

# Networked Data Lab project 2: Children and Young People Mental Health in Liverpool and Wirral

Networked Data Lab Liverpool CCG, Wirral CCG and Wirral Council,  
and the University of Liverpool

*Authors: B. Barr, J. O'Brien, and R. Piroddi  
on behalf of Liverpool and Wirral Networked Data Lab*

Liverpool: Tim Caine, Helen Duckworth, Annmarie Daley  
Wirral: Matthew Gilmore, Lee Kirkham, Beverley Murray

With data support from: Simon Chambers, Karen Jones, Dimitris Tsintzos

## INTRODUCTION

A recent report published by Children's Commissioner[1] shows that rates of probable mental disorders in children's have increased by six percentage points since 2018, to one in six (16%) in July 2020. This potentially reflects of the impact of the pandemic. There is growing concern that child health, already at crisis point pre COVID-19, will suffer further as we emerge from the pandemic. Local analysis[2] identified several key child health issues emerging as a result of the pandemic:

- the diversion of health and social care resulting from lockdown,
- interruption of and planned return to schooling,
- increased health risks of lockdown, particularly domestic abuse, mental health and impacts on young carers,
- long-term impacts on child poverty and social inequalities.

Inequalities in services and identification of increased risks are themes common to both Local Transformational Plans and The Liverpool Mental Health and Emotional Wellbeing (MHEWB) 5-year plan[2] and Forward Thinking Wirral.[3]

Adversity in childhood can create harmful levels of stress which impact healthy brain development. As a result, this has long-term implications on learning, behaviour, and health. Adverse Childhood Experience (ACEs) have been found to be associated with a range of poorer health and social outcomes in adulthood. One in three diagnosed mental health conditions in adulthood are known to directly relate to adverse childhood experience. The Wirral Partnership for children, young people and families focus on building the confidence and resilience of children, young people, and their families with a greater emphasis on a whole family approach. To do this we need to understand what issues children and younger people are facing and whether services are effectively responding. Through recent workshops and consultations, young people have told us that they feel demotivated and anxious and COVID 19 has exacerbated these feelings.

A major concern for the Liverpool Child Health System has been recent increases in the number of children being taken into care. A key risk influencing this adverse outcome is the mental health of young mothers. There is growing evidence that adverse maternal mental health adversely affect child health outcomes[4,5] and this in part mediates the relationship between poverty and the poor mental health of children. The adverse mental health trajectories of young mothers potentially start in childhood, which means that identifying and preventing these trajectories can help prevent the cycles of poor health being reproduced over generations.

To address these concerns, we conducted analysis of linked data on the use of health services for mental health problems by children and young children to understand how patterns of usage vary across this population and the impact of the pandemic on this.

Specifically, we sought to answer the following research question was:

- How did the use of health services for mental health problems vary among the younger population (ages 0-25) of Liverpool and Wirral between 2019 and 2021? and how has this changed during the Covid-19 pandemic?

This analysis covers outcomes of interests of: Liverpool CCG Children and Families Commissioning, Liverpool City Council, Cheshire and Wirral Partnership, Wirral Future in Mind collaborative, Wirral Partnership for Children, Young People and Families and Wirral Council.

### **Data and Outcomes.**

The data comprised of pseudonymised individual linked data between Jan 2019 to June 2021 on all people aged 0-25 years old residing in the local authority boundaries of Liverpool and Wirral from 3 data sources:

- Secondary User Service (SUS) – used to extract data on hospital admissions.
- Emergency Care Dataset (ECDS) – used to extract data on A&E attendances.
- Mental health Service Data Set (MHSDS) – used to extract referrals to and contacts with Children and Adolescent Mental Health Services (CAMHS) and Adult Mental Health Services (AMHS). These we collectively refer to below as routine mental health services. These are contacts with services that provide routine care for people suspected or diagnosed mental health and wellbeing need, learning disabilities, autism, or other neurodevelopmental conditions. They are distinct from emergency admissions or A&E attendances in the other data sources, that may occur due to a crisis.

These data were used to define the following outcomes:

1. Emergency hospital admissions for self-harm, alcohol, and substance abuse, eating disorders and other mental health problems. (Extracted from SUS)
2. Attendance to A&E for self-harm, alcohol, and substance abuse, eating disorders. (Extracted from ECDS)
3. Any referrals to Mental Health Services. (Extracted from MHSDS)
4. Any contacts Mental Health Services. (Extracted from MHSDS)
5. People with any contact with health services for a mental health problem – defined as any person with at least one of the outcomes 1-4, during this period.

Please see in Appendix B the codes that we used to define the outcomes.

In addition, age, sex, ethnicity and LSOA of residence were extracted from these records for the analysis. Due to the high levels of missingness in the ethnicity field this was not used in the analysis. In order to calculate rates per population, data on outcomes 1-5 were aligned to the appropriate mid-year ONS population estimates[6]. As 2021 estimates were not available, we used 2020 estimates for this year.

To augment this information, we linked the individual level data to area-based contextual measures based on the Lower Super Output Area (LSOA) in which the patient lived. These measures included:

- The 2019 index of multiple deprivation (IMD 2019) from the Ministry of Housing, Communities & Local Government.[7]

- Community Needs Index (CNI) which is a composite measure developed by Oxford Consultants for Social Inclusion (OCSI) for the Local Trust, designed to identify areas experiencing challenges in relation to social infrastructure (e.g. community, civic, educational and cultural assets), connectedness (e.g. digital infrastructure, isolation and strength of the local jobs market) and civic engagement (e.g. levels of third sector civic and community activity and barriers to participation and engagement). It is designed to measure poor community and civic infrastructure as a separate concept to IMD.
- Access to green space measured as the percentage of space that is green space within a 900-metre buffer (~15 mins walk) distance for each postcode. This is then averaged to the LSOA level. This indicator is one component of the AHAH index developed by the Consumer Research Data Centre.[8]
- GPs per 1000 population using data from the GP practice census from NHS digital. [9]
- Percentage of population from White British/ White Other ethnicity from the ONS census[6]
- Lone parents as a percentage of all households (ONS Census 2011).

## ANALYSIS

Firstly we investigated the age and sex distribution of people with any contact with health services for a mental health problem (outcomes 5), plotting this as a percentage of the population for singles years of age for males and females. We then investigated the distribution of each of the outcomes 1-4 by deprivation level using Locally Weighted Scatterplot smoothing (LOWESS), stratified by sex and 2 age groups (0-14 year olds and 15-25 year olds). We then graphically explored how the composition of emergency admissions and A&E attendances by reason for admission / attendance changed with deprivation level for these age and sex groups. To explore hotspots of activity and highlight if there were different geographical patterns for emergency activity compared to routine mental health services we mapped the rates for these two outcomes (1 & 3), also plotting a bivariate map highlighting areas with potential unmet needs – that have high levels of acute activity but low levels of use of routine mental health services.

