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

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**Abstract** (250 words)

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 five year period (April 2016 to February 2021). An interrupted time series analysis was used to estimate the presentations and admissions that would have been seen in year five without the pandemic using the data from years one to four. 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 five years. There was a 38.1% (95% confidence interval 33.9-42.3%) 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% (17.4-29.4%) 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 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.

**Key words:** COVID-19 pandemic,children, adolescents, young adults, acute illness

**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 World Health Organisation (WHO) declared the COVID-19 pandemic on 11th of 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 and young adults however are largely asymptomatic.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 have 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 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 ED and regional mixed Major Trauma Centre (MTC). The two key objectives were firstly to assess the impact on overall ED presentations and hospital admissions and secondly to assess the impact of the pandemic on a number of specific medical, surgical, trauma, and mental health conditions.

**Box 1. Key dates during the pandemic in the UK4**

First COVID-19 case in UK - 29th January 2020

COVID-19 pandemic declared by The World Health Organisation - 11th March 2020

**First national lockdown** – 26th March to 15th June 2020\*

Online school learning – from 24th March with phased reopening from 1st June 2020

School summer holiday – 23rd July to 1st September 2020

Return to in-school learning for all students – 3rd September to 18th December 2020

**Second national lockdown** (continuation of normal schooling) – 5th November to 2nd December 2020\*

Christmas school holiday – 19th December 2020 to 3rd January 2021

**Third National lockdown** – 6th January 2021 to 11th April 2021\*

Re-start of online school learning – 6th January 2021 to 7th March 2021

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

**Methods**

Study design and participants

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

Participants were patients aged 0-24 complete years who had presented to University Hospital Southampton NHS Foundation Trust over a 5 year period from 1st 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. This was defined as being in hospital for more than four hours.

Population subgroups

We planned subgroup analyses by different presentations based on diagnostic labels in the ED: respiratory infection (e.g. bronchiolitis, pneumonia and croup); asthma or wheeze (merged given that they are potentially overlapping diagnoses); gastrointestinal infections (e.g. gastroenteritis and vomiting); general surgical presentations; mental health (e.g. 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 version 16 (Stata Corporation, College Station, USA). This approach was used to control for seasonality and forecast the number of ED presentations that would have been seen had there not been a pandemic (the counterfactual) based on the previous four years of data. 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% confidence intervals). 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 two 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 squared 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

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. The study was registered at clinicaltrials.gov (NCT04893122).

Role of funding source

This study was funded by the University of Southampton Faculty of Medicine. The funder had no role in the conduct of the study or the decision to publish.

**Results**

Participants

A total of 166,459 patients aged 0 to 24 complete years presented to University Hospital Southampton NHS Foundation Trust from 1st April 2016 to 25th February 2021. Of these, 86,164 (52%) were male and 137,411 patients (82.5%) were of white ethnicity. The largest group of patients presenting to ED were in age groups 0 to 4 years, accounting for 57,166 presentations (34.3% total presentations) followed by those aged 18-24 years, accounting for 52,447 presentations (31.5%). Table 1 shows the patient demographics for patients presenting over the 5 year period, before and during the pandemic. Details for those admitted are shown in 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 (year 4) and during (year 5) 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 (pre-pandemic) 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 for seasonal variation and long-term trends (e.g. increasing presentations over time). 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 without a pandemic, there were 38.1% (95% confidence interval 33.9-42.3%) 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% (46.5-72.5%), asthma/wheeze 55.9% (45.7-66.2%) and gastrointestinal infections 64.1% (54.8-73.5%). Smaller reductions were seen for mental health (30.3% [24.0-42.5%]) and trauma (33.3% [24.0-42.5%]) presentations. For surgical presentations, burns/scalds and allergy/anaphylaxis, observed presentation numbers were similar to estimated ones (Table 2).

|  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
|  | **Pre-pandemic** | | | |  |  |  |  |  | **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 to 4 years | 12,251 | 34.2% | 12,121 | 34.6% | 12,485 | 35.3% | 12,629 | 34.3% |  | 7,680 | 32.9% |
| 5 to 10 years | 5,361 | 15.0% | 5,331 | 15.2% | 5,578 | 15.8% | 6,051 | 16.4% |  | 3,483 | 14.9% |
| 11 to 17 years | 6,515 | 18.2% | 6,263 | 17.9% | 6,485 | 18.3% | 7,061 | 19.2% |  | 4,718 | 20.2% |
| 18 to 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 | 88.4% | 29,428 | 88.8% | 29,515 | 88.6% | 29,629 | 87.3% |  | 18,822 | 87.9% |
| Non-white ethnicity | 3,938 | 11.6% | 3,715 | 11.2% | 3,791 | 11.4% | 4,318 | 12.7% |  | 2,597 | 12.1% |
| 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% |
| NHS 111 | 2,905 | 8.1% | 3,254 | 9.3% | 3,189 | 9.0% | 2,689 | 7.3% |  | 3,327 | 14.4% |
| 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% |

