

Impact of COVID-19 pandemic on emergency department attendances for young people

Folasade Solanke,¹ Stephanie Easton,^{1,2} Anna Selby,^{1,2} David James,² Graham Roberts^{1,2,3,4}

► Additional supplemental material is published online only. To view, please visit the journal online (<http://dx.doi.org/10.1136/archdischild-2021-323389>).

¹Faculty of Medicine, University of Southampton, Southampton, UK

²Department of Child Health, University Hospital Southampton NHS Foundation Trust, Southampton, UK

³David Hide Asthma and Allergy Research Centre, St Mary's Hospital, Newport, UK

⁴NIHR Southampton Biomedical Research Centre, University Southampton NHS Foundation Trust, Southampton, UK

Correspondence to

Professor Graham Roberts, University of Southampton Faculty of Medicine, Southampton, UK; g.c.roberts@soton.ac.uk

Received 16 October 2021
Accepted 8 April 2022
Published Online First
12 May 2022

ABSTRACT

Introduction There are concerns that the COVID-19 pandemic is having an indirect negative impact on young people. We aimed to assess the impact of the pandemic on emergency department (ED) presentations and admissions.

Design We analysed ED presentations and admissions from a 5-year period (April 2016–February 2021). An interrupted time series analysis was used to estimate the presentations and admissions that would have been seen in year 5 without the pandemic using the data from years 1 to 4. These estimations were used to calculate the difference between the expected and the observed presentations and admissions during the pandemic year.

Results There were 166 459 presentations over 5 years. There was a 38.1% (95% CI 33.9% to 42.3%) reduction in presentations during the pandemic with no variation by sex, age, deprivation or ethnicity. Largest reductions were associated with children being home schooled rather than with lockdowns. For admissions, there was a 23.4% (17.4% to 29.4%) reduction, less for 5–17 year age group. Infection and asthma/wheeze presentations reduced by around 60% with smaller reductions for mental health and trauma. There was no change for surgical presentations, burns/scolds or allergic reactions. There was an increase in females aged 11–17 years presenting with mental health issues during the pandemic.

Conclusions During the pandemic, there was a substantial reduction in both ED presentations and admissions. The differential impact on specific presentations suggests this was due to the impact of social distancing and reduced social mixing rather than widening of health inequality or increased barriers to care.

Trial registration number NCT04893122.

INTRODUCTION

The COVID-19 infection was initially identified in Wuhan, China in December 2019, with cases of pneumonia of unknown origin.¹ The first reported cases of COVID-19 in the UK were identified at the end of January 2020.² The WHO declared the COVID-19 pandemic on 11 March 2020.¹ COVID-19 gives rise to respiratory symptoms accompanied by other syndromic features, with older individuals disproportionately affected.³ The UK government introduced social distancing and national lockdown measures from March 2020 (box 1).⁴

The impact COVID-19 has on older members of society is well documented.³ Children, adolescents

WHAT IS ALREADY KNOWN ON THIS TOPIC

⇒ Children, adolescents and young adults are largely not particularly unwell with COVID-19. A decrease in paediatric emergency presentations was seen in the first few months of the pandemic. Concern has been expressed that reduced presentations may lead to harm, especially with serious medical and surgical pathologies.

WHAT THIS STUDY ADDS

⇒ There was a large reduction in presentations and admissions during the pandemic with no variation by sex, age, deprivation or ethnicity. Larger reductions were seen for infection and with no change for surgical presentations suggesting this was driven by social distancing and reduced social mixing. There was an increase in females aged 11–17 years presenting with mental health issues during the pandemic.

HOW THIS STUDY MIGHT AFFECT RESEARCH, PRACTICE OR POLICY

⇒ We need to understand how the use of different emergency care pathways changed to help future public health messaging to sign post the most appropriate pathway. We need to understand which pandemic interventions were most important in reducing infectious disease presentations; some might be appropriately continued after the pandemic. We need to understand how to support the mental health of female adolescents, particularly around their exposure to digital media.

and young adults however are largely not particularly unwell with COVID-19.⁵ There are potential indirect impacts of the pandemic on children with possible social, economic, psychological and medical affects. Adolescents and young adults are another vulnerable group, especially in terms of mental health problems.⁶ The Office for National Statistics has documented a general rise in symptoms of depression.⁷ Parents have had to make the decision as to whether their child sufficiently unwell to need to be taken to hospital during the pandemic. Barriers to presentation to hospital may



© Author(s) (or their employer(s)) 2022. No commercial re-use. See rights and permissions. Published by BMJ.

To cite: Solanke F, Easton S, Selby A, et al. *Arch Dis Child* 2022;**107**:e1.

Box 1 Key dates during the pandemic in the UK⁴

First COVID-19 case in UK: 29 January 2020.
 COVID-19 pandemic declared by The WHO: 11 March 2020.
 First national lockdown: 26 March–15 June 2020.*
 Online school learning: from 24 March with phased reopening from 1 June 2020.
 School summer holiday: 23 July–1 September 2020.
 Return to in-school learning for all students: 3 September–18 December 2020.
 Second national lockdown (continuation of normal schooling): 5 November–2 December 2020.*
 Christmas school holiday: 19 December 2020–3 January 2021
 Third national lockdown: 6 January 2021–11 April 2021.*
 Restart of online school learning: 6 January 2021–7 March 2021.

