17) and binary sex (M/F) has been derived from health records. Incidence of these outcomes was determined based on the first prescription or referral for an individual, after which point, they were no longer considered to be 'at risk' for the relevant outcome. Numerators for incidence rates therefore count the number of new prescriptions for individuals at-risk in a given age group or sex category – i.e., only the first prescription (overall and by class) or

Aged 0-17 years between 1st January 2012 and 31st December 2022

NHS Grampian Region

Aberdeenshire Local Authority Region	Moray Local Authority Region	Aberdeen City Local Authority Region
		Aberdeen City Child Protection Register

Fig. 1. A representation of the geographical overlap of the study population definition and sub-groups, 1) children on the child protection register in Aberdeen City Local Authority Region and 2) the general population in NHS Grampian region with no registration.

referral for an individual is ever counted, after which point they were no longer 'at risk'.

Denominators for incidence rate were per 1000 person-years and the population 'at risk' in each age-/sex-category has been determined from annual mid-year population statistics (National Records of Scotland, 2022), excluding counts of children with a CPR registration in the relevant categories. Denominators for children with a CPR registration were calculated from the total number of children in this group who were 'at risk' in the relevant age- and sex-categories (Vandenbroucke and Pearce, 2012). We have also calculated Incidence Rate Ratios (IRRs) and 95% Confidence Intervals (CIs) to compare age- and sex-specific incidence rates between children with a CPR registration and the general population (Rothman et al., 2008).

2.8. Data availability

All analysis was carried out in the Grampian Data Safe Haven (project ID: DaSH520) on pseudonymised individual-level data. As per the Scottish Safe Haven Charter, only aggregate data can be released from the Grampian Data Safe Haven for publication, but all individual-level data will be archived for 5 years on project completion and may be accessed by application to the Grampian Data Safe Haven (email dash {at}abdn.ac.uk) on condition that appropriate project approvals are secured. Following the archiving period, this data will be deleted.

Data analysis and figure generation were conducted using R (version 4.2.1) in RStudio (version 2023.06.2 build 561). Summary data which could be released from the trusted research environment as well as analysis and visualisation code are available in the project GitHub repository (URL: https://github.com/will-ball/NDL3_Child_Protection/https://doi.org/10.5281/zenodo.10245708).

3. Results

3.1. Child protection register

3.1.1. Overview

During the study period, 1498 individual children received 1719 total new registrations, with an annual mean of 170 individuals and 171 registrations. 20% of all registrations (n = 351) were for children before their date of birth. For registrations following birth, the median age at registration was 3 years of age (IQR 2–4 years). The median length of time on the register was 185 days (IQR 98–282).

3.1.2. Linkage to health records

Full results from the record linkage process are detailed in Appendix A, Section 1. Of the 1498 individuals identified with a CPR registration, 31% (n = 469) could not be matched to their health records. Children with a CPR registration who were not matched had a median age at registration of 0 years (vs. 3 years for those matched) and a higher proportion of their registrations were pre-birth (34% unmatched vs. 18% matched).

3.2. Mental health service use

Of the 1029 Children with a CPR registration who were matched to health records, during the study period, 1 in 7 (n = 152) received a mental health prescription (Table 1). 1 in 14 (n = 76) were prescribed a medicine used to treat ADHD and 1 in 41 (n = 25) were prescribed a medicine to treat depression. 1 in 4 (n = 283) received a specialist outpatient CAMHS referral. 31% (n = 320) of children with a CPR registration had a recorded referral to specialist outpatient CAMHS or any class of mental health prescription, with 18% (n = 183) receiving only a referral and 8% (n = 83) having both a referral and prescription.

Annual counts and proportions of these outcomes, by year of first CPR registration, were higher for those with a registration in the first half of the study period (Table 1) due to age at registration. Children registered in the early part of the study period were in the cohort longer and had more years to have an outcome. The prevalence of ADHD prescription was low in the latter half of the study period and all but 3 years had less than 5 antidepressant prescriptions. Children with a CPR registration in the first year of the study period (2012) had the highest prevalence of mental health prescription (15%), antidepressant prescription (4%) and CAMHS referral (27%).