To investigate the association between each of the area-based measures and emergency activity (admissions and A&E attendances) and contacts with routine services we fitted a Poisson regression model for each of the outcomes with data at the LSOA level stratified by age group, with the 6 area based measures and sex as covariates. To model the log of the rate for each outcome we include the population as an offset on the model.

To investigate the impact of the pandemic on our outcomes we fitted similar Poisson regression models using monthly data for each LSOA, by age group and sex. In these models we included a variable indicating the 4 stages of the pandemic: before the pandemic (before April 2020), the first lock down (April 2020 to May 2020), Further lock downs (June 2020 to February 2022), and after lockdowns (March 2022- June 2022). To understand differential effects this was included in the model interacted with age sex and tercile of deprivation. We used tercile (rather than quintile) due to the small number of monthly values in the data when breaking it down by a greater number of deprivation categories. To visualise these effects, we plotted the predicted trend in the outcomes over time from these models. The regression formulae and more information on the regression model are in Appendix C.

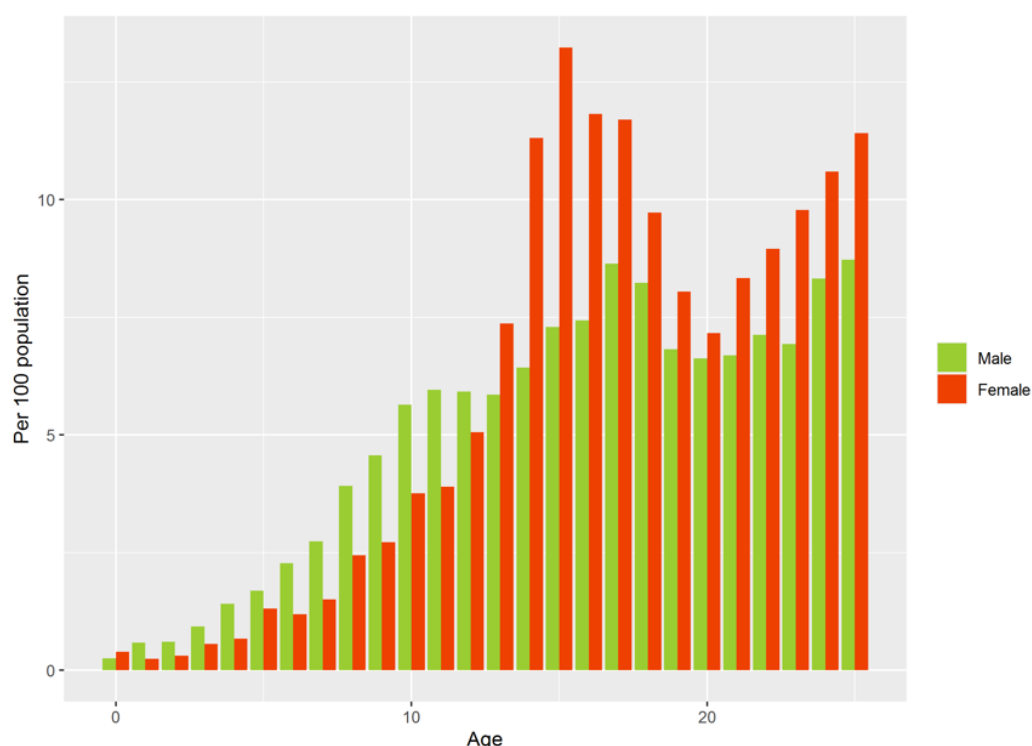
## RESULTS

Between January 2019 and June 2022 15101 children and young people aged up to the age of 25 had experienced at least one of these outcomes. This was around 5% of estimated population

(319,713). These children and young people had experienced 2630 A&E attendances, 11,700 admissions, 121,591 contacts with mental health services and 27,446 referrals for mental health problems as defined above.

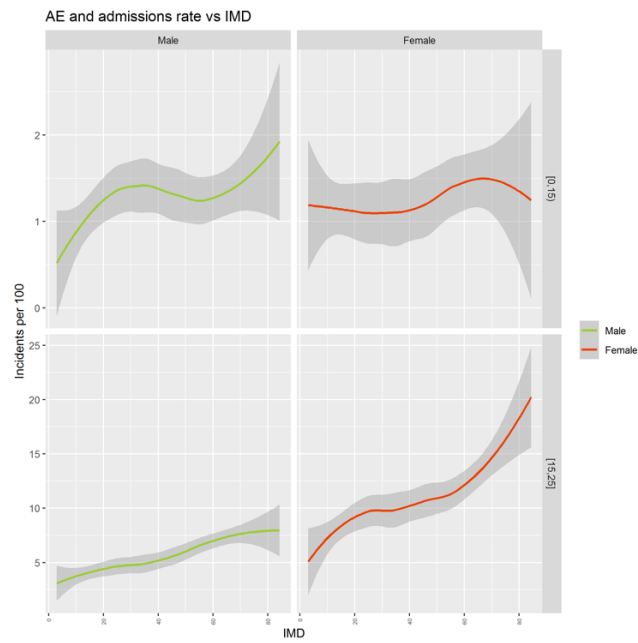
Figure 1 shows proportion of young people with any contact with health services during this period for a mental health problem. While rates for boys are slightly higher than for girls up to the age of 12, after the age of 13 the rates for girls are markedly higher. The rate spikes at around the ages of 15-19 and 21-25 among this group. Around 7% (6204) of girls over the age of 12 were in contact with health services during this period.

**Figure 1. The % of children and young people (0-25) with any contact with health services during this period for a mental health problem (outcomes 1-4)**

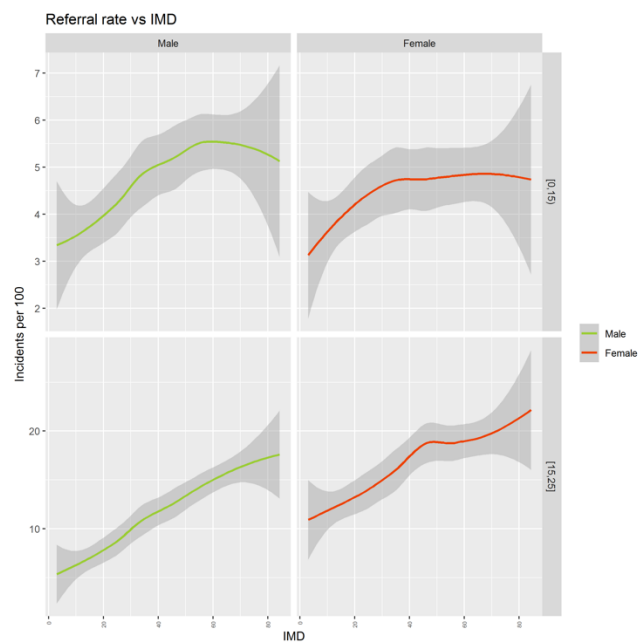


Figures 2, 3 & 4 show the rates for A&E/emergency admissions, referrals and contacts with mental health services against Index of Multiple Deprivations (IMD) scores (lower score is less deprived higher more deprived) stratified by age and sex. The relationship with deprivation is particularly strong for emergency activity and referrals for young women – aged 15-25 in particular. This however is less the case for contacts with routine mental health services. This could indicate that that young women with mental health problems in deprived areas are not sufficiently accessing routine mental health services and are therefore ending up in A&E or as an emergency admission.