*Date when non-essential shops were allowed to open.

include societal restrictions, problems with local transport and illness and shielding in the family. A decrease in paediatric emergency presentations was seen in the few months following the onset of the pandemic in March 2020 in different UK hospitals.^{8 9} This decrease in paediatric emergency presentations and healthcare utilisation is potentially harmful, especially with serious medical and surgical pathologies.^{10 11}

In this study, we explored the impact of COVID-19 on emergency presentations in 0–24 year olds over the first year of the pandemic in a large emergency department (ED) and regional mixed major trauma centre. The two key objectives were first to assess the impact on overall ED presentations and hospital admissions and second to assess the impact of the pandemic on a number of specific medical, surgical, trauma and mental health conditions.

METHODS

Study design and participants

We undertook a retrospective observational study using an anonymised database of patients who presented to University Hospital Southampton NHS Foundation Trust in the UK.

Participants were patients aged 0–24 complete years who had presented to University Hospital Southampton NHS Foundation Trust over a 5-year period from 1 April 2016. There were no exclusion criteria. The dataset was fully anonymised prior to analysis. Further details are in the online supplement.

Outcomes

The primary outcome was attendance to ED in Southampton. This was defined as being booked into the ED admission system or onto the paediatric assessment unit admission system before September 2019. The secondary outcome was admission to University Hospital Southampton NHS Foundation Trust.

Population subgroups

We planned subgroup analyses by different presentations based on diagnostic labels in the ED: respiratory infection (eg, bronchiolitis, pneumonia and croup); asthma or wheeze (merged given that they are potentially overlapping diagnoses); gastrointestinal infections (eg, gastroenteritis and vomiting); general surgical presentations; mental health (eg, overdose, self-harm); traumatic/accidental injuries (focused on head injuries, fractures and sprains/ligament injuries); burns/scalds; and allergy/anaphylaxis. These groups were not intended to cover all presentations.

It was hypothesised that infectious disease, wheeze/asthma (most exacerbations are driven by viral infections),^{12 13} trauma and allergy presentations would fall while there would be no change in surgical presentations and an increase in mental health presentations.

Statistical analysis

The data for presentation and admission were initially assessed graphically. Overall numbers of presentations and admissions were reviewed for each week from April 2016 to February 2021. Data were compared by sex, age, ethnicity, deprivation and specific presentations.

An interrupted time series analysis was undertaken to assess the impact of the pandemic on attendances and admissions using Stata V.16 (Stata Corporation). This approach was used to estimate the number of ED presentations that would have been seen had there not been a pandemic (the counterfactual) based on the previous 4 years of data. This approach controls for long-term trends. The primary analysis focused on presentations.

We additionally undertook subgroup analyses on the different sex, age subgroups, ethnicity, deprivation and specific presentations. The analysis was repeated for admission data. The time series forecast enabled us to estimate the difference between the expected attendances/admissions (counterfactual) and observed ones during the pandemic period. This was presented as absolute and relative difference (95% CIs). A p value of less than 0.05 was taken to indicate statistical significance.

As a secondary analysis, we estimated the expected number of presentations and admissions using the average of the preceding 2 years on the basis that this minimised the impact of any long-term trends. We used this to assess whether the impact of the pandemic was similar for each subgroup for each presentation. This was assessed with a χ^2 analysis to highlight overall differences.

It has been suggested that 24 or more time points have more than 80% power to detect an effect size of 1 or greater, with a minimum of 8 time points per period needed for sufficient power in estimating regression coefficients.¹⁴

Ethical and research governance

The study was registered at clinicaltrials.gov.

RESULTS

Participants

A total of 1 664 59 patients aged 0–24 years presented to University Hospital Southampton NHS Foundation Trust from 1 April 2016 to 25 February 2021. Of these, 86 164 (52%) were male, and 137 411 (83%) patients were of white ethnicity. The largest group of patients presenting to ED were in age groups 0–4 years, accounting for 57 166 (34%) presentations followed by those aged 18–24 years, accounting for 52 447 (32%) presentations (online supplemental table S1). **Table 1** shows the patient demographics for patients presenting over the 5-year period, before and during the pandemic. There were less than 200 COVID-19 cases in the study group during the study period. Details for those admitted are shown in online supplemental table S2.