3.3. Age- and sex-specific incidence rates and Incidence Rate Ratios

Fig. 2 shows incidence rates per 1000 person-years for mental health outcomes by sex and age group (for age at outcome) for Children with a CPR registration and General Population. Fig. 3 shows Incidence Rate Ratios comparing between Children with a CPR registration and the General Population. Incidence rates for categories with fewer than 5 outcomes in total over the study period have not been reported for disclosure purposes.
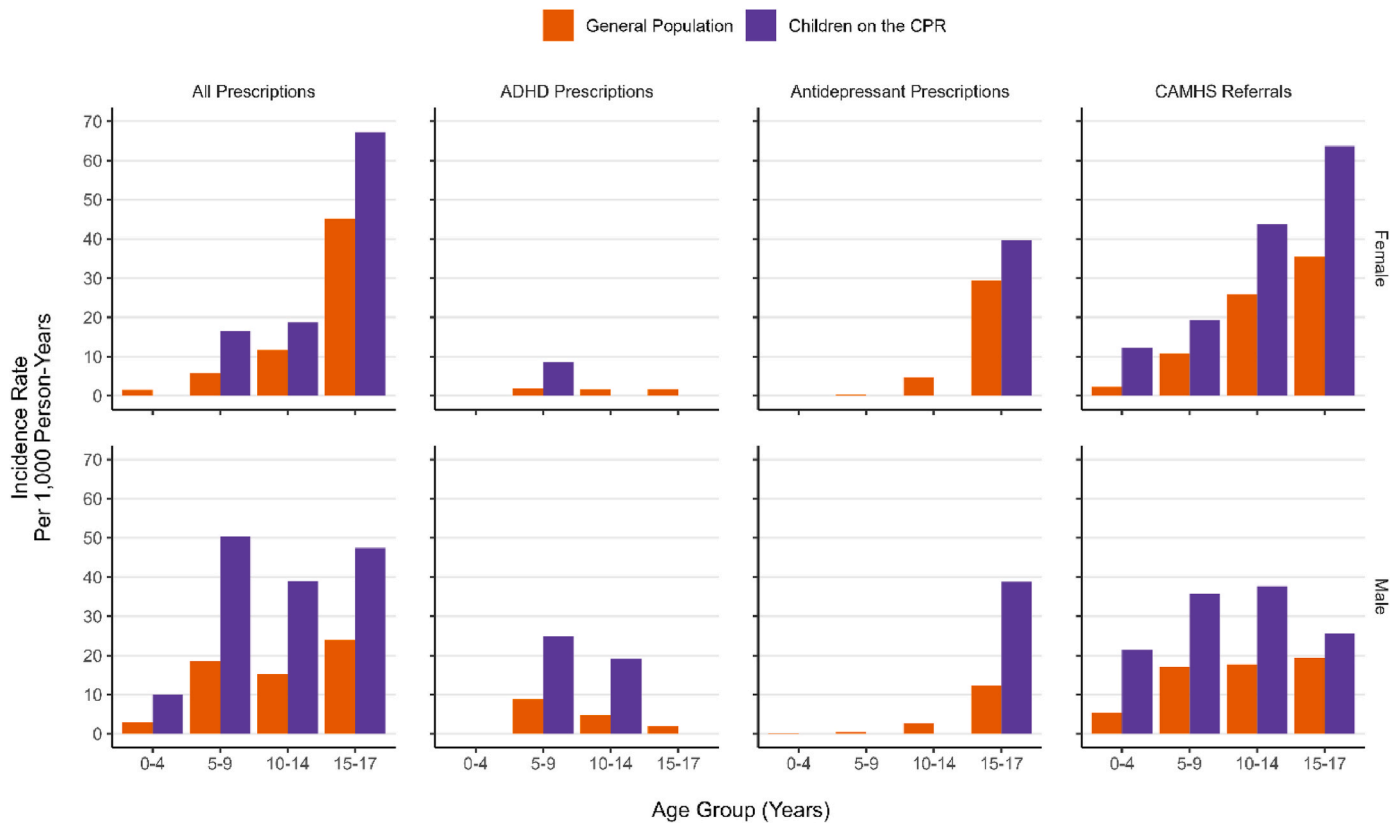
Incidence rates for any mental health prescription increased with age and were higher in males than females, apart from in the oldest age group. The highest incidence rate was for girls aged 15–17 with a CPR registration (IR: 67.3 prescriptions per 1000 person-years). For both males and females and at each age group, incidence rates for any prescription were higher in children with a CPR registration. The largest absolute difference was among boys aged 5–9 years with a CPR registration, who had an additional 31.8 prescriptions per 1000 person-years (Fig. 2). The largest relative difference was among boys aged 0–4 years, whose rate of prescription for Children with a CPR registration was 3.3 times higher than the General Population (95% CI: 1.5–6.4) (Fig. 3).

Where it has been possible to report incidence rates for ADHD prescriptions, they were highest in males aged 5–9 (IR: 24.9 ADHD

Table 1
Prevalence of mental health prescribing (overall and by class) and CAMHS referral for Children with a CPR registration, by year of first registration. Note: counts of less than 5 cannot be reported due to potential disclosure risk.

Year	Individuals	Prescribing						Referrals	
		Any Mental Health Prescription	Prescription (%)	ADHD Prescriptions	ADHD (%)	Antidepressant Prescriptions	Antidepressant (%)	CAMHS Referrals	Referral (%)
2012	146	22	15.1	10	6.8	6	4.1	40	27.4
2013	174	23	13.2	18	10.3	<5	–	38	21.8
2014	152	16	10.5	6	3.9	5	3.3	33	21.7
2015	146	15	10.3	8	5.5	<5	–	22	15.1
2016	169	21	12.4	13	7.7	5	3	28	16.6
2017	155	7	4.5	<5	–	<5	–	20	12.9
2018	134	10	7.5	6	4.5	<5	–	19	14.2
2019	182	14	7.7	8	4.4	<5	–	22	12.1
2020	158	6	3.8	<5	–	<5	–	16	10.1
2021	130	8	6.2	<5	–	<5	–	13	10
2022	157	10	6.4	<5	–	<5	–	16	10.2
Total	1029	152	14.8	76	7.4	25	2.4	283	27.5

Fig. 2. Incidence rates per 1000 person-years for measures of mental health service use, by age group, sex and for children with a CPR registration and the general population. Source: NHS Grampian, Aberdeen City Council.

prescriptions per 1000 person-years) with a CPR registration. Rates were higher among Children with a CPR registration than the General Population within each age and sex category. The largest absolute difference was among males aged 5–9 years with a CPR registration, who had an additional 16 ADHD prescriptions per 1000 person-years (Fig. 2). The largest relative difference was among girls aged 5–9 years, whose rate for Children with a CPR registration was 4.5 times higher than the General Population (95% CI: 2.1–8.4) (Fig. 3).