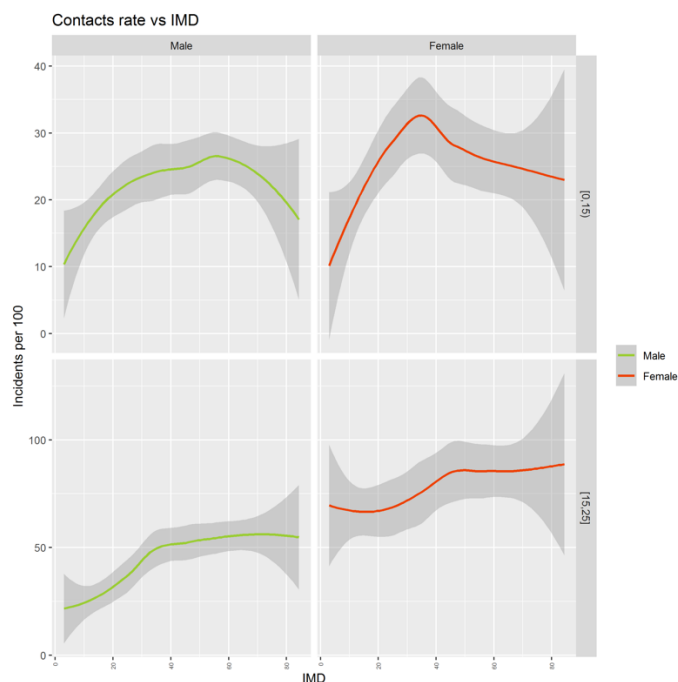
**Figure 2. A&E and Emergency admissions relating to MH compared to IMD**



