

The impact of the COVID-19 pandemic on children and adolescent mental health inpatient service use in England: An interrupted time-series analysis of national patient records

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Abstract:	<p>Background: During the initial phases of the COVID 19 pandemic children and young people (CYP) faced significant restrictions. The virus and mitigation approaches significantly impacted how health services could function, and be safely delivered.</p> <p>Aims: To investigate the impact of COVID-19 lockdowns on CYP psychiatric admission trends during lockdowns 1 (started 23/032020) and 2 (started 05/11 2020) of the COVID 19 pandemic in England.</p> <p>Methods: Routinely collected, retrospective, English administrative data looking at psychiatric hospital admissions, length of stay and patient demographic factors were analysed using an interrupted time series analysis (ITSA) to estimate the impact of COVID 19 lockdowns 1 and 2 on service use trends. We analysed data of 6,250 CYP (up to 18 years of age) using ordinary least squares (OLS) regression analysis with Newey–West standard errors to handle autocorrelation and heteroscedasticity.</p> <p>Results: Psychiatric hospital admissions for CYP significantly fell during lockdown 1, and then fell further even during lockdown 2. A greater proportion of admissions during lockdown were out of area or to independent sector units. During lockdown, the average age of CYP admitted was older and a greater proportion were female. There was also a significant increase in the proportion of looked-after children and CYP from the most socio-economically deprived areas admitted during lockdown 2.</p> <p>Conclusions: During both lockdowns, fewer CYP had psychiatric admissions. The subsequent rise in admissions for more socio-economically deprived CYP and looked after children suggests these CYP may have been disproportionately affected by the pandemic, or overlooked during earlier phases.</p>

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1 **The impact of the COVID-19 pandemic on children and adolescent mental health inpatient service**
2 **use in England: An interrupted time-series analysis of national patient records**

3

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14

15 **Abstract**

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17 faced significant restrictions. The virus and mitigation approaches significantly impacted how health
18 services could function, and be safely delivered.

19 Aims: To investigate the impact of COVID-19 lockdowns on CYP psychiatric admission trends during
20 lockdowns 1 (started 23/032020) and 2 (started 05/11 2020) of the COVID 19 pandemic in England.

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23 series analysis (ITSA) to estimate the impact of COVID 19 lockdowns 1 and 2 on service use trends. We
24 analysed data of 6,250 CYP (up to 18 years of age) using ordinary least squares (OLS) regression
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27 further even during lockdown 2. A greater proportion of admissions during lockdown were out of area
28 or to independent sector units. During lockdown, the average age of CYP admitted was older and a
29 greater proportion were female. There was also a significant increase in the proportion of looked-after
30 children and CYP from the most socio-economically deprived areas admitted during lockdown 2.

31 Conclusions: During both lockdowns, fewer CYP had psychiatric admissions. The subsequent rise in
32 admissions for more socio-economically deprived CYP and looked after children suggests these CYP
33 may have been disproportionately affected by the pandemic, or overlooked during earlier phases.

34 **1 Introduction**

35 During the COVID 19 pandemic in the UK, lockdowns, amongst other restrictions, were instigated to
36 prevent the National Health Service from becoming overwhelmed and to limit deaths.¹ For children
37 and young people (CYP) this caused a major interruption to in-person learning, social and community
38 networks, recreational activities and ready access to health care.² Although CYP are less likely to
39 contract severe forms of COVID-19 requiring hospitalisation or die from the infection³, due to concerns
40 about their ability to asymptotically spread the virus to those more vulnerable, the restrictions
41 placed upon CYP were as strict, and in some ways stricter (e.g. school closures) than those placed upon
42 working age adults.

43 The COVID-19 pandemic is having profound mental health consequences for CYP^{2,4}. As well as the
44 direct impact of the pandemic and its restrictions on mental health, COVID-19 also impacted service
45 delivery and availability for people with mental health disorders. Due to concerns about risk of
46 spreading the virus, many outpatient mental health teams moved to almost complete remote
47 working, with access to many treatments and interventions reduced. Although inpatient wards
48 remained open, they faced significant challenges due to staff sickness or self-isolation, social
49 distancing and patient infection outbreaks. Mental health services staffing was also further stretched
50 as some healthcare resources were redeployed to deal with COVID-19 in general hospitals.