Reporting of incidence rates for antidepressant prescriptions has been limited to those aged 15–17 years only for Children with a CPR registration. Among all rates reported, incidence increased with age group and was highest for girls aged 15–17 years with a CPR registration (IR: 39.7 antidepressant prescriptions per 1000 person-years). The largest absolute difference was among males aged 15–17 years with a CPR registration, who had an additional 26.4 antidepressant prescriptions per 1000 person-years (Fig. 2). The largest relative difference was among boys aged 15–17 years, whose rate for Children with a CPR registration was 3.1 times higher than the General Population (95% CI: 1.0–7.3) (Fig. 3).

Incidence rates for CAMHS referrals were highest among girls aged 15–17 years with a CPR registration (IR: 63.7 referrals per 1000 person-years). For girls, both with a CPR registration and in the General Population, the incidence of referral increased with age. However, for boys with a CPR registration, the peak incidence rate was age 10–14 years. At each age group and for both boys and girls, Children with a CPR registration had higher incidence rates than the General Population. The largest absolute difference was among girls aged 15–17 years with a CPR registration, who had an additional 28.3 referrals per 1000 person-years (Fig. 2). The largest relative difference was among girls aged 0–4 years, whose rate for Children with a CPR registration was 5.4 times higher than the General Population (95% CI: 2.9–9.1) (Fig. 3).

4. Discussion

4.1. Principle findings

Children at risk of significant harm who also experience social work intervention were at increased risk of mental health service use during childhood and adolescence. We found that children with a CPR registration had higher absolute incidence rates of mental health service use than the general population. This was observed in each of our measures of mental health disorder, for both males and females and in each age group up to the age of 17 years. The absolute difference in incidence rates across all measures was between 6.1 and 31.8 additional outcomes per 1000 person-years for children with a CPR registration. The relative difference in incidence rates was between 1.2 and 5.4 times higher for children with a CPR registration than the general population.

4.2. Strengths and limitations

4.2.1. Strengths

Our study benefits from total population coverage of health and CHI records for the NHS Grampian region and in the Aberdeen City Council area for the CPR. CAMHS referral data are recorded as part of a statutory requirement for reporting national statistics on patient waiting list times. PIS is the definitive source of information relating to prescriptions dispensed or prescribed in the community. Individual-level linkage of these data sources, including by matching CHI identifiers to the CPR, adds value to these high-quality administrative data sources. For instance, contextual information such as a history of social work involvement is missing from health records. This work reveals trends which were not visible in each dataset alone and which are not available in publicly published aggregate statistics.

To our knowledge, this is the first linkage of its kind in Scotland and
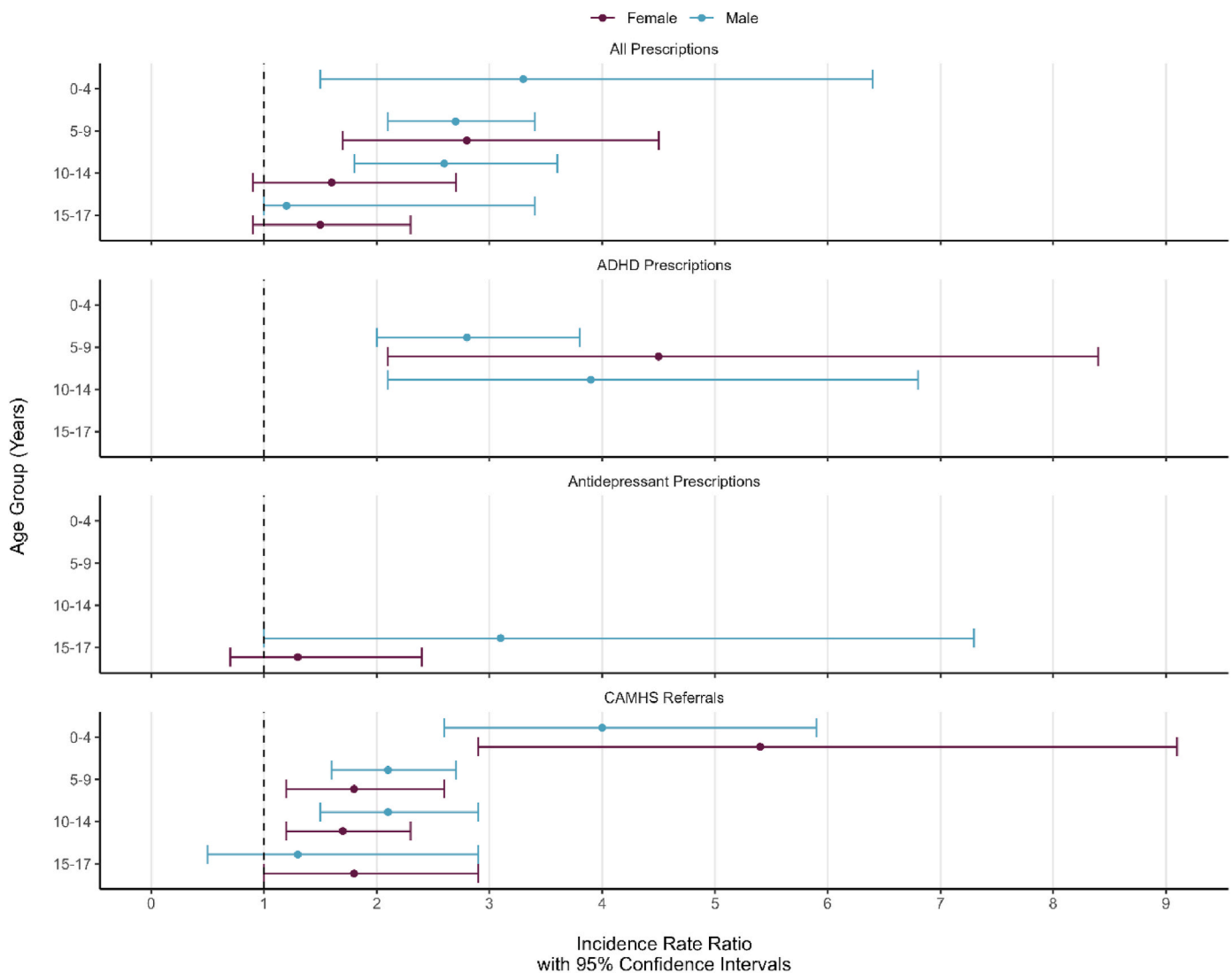
Fig. 3. Incidence Rate Ratios for mental health service use measures, comparing Children with a CPR registration and the General Population, by age group and sex. Source: NHS Grampian and Aberdeen City Council.