Weekly presentations and admissions before and during the pandemic

Figure 1 shows the weekly ED presentations and admissions by sex, age subgroup, deprivation decile subgroup and ethnicity during the year before and during the pandemic. In mid-March 2020, there is an obvious substantial reduction in the number of

Table 1 Summary of participants presenting to emergency department

	Prepandemic				Pandemic					
	Year 1	Year 2	Year 3	Year 4	Year 5					
All	35 806	100.0	35 059	100.0	35 407	100.0	36 827	100.0	23 360	100.0
Males	18 656	52.1	18 375	52.4	18 488	52.2	19 022	51.7	11 623	49.8
Females	17 144	47.9	16 681	47.6	16 913	47.8	17 799	48.3	11 725	50.2
0–4 years	12 251	34.2	12 121	34.6	12 485	35.3	12 629	34.3	7 680	32.9
5–10 years	5 361	15.0	5 331	15.2	5 578	15.8	6 051	16.4	3 483	14.9
11–17 years	6 515	18.2	6 263	17.9	6 485	18.3	7 061	19.2	4 718	20.2
18–24 years	11 679	32.6	11 344	32.4	10 859	30.7	11 086	30.1	7 479	32.0
Low deprivation	9 963	28.0	9 770	28.1	9 711	27.6	10 317	28.2	6 691	28.8
Moderate deprivation	13 316	37.4	13 487	38.7	13 624	38.7	13 932	38.1	9 026	38.8
High deprivation	12 285	34.5	11 561	33.2	11 828	33.6	12 310	33.7	7 538	32.4
White ethnicity	30 017	83.8	29 428	83.9	29 515	83.4	29 629	80.5	18 822	80.6
Non-white ethnicity	3 938	11.0	3 715	10.6	3 791	10.7	4 318	11.7	2 597	11.1
Admitted	6 870	19.1	6 706	19.0	7 246	20.6	7 568	20.7	5 293	22.8
Discharged	28 936	80.3	28 353	80.5	28 161	79.9	29 259	80.1	18 067	77.8
Own transport	22 636	71.5	22 652	73.2	23 201	74.7	27 244	77.5	17 965	76.9
Ambulance	7 094	22.4	6 860	22.2	7 092	22.8	7 271	20.7	5 150	22.0
Public transport	1 612	5.1	1 210	3.9	653	2.1	546	1.6	165	0.7
Other arrival mode	301	1.0	218	0.7	108	0.3	109	0.3	80	0.3
Self or carer referral	23 741	66.4	23 970	68.4	25 668	72.5	28 883	78.4	17 138	74.1
Emergency and hospital referral	4 213	11.8	3 174	9.1	2 144	6.1	1 455	4.0	488	2.1
National Health Service (NHS) 111	2 905	8.1	3 254	9.3	3 189	9.0	2 689	7.3	3 327	14.4
General Practitioner (GP) referral	3 817	10.7	3 768	10.7	3 801	10.7	3 056	8.3	1 731	7.5
Other referral pathway	1 077	3.0	893	2.5	605	1.7	744	2.0	439	1.9
Trauma	5 874	16.4	5 874	16.8	6 820	19.3	6 144	16.7	3 523	15.1
Surgical	2 163	6.0	1 806	5.2	1 524	4.3	1 658	4.5	1 541	6.6
Respiratory infections	1 212	3.4	3 152	9.0	4 373	12.4	4 853	13.2	1 872	8.0
Asthma/wheeze	815	2.3	1 078	3.1	1 434	4.1	1 023	2.8	2.5%	815
Mental health	756	2.1	1 392	4.0	1 926	5.4	1 926	5.2	1 441	6.2
Burns/scalds	485	1.4	407	1.2	389	1.1	446	1.2	379	1.6
Allergy	310	0.9	335	1.0	296	0.8	295	0.8	219	0.9
Gastrointestinal infections	286	0.8	618	1.8	1 056	3.0	1 199	3.3	473	2.0

Data are number (column percentage).

Year 1: 1 April 2016–31 March 2017 (365 days); year 2: 1 April 2017–31 March 2018 (365 days); year 3: 1 April 2018–31 March 2019 (365 days); year 4: 1 April 2019–12 March 2020 (347 days); year 5: 13 March 2020–26 February 2021 (351 days). Information about sex and ethnicity not available for all patients. Other arrival mode includes custodial services, police and unknown. NHS 111 also includes NHS Direct and other NHS advice. Other referral pathway includes custodial services, police service, planned review and unknown. Trauma just covers head injuries, fractures and soft tissue injuries. A comparison with Southampton local authority demographic data is given in online supplemental table S1.

presentations and admissions, irrespective of sex, age subgroup, deprivation decile subgroup and ethnicity.

Predicting presentations and admissions had the pandemic not occurred

Figure 2 shows a graphical representation of the number of presentations and admissions at different time points comparing the year before (prepandemic) and the year of the pandemic. It also shows the estimated presentations and admissions assuming the pandemic had not occurred. These time series forecasts allow seasonal variation and long-term trends (eg, increasing presentations over time) to be taken into account. The largest drops in presentations are seen with national lockdowns combined with home schooling. ED presentations return to their expected levels when schools reopened in September 2020. There was not such a marked reduction in activity in the second period of lockdown (box 1) until children stopped school the start of the Christmas holiday.