51 Since the start of the COVID 19 pandemic there has been very limited research on the impacts on
52 inpatient mental health services, focus has been more on adult community and outpatient
53 populations.^{5,6,7}

54 Out of area mental health admissions have caused significant controversy over recent years with
55 numerous media articles describing negative experiences and policy initiatives aiming to minimise
56 these occurrences.⁸ The impact of the pandemic on out of area admissions is not yet known. A better
57 understanding of inpatient mental health services use during the pandemic is crucial to help plan
58 effective service provision going forward in the pandemic recovery period and to assist mental health
59 care providers and commissioners to better respond to future disruptions.

59 This study therefore aims to investigate the impact of the early stages of the pandemic on inpatient
60 mental health admissions for CYP, in terms of service use and out-of-area admissions. We
61 hypothesised that the national lockdowns, introduced in England on the 23rd of March 2020 and 5th
62 November 2020, led to a reduction in CYP mental health admissions in England.

63 **2 Method**

64 2.1 Study design

65 NHS England, through seven regional Specialised Commissioning Teams across England, directly
66 commissions specialised CYP mental health inpatient provision.

67 In this observational retrospective study, we compared changes in the use of inpatient mental health
68 services by CYP (aged up to 18 years) before and after the onset of the COVID19 pandemic lockdowns
69 in England. To do this, we adopted a quasi-experimental study design following guidance from the
70 Medical Research Council on conducting natural experiments.⁹

71 2.2 Data

72 The anonymised individual-level electronic medical records on CYP inpatient admissions were
73 extracted from the national specialised mental health Patient Level Dataset across England between
74 1 January 2018 and 31 March 2021. The specialised mental health dataset was populated by provider

75 NHS Trusts and held nationally in secure databases (this collection has now retired and is now merged
76 with Mental Health services dataset).

77 Commissioned inpatient services were provided by 41 NHS Trusts and 14 private hospitals. The data
78 included the dates of hospital admission and discharge, type of ward, and whether the admission was
79 to a private psychiatric hospital. It also included socio-demographic characteristics of the admitted
80 CYP, including age, gender, ethnicity, whether they have been looked after or in full-time education,
81 and socio-economic deprivation based on the Office of National Statistics- Index of Multiple
82 Deprivation (ONS-IMD). Ethnicity was used to create a dummy for identifying CYP from Black, Asian or
83 Minority Ethnic (BAME) background.

84 Data were converted into weekly number/rates of mental hospital admissions, reflecting 169 weeks
85 (117 weeks pre-pandemic and 52 weeks after pandemic onset). Out-of-area admissions were defined
86 as admissions further than 50 miles from the patient's residence (NHSE report, 2014) or a clinician
87 notification of out-of-area admission based on natural clinical flows (i.e., acceptable clinical flow to
88 units recognising that there may be patient choice or specific clinical needs to admit outside). In terms
89 of missing data, if the date of discharge was missing we imputed length of stay with the mean within-
90 patient length of stay. However, if a patient only had one admission the length of stay was treated as
91 a missing observation. This approach was determined after performing a missing data analysis and
92 looking at the distribution of missing observations across time. Moreover, we defined a variable as the
average (entire) length of stay of all patients admitted in a week. We also defined a variable based on
the mean number of total admissions per patient admitted in each week. This was to proxy the severity
of the patients admitted each week and it was expected that if more severe patients (i.e. those with
multiple hospital admissions during the entire observation period) were admitted in a week, this
variable would be higher.