the UK, providing previously unknown information but also highlighting challenges that may be addressed in future linkage efforts. We have demonstrated a reproducible method of record linkage between social work and health data which can be repeated elsewhere or built upon to achieve national coverage. Finally, this research has been informed at all stages of the research and publication process by extensive Public and Patient Inclusion and Engagement activities, including topic selection, methods development and interpretation of results, as outlined in Appendix A, Table S2.

4.2.2. Limitations

The main limitation of this study is the lack of a common identifier in the data sources which required a deterministic linkage approach to link the Child Protection Register Population to their health records. Although a majority of matched records were deemed high quality (i.e. based on matches in forename, surname and date of birth with or without address), almost one-third of children on the register could not be matched to their health records. Given observed differences between matched and unmatched individuals it is likely that the probability of linkage varies between some population subgroups, which may lead to selection bias influencing observed rates of outcomes. If children with a CPR registration who were not matched to health records later had an outcome in the data, it would have been recorded in the General

Population counts/rates. This would result in an underestimation of the difference between the groups.

Another source of potential underestimation is the non-identification (in this data) of children with a CPR registration from outside of Aberdeen City, including residents in the rest of the NHS Grampian Health Board. We chose to include residents of Aberdeenshire and Moray Local Authorities in the General Population comparison group mainly to ensure greater accuracy in calculating outcome rates. Our measured outcomes are relatively rare in this young population and including a larger population at risk results in capturing a larger number of outcomes. However, this does risk misclassification bias due to migration – children who receive a CPR registration in Aberdeenshire or Moray, but later move to Aberdeen City and have a prescription or referral will contribute to the general population rates. Equally though, because we include outcome records for residents outside of Aberdeen City, we are also able to record outcomes which would otherwise be missed for children who migrate outwards. Annual counts of children on the CPR in Aberdeenshire and Moray from the study period suggest there are up to around 1500 children who may have been misclassified as part of the general population (Scottish Government, 2024). We consider that the risk of misclassification bias is likely to have a small effect on our calculated rates and that any bias will lead to an underestimate of the difference between children with a CPR registration and the General

Population.

Our estimation of mental health disorder prevalence is limited by the measures available to us. Prescribing and specialist outpatient CAMHS referral data are both administrative sources and do not necessarily reflect clinical need/severity (in the case of referral) or the clinical indication (for prescription). Although the British National Formulary (BNF) groups together medications which are intended to be used for similar purposes, some are applicable to treat multiple conditions or can be prescribed 'off license' (intended to treat another condition).

Our descriptive research is limited to a single, relatively affluent geographical area and may not be generalisable to the wider population. Rates of children with a CPR registration and mental health service use vary throughout Scotland and the wider UK.

The Child Protection Register provides a measure of children who have been identified as having suffered or are at risk of significant harm, however trajectories through various social work, care and child protection systems are often complex. We are unable to fully capture that complexity and investigate wider impacts on mental health in this work as we do not have access to all sources of social work data.

4.3. How does it compare with other work?

Variability in the organisation of child protective systems around the world makes direct comparison to the findings of this work somewhat difficult. However, there is an established literature exploring the mental health outcomes of children who had some form of contact with state-run social care/welfare services. This ranges from instances where children had been referred for suspected maltreatment, to being placed in foster or residential care away from their biological parents.

Research from Australia using linked administrative records found an increased prevalence (20% vs 3.6%) of mental health disorder diagnoses among children with substantiated child maltreatment allegations (roughly equivalent to our studied population) compared to the general population (O'Hare et al., 2023). In regression analysis including adjustment for potential confounders, they found that the risk of a mental health event was 2–3 times higher for children with substantiated maltreatment allegations. Additional research also found that children with unsubstantiated claims (i.e. not meeting the threshold for intervention - equivalent to being referred to social work but not requiring a CPR registration) were also at increased risk of poor mental health during childhood (O'Hare et al., 2023).

Despite this variability in the populations being studied, there is a concordance among the international literature to find that children with a history of involvement with child protective services have a higher prevalence of mental health disorders or mental health service use than the general population (Bronsard et al., 2016; Kääriälä et al., 2022; Mills et al., 2013; Seker et al., 2022). Greater involvement (i.e. a higher level of intervention severity) with child protective services has been associated with a higher prevalence of mental health disorders (O'Hare et al., 2023), although all levels of involvement had higher prevalence than the general population. The general pattern aligns well with our finding of a higher risk of receiving a mental health prescription or specialist outpatient referral for children with a CPR registration in this study. A Norwegian study exploring the prevalence of mental health disorders and ADHD in children in child welfare found that both were higher than the general population (Nilsen et al., 2021), which appears to complement our findings related to outpatient referrals and classes of medication. Much of the evidence described above relies on self-reported measures of mental health disorders, but studies using outcomes related to health service use or prescribing as measures of mental health disorders also exist.