**Table 1: Summary of participants presenting to emergency department.** Data are number (column percentage). Year 1: 01/04/2016 to 31/03/2017 (365 days); Year 2: 01/04/2017 to 31/03/2018 (365 days); Year 3: 01/04/2018 to 31/03/2019 (365 days); Year 4: 01/04/2019 to 12/03/2020 (347 days); Year 5: 13/03/2020 to 26/02/2021(351). 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 Table S1.

For admissions, a 23.4% (17.4-29.4%) reduction was seen during the pandemic (year 5) compared to numbers estimated by the time series analysis (Table 2). No significant reduction was seen for school age (5 to 17 years) children nor those from low deprivation households (Table 2). There were dramatic reductions in infection driven admissions (respiratory infections 60.7% [46.0-75.5%], asthma/wheeze 42.6% [29.6-55.8%]). There were also smaller reductions in mental health admissions (28.5% [19.9-37.1%], although this was in part due to a change in the care pathway with access to next day community psychiatry assessment during the pandemic), and trauma (44.8% [35.8-53.8%]) 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 to 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)(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 verses 1.3% reductions respectively, p<0.001)(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 (Table S19, Figure S1). Similar differences in admissions for mental health problems were seen (Table S20). There was also a smaller reduction for the 18-24 year age group for respiratory infections presentations than other groups (26.8% verses 63.2, 67.2 and 45.3% for 0-4, 5-10 and 11-17 year age groups respectively, p<0.001) (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% verses 63.9 and 67.2% for 0-4, and 5-10 year age groups, p<0.001) (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% verses 29.3, 44.6 and 47.4% for the 0-4, 5-10 and 11-17 year age groups respectively, p<0.001)(Table S8); these differences where not seen in the admission data (Table S16).

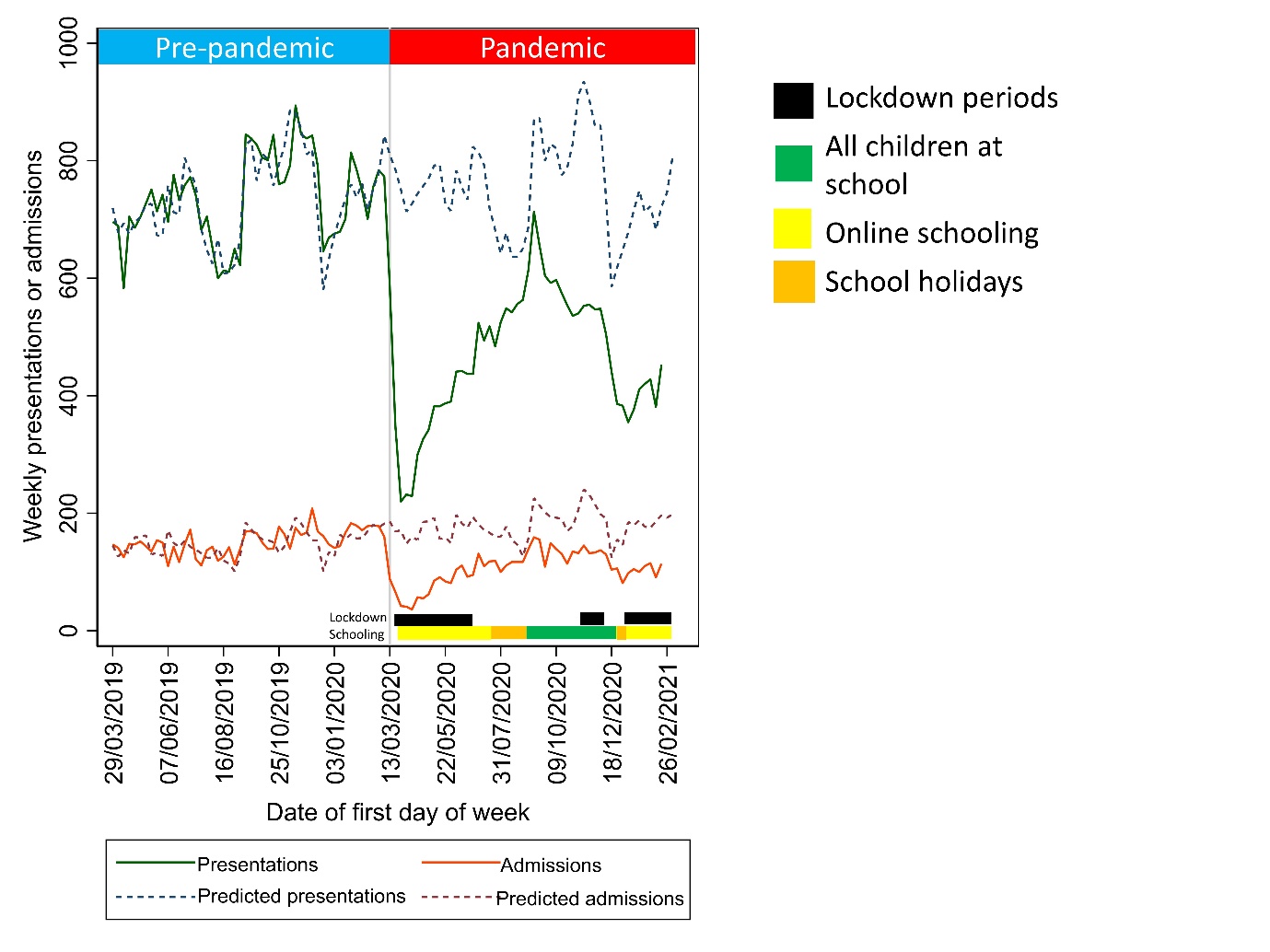
1. **By sex (b) By age group (c) By deprivation group (d) By ethnicity**