93 2.3 Statistical analysis

94 We performed an interrupted time-series analysis (ITSA) with a single group (i.e. no control group
95 available) and two "events" to estimate the immediate (i.e. in the first week of the event) and
96 subsequent (from the second until last week of the event) impact of the pandemic and associated
97 public health measures. The first "event" occurred on 23 March 2020 when initial restrictions started
98 to be legally put into place and the second "event" occurred on 5 November 2020 when the second
99 wave lockdown started. ITSA models the impact of an event (in this case the lockdown, a public health
100 measure to mitigate the COVID-19 pandemic) on a time varying outcome. This approach is considered
101 a strong quasi-experimental design and has been applied across a wide range of healthcare settings.¹⁰

102 Pre-existing time trends, immediate impact and subsequent impact were all assumed to be linear and
103 were estimated with ordinary least squares (OLS) with Newey–West standard errors to handle
104 autocorrelation in addition to possible heteroscedasticity. We used the Cumby-Huizinga test to ensure
105 that each fitted ITSA model accounted for the correct autocorrelation structure (i.e. number of lags).
106 As a sensitivity analysis, we also performed ITSA using generalised Least Squares in case the linear
107 trends assumption was violated.

108 The ITSA was performed on a number of outcomes of interest including weekly number of
hospital admissions and length of stay, weekly rate of private hospital admissions, weekly number of
out-of-area admissions, weekly number of admissions by patient characteristics (i.e. looked-after
status, BAME background, and ONS-IMD quintiles (with 1 most deprived to 5 least deprived).

109 To estimate the impact of the pandemic on hospital length of stay, inverse probability weighting (IPW)
110 was used to adjust for changes in the composition of the sample (i.e. differences in the types of CYP
111 seen by services before and after the pandemic onset). Logistic regression was performed to estimate
112 the propensity of a weekly observation occurring after the first lockdown (compared with before it)

based on the mean age, proportion of females, proportion of CYP in full education, proportion of looked-after children, proportion from a BAME background, proportion of highest quintile of ONS-IMD, mean number of hospital admissions per patient, and proportion of patients with censored data. The latter variable was included in the propensity score as a dummy indicating whether patients were admitted right at the end of the study's observation period and had no discharge date (i.e. to account for right censoring). The observations used in the ITSA were weighted based on the inverse probability of being observed after the first lockdown adjusting therefore for differences in the patient case-mix before and after the first lockdown. Following good statistical practice, we also used the confounding variables (i.e. those used in the logit regression to estimate the propensity score) in the ITSA as covariates.^{11 12}

113 2.4 Funding Statement

114 The Funder had no role in the research undertaken.

115 2.5 Reporting Statement

116 The RECORD statement was used to report the methods and results of the study¹³

117 2.6 Ethics Statement

118 The Far Away From Home Study received ethics approval (REC approval number: 289113
119 20/WM/0314.

120 2.7 Consent Statement

121 This study was conducted using anonymous, population level data. Consent was therefore not sought
122 from participants.

123 2.8 Declaration of Interest statement: None

124 3 Results

125 3.1 Patient characteristics

126 Between 1 January 2018 and 31 March 2021 there were 10,657 psychiatric hospital admissions (to all
127 types of wards) of 6,250 CYP (up to 18 years of age) patients in England. About a third of these
128 admissions (37%) were to private hospitals. The mean age of these CYP at their first admission
during the follow-up period was 15.3 years (SD: 1.7), 70% were female and 18% from BAME
backgrounds (Table 1). Where data were available, 11% (of 86%) were looked after children and 43%
(of 65%) in full-time education. The mean number of admissions per patient over the 3.25 years was
1.7 (SD: 1.2) with an average length of stay per admission of 93 (SD: 94) days. The mean number of
out-of-area hospital admissions was 0.48 (SD: 0.80), reflecting 28% of all admissions.

129 [Table 1]

146

147 3.2 Impact of COVID-19 pandemic on hospital admissions

148 Table 2 shows the results from the ITSA. The level that the trend of each outcome variable started at
149 the beginning of the follow-up period (i.e. Jan 2018) is presented in the F column and the trends before
150 the pandemic in the A column. Columns B and C present the immediate impact (i.e. in the first week)
151 and the subsequent trend of lockdown 1 compared with pre-COVID-19 trends. Similarly, columns D
152 and E show the immediate and subsequent trends for lockdown 2. The number of lags used in each
153 ITSA model are presented in column G, the post lockdown 1 trend in column H (i.e. which is the sum
154 of the trends in columns A and C), and the post lockdown2 trend in column I (which is the sum of the

155 trends in columns A, C, and E).