**Figure 3. Referrals to routine mental health services compared to IMD**

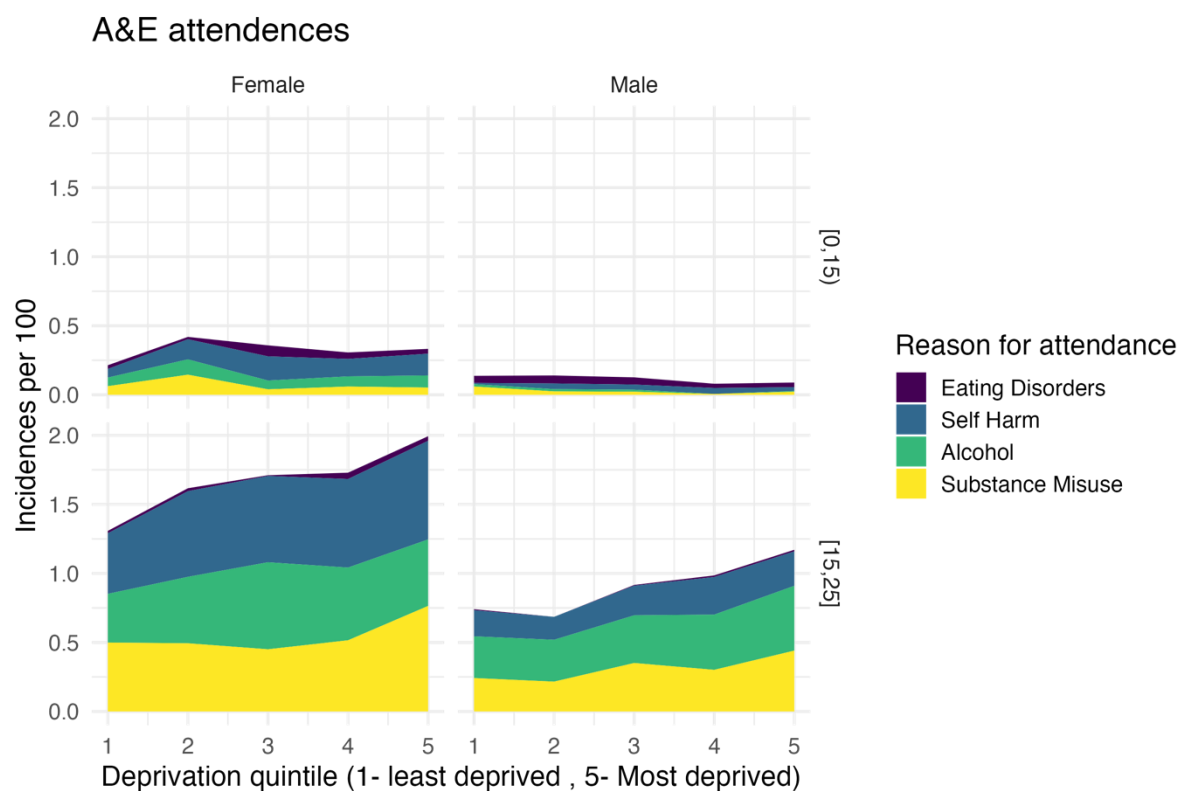


**Figure 4. Contacts with routine mental health services compared to IMD**



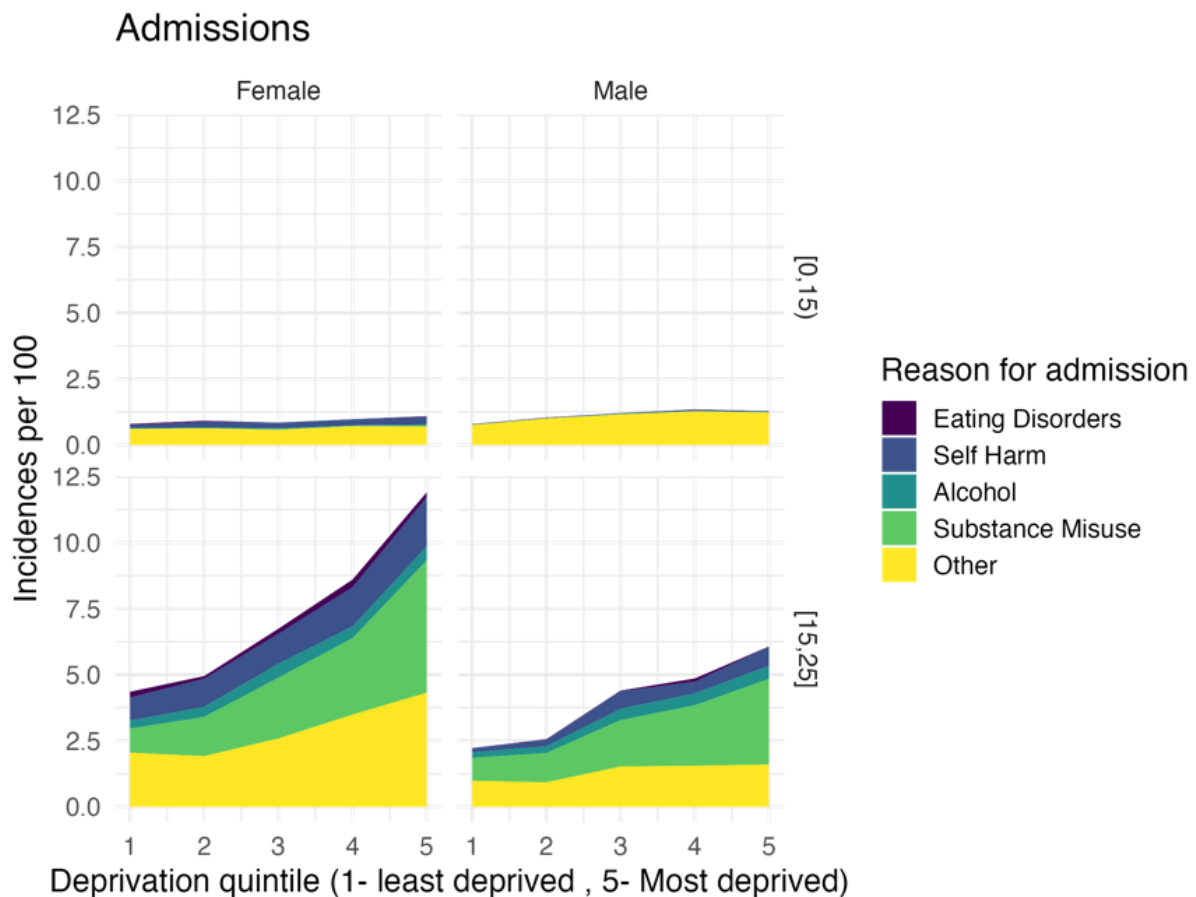
The data shown in Figures 5 & 6 show the relationship with deprivation decomposed by the reasons for A&E attendances and hospital admissions. The facet showing reasons for A&E rates among 15-25 year-old females brings into relief the higher rates for this group across all categories. This indicates that substance misuse is driving the steep relationship with deprivation

**Figure 5 A&E attendance per 100 population by deprivation broken down by reason for attendance.**



When looking at emergency admission the relationship with deprivation is even more stark for young women and is particularly drive by substance misuse and “other” mental health problems.

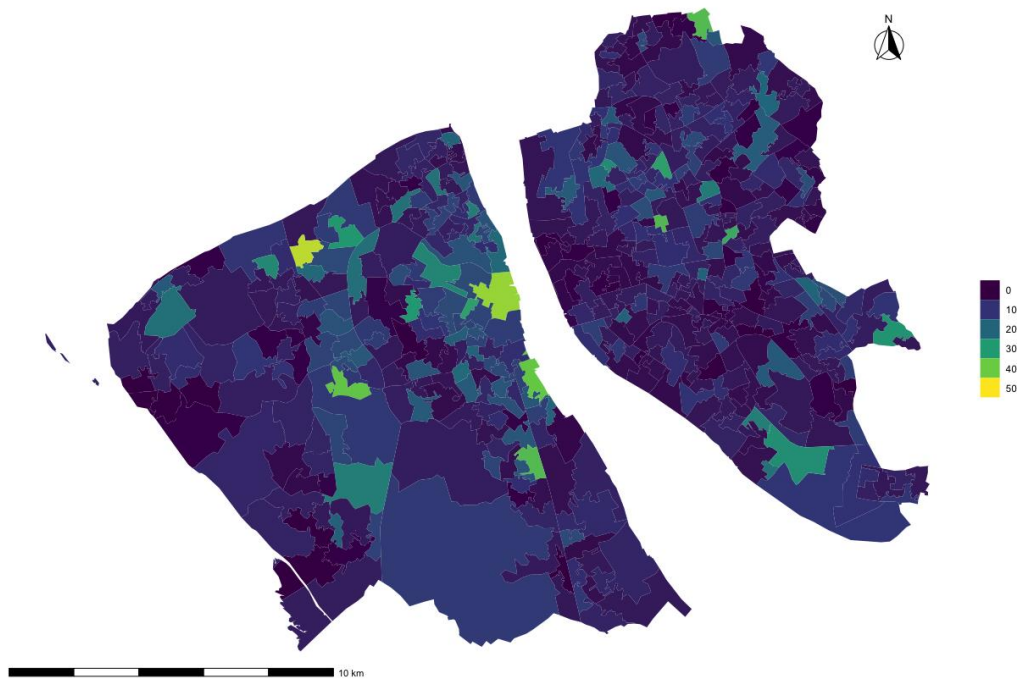
**Figure 6 Emergency admissions per 100 population by deprivation broken down by reason for attendance.**



### Geographic distributions

Figure 7 shows a map of emergency admission rates for young women (15-25 year olds) indicating how hospital admissions rates are higher in Wirral than in Liverpool, especially in high-deprivation areas of Birkenhead, Wallasey, and especially Leasowe (shown in yellow tones). Rates of contact with routine mental health services are shown in Figure 8, indicating a very different pattern. Some areas have very high contact rates (and one area was removed as it was an extreme outlier). These areas may reflect specific service centres such as care homes. Overall, however the areas particularly in Wirral with high contacts don't seem to be the same as those with high levels of admissions.