Estimated impact of the pandemic on presentations and admissions

Based on the time series analyses forecast of the ED presentations had there not been a pandemic, there were 38.1% (95% CI 33.9% to 42.3%) fewer ED presentations during the pandemic year (table 2). Similar reductions were seen for each gender, age, deprivation decile and ethnicity subgroup. This reduction was most dramatic in infectious disease ED presentations: respiratory infections: 59% (95% CI 46.5% to 72.5%), asthma/wheeze: 55.9% (95% CI 45.7% to 66.2%) and gastrointestinal infections: 64.1% (95% CI 54.8% to 73.5%). Smaller reductions were seen for mental health (30.3% (95% CI 24.0 to 42.5%)) and trauma (33.3% (95% CI 24.0 to 42.5%)) presentations. For surgical presentations, burns/scalds and allergy/anaphylaxis, observed presentation numbers were similar to estimated ones (table 2).

For admissions, a 23.4% (95% CI 17.4% to 29.4%) reduction was seen during the pandemic (year 5) compared with numbers

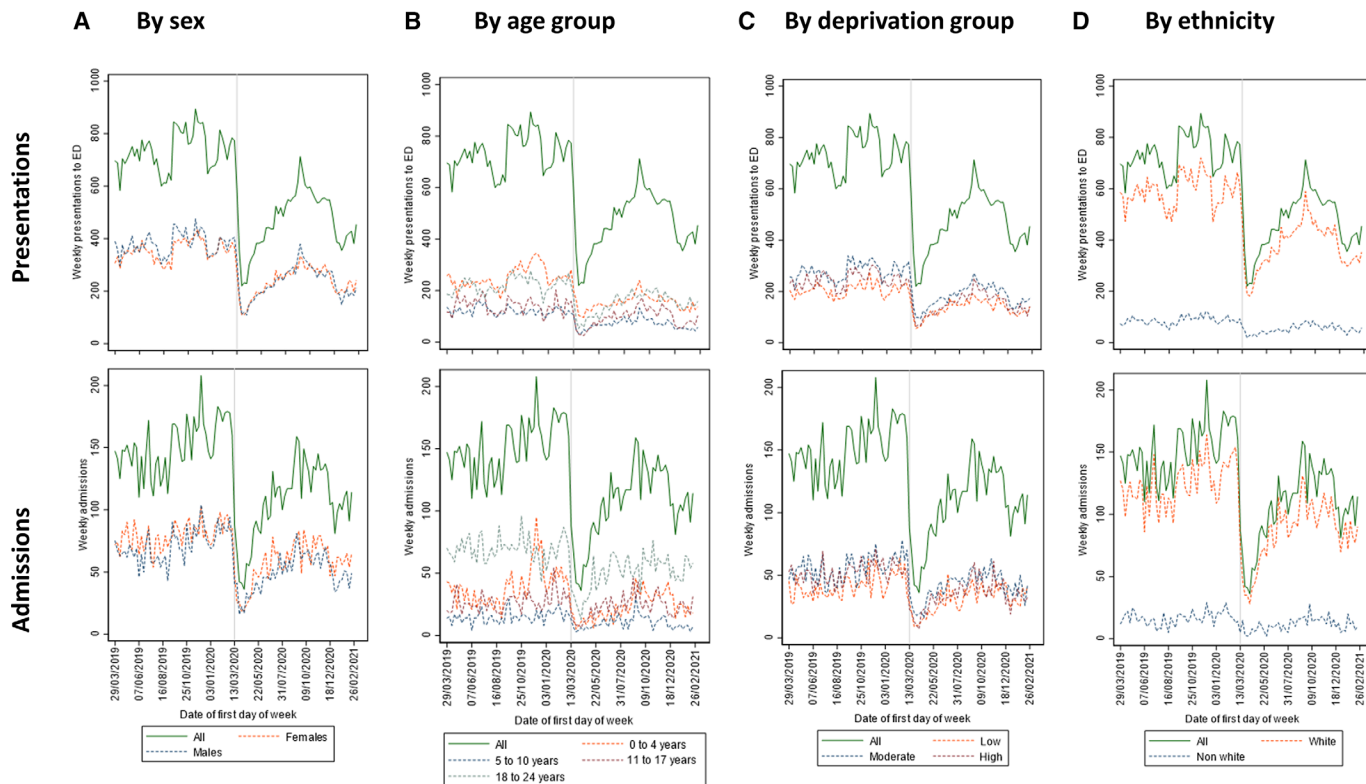


Figure 1 Weekly presentations and admissions before and during the pandemic. Presentations to emergency department and admissions by week for 1 year before (year 4) and after (year 5) the start of the pandemic (marked with grey line). Data presented for all and then split by (A) sex, (B) age group, (C) deprivation decile and (D) ethnicity.