156 [Table 2]

157 Prior to the pandemic, there was an average of approximately 83 admissions per week. As Table 2
158 shows, there were 53.47 (95%CI: -66.47;-40.77) fewer admissions during the first week of the
159 pandemic restrictions followed by a decrease in weekly trend of hospital admissions relative to the
160 pre-pandemic trend of -0.47 (95%CI: -0.83;-0.11) admissions per week. The weekly number of
161 admissions decreased by -0.46 (95%CI: -0.65;-0.27) (or 2%) after lockdown 1 and by -0.21 (95%CI:-
162 0.38;-0.04) after lockdown 2. Similarly, the average length of stay per admission decreased by 1.12
163 (95%CI:- 1.73;-0.52) days per week after lockdown 1 and by 3.72 (95%CI:- 6.46;-0.97) days per week
164 after lockdown 2.

165 The patients admitted to hospital during the first week of lockdown 1 had on average 0.57 (95%CI:
166 0.30;0.84) more admissions over the follow-up period, suggesting that during this week more complex
167 cases were admitted to hospital. However, there was no further impact on the trends of the number
168 of admissions per patient.

169 The results also showed an increase in admissions to private hospitals in the first week of lockdown 1
170 by 9.2 (95%CI: 5.2;13.1) percentage points (p.p), but the system seemed to adjust to pre-pandemic
171 levels after lockdown 2 (i.e. a rapid fall in private admissions by 11.5 p.p. (95%CI: 19.2;3.7) followed
172 by a slight increase in weekly trends after lockdown 2).

173 Out-of-area hospital admissions also increased in the first week of lockdown 1 by 6.4 p.p. (95%CI:
174 1.8;11.0), as indicated by clinician's defined natural clinical flow, and 8.7 p.p. (95%CI: 2.7;14.8) based
175 on distance (i.e. >50 miles). However, there was no further impact on the level or trends of out-of-
176 area admissions.

177 In terms of changes in the socio-demographic characteristics of CYP admitted to hospital, the mean
178 age was 0.545 (95%CI: 0.399;0.690) years greater during the first week of lockdown 1 and increased
179 by another 0.384 (95%CI: <0.001;0.769) during the first week of lockdown 2.

180 There was an increase of 0.3 p.p. (95%CI: <0.1;0.7) per week in the proportion of females admitted
181 after lockdown 1 and 0.4 p.p. (95%CI: 0.1;0.8) per week in the proportion of patients from BAME
182 background admitted after lockdown 2. After lockdown 2, there was an immediate (i.e. in the first
183 week of the lockdown) increase in the proportion of looked after children admitted to hospital by 17.4
184 p.p. (95%CI: 11.6;1.3) followed by a downward trend of 1.1 p.p. (95%CI: 0.8;1.3).

185 Similarly, there was a downward trend in the admission of patients from the most socio-economically
186 deprived areas by 0.6 p.p. (95%CI: 0.2;0.9) per week after lockdown 2. This trend could have reflected
187 a downward adjustment after a considerable increase in the admissions of patients from the most
188 socio-economically deprived areas by 7.3 pp (95%CI: 1.2;13.4) during the first week of lockdown 2.

189 Figure 1. presents graphically the impact of the two lockdowns on the trends of four main outcome
190 variables. The upper left graph of Figure 1 shows a considerable (65%) decrease in admissions
191 immediately after lockdown 1 (65% reduction). The upper right graph depicts the trends in out of area
192 admissions, with a very rapid increase followed by a slower decrease back to pre-pandemic levels. The
193 lower left graph depicts the trends in mean number of total admissions of patients admitted in a week.
194 The lower right graph shows contrasting findings in admissions amongst CYP from the most deprived
195 quintile across the two lockdowns. A fall in admissions was noted immediately after lockdown 1, but
196 the trend was not sustained, and the percentage of admissions involving CYP from the most deprived
197 areas went back to pre-pandemic levels. On the other hand, although immediately after the second
198 lockdown, CYP from the most deprived quintile experienced a significant rise in admissions, it was
199 followed by a minimal but sustained decrease in admission trends.