**Figure 7** Emergency admissions, 15-25 year old young women per 100 population by LSOA



**Figure 8** Contacts with routine mental health services for 15-25 year old young women per 100 population by LSOA

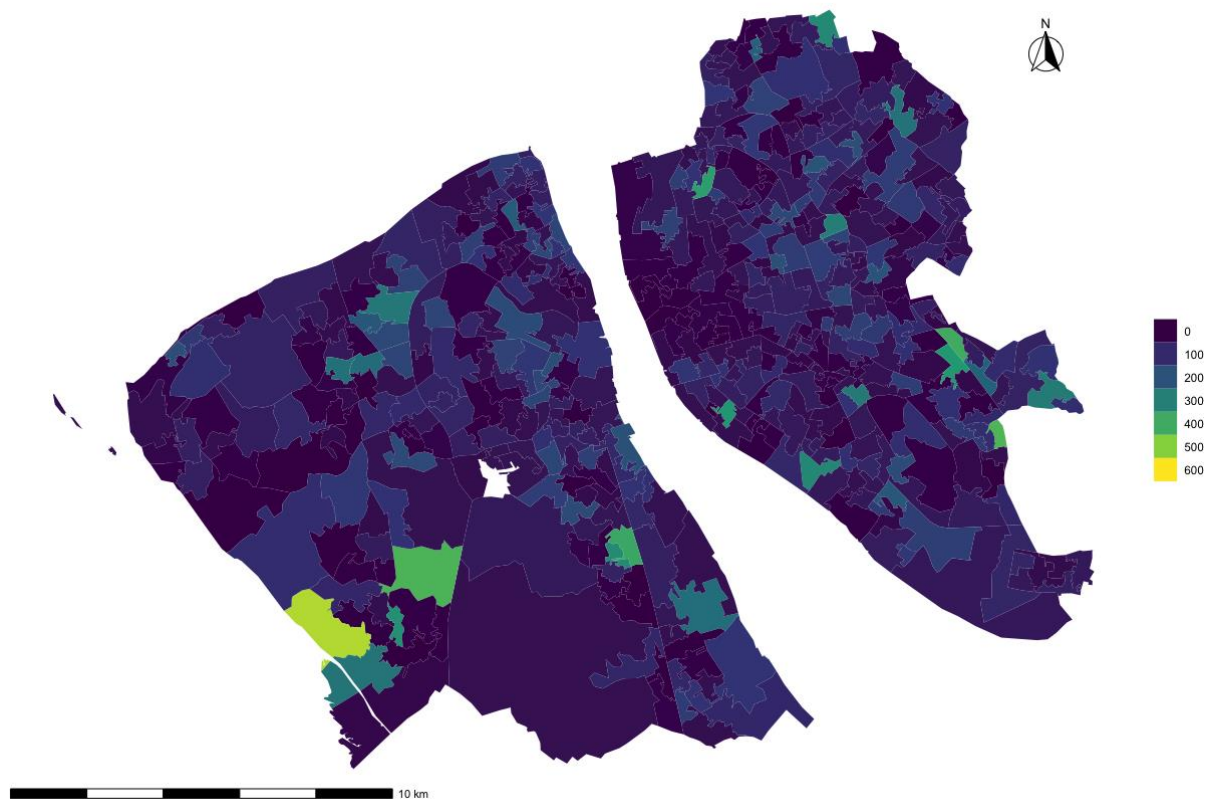
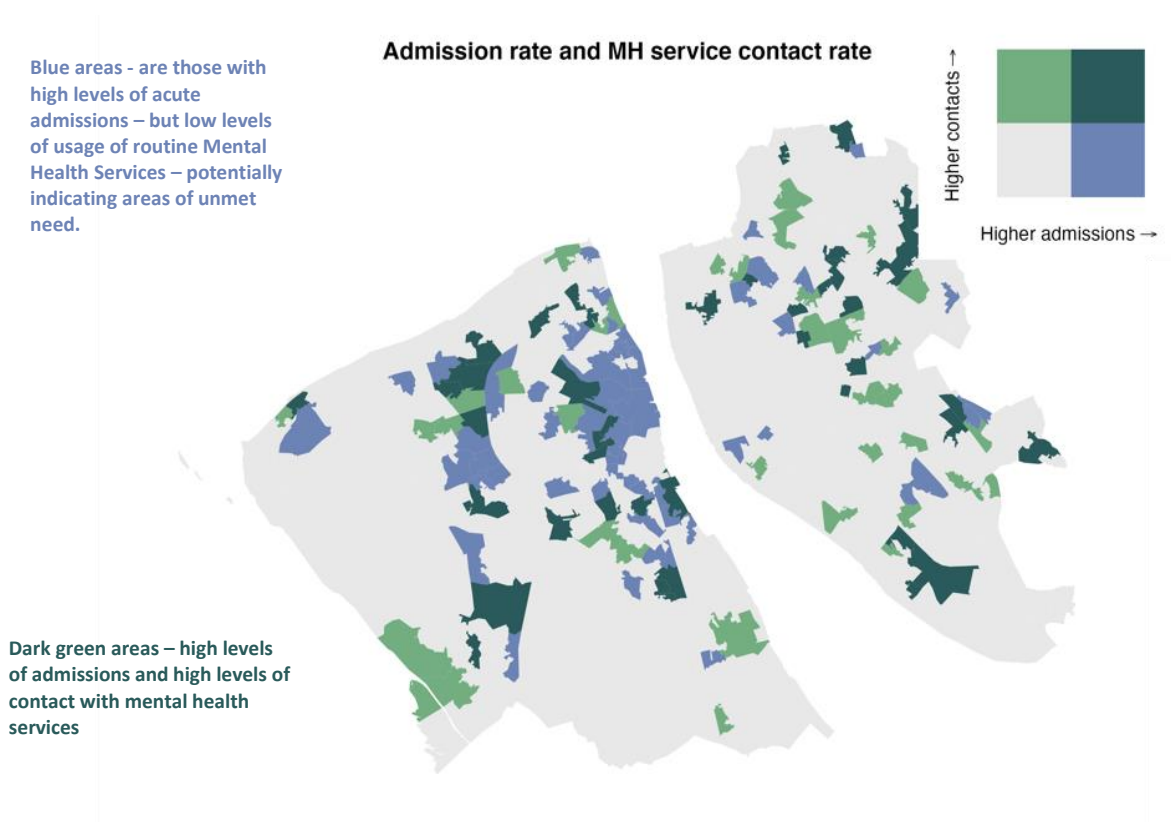




Figure 9 show those LSOA that feature either higher admissions and/or contacts rates. Areas with high admissions rates, but low contact rates with routine mental health services – shown in blue, might show the areas with poor access and uptake of routine mental health services, where mental health problems reaching crisis and ending up in emergency admissions. These seem to particularly be in the Wirral and around Birkenhead.

**Figure 9. Bivariate map by LSOA showing relationship between hospital admissions contacts with routine mental health services.**



### Understanding association with area-based measures.

Figures 10 shows the relationship between each of the area-based factors and A&E/admissions. There is some evidence that access to green space and access to primary care is associated with lower level of emergency activity for mental health problems in this age group. Areas with a higher proportion of people from a white ethnicity, that were more deprived and had a higher Community Needs Index (indicating poorer community and civic infrastructure) tended to have higher Admission and A&E attendance rates.