Previous results from an examination of prescribing and referrals for all children in the NHS Grampian region (Ball et al., 2023) reinforce our finding that children with a CPR registration have a greater risk of mental health disorders. Ball et al. (2023) estimated a lower prevalence of mental health prescriptions (8.2%) and referrals to specialist outpatient CAMHS (15%) for all children in the same region than we found for children with a CPR registration (prescriptions – 14.8%, referrals – 27.5%). They also found rates of prescribing and referral generally increasing with age, but clear gender-based differences, with older girls receiving more treatment for depression and younger boys receiving more treatment for ADHD. The trends described above are replicated in this study for children with a CPR registration but with higher incidence rates than the general population. Other work has also found that prescribing of psychotropic medications in youth experiencing child welfare/protective services is higher overall, although there is variation based on the frequency of medication use (Leslie et al., 2010) and by state in the United States of America (Rubin et al., 2012).

Although not tested in this study, other research has found higher rates of mental health-related hospitalisation (Leckning et al., 2023) and emergency department attendance (MacDonald et al., 2022). A Scottish study of 'Looked After Children' found increased rates of ADHD, depression and self-harm (Fleming et al., 2021). In Scotland, a child is 'Looked After' once they are legally under the care of their Local Authority. This generally includes being placed into foster or residential care but may also include staying at home (with regular social work contact). Looked After Children are taken into care for many of the same reasons that children appear on the Child Protection Register, but the populations will differ as not all children with a CPR registration will become Looked After. Children may also be removed from the Child Protection Register once they become Looked After and enter care, as their risk of harm may then be sufficiently reduced.

4.4. Unanswered questions and future work

Future research should calculate the incidence and prevalence of poor mental health in this population using self-reported measures such as the Strengths and Difficulties Questionnaire (SDQ) (Goodman, 1997) or the Warwick-Edinburgh Mental Well-being Scale (WEMWBS) (Clarke et al., 2011) to compare with patterns in healthcare-related indicators of mental health disorder. As indicators of service use, the proxy measures in this work may not reflect the true need for mental health support. Additional individual-level epidemiological studies, supported by data linkage, can help to assess whether patterns of higher risk of mental health service use are due to increased need or increased recognition of need in this population. This work can inform policy aimed at reducing exposure to harm in childhood and around service prioritisation for this population.

This research looked at 10 years of CPR registrations and associated health records. Due to the young age at which children are commonly added to the CPR and the length of our study period, the youngest in the cohort have less opportunity to have an outcome of interest, which is problematic as mental health service use is rare in younger aged children. Future work should explore longer-term outcomes for children listed with a CPR registration.

This work was able to link individuals on a single CPR from Aberdeen City Council to health records. Future work might look to replicate the methods used in this study in other regions, which can provide epidemiological evidence to inform both local and national policy decision-making. In addition, expanding the geographical scope of this project should be considered to address methodological limitations. Migration can lead to misclassification as relocation between local authority areas whilst appearing on a CPR is a trigger for de-registration and children moving into the area may have had a preceding CPR registration elsewhere that is not recognised in the local data.

To aid future research in this area, the common identifier for health records should be included in the Child Protection Register and other social work data as standard to enable exact matching approaches to data linkage. This will avoid the requirement for probabilistic or deterministic record linkage approaches likely to result in incomplete linkages, leading to the underestimation of outcome incidence rates. Relying on non-exact record linkage may also introduce selection bias

into any causal analysis as the likelihood of linkage in population sub-groups may vary (Harron et al., 2017). In addition, the CHI seeding of these data sources will allow for improved integration between health and social services.

Future research which integrates health and social care data sources and professional expertise can build on the methods used here to further investigate longitudinal effects of Child Protection interventions or access to mental health services, among other topics which can more directly inform operational decision-making and policy at a variety of levels.

5. Conclusions

We demonstrated that children with a CPR registration are at increased risk of mental health service use in each age group during childhood and for both sexes. We recommend enhanced and targeted support for mental health for children with a CPR registration throughout childhood. Current guidance around child protective services in Scotland (Scottish Government, 2023b) highlights the need for involvement of mental health services in the treatment of mental health disorders among children with an active CPR registration, but does not practically address the ongoing increased risk throughout childhood and adolescence. Future research should prioritise work which can inform appropriate clinical service design to support this population or wider policy interventions to reduce exposure to risk of harm and prevent longer-term mental health service use.

We have also demonstrated a reproducible and repeatable method of record linkage between administrative social work data and health records for research and we have identified limitations in a deterministic matching approach which can be addressed in future similar efforts. To avoid introducing selection or other sources of bias into future research, and to provide an integrated approach to caring for children at risk of significant harm, a common unique identifier should be included in both data sources and national coverage should be prioritised.

5.1. Public Involvement

A detailed summary of the Patient and Public Involvement and Engagement (PPIE) activities conducted in relation to this work to date can be found in a GRIPP-2 reporting tool in the supplementary materials (Table S2). In short, PPIE activities have influenced the design and conduct of this study in a range of ways. Review of lay summaries of the project for data access and ethical approval applications improved readability and comprehension. Discussions with both the ACHDS PPIE group and the group of professionals have confirmed the importance of the topic, particularly the need for greater integration of a variety of data sources. Their insights have also shaped the research questions asked and the types of methods applied to answer those questions. Discussions with both groups have informed our description of data management, particularly concerning data protection, in outputs associated with this project. Their insights have also informed the acknowledged limitations of this study.