200 [Figure 1]

201 **4 Discussion**

202 The COVID 19 pandemic had a significant impact on the functioning of mental health services and the
203 use of inpatient beds within England. To our knowledge this is the first national level study
204 investigating the impact of COVID-19 and related Public Health measures on CYP hospital inpatient
205 admissions during the pandemic across England.

206 These national data indicate that, across England there was a significant decrease in hospital
207 admissions during lockdown 1 and a further decrease in lockdown 2. This is likely to be because of a
208 raising of the threshold for admission referral and acceptance, and prioritisation of the most unwell
209 to be admitted to hospital as there were **staffing shortages and bed closures during that period. This**
is supported by our findings that during the early part of the first lockdown, the admitted patients had
a higher number of hospital admissions during the follow-up period compared to those admitted pre-
pandemic, indicating a higher severity of illness. Alternatively, it could also be possible that there was
increased community provision of MH services, including alternative modes of service delivery (i.e.,
online appointments); however national service data suggested a decrease of community
referrals was observed during the same period.¹⁴

210 Whilst admissions overall fell at the beginning of lockdown, a significantly higher percentage of those
211 who were admitted went to private sector units. These findings may be the result of government
212 policies to engage with independent sector providers during the unprecedented redeployment of NHS
213 resources to manage COVID-19; **or differences in agility to change practice in response to restrictions**
between the NHS and the private sector. Outsourcing of NHS services to private sector is increasingly
common in England,¹⁵ which may have increased during the pandemic for some services including
psychiatric inpatient services.

214 There was also an initial increase in the number of out-of-area admissions during lockdown. Out-of-
215 area admissions have been an ongoing problem within CAMHS even prior to the pandemic⁸. It is
216 concerning to have seen a rise in out-of-area admissions during COVID 19, since it is likely that the
217 combination of the distance, risks of contracting and spreading the virus and government restrictions
218 will have had added to the complexity of these admissions. Following the initial rise in out-of-area
219 admissions, these fell across the lockdowns to return to pre-pandemic levels, however many would
220 argue that these levels should be lower than they currently are and that services should be better
221 prepared to avoid out-of-area admissions in such a vulnerable population.

222 Mean length of hospital was steadily decreasing prior to the pandemic. However, length of stay fell
223 more rapidly during the pandemic. The final phase of a psychiatric admission usually includes regular
224 periods of home leave of increasing length, until clinicians are satisfied that the patient is safe to be
225 discharged. However, since the locations to which a patient could go on leave were restricted, and
226 any time at home counted as an infection risk which necessitated repeated testing and quarantining
227 prior to returning to the ward, this process was often not feasible. Clinicians were therefore required
228 to discharge patients with few to no trial periods of leave. This necessary change in practice may also
229 explain the higher-than-normal re-admission rate during this period.

230 There was a reduction in the proportion of admitted males lockdown 1 and lockdown 2. The reasons
231 for this are not clear and may represent lower help-seeking amongst males or overall lower self-
232 harming or risk behaviours. Lockdown may also have restricted access to alcohol and illicit substances,
233 which are overall used more frequently by young males compared to females¹⁶ and can have negative
234 effects on mental health and risk within young people.¹⁷

235 There was a significant rise in admissions of those from the most deprived areas of the country at the
236 start of lockdown. Studies have shown that the COVID 19 pandemic has most significantly impacted
237 those from deprived areas¹⁸ and these findings suggest that it has worsened health inequalities within
238 child and adolescent mental health care.