**Figure 10. Relative association between area-based indicators and A&E/Emergency Admissions estimated from Poisson regression model. Showing the relative association for each standard-deviation variation in the area-based measures.**

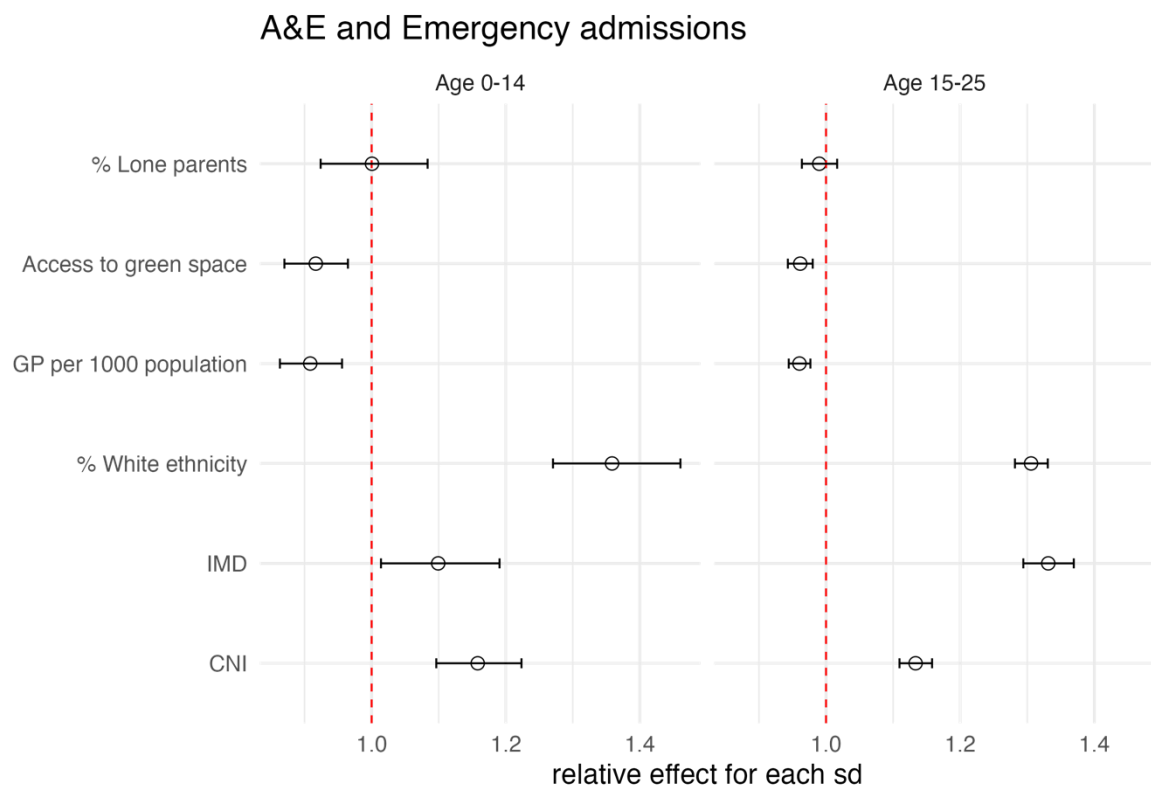
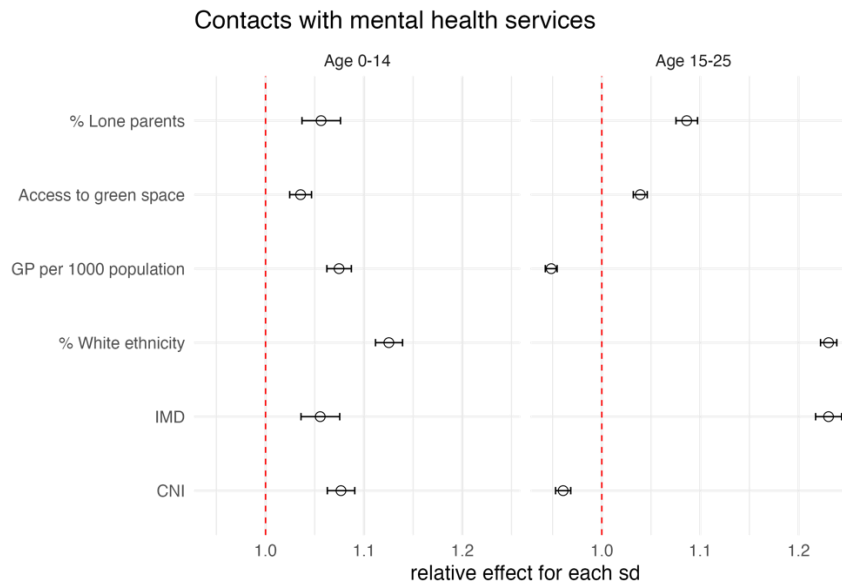


Figure 11 shows the relationship between each of the area-based factors and contacts with routine mental health services. Here we find a different relationship compared to the association with emergency activity. The relationship with deprivation and ethnicity is similar, but with the other factors the association varies depending on age group and is in the unexpected direction in some cases, e.g greater contact rates for younger children in places with more GPs per head – but the opposite relationship with older children and young people. Contact rates are higher in places with better access to green space.

**Figure 11. Relative association between area-based indicators and contacts with routine mental health services estimated from Poisson regression model. Showing the relative association for each standard-deviation variation in the area based measures.**



### The impact of the pandemic.

Figures 12 reveal the impact of the pandemic on emergency admission stratified by age ,sex and deprivation. With the onset of lockdown in April 2020 there was a drop in admissions particularly for the younger age groups and amongst the most deprived areas, admissions remained low until the beginning of 2021 when they have started to rise rapidly recently. Figure 13 shows that Pandemic had a greater impact on reducing contacts with routine mental health services amongst the younger age groups. Contacts had not returned to pre-pandemic levels by June 2021. In the older age group the pandemic had less of an impact on activity in routine mental health services, although there seems to have been an increase in activity from the beginning of 2021.

Figure 12. Modelled trend in A&E and Admission numbers over the stages of the pandemic estimated using a Poisson regression model.