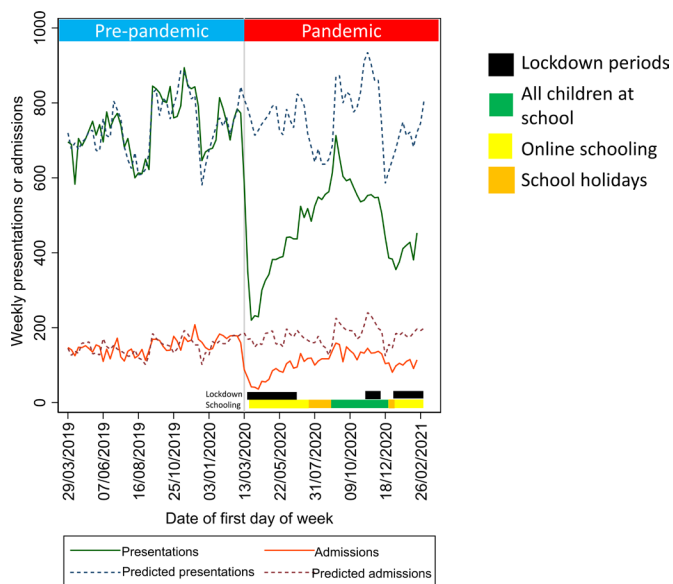


Figure 2 Observed presentations to emergency department and admissions with estimated activity had the pandemic not occurred. Time series analysis fitted to data from first 4 years and then used to estimated activity in pandemic year 5 assuming the pandemic had not occurred (dotted lines). The time series approach models trend (long-term changes), cycle (aperiodic oscillations around the trend), seasonal (increased presentations in autumn and winter) and random noise. Green line represents presentations, and red line represents admissions. During the prepandemic year (year 4), the estimated line is seen to be a close but not exact fit with the observed data. Time series models presented in online supplemental figures S2 and S7.

estimated by the time series analysis (table 2). No significant reduction was seen for school age (5–17 years) children nor those from low deprivation households (table 2). There were dramatic reductions in infection driven admissions (respiratory infections 60.7% (95% CI 46.0 to 75.5%), asthma/wheeze 42.6% (95% CI 29.6 to 55.8%)). There were also smaller reductions in mental health admissions (28.5% (95% CI 19.9 to 37.1%)) (in part due to access to next day community psychiatry assessment during the pandemic preventing some admissions) and trauma (44.8% (95% CI 35.8 to 53.8%)) admissions. Surgical admission were not significantly reduced during the pandemic (table 2). There were too few admissions to see the possible impact of the COVID-19 pandemic on gastrointestinal infections, burns/scalds and allergy/anaphylaxis related admissions.

In our secondary analysis, we found that the impact was different between subgroups for some presentations when expected pandemic year 5 presentations and admissions were calculated as an average of the previous years and compared with the observed data. Specifically, for mental health presentations, there was an increase (26.6%) in presentations for the 11–17 year age group, while they were similar or reduced for the other age groups during the pandemic year (25.0%, 7.5% and 29.8% reductions for 0–4, 5–10 and 18–24 year age groups, respectively, $p < 0.001$) (online supplemental table S7). Additionally, while there was a large reduction in males presenting with mental health problems, there was a similar number of female presentations (31.5% vs 1.3% reductions, respectively, $p < 0.001$) (online supplemental table S7). Further analysis confirmed that females in the 11–17 year group who were more likely to present with mental health problems during the pandemic (online supplemental table S19, figure S1). Similar differences in admissions for mental health problems were seen

Table 2 Summary of observed (A) presentations and (B) for pandemic year 5 and estimated presentations if there had not been a pandemic

A. Presentations	Observed		Estimated had there not been a pandemic		Absolute difference		Relative difference
	Pandemic (year 5)	Percentage	Pandemic (year 5)	Percentage	Mean	95% CI	
All	23 360	100.0	37 740	100.0	-14 380	-12 784 to -15 977	
Males	11 623	49.8	19 581	51.9	-7958	-7062 to -8855	
Females	11 725	50.2	18 318	48.5	-6593	-5815 to -7371	
0 to 4 years	7680	32.9	13 100	34.7	-5420	-4749 to -6092	
five to 10 years	3483	14.9	6282	16.6	-2799	-2435 to -3163	
eleven to 17 years	4718	20.2	7859	20.8	-3141	-2638 to -3643	
18 to 24 years	7479	32.0	11 337	30.0	-3858	-3261 to -4456	
White ethnicity	18 822	80.6	30 546	80.9	-11 725	-10 438 to -13 012	
Non-white ethnicity	2597	11.1	4384	11.6	-1690	-1424 to -1957	
Low deprivation	6691	28.6	11 583	30.7	-4892	-4416 to -5367	
Moderate deprivation	9026	38.6	14 388	38.1	-5362	-4746 to -5979	
High deprivation	7538	32.3	12 495	33.1	-4957	-4358 to -5556	
Respiratory infections	1872	8.0	4624	12.3	-2752	-2150 to -3354	
Asthma/wheeze	579	2.5%	1313	3.5	-737	-600 to -869	
Gastrointestinal infections	473	3.3	1198	3.2	-768	-656 to -880	
Surgical	1541	6.6	1535	4.1	6	167 to -156	
Mental health	1441	6.2	2066	5.5	-625	-495 to -754	
Trauma	3523	16.7	5281	14.0	-1758	-1269 to -2247	
Burns/scalds	379	1.6	390	1.0	-11	45 to -68	
Allergy	219	0.9	262	0.7	-43	3 to -89	