239 4.1 Comparison with other studies

240 Studies have indicated that the COVID-19 pandemic has a substantial impact on public mental health
241 and that certain population groups are at greater risk of worsening mental health. Chen et al (2020)
242 looked at medium term trends in secondary care psychiatry referrals and found that across the
243 population there was an initial fall in referrals followed by an acceleration in the referral rate
244 compared to previous year.¹⁹ However, when groups who were suspected to be more vulnerable to
245 the effects of the pandemic were analysed separately, such as older adults and CYP, this trend was
246 not seen.²⁰ This fits with our data since there is no rapid re-increase in admissions following the initial
247 fall, instead there were further decreases in admission numbers. Bakolis et al. (2020) also found
248 ongoing reduced caseloads for CAMHS both during and after lockdown 1, with more non face-to-face
249 contacts.²¹ Our finding of higher complexity of the cases who did present during lockdown is also in
250 line with the findings of Mukadam et al (2021) who showed lower numbers of psychiatric
251 presentations to emergency departments but of those who presented a higher proportion were
252 admitted to inpatient units.²² Steeg et al. reviewed studies of looking at self-harm presentations
253 finding sustained reductions in service utilisation during 2020 which correlates with our findings
254 however there were increases in service utilisation following self-harm in adolescents from 2021²³.

255 4.2 Limitations of this study

256 The main strength of this study is the use of individual patient data from the entire country that
257 ensures the generalisability of the results across England. However, it is also subject to limitations.
258 First, this routinely collected data did not capture information about young people who may have
259 been close to the threshold for admission but were not admitted. Second, it was not possible to fully
260 disentangle the impact of the pandemic on the population's mental health from the impact of policy
261 responses on the provision of inpatient care. However, it is important to analyse and reflect upon the
262 events of the COVID 19 pandemic in order for the NHS to devise and navigate recovery plans following
263 the pandemic as well as optimising any future pandemic responses. Last, we did not investigate the
264 impact of the pandemic on outpatient visits, primary care presentations or emergency department
presentations. Studies have found a decreased total number of presentations to hospital emergency
departments, and increased proportion of children and with self-harm presentations but no increase
in the proportion of severe self-harm within those presenting with self-ham. 23

265 4.3 Service Implications:

266 There is consensus that the pandemic has resulted in significant implications for CYP mental health,
267 including an increased burden of poor mental health and potentially substantial demand for services⁷.
268 However, specific sub-groups may have experienced greater risks and difficulties, such as CYP living in
269 deprived areas, those from ethnic minorities, and vulnerable children, including looked-after children.
270 To avoid deepening or widening inequalities, it will be necessary to not only actively identify the extent
271 of these inequalities and associated drivers but also reach out to these populations to address hidden
272 unmet needs and provide a universally proportionate response.²⁴

273 With the phased delegation of Specialised Mental health services to the Integrated Care systems
274 beginning in July 2022, commissioning of CYP MH services in England are moving away from the
275 historic four-tier structural framework of service provision with unspecialised, universal services at
276 tier 1 funded by local authorities, tier 2-3 funded by Clinical commissioning groups and inpatient

277 treatment facilities at tier 4 funded by NHS Specialised Commissioning teams. However, the pre-
278 existing variation in commissioning and delivery structures has led to a complex, fragmented system
with variability in the quality of patient outcomes.^{25 26}

279 The key findings of our study, reflecting decreased hospital admissions during the pandemic along
280 with a concurrent decrease in community provision as per the publicly available data on community
281 provision, highlights the importance of focussing on expanding the provision of preventative and
282 community-based services, ensuring equitable access, and the potential of preventing much longer,
283 more expensive courses of inpatient treatment for repeated or complex admissions.

284 Similar to other studies,²⁷ we recommend the following to inform commissioning while accounting for
285 the direct and indirect impact of the ongoing COVID-19 pandemic:

- 286 • Map existing provision of CYP MH services along with system level understanding of funding
287 including system developmental monies across all tiers of the CYP pathway to enable accurate
288 estimates of treatment gaps and effective commissioning of services.
- 289 • Working with local authorities, ICSs should **maximise the prevention offer of early childhood**
290 **services** while expanding and improving quality, provision, and access associated with low-
291 level, preventative and universal CYP MH services.
- 292 • Identify avoidable health inequalities alongside risk factors (including protective factors)
293 across the CYP MH pathway.

304

305 **Conflict of interest**

306 None

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314 concept and facilitating data access. Importantly, we thank the Children and young people who used
315 these healthcare services, and we hope that this study will contribute to improving their access,
316 experience, and outcomes.

317 **Author Contribution**

318 AT was involved in the design of the study, analysis of the data, interpretation of the data, drafting
319 the work and approval of the version to be published.