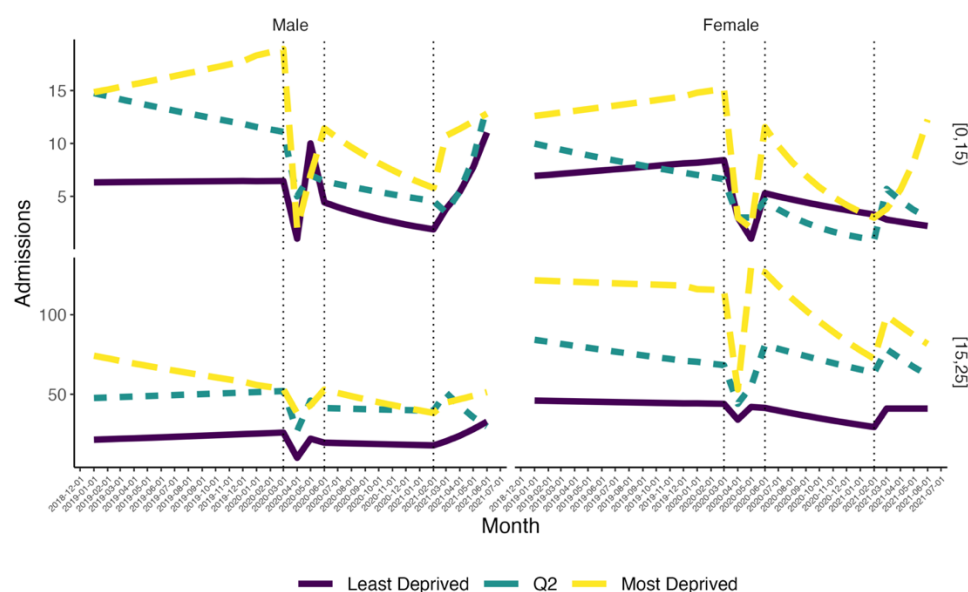
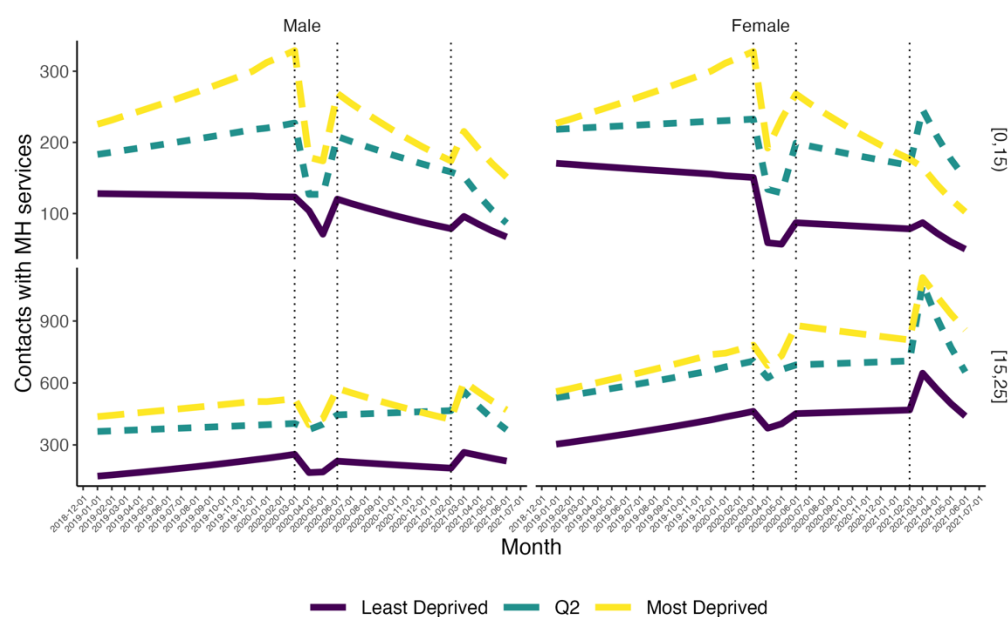


Figure 13. Modelled trend in contacts with routine mental health services over the stages of the pandemic estimated using a Poisson regression model.



## Discussion

### Key findings:

Those accessing service for mental health problems are disproportionately girls and young women. This is especially noticeable in the age group between 15 and 25, where 7% or more of the total population in this demographic sector had any contact with health services for a mental health problem.

There is evidence of a relationship with use of mental health services and deprivation, with the steepest gradient between increase deprivation and increased use of acute services in the 15-25 young women. The relationship between referrals and deprivation is similar, but then these referrals seem to fail to be followed by mental health contacts, possibly indicating some unmet need.

Emergency activity seem to be particularly driven by substance abuse and self-harm concentrated in the most deprived areas. The pattern of emergency activity broadly reflects expected drivers of need, including deprivation but also, places with lower social capital, less access to green space, poorer provision of primary care. Use of routine mental health services does not quite seem to match this pattern, although it is higher in more derived areas, we don't observe the same associations with environmental factors, primary care access and social capital.

Spatial visualization of data reveals pockets of high emergency activity but low use of routine mental health services, particularly in the Wirral, potentially identifying areas of unmet need where more pro-active management and improved access to routine mental health services could prevent escalation into emergency activity. Across all areas of service use we find activity higher in places with a higher proportion of the population from a white ethnicity. It's unclear the extent to which this reflects patterns of need or poorer access to services amongst people from minority ethnic groups.

People accessing services for mental health problems are more likely to be of white ethnicity than would be expected from the population as a whole.

The pandemic reduced activity considerably, probably due to service disruption: the time trend data show that the activity has considerable peaks at the end of lockdown periods, however after those monthly peaks the activity level fails to reach the pre-pandemic levels. This is most noticeable in terms of contact with mental health services in the younger age groups.

### **Limitations:**

In this analysis we were unable to access linked primary care data. This was mostly due to unresolved information governance issues in Wirral. The data from ECDS were in all likelihood an undercount of emergency contacts due to mental health causes for two reasons: first, because the dataset, while introduced in October 2017, had experienced practical difficulties to be implemented in Merseyside at least, with many providers not submitting returns to this repository, and secondly, because of difficulties in coding of mental health events in A&E. Some codes continued to be linked to obsolete ICD10 based codes used in previous A&E data, even though the purpose of establishing ECDS was to improve coding of Emergency service use. MHSDS data is relatively new and underused: while extracting data for this process, we discovered an issue with inconsistent pseudonymisations. We have tried to rectify this issue, but the data may need further validation.

We could only perform regression on small-areas aggregate data, because of the lack of individual linked data and characteristics for the whole population in Liverpool and Wirral and not just the ones who had contacts with services. Further analysis focussing on individual level data would have been more useful, as would have been conducting multilevel regression. We did not differentiate between referrals rejected and accepted, or distinguished between people who were already known to the system, these might have given more insight into the trends we were able to visualise.

### **Implications for policy:**

There is an urgent need to tailor intervention to adolescent girls and young women, especially the ones that experience more financial hardship. This is important not only in terms of health inequality but because there is strong evidence of poor maternal mental health mediated through poverty leading to poor both physical and mental health in children and a strong predictor for children being taken into care.

Addressing these health needs would lead to improved and fairer outcomes not only in this generation but in future generations as well and it is one very plausible way to break the circle of repeating patterns of poor health in underprivileged communities.

It is however also noticeable that the segment of young population most at risk falls in age in a grey area of transition of mental health services, between CAMHS and adult mental health services. There is a need to rethink how the mental health services for this particular age segment, 15-25, are targeted, structured, implemented and delivered. The analysis here indicates that this segment is relatively large in Liverpool and Wirral and there seem to be pockets of unmet need that could potentially be addressed through better services design.

## Conclusions

We conducted an analysis of mental health service utilisation in the young population of Liverpool and Wirral between 2019 and June 2021. We found evidence of greater need especially in adolescent girls and young women between the ages of 15 and 25 and a strong association between acute use of services and deprivation. While referrals in these segments are following the trends of acute episodes, contacts with mental health services seem to follow a different pattern. Additionally, mental health services activity levels have not recovered to pre-pandemic levels, despite evidence that the need for these services has increased as a consequence of the pandemic. Next steps for this analysis are to develop better approaches to model of risk and unmet needs to target interventions and address inequalities.