B. Admissions	Observed		Estimated had there not been a pandemic		Absolute difference		Relative difference
	Pandemic (Year 5)	Percentage	Pandemic (year 5)	Percentage	Mean	95% CI	
All	5293	100.0	6911	100.0	-1618	-1203 to -2033	
Males	2447	47.3	3510	50.8	-1063	-853 to -1273	
Females	2842	52.7	3678	53.2	-836	-595 to -1078	
0-4 years	1146	26.1	1566	22.7	-420	-277 to -562	
5-10 years	501	10.0	525	7.6	-24	45 to -93	
11-17 years	1145	17.9	1195	17.3	-50	88 to -187	
18-24 years	2501	46.1	3606	52.2	-1105	-868 to -1341	
White ethnicity	4260	88.2	5924	85.7	-1664	-1317 to -2012	
Non-white ethnicity	567	11.8	797	11.5	-218	-142 to -294	
Low deprivation	1518	27.8	1597	23.1	-79	92 to -250	
Moderate deprivation	2045	37.4	2981	43.1	-936	-756 to -1116	
High deprivation	1694	34.8	2893	41.9	-1200	-1062 to -1338	
Respiratory infections	359	6.8	913	13.2	-554	-420 to -689	
Asthma/wheeze	314	5.9	547	7.9	-233	-162 to -305	
Gastrointestinal infections	69	1.3	-	-	-	-	
Surgical	764	14.4	659	9.5	-96	194 to -1	
Mental health	771	14.6	1078	15.6	-307	-214 to -400	
Trauma	355	6.7	643	9.3	-288	-230 to -346	
Burns/scalds	8	0.2	-	-	-	-	
Allergy	59	1.1	-	-	-	-	

Data are counts (percentages). Differences represent absolute (table) and relative (figure) differences (95% CIs) between estimated presentations or admissions had there not been a pandemic and observed presentations or admissions. Estimates are based on the time series analysis data from years 1-4, Year 5: 13 March 2020-25 February 2021 (50 weeks). Some admission estimates missing as there were insufficient admission each week to generate a time series equation. Time series models are presented in online supplemental figure S21-S11, S20-S24.

(online supplemental table S20). There was also a smaller reduction for the 18-24 year age group for respiratory infections presentations than other groups (26.8% vs 63.2%, 67.2% and 45.3% for 0-4, 5-10 and 11-17 year age groups, respectively, $p < 0.001$) (online supplemental table S3). For admissions, there were smaller reductions for both the 11-17 and 18-24 year age groups than for other age groups (1.3% and 25.2% vs 63.9% and 67.2% for 0-4, and 5-10 year age groups, $p < 0.001$) (online supplemental table S11). Lastly, for accident and trauma presentations, there was a much larger reduction in presentations for the 18-24 age group compared with other age groups (56.2% vs 29.3%, 44.6% and 47.4% for the 0-4, 5-10 and 11-17 year age groups, respectively, $p < 0.001$) (online supplemental table S8);

these differences were not seen in the admission data (online supplemental table S16).

DISCUSSION

During the COVID-19 pandemic, there was a substantial reduction in the number of ED presentations for children, adolescents and young adults, irrespective of sex, age, deprivation decile and ethnicity. There was a smaller reduction in admissions. Reduction in presentations were associated with each national lockdown, with a large increase coinciding with the return to in person schooling in September 2020. The reductions were most evident in infectious disease-related presentations such

as respiratory infections and asthma/wheeze. There were also reductions in the overall presentation and admission rates of mental health and trauma-related attendances. However more females aged 11–17 years presented with mental health problems during the pandemic. This contrasted with surgical presentations which were similar to previous years.

Other studies considering the impact of the pandemic on ED presentations and admissions

Other studies have documented pandemic-related reductions in presentations and admissions, both in the UK and globally.^{8–11} Compared with the previous year, there was a similar 60% decrease in weekly paediatrics ED presentations during the first weeks of the first UK lockdown in Manchester.¹¹ Similar reductions were seen in Oxfordshire where infectious disease related presentations also showed the greatest reductions.¹⁵ Reductions in communicable disease presentations have also been observed in other countries.¹⁶ This contrasts with acute surgical presentations that have been hardly affected by the pandemic.¹⁷

There has been a concern that the reduction in presentations might have impacted on the timely access of patients to medical care.¹⁰ One study focusing on the initial few weeks of the pandemic in UK and Ireland found that only 6.5% of presentations to children's EDs were delayed.¹¹ Of those that were delayed, there was a low rate of admissions and low probability of harm for overall outcomes.¹¹ Reassuringly, other studies have shown greater reduction of presentation for lower acuity cases than higher acuity cases over 6 months of the pandemic period, with patients presenting if deemed necessary.^{9 17} The lack of change in surgical presentations in our and other studies suggests patients are presenting when their condition is critical.¹⁶ Concern has been raised about the potential for poverty to lead to inequity in access to medical care during the pandemic,¹⁸ and there are also reports relating harm to poverty and ethnicity.^{19 20} We found no evidence that either deprivation or ethnicity affected the presentations or admission during the first year of the pandemic within a free at the point of delivery national health service.