320 JH was involved in the design of the study, interpretation of the data, drafting the work and final
321 approval of the version to be published.

322 BG was involved in the design of the study, reviewing of the draft and final approval of the version to
323 be published.

324 KS was involved in the design of the study, interpretation of the data, reviewing the draft and final
325 approval of the version to be published.

326 AP was involved in the original conception of the study, the design of the study, acquisition of the
327 data, interpretation of the data, reviewing the draft and final approval of the version to be published.

328 **Data availability**

329 The data that support this study were obtained from the national specialised mental health Patient
330 Level Dataset that prohibits using or sharing the data beyond this study.

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Table 1. Patient characteristics in the entire sample (n=6,250)

Variable	Pre-pandemic (n=6,156)	Post-pandemic (n=94)	Total sample (n=6,250)
Mean age at first admission (SD) [Median; IQR]	15.3 (1.7) [16;3]	15.6 (1.6) [16;2]	15.3 (1.7) [16;3]
Gender			
Female	70%	72%	70%
Missing	1%	2%	1%
BAME background			
Yes	18%	18%	18%
Missing	7%	6%	7%
Looked after			
Yes	11%	8%	11%
Missing	14%	13%	14%
In full education			
Yes	43%	34%	43%
Missing	35%	47%	35%
Mean number of admissions per patient (SD) [Median; IQR]	1.7 (1.2) [1;1]	1.2 (0.6) [1;0]	1.7 (1.2) [1;1]
Mean length of stay (SD) [Median; IQR] n	93 (94) [68;94] 6,065	65 (65) [43;77] 71	93 (94) [67;94] 6,136
Mean number of out-of-area admissions per patient (SD) [Median; IQR]	0.48 (0.8) [0;1]	0.33 (0.6) [0;1]	0.48 (0.80) [0;1]

SD: standard deviation; IQR: Interquartile range expressed as the difference between percentile 75 and percentile 25;

Table 2. Impact of Covid19 pandemic in England on child and adolescent mental health services