## Appendix

### Appendix A. Open data sources and notes

| Data set                                | Publisher / source   | Notes |
|---|--|-------|
| QS201EW (Ethnic group)                  | NomisWeb. Available via:<br><a href="https://www.nomisweb.co.uk/census/2011/qs201ew">https://www.nomisweb.co.uk/census/2011/qs201ew</a>  |       |
| ONS English Indices of Deprivation 2019 | ONS. Available via:<br><a href="https://www.gov.uk/government/statistics/english-indices-of-deprivation-2019">https://www.gov.uk/government/statistics/english-indices-of-deprivation-2019</a> |       |

|   |  |  |
|---|--|--|
| KS105EW (Household Composition – Lone Parents)              | NomisWeb:<br><a href="https://www.nomisweb.co.uk/census/2011/ks105ew">https://www.nomisweb.co.uk/census/2011/ks105ew</a>   |  |
| <i>Access to Hazards and Assets for Health (AHAH, 2017)</i> | Comsumer Data Research Centre. Available via:<br><a href="https://data.cdrc.ac.uk/dataset/access-healthy-assets-hazards-ahah">https://data.cdrc.ac.uk/dataset/access-healthy-assets-hazards-ahah</a> | The greenspace indicator labelled as 'active' is based on the distance people have to travel to their nearest greenspace access point conducive to physical activity (high value is less access to green space - distance). The second greenspace indicator labelled as 'passive' is based on the proportion of greenspace within a 900 meter buffer (~15 mins walk) from where people live (high value is more green space - area). |

## Appendix B. Outcome definition

| Emergency hospital admissions     | Source: SUS                 |
|-----------------------------------|-----------------------------|
| reason                            | IDC-10 code (any position)  |
| Eating disorder                   | F50                         |
| Self-harm                         | X60:X84                     |
| Alcohol abuse                     | F10,X45,X65,Y15             |
| Substance abuse                   | F11:F19                     |
| Any other mental health diagnosis | F00:F99 excl F10-19 and F50 |

| A&E Attendance | Source: ECDS               |
|----------------|----------------------------|
| reason         | Snomed code (any position) |

|                 |                  |
|-----------------|------------------|
| Eating disorder | 54, 105          |
| Self-harm       | 1465             |
| Alcohol abuse   | 24,29,36,37,1253 |
| Substance abuse | 1492             |

## Appendix C. Regression formulae

### Data:

We considered outcomes by for each age and sex group within each LSOA for each month, alongside ONS mid-year population estimates for the respective year. These were linked at the LSOA level with several area-based characteristics.

### Poisson regression model to investigate geographical context:

$$\log(Y_{ij}) = \beta_0 + \beta_1 T_j + \beta_2 Age_{ij} + \beta_3 Sex_{ij} + \beta_m ABM_{im} + \log(pop_{ij})$$

### Poisson regression model to investigate the impact of Covid-19:

$$\log(Y_{ij}) = \beta_0 + \beta_1 T_j + \beta_2 Age_{ij} + \beta_3 Sex_{ij} + \beta_4 IMD_i * COVID_j + \log(pop_{ij})$$

### Where:

- $Y_{ij}$  is any of the outcomes considered per LSOA  $i$  in month  $j$ .
- $T_j$  is a time-trend term for the time interval considered in the analysis, in months.
- $Age_{ij}$  is an age group in LSOA  $i$  in month  $j$ .
- $Sex_{ij}$  is sex in LSOA  $i$  in month  $j$ .
- $ABM_{im}$  is any of the  $m = [1: 5]$  area-based measures per LSOA  $i$
- $IMD_i$  is one of the 5 area-based measures, the 2019 index of multiple deprivation (IMD) in LSOA  $i$ .
- $COVID_j$  is an indicator of whether month  $j$  was during the Covid-19 pandemic and/or one of the three phases of the pandemic in England.
- $\beta$  are the parameters of the regression.



## REFERENCES

- 1 The state of children's mental health services 2019/20. Child. Comm. Engl. 2021.<https://www.childrenscommissioner.gov.uk/report/mental-health-services-2019-20/> (accessed 7 Mar 2022).
- 2 CHILDREN AND YOUNG PEOPLE'S MENTAL HEALTH AND EMOTIONAL WELLBEING TRANSFORMATION PLAN: 4 YEARS ON. <https://www.liverpoolccg.nhs.uk/media/4250/cyp-mhewb-ltp-4-years-on-final.pdf>. (accessed 7 Mar 2022).
- 3 Wirral children and young people transformation plan. <https://www.wirralintelligenceservice.org/media/2762/190307-wirral-children-and-young-people-transformation-plan-2018-19-final-version.pdf> (accessed 7 Mar 2022).
- 4 Griffiths LJ, Johnson RD, Broadhurst K, *et al.* Maternal health, pregnancy and birth outcomes for women involved in care proceedings in Wales: a linked data study. *BMC Pregnancy Childbirth* 2020;**20**:697. doi:10.1186/s12884-020-03370-4
- 5 O'Donnell M, Maclean MJ, Sims S, *et al.* Maternal mental health and risk of child protection involvement: mental health diagnoses associated with increased risk. *J Epidemiol Community Health* 2015;**69**:1175–83. doi:10.1136/jech-2014-205240
- 6 Nomis - Official Labour Market Statistics. <https://www.nomisweb.co.uk/default.asp> (accessed 7 Mar 2022).
- 7 English indices of deprivation 2019. GOV.UK. <https://www.gov.uk/government/statistics/english-indices-of-deprivation-2019> (accessed 7 Mar 2022).
- 8 AHAH Version 2 (Access to Healthy Assets and Hazards) – Place-based Longitudinal Data Resource. <https://pldr.org/dataset/2z9yv/ahah-version-2-access-to-healthy-assets-and-hazards> (accessed 7 Mar 2022).
- 9 General Practice Workforce. NHS Digit. <https://digital.nhs.uk/data-and-information/publications/statistical/general-and-personal-medical-services> (accessed 7 Mar 2022).
- 10 Daras K, Green MA, Davies A, *et al.* Open data on health-related neighbourhood features in Great Britain. *Sci Data* 2019;**6**:107. doi:10.1038/s41597-019-0114-6
- 11 Green MA, Daras K, Davies A, *et al.* Developing an openly accessible multi-dimensional small area index of 'Access to Healthy Assets and Hazards' for Great Britain, 2016. *Health Place* 2018;**54**:11–9. doi:10.1016/j.healthplace.2018.08.019
- 12 Left-Behind-Areas-IMD-2019-REVISED-SLIDE-DECK-with-revised-unemployment-slide-Read-Only-copy.pdf. <https://localtrust.org.uk/wp-content/uploads/2020/07/Left-Behind-Areas-IMD-2019-REVISED-SLIDE-DECK-with-revised-unemployment-slide-Read-Only-copy.pdf> (accessed 7 Mar 2022).

- 13 local\_trust\_ocsi\_left\_behind\_research\_august\_2019.pdf. [https://localtrust.org.uk/wp-content/uploads/2019/08/local\\_trust\\_ocsi\\_left\\_behind\\_research\\_august\\_2019.pdf](https://localtrust.org.uk/wp-content/uploads/2019/08/local_trust_ocsi_left_behind_research_august_2019.pdf) (accessed 7 Mar 2022).