Possible explanations to changes in ED presentations and admissions

There are many possible reasons for the reduction in ED presentations and admissions. Families may have a higher threshold for their children to self-present due to the pandemic's stay at home instruction. The pattern of healthcare access behaviour may have switch from accessing face-to-face services to using virtual 111 and GP telephone services.²¹ However, this highlights the need for clear governmental messaging that critically unwell young people should still seek ED care even in a national emergency.

Social distancing and reduced mixing have led to a reduction in all infectious conditions reducing the number of infection-related ED presentations during the pandemic.^{15 17} This may explain some of the reduction in asthma and wheeze presentations^{22 23} as most are driven at least in part by viral infections.^{12 13} The large reduction in pollution levels associated with stay at home rules may have also reduced the number of pollution-related exacerbations.^{24 25}

Although there was a small reduction in mental health presentation, they were increased for females aged 11–17 years. This may potentially have been due to less face-to-face interactions with friends resulting in loneliness and worsened mental health²⁴ or due to changing between online and face-to-face schooling.²⁵ Loneliness is associated with being female and

older adolescence,²⁴ potentially explaining the sex difference. There are big differences in digital use between adolescent males and females with boys spending more time gaming, while girls spent more time on smartphones, social media and texting in general.²⁶ Greater digital media use has been associated with lower well-being.

Strengths and limitations of the study

The study analysed a very large number of patient episodes from a large emergency department. Southampton is demographically representative of the UK population in ethnic diversity and socioeconomic status. We were able to take into account the long-term trends and look for potential changes in coding practices, seasonality and variation from year to year in weather. There are a few weaknesses in this study including that we only used ED diagnostic codes, which may not always be accurate. There were limited numbers to enable a detailed analysis of all the subgroups.

SUMMARY AND CONCLUSIONS

ED attendances reduced substantially over the pandemic, particularly for conditions related to infection. Reassuringly, there was little change in surgical conditions suggesting that patients were appropriately presenting to hospital. It is important to continue to inform the public as to when to present to hospital, GP or NHS 111 for different types of care according to acuity. The increase in mental health presentations in young females is concerning, and consideration needs to be given as to how to support these adolescents, especially around the increased exposure to digital media during the pandemic.

Correction notice This article has been corrected since it was first published. Table 2 has been updated so that it reflects what was originally submitted by the authors.

Acknowledgements We would like to acknowledge Khatija Omer for her support in providing the routine data for this analysis. Also to Louise Roberts (15 year old) for her comments on the protocol, her interpretation of the data and feedback on the draft manuscript.

Contributors FS and GR conceived the study and developed the protocol with the help of the other authors. DJ provided the data. FS, AS and GR analysed the data. All the authors contributed for to the interpretation of the analysis and drafting and revising the manuscript. All authors approved of the final version of the manuscript and agree to be accountable for the work. GR acts as guarantor for the paper and accepts full responsibility for the work and the conduct of the study, had access to the data, and controlled the decision to publish.

Funding This work was supported by The University of Southampton Faculty of Medicine. GR is supported by the National Institute of Health Research Southampton Biomedical Research Centre.

Competing interests None declared.

Patient consent for publication Not applicable.

Ethics approval This study used anonymised routine clinical data from NHS patients, being assessed and approved by Health Research Authority (21/HRA/1441). This was also assessed and approved by the University of Southampton Faculty of Medicine research ethics committee.

Provenance and peer review Not commissioned; externally peer reviewed.

Data availability statement No data are available. Data are not available for sharing due to lack of ethical permission.

Supplemental material This content has been supplied by the author(s). It has not been vetted by BMJ Publishing Group Limited (BMJ) and may not have been peer-reviewed. Any opinions or recommendations discussed are solely those of the author(s) and are not endorsed by BMJ. BMJ disclaims all liability and responsibility arising from any reliance placed on the content. Where the content includes any translated material, BMJ does not warrant the accuracy and reliability of the translations (including but not limited to local regulations, clinical guidelines, terminology, drug names and drug dosages), and is not responsible for any error and/or omissions arising from translation and adaptation or otherwise.

This article is made freely available for personal use in accordance with BMJ's website terms and conditions for the duration of the covid-19 pandemic or until otherwise determined by BMJ. You may download and print the article for any lawful, non-commercial purpose (including text and data mining) provided that all copyright notices and trade marks are retained.