Outcome variable	A Pre-trend Coeff (se) [95%CI]	B Immediate effect (lockdown1) Coeff (se) [95%CI]	C Slope post (lockdown1) Coeff (se) [95%CI]	D Immediate effect (lockdown2) Coeff (se) [95%CI]	E Slope post (lockdown2) Coeff (se) [95%CI]	F Constant Coeff (se) [95%CI]	G Lags	H Post-trend Lockdown 1 Coeff (se) [95%CI]	I Post trend Lockdown 2 Coeff (se) [95%CI]
Weekly admissions	0.01 (0.13) [-0.26;0.27]	-53.47 (6.58) [-66.47;-40.77]	-0.47 (0.18) [-0.83;-0.11]	-1.14 (1.73) [-4.55;2.28]	0.25 (0.13) [-0.01;0.50]	82.82 (9.95) [63.17;102.47]	5	-0.46 (0.10) [-0.65;-0.27]	-0.21 (0.09) [-0.38;-0.04]
LOS	-0.40 (0.14) [-0.68;-0.12]	-2.43 (8.02) [-18.27;13.42]	-0.72 (0.25) [-1.22;-0.22]	15.63 (10.04) [-4.21;35.46]	-2.59 (1.35) [-5.26;0.07]	73.83 (195.27) [-311.90;459.57]	6	-1.12 (0.30) [-1.73;-0.52]	-3.72 (1.39) [-6.46;-0.97]
Number of admissions per patient	0.01 (>0.00) [0.01;0.01]	0.57 (0.14) [0.30;0.84]	0.01 (0.01) [-0.01;0.2]	-0.03 (0.02) [-0.08;>0.00]	-0.04 (0.02) [-0.08;>0.00]	1.97 (0.06) [1.86;2.08]	1	0.01 (>0.01) [<-0.00;0.03]	-0.03 (0.02) [-0.06;0.01]
% private providers	-0.001 (0.000) [-0.001;-0.001]	0.092 (0.020) [0.052;0.131]	-0.001 (0.001) [-0.003;0.002]	-0.115 (0.039) [-0.192;-0.037]	0.009 (0.003) [0.002;0.015]	0.426 (0.012) [0.403;0.450]	10	-0.002 (0.001) [-0.004;0.001]	0.007 (0.003) [0.002;0.013]
% Out of area admissions (natural clinical flow)	<-0.000 (<0.000) [<-0.001;>0.000]	0.064 (0.023) [0.018;0.110]	-0.003 (0.002) [-0.006;0.001]	-0.030 (0.037) [-0.102;0.425]	0.003 (0.003) [-0.003;0.010]	0.228 (0.011) [0.205;0.250]	7	-0.003 (0.002) [-0.006;0.006]	0.006 (0.002) [-0.004;0.005]
% Out of area admissions (>50m)	<-0.000 (<0.000) [-0.001;<-0.001]	0.087 (0.30) [0.027;0.148]	-0.003 (0.002) [-0.006;0.001]	0.019 (0.071) [-0.121;0.160]	0.002 (0.004) [-0.005;0.009]	0.229 (0.009) [0.210;0.248]	3	-0.003 (0.002) [-0.007;0.001]	-0.001 (0.004) [-0.008;0.006]
Age	0.002 (0.001) [0.001;0.003]	0.545 (0.074) [0.399;0.690]	-0.009 (0.005) [-0.020;0.002]	0.384 (0.195) [<0.001;0.769]	-0.003 (0.016) [-0.035;0.028]	15.29 (0.04) [15.21;15.38]	0	-0.071 (0.001) [-0.018;0.004]	-0.010 (0.015) [-0.040;0.019]
% females	<0.000 (<0.000) [<-0.001;<0.00]	0.007 (0.029) [-0.050;0.063]	0.003 (0.002) [<-0.001;0.006]	-0.017 (0.066) [-0.147;0.112]	-0.009 (0.005) [-0.019;0.001]	0.738 (0.012) [0.714;0.763]	0	0.003 (0.002) [<-0.001;0.007]	-0.006 (0.005) [-0.015;0.004]
% BAME	<0.000 (<0.000) [<-0.001;<0.00]	-0.030 (0.040) [-0.108;0.049]	-0.001 (0.002) [-0.005;0.003]	0.005 (0.036) [-0.067;0.076]	0.005 (0.003) [-0.001;0.011]	0.178 (0.005) [0.167;0.189]	15	-0.001 (0.002) [-0.005;0.003]	0.004 (0.002) [0.001;0.008]
% looked after children	<0.000 (<0.000) [<-0.001;<0.00]	0.035 (0.027) [-0.019;0.089]	-0.002 (0.001) [-0.005;0.001]	0.174 (0.030) [0.116;0.233]	-0.009 (0.002) [-0.013;-0.005]	0.141 (0.010) [0.122;0.160]	10	-0.002 (0.001) [-0.005;0.001]	-0.011 (0.001) [-0.013;-0.008]
% Q1 IMD	0.000 (0.000) [0.000;0.000]	-0.041 (0.014) [-0.068;-0.013]	-0.001 (0.001) [-0.002;0.001]	0.073 (0.031) [0.012;0.134]	-0.005 (0.002) [-0.009;-0.001]	0.162 (0.007) [0.148;0.176]	6	<0.001 (0.001) [-0.002;0.001]	-0.006 (0.002) (-0.009;-0.002)

Notes: The coefficients of the OLS regression with Newey–West standard errors (se) and 95% confidence intervals (CI); Column A: the trend before the pandemic; Column F: the starting level of the trend at the beginning of the follow-up period (i.e. Jan 2018). Columns B and C: present the immediate impact (i.e. in the first week) and the subsequent trend of lockdown 1 compared with pre-COVID-19 trends; Columns D and E: the immediate and subsequent trends for lockdown 2; Column G: the number of lags used in each ITSA model; Column H: the overall post lockdown 1 trend; Column I: the overall post lockdown2

trend; LOS: length of stay; BAME: Black Asian and Minority Ethnic group; Q1: first quintile; IMD: Index of Multiple Deprivation; Statistically significant results of interest are presented in bold.

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Figure 1. Interrupted time-series graphs of key outcomes