Ethical approval statement

This project was approved by the North Node Privacy Advisory Committee (NNPAC) (project ID: 6/105/22). NNPAC provides researchers with streamlined access to NHS Grampian data for research purposes and committee approval incorporates approvals from: the project sponsor, institutional ethics committee, the local Caldicott Guardian, and NHS Research & Development. It was not practicable to obtain informed consent from individual patients for this research which uses electronic patient records. Use of this pseudonymised unconsented patient information received ethical approval from the North Node Privacy Advisory Committee as detailed above. All research methods using human data were performed in accordance with the Declaration of Helsinki.

CRediT authorship contribution statement

William P. Ball: Writing – review & editing, Writing – original draft, Visualization, Validation, Software, Methodology, Investigation, Formal analysis, Data curation, Conceptualization. **Caroline Anderson:** Writing – review & editing, Supervision, Resources, Data curation, Conceptualization. **Corri Black:** Writing – review & editing, Supervision, Project administration, Methodology, Funding acquisition, Conceptualization. **Sharon Gordon:** Writing – review & editing, Project administration, Funding acquisition, Conceptualization. **Michael Lackenby:** Writing – review & editing, Data curation. **Martin Murchie:** Writing – review & editing, Supervision, Resources, Data curation, Conceptualization. **Bārbala Ostrovska:** Writing – review & editing, Conceptualization. **Katherine O'Sullivan:** Writing – review & editing, Resources, Data curation, Conceptualization. **Helen Rowlands:** Writing – review & editing, Data curation, Conceptualization. **Magdalena Rzewuska Díaz:** Writing – review & editing, Conceptualization. **Jessica E. Butler:** Writing – review & editing, Visualization, Validation, Supervision, Software, Project administration, Methodology, Investigation, Funding acquisition, Formal analysis, Data curation, Conceptualization.

Declaration of competing interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

Data availability

Authors cannot share raw data, but it is available subject to application to Grampian DaSH. Summary data and code is available via a link in the paper

Appendix A. Supplementary data

Supplementary data to this article can be found online at https://doi.org/10.1016/j.socscimed.2024.117057.

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Appendix A. Supplementary Materials

1. **Record Linkage of the Aberdeen City Council Child Protection Register and Community Health Index in NHS Grampian**

Background

This document details the methods and results of a record linkage project designed to match electronic health records held by NHS Grampian (NHS Grampian, 2022b, 2022a) to individuals on the Child Protection Register (CPR) held by Aberdeen City Council (Aberdeen City Council, 2022). This project supports an epidemiological analysis of mental health service use among children at risk of serious harm. The Child Protection Register is not ordinarily seeded with Community Health Index number (Public Health Scotland, 2022), the gold standard identifier used in health records, which makes exact record linkage impossible. In order to link these records at an individual level, analysts based in the Grampian Data Safe Haven (DaSH) (O'Sullivan and Wilde, 2023) conducted deterministic record linkage.

Methods

The matching took place in a sequential process, attempting to match on different criteria. There were 12 match types or 'blocks' in total, with 4 considered 'high quality', and 8 of 'lower quality' (Table 1). Those with single incidence 'high quality' matches in the first 4 blocks were excluded from further matching attempts. The matches were scored, and a score threshold determined for inclusion from the lower quality matches. These methods were based on an approach published elsewhere (Padmanabhan et al., 2019).

Table 1. CHI matching criteria for automated deterministic record linkage. Note: Unless otherwise indicated (e.g. blocks 9 and 10) all searches were against the NHS Grampian CHI register from 2021

Quality	Block	Family Name		Forename	Date of Birth	Postcode
		Current	Previous			
High	1	X		X	X	X
High	2		X	X	X	X
High	3	X		X	X	
High	4		X	X	X	
Lower	5			X	X	
Lower	6	X			X	
Lower	7	X			X	
Lower	8				X	X
Lower	9				X	X
Lower	10				X	X
Lower	11				X	
Lower	12	Split Names	Split Names	Split Names		

The Aberdeen City Council CPR extract included all registrations which started or ended between the 1st January 2012 and the 31st December 2022. This included registrations with a registration date before the

start of the study period but an end date after. For the purposes of the main analysis in this project, these individuals were excluded from the study.

Results

A total of 1,560 individuals were identified in the Aberdeen City Council CPR extract, of which 1,077 (69%) were able to be matched to a CHI number. Table 2 shows the count and proportion of matched records at each sequential block. 61.1% (n = 954) of all CPR records were matched in the first 4 high quality blocks, which accounts for 88.5% of all matched records. Based on date of registration, 1,498 individuals met the inclusion criteria for the main analysis.

Table 2. Deterministic Record Linkage Results by block number. Source: Grampian Data Safe Haven (DaSH)

Block Number	Quality	Count	Proportion
1	High	362	23.2%
2	High	28	1.8%
3	High	487	31.2%
4	High	77	4.9%
5	Lower	26	1.7%
6	Lower	83	5.3%
7	Lower	7	0.4%
8 - 12	Lower	7	0.4%
Unmatched		483	31.0%
Total		1,560	100.0%

Discussion

Following a deterministic record linkage process allowed us to match most children with a CPR registration to their electronic health records using the Community Health Index. A more tailored approach with manual interpretation of likely matches may have yielded a higher proportion, but there is a need to balance the competing aims of precision and timely use of resources. Factors which may improve success in future record linkage efforts in this population include the availability of additional demographic information and/or additional reference datasets (e.g. multiple CHI register versions at different time points, including with additional geographic coverage).