ORCID iD

Graham Roberts <http://orcid.org/0000-0003-2252-1248>

REFERENCES

- World Health Organisation. Rolling updates on coronavirus disease (COVID-19), 2021. Available: <https://www.who.int/emergencies/diseases/novel-coronavirus-2019/events-as-they-happen> [Accessed 16 October 2021].
- Wright O. *Coronavirus: how the UK dealt with its first Covid case*. England: BBC, 2021. <https://www.bbc.co.uk/news/uk-england-55622386#:~:text=It's%20exactly%2012%20months%20since,Covid%2D19%20in%20the%20UK.&text=On%2023%20January%20%2D%20the%20day,world%20to%20enter%20coronavirus%20lockdown>
- Shahid Z, Kalayanamitra R, McClafferty B, et al. COVID-19 and older adults: what we know. *J Am Geriatr Soc* 2020;68:926–9.
- Institute for government. *Timeline of UK coronavirus lockdowns, March 2020 to March 2021*. London, 2021.
- Tuna Toptan SC, Hoehl S. *Pediatrics and COVID-19. Coronavirus disease - COVID-19*. Cham: Springer, 2021: 1318. 197–208.
- National Health Service. Children and young people's mental health services, 2019. The NHS long term plan. Available: <https://www.longtermplan.nhs.uk/online-version/chapter-3-further-progress-on-care-quality-and-outcomes/a-strong-start-in-life-for-children-and-young-people/children-and-young-peoples-mental-health-services/> [Accessed 16 Oct 2021].
- Office of National Statistics. Coronavirus and depression in adults, Great Britain: June 2020. Coronavirus and depression in adults, Great Britain [Internet], 2020. Available: <https://www.ons.gov.uk/peoplepopulationandcommunity/wellbeing/articles/coronavirusanddepressioninadultsgreatbritain/june2020> [Accessed 16 Oct 2021].
- Isba R, Edge R, Jenner R, et al. Where have all the children gone? Decreases in paediatric emergency department attendances at the start of the COVID-19 pandemic of 2020. *Arch Dis Child* 2020;105:704.1.
- Dann L, Fitzsimons J, Gorman KM, et al. Disappearing act: COVID-19 and paediatric emergency department attendances. *Arch Dis Child* 2020;105:810–1.
- Lazzerini M, Barbi E, Apicella A, et al. Delayed access or provision of care in Italy resulting from fear of COVID-19. *Lancet Child Adolesc Health* 2020;4:e10–11.
- Roland D, Harwood R, Bishop N, et al. Children's emergency presentations during the COVID-19 pandemic. *Lancet Child Adolesc Health* 2020;4:e32–3.
- Ramsahai JM, Hansbro PM, Wark PAB. Mechanisms and management of asthma exacerbations. *Am J Respir Crit Care Med* 2019;199:423–32.
- Makrinioti H, Custovic A, Hasegawa K, et al. The role of interferons in preschool wheeze. *Lancet Respir Med* 2021;9:9–11.
- Ewusie JE, Soobiah C, Blondal E, et al. Methods, applications and challenges in the analysis of interrupted time series data: a scoping review. *J Multidiscip Healthc* 2020;13:411–23.
- Charlesworth JEG, Bold R, Pal R. Using ICD-10 diagnostic codes to identify 'missing' paediatric patients during nationwide COVID-19 lockdown in Oxfordshire, UK. *Eur J Pediatr* 2021;180:3343–57.
- Silvagni D, Baggio L, Lo Tartaro Meragliotta P, et al. Neonatal and pediatric emergency room visits in a tertiary center during the COVID-19 pandemic in Italy. *Pediatr Rep* 2021;13:168–76.
- Irvine MA, Portales-Casamar E, Goldman RD. An interrupted time-series analysis of pediatric emergency department visits during the coronavirus disease 2019 pandemic. *Pediatr Emerg Care* 2021;37:325–8.
- Cheng TL, Moon M, Artman M, et al. Shoring up the safety net for children in the COVID-19 pandemic. *Pediatr Res* 2020;88:349–51.
- Sharma S, Wong D, Schomberg J, et al. COVID-19: differences in sentinel injury and child abuse reporting during a pandemic. *Child Abuse Negl* 2021;116:104990.
- Abrams EM, Greenhawt M, Shaker M, et al. The COVID-19 pandemic: adverse effects on the social determinants of health in children and families. *Ann Allergy Asthma Immunol* 2022;128:19–25.
- Marshall M, Howe A, Howsam G, et al. COVID-19: a danger and an opportunity for the future of general practice. *Br J Gen Pract* 2020;70:270–1.
- Guignon OL, Morpew T, Ehwerhemuepha L, et al. Evaluating the impact of coronavirus disease 2019 on asthma morbidity: a comprehensive analysis of potential influencing factors. *Ann Allergy Asthma Immunol* 2021;127:91–99.
- Ulrich L, Macias C, George A, et al. Unexpected decline in pediatric asthma morbidity during the coronavirus pandemic. *Pediatr Pulmonol* 2021;56:1951–6.
- Cooper K, Hards E, Moltrecht B, et al. Loneliness, social relationships, and mental health in adolescents during the COVID-19 pandemic. *J Affect Disord* 2021;289:98–104.
- Schwartz KD, Exner-Cortens D, McMorris CA, et al. COVID-19 and student well-being: stress and mental health during Return-to-School. *Can J Sch Psychol* 2021;36:166–85.
- Twenge JM, Martin GN. Gender differences in associations between digital media use and psychological well-being: evidence from three large datasets. *J Adolesc* 2020;79:91–102.