**Admissions Presentations**

**Figure 1:** **Weekly presentations and admissions before and during the pandemic.** Presentations to emergency department and admissions by week for one year before and after 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 four 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 lines represents presentations and red line represent admissions. During the pre-pandemic year, the estimated line is seen to be a close but not exact fit with the observed data. Time series models presented in Figure S2 and S7.

**a. Presentations**

|  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- |
|  | **Observed** | | **Estimated assuming no pandemic** | | **Absolute difference** | | | **Relative difference** |
|  | Pandemic (Year 5) | Percentage | Pandemic (Year 5) | Percentage | Mean | 95% confidence interval | |
| All | 23,360 | 100.0% | 37,740 | 100.0% | -14,380 | -12,784 | -15,977 |
| Males | 11,623 | 49.8% | 19,581 | 51.9% | -7,958 | -7,062 | -8,855 |
| Females | 11,725 | 50.2% | 18,318 | 48.5% | -6,593 | -5,815 | -7,371 |
| 0 to 4 years | 7,680 | 32.9% | 13,100 | 34.7% | -5,420 | -4,749 | -6,092 |
| 5 to 10 years | 3,483 | 14.9% | 6,282 | 16.6% | -2,799 | -2,435 | -3,163 |
| 11 to 17 years | 4,718 | 20.2% | 7,859 | 20.8% | -3,141 | -2,638 | -3,643 |
| 18 to 24 years | 7,479 | 32.0% | 11,337 | 30.0% | -3,858 | -3,261 | -4,456 |
| White ethnicity | 18,822 | 80.6% | 30,546 | 80.9% | -11,725 | -10,438 | -13,012 |
| Non-white ethnicity | 2,597 | 11.1% | 4,384 | 11.6% | -1,690 | -1,424 | -1,957 |
| Low deprivation | 6,691 | 28.6% | 11,583 | 30.7% | -4,892 | -4,416 | -5,367 |
| Moderate deprivation | 9,026 | 38.6% | 14,388 | 38.1% | -5,362 | -4,746 | -5,979 |
| High deprivation | 7,538 | 32.3% | 12,495 | 33.1% | -4,957 | -4,358 | -5,556 |
| Respiratory infections | 1,872 | 8.0% | 4,624 | 12.3% | -2,752 | -2,150 | -3,354 |
| Asthma/wheeze | 579 | 2.5% | 1,313 | 3.5% | -737 | -600 | -869 |
| Gastrointestinal infections | 473 | 3.3% | 1,198 | 3.2% | -768 | -656 | -880 |
| Surgical | 1,541 | 6.6% | 1,535 | 4.1% | 6 | 167 | -156 |
| Mental health | 1,441 | 6.2% | 2,066 | 5.5% | -625 | -495 | -754 |
| Trauma | 3,523 | 16.7% | 5,281 | 14.0% | -1,758 | -1,269 | -2,247 |
| Burns/scalds | 379 | 1.6% | 390 | 1.0% | -11 | 45 | -68 |
| Allergy | 219 | 0.9% | 262 | 0.7% | -43 | 3 | -89 |