Aside from probabilistic or deterministic record linkage approaches using identifying information, including the Community Health Index number in Aberdeen City Council datasets would allow for exact matching approaches in future.

Table S1. List of mental health medications by British National Formulary Section and Subsection

BNF Section Code	Section Name	BNF Subsection Code	Subsection Name	Approved Name
401	Hypnotics and Anxiolytics	40101	Hypnotics	Melatonin
				Zopiclone
				Temazepam
				Nitrazepam
				Zolpidem
				Chloral Hydrate
				Cloral Betaine
				Sodium Oxybate
		40102	Anxiolytics	Diazepam
				Lorazepam
				Buspirone Hydrochloride
402	Drugs used in psychoses and related disorders	40201	Antipsychotic drugs	Olanzapine
				Risperidone
				Aripiprazole
				Chlorpromazine Hydrochloride
				Quetiapine
				Haloperidol
				Sulpiride
				Levomepromazine
				Trifluoperazine
				Promazine Hydrochloride
				Lurasidone Hydrochloride
		40202	Antipsychotic depot injections	Aripiprazole
		40203	Drugs used for mania and hypomania	Lithium Carbonate
				Sodium Valproate
403	Antidepressant drugs	40301	Tricyclic and related antidepressant drugs	Amitriptyline
				Nortriptyline
				Clomipramine Hydrochloride
				Imipramine Hydrochloride
				Lofepramine
				Trazodone Hydrochloride
				Dosulepin Hydrochloride
		40302	Monoamine-oxidase inhibitors	Phenelzine
		40303	Selective serotonin re-uptake inhibitors	Sertraline
				Fluoxetine
				Citalopram
				Escitalopram
				Fluvoxamine Maleate
				Paroxetine

		40304	Other antidepressant drugs	Mirtazapine
				Duloxetine
				Flupentixol
				Venlafaxine
				Agomelatine
				Vortioxetine Hydrobromide
404	CNS Stimulants and drugs used for ADHD	40400	CNS Stimulants and drugs used for ADHD	Methylphenidate Hydrochloride
				Atomoxetine
				Lisdexamfetamine Dimesylate
				Dexamfetamine Sulfate
				Modafinil
				Guanfacine Hydrochloride
410	Drugs used in substance dependence	41001	Alcohol dependence	Acamprosate Calcium
		41002	Nicotine dependence	Nicotine
				Varenicline Tartrate
		41003	Opioid dependence	Methadone Hydrochloride
				Buprenorphine And Naloxone

Table S2. Patient and public involvement (PPI) in this study, described using the GRIPP 2-SF checklist (Staniszewska et al., 2017)

Section and Topic	Item
1. Aim Report the aim of the study	We wanted to look at the mental health care service use of children listed on the Aberdeen City Council Child Protection Register (CPR) (between 2012 and 2022) using healthcare administrative information on community prescriptions and referrals to outpatient Child and Adolescent Mental Health Services (CAMHS) for the wider NHS Grampian region. We followed a process which let us connect these sources of information for specific individuals. We did this in a way that meant that sensitive information would be accessed safely by researchers in a trusted research environment. Researchers could not see names, dates of birth or addresses alongside health information. We wanted to understand which types of people were listed on the child protection register and count how many mental health outcomes they had compared to people not on the register. As children on the register had differences in their age compared with those not on the register, we also calculated rates to allow for better comparisons between the groups.
2. Methods Provide a clear description of the methods used for PPI in the study	Our approach to PPI has previously been described in more detail (table S1 from Ball et al., 2022). We developed a framework based on the National Institute for Health and Care Research (NIHR) guidance, which included working alongside the funder of this work and the creation of a local PPI plan for specific activities. We involved two types of public research partners: members of the public interested in the application of data science in health and social care research, and professionals working with children experiencing vulnerability - advocates for these children's needs. We intended that public research partners would contribute to this research at all stages of project development and execution. Below we describe these activities in more detail: To maintain continuity across the research topics in this project, the Aberdeen Centre for Health Data Science (ACHDS) PPIE group was established. In addition to asynchronous email communication, as needed, we held two 90-minute online discussions. The ACHDS PPIE group includes people from the local community in the North East of Scotland from a variety of backgrounds. They have assisted in refining the focus of research questions, with the development of the project approval applications, by enhancing readability and comprehension of outputs aimed at engaging with professionals working with at-risk children, and in planning questions to be discussed. One member of the ACHDS PPIE group contributed to the review and editing of this pre-print article and has been listed as a co-author. In addition to activities undertaken with the ACHDS PPIE group (n=9), we also held two 90-minute online discussions with professionals who interact with and support young people who are vulnerable. This included social workers, people working in schools (primary and secondary) and from the third sector (i.e. charities that focus on youth work). The first meeting involved 15 professionals and centred on developing analysis plans. This discussion primarily revolved around ways in which accessing and sharing data about children at risk, along with the types of information they deemed most useful. In the second meeting, which was attended by 6 people (due to seasonal pressures), we presented our results. The purpose was sense-checking and interpretation of results and to collaboratively formulate key messages our scientific output should convey. Each group meeting had a clearly defined purpose and was facilitated by an experienced facilitator. Detailed summaries of each meeting were taken and shared with both the research team (for information) and the public research partners (for verification and more comments). Furthermore, we would convene with the analytical team to determine how each insight captured from a public research partner would be actioned. This process led to key decisions for enhancing our

