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

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.

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 signpost 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.

INTRODUCTION
The COVID-19 infection was initially identified in Wuhan, China in December 2019, with cases of pneumonia of unknown origin. The first reported cases of COVID-19 in the UK were identified at the end of January 2020. The WHO declared the COVID-19 pandemic on 11 March 2020. COVID-19 gives rise to respiratory symptoms accompanied by other syndromic features, with other individuals disproportionately affected. The UK government introduced social distancing and national lockdown measures from March 2020 (box 1). The impact COVID-19 has on older members of society is well documented. Children, adolescents and young adults however are largely not particularly unwell with COVID-19. 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. The Office for National Statistics has documented a general rise in symptoms of depression. 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...
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. This decrease in paediatric emergency presentations and healthcare utilisation is potentially harmful, especially with serious medical and surgical pathologies.

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 group); 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), 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 $\chi^2$ 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.

Ethical and research governance
The study was registered at clinicaltrials.gov.

RESULTS

Participants
A total of 166 459 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...
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 the year before (prepandemic) and the year of the pandemic. It also shows the estimated presentations and admissions assuming the year before (prepandemic) and the year of the pandemic. 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 the year before (prepandemic) and the year of the pandemic.

Table 1  Summary of participants presenting to emergency department

<table>
<thead>
<tr>
<th>Year</th>
<th>Pandemic</th>
<th>Prepandemic</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>2016-2017</td>
<td>2018-2019</td>
</tr>
<tr>
<td>2</td>
<td>2017-2018</td>
<td>2018-2019</td>
</tr>
<tr>
<td>3</td>
<td>2018-2019</td>
<td>2019-2020</td>
</tr>
<tr>
<td>4</td>
<td>2019-2020</td>
<td>2020-2021</td>
</tr>
<tr>
<td>5</td>
<td>2020-2021</td>
<td>2021-2022</td>
</tr>
</tbody>
</table>

Data are number (column percentage).

For surgical presentations, burns/scalds and allergy/anaphylaxis, observed presentation numbers were similar to estimated ones (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: 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 year (table 3). Similar reductions were seen for each gender, age, deprivation decile and ethnicity subgroup. This reduction was most dramatic in infectious disease ED presentations: 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.

Estimated impact of the pandemic on presentations and admissions

Based on the time series analyses forecast of the ED presentations and admissions 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: 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.
Original research

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...
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 the 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. 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. Similar reductions were seen in Oxfordshire where infectious disease related presentations also showed the greatest reductions. Reductions in communicable disease presentations have also been observed in other countries. This contrasts with acute surgical presentations that have been hardly affected by the pandemic.

There has been a concern that the reduction in presentations might have impacted on the timely access of patients to medical care. 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. Of those that were delayed, there was a low rate of admissions and low probability of harm for overall outcomes. 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. The lack of change in surgical presentations in our and other studies suggests patients are presenting when their condition is critical. Concern has been raised about the potential for poverty to lead to inequity in access to medical care during the pandemic, and there are also reports relating harm to poverty and ethnicity. 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. 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. This may explain some of the reduction in asthma and wheeze presentations as most are driven at least in part by viral infections. 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. DI 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.

6 of 7
REFERENCES