**Table 2: Summary of observed (a) presentations and (b) for pandemic year 5 and estimated presentations if there had not been a pandemic.** Data are counts (percentages).Differences represent absolute (table) and relative (figure) differences (95% confidence intervals) between estimated presentations or admissions without a pandemic and observed presentations or admissions. Estimates are based on the time series analysis data from years 1-4. Year 5: 13/03/2020 to 25/02/2021 (50 weeks). Some admission estimates missing as there were insufficient admission each week to generate a time series equation. Time series models presented in Figure S2 to S11 and S20 to S24.

**b. Admissions**

|  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- |
|  | **Observed** | | **Estimated assuming no pandemic** | | **Absolute difference** | | | **Relative difference** |
|  | Pandemic (Year 5) | Percentage | Pandemic (Year 5) | Percentage | Mean | 95% confidence interval | |
| All | 5,293 | 100.0% | 6,911 | 100.0% | -1,618 | -1,203 | -2,033 |
| Males | 2,447 | 47.3% | 3,510 | 50.8% | -1,063 | -853 | -1,273 |
| Females | 2,842 | 52.7% | 3,678 | 53.2% | -836 | -595 | -1,078 |
| 0 to 4 years | 1,146 | 26.1% | 1,566 | 22.7% | -420 | -277 | -562 |
| 5 to 10 years | 501 | 10.0% | 525 | 7.6% | -24 | 45 | -93 |
| 11 to 17 years | 1,145 | 17.9% | 1,195 | 17.3% | -50 | 88 | -187 |
| 18 to 24 years | 2,501 | 46.1% | 3,606 | 52.2% | -1,105 | -868 | -1,341 |
| White ethnicity | 4,260 | 88.2% | 5,924 | 85.7% | -1,664 | -1,317 | -2,012 |
| Non-white ethnicity | 567 | 11.8% | 797 | 11.5% | -218 | -142 | -294 |
| Low deprivation | 1,518 | 27.8% | 1,597 | 23.1% | -79 | 92 | -250 |
| Moderate deprivation | 2,045 | 37.4% | 2,981 | 43.1% | -936 | -756 | -1,116 |
| High Deprivation | 1,694 | 34.8% | 2,893 | 41.9% | -1,200 | -1,062 | -1,338 |
| Respiratory infections | 359 | 6.8% | 913 | 13.2% | -554 | -420 | -689 |
| Asthma/wheeze | 314 | 5.9% | 547 | 7.9% | -233 | -162 | -305 |
| Gastrointestinal infections | 69 | 1.3% | - |  | - |  |  |
| Surgical | 764 | 14.4% | 659 | 9.5% | -96 | 194 | -1 |
| Mental health | 771 | 14.6% | 1,078 | 15.6% | -307 | -214 | -400 |
| Trauma | 355 | 6.7% | 643 | 9.3% | -288 | -230 | -346 |
| Burns/scalds | 8 | 0.2% | - |  | - |  |  |
| Allergy | 59 | 1.1% | - |  | - |  |  |

**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 to 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 UK and Ireland found that over 90% 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 six 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

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.18 However there is a need for clear governmental messaging that critically unwell young people should still seek ED care.

Social distancing and reduced mixing has 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 presentations19,20 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 has also probably reduce the number of pollution related exacerbations.19,20

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 health21 or due to changing between online and face-to-face schooling.22 Loneliness is associated with being female and older adolescence,21 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.23 Greater digital media use has been associated with lower wellbeing.

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.

**Declaration of interests**

None of the authors have any conflict of interest with respect to this manuscript.

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**Data sharing statement**

Data is not available for sharing due to lack of ethical permission.

**What is already known on this topic**

Children, adolescents and young adults are largely asymptomatic with COVID-19. A decrease in paediatric emergency presentations was seen in the few months of the pandemic. Concern has been expressed about the potential for 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 presenting with mental health issues during the pandemic.

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