Section and Topic	Item
	analytical methods, revising data presentation, evolving our interpretations, recognising limitations, and considering the research or practice implications. Research implications were either reported in the article or shared with the Aberdeen Health Determinants Research Collaboration. Practical implications were also brought to discussions within organisations of participating professionals from the local authority, serving as a critical vehicle for direct local impact.
3. Results Outcomes—Report the results of PPI in the study, including both positive and negative outcomes	Following a presentation by the analytical team of the early research questions and analysis plans, and group discussion the ACHDS PPIE group: • Highlighted the importance of understanding how children came onto the register and the context of efforts to avoid registration. • Advised that we should consider the limitations of the available (administrative) data carefully. • Stressed the importance of considering readers of research outputs who might have lived experience of interactions with social work teams or being on the child protection register. • Recommended that we clearly communicate the steps that have been taken to protect data about individuals to reassure the public that their information has been handled responsibly and ethically. Following a presentation by the analytical team of their proposed analytical plans, and group discussion, the group of professionals who support children experiencing vulnerability: • Highlighted the importance of timely and accessible sharing of information about vulnerable children. This took the form of personal experiences and opinions of information sharing/collaboration in practice between professional groups. Various real-world examples were shared of times when information sharing broke down or was less than optimal, leading to negative outcomes for children which could have been avoided. • Suggested additional sources of information that could provide a more rounded contextual overview of children experiencing vulnerability. • Raised that the Child Protection Register listed mostly younger children and that the long-term impacts of their early life experiences on their mental health may not manifest until later. • Discussed the concept of vulnerability, specifically noting that children on the child protection register are not the only ones who experience vulnerability. Following a presentation by the analytical team of the results of the analysis, and group discussion, the ACHDS PPIE group: • Advised on visual presentation to better describe the CPR population, including stating the age range (0-17 years) and breaking down the total number of registrations by age range. • Advised on ensuring clarity in the objectives and maintaining simplicity in graphics to enhance understanding. • Suggested more descriptive titles and better visuals for slides, especially when comparing incidences of outcomes across different denominations. • Discussed the importance of intergenerational trauma. • Acknowledged the importance of presentation methods in conveying messages clearly, suggesting the use of infographics and clearer titles for figures, especially for slides on prescribing ADHD and anti-depressant medications. Following a presentation by the analytical team of the results of analysis, and group discussion, the group of professionals who support children experiencing vulnerability:

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	- Confirmed that the findings reflected what they observed in their services. - Discussed how children's registration on the CPR leads to slightly quicker access to care, sparking a wider debate about recognising and intervening in mental health issues in this group, with a focus on how support is often reactive and crisis driven. ▪ Reiterated concerns about the possible over/misdiagnosis of ADHD, noting that girls with ADHD are often overlooked due to distinct presentations, and emphasising the importance of gender-sensitive approaches in diagnosis and treatment. This sparked a thought-provoking debate challenging the idea of ADHD being solely a biological condition, as evidenced in this study. - Reiterated the importance of improved trauma training for educators and professionals working with children, emphasising advocacy and support for both children and parents. - Identified specific audiences we should share the results of this study with directly. - Concluded with reflections on 'rethinking how we best wrap care around children at risk of harm', in this: reframing the mental health care framework, advocating for a more holistic care, trauma-informed approach that supports families and minimises harm to children, and calls for broader policy changes and resource allocation to address the root causes of mental health issues.
4. Discussion Outcomes—Comment on the extent to which PPI influenced the study overall. Describe positive and negative effects	To date, PPI activities have influenced the design and conduct of this study in a range of ways. Discussions with both the ACHDS PPIE group and the group of professionals have confirmed the importance of the topic, particularly the need for greater integration of a variety of data sources. Review of lay summaries of the project for data access and project approval applications has improved readability and comprehension. Their insights have also shaped the research questions asked and the types of methods applied to answer those questions. Consulting with professionals specialised in working with at-risk children played a crucial role in contextualising our analysis. Their insights primarily validated but also challenged or enhanced our interpretations, aiding us in truly understanding the meaning behind the numbers. Discussions with both groups have informed our description of data management, particularly concerning data protection, in outputs associated with this project. Their insights have also informed the acknowledged limitations of this study and implications for research and practice. Overall, we noted that an important impact of interactions with public research partners in this project was continuous encouragement for the research team to think critically, allowing for a more nuanced and comprehensive understanding. Relevant insights and recommendations from the discussions will be shared with Grampian CAMHS and Aberdeen City Council to inform service planning and training to improve support for CYP and staff involved in their care.
5. Reflections Critical perspective—Comment critically on the study, reflecting on the things that went well and those that did not, so others can learn from this experience	Involving members of the community - the ACHDS PPIE group - has been helpful and rewarding as the group has become more established and embedded in the work of this research team. They have a good familiarity with the researchers and background knowledge provided by interaction related to previous projects on similar topics. We endeavoured to involve community youth groups through the local authority. However, youth groups in the city were in the midst of re-establishing their activities reflecting the wider post-pandemic shift in engagement practices. Overall, in the absence of the possibility to involve children directly, professionals who support children experiencing vulnerability were well-placed to advocate for these children. A crucial aspect of our involvement was gaining access, facilitated by the support from the local authority, our project partner. Establishing trust and understanding the different views on PPI between academia and the local authority took time and effort, but resulted in valuable insights.