NIHR | Policy Research Unit Children and Families

Changes in hospital contacts during the COVID-19 pandemic among vulnerable children and young people

4th November 2021

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Funding

This project was funded by the National Institute for Health Research (NIHR) Policy Research Programme. The views expressed are those of the author(s) and not necessarily those of the NIHR or the Department of Health and Social Care. The development of the ECHILD Database is supported by ADR UK (Administrative Data Research UK), an Economic and Social Research Council (part of UK Research and Innovation) programme (ES/V000977/1).

Ethics

Ethical approval for this project was granted by the National Research Ethics Service (17/LO/1494) and NHS Health Research Authority Research Ethics Committee (20/EE/0180). Permissions to use linked, de-identified data from Hospital Episode Statistics and the National Pupil Database in the ECHILD Database were granted by DfE (DR200604.02B) and NHS Digital (DARS-NIC-381972-Q5F0V-v0.5).

Acknowledgements

The ECHILD project is in partnership with NHS Digital and the Department for Education (DfE) and we thank the following individuals for their valuable contributions to the project: Michael Chapman, Garry Coleman, Richard Caulton, Joanna Geisler, Catherine Day (NHS Digital), Chris Douglass and Gary Connell (DfE).

We are grateful to the Office for National Statistics (ONS) for providing the trusted research environment for the ECHILD Database. ONS agrees that the figures and descriptions of results in the attached document may be published. This does not imply ONS's acceptance of the validity of the methods used to obtain these figures, or of any analysis of the results.

This report describes analysis of the ECHILD Database which uses data from the DfE, NHS Digital and the ONS. The DfE, NHS Digital and ONS do not accept responsibility for any inferences or conclusions derived by the authors.

We thank all the children, young people, parents and carers who contributed to the ECHILD project, as well as Dr Erin Walker (UCL Partners) who led this involvement. We would particularly like to thank members of the National Children' Bureau Young Research Advisors, National Children' Bureau Family Research Advisory Groups, NIHR Great Ormond Street Hospital (GOSH) Biomedical Research Centre (BRC) Parent and Carer Advisory Group, GOSH Young People's Forum and GOSH Young Persons Advisory Group for their input to this project. We also gratefully acknowledge all children and families whose de-identified data are used in this analysis.

We would like to thank Nicolas Libuy, Max Verfuerden, Pia Hardelid, Chloe Parkin and Matthew Lilliman for their contributions to this project.

Disclaimer

This work was produced using statistical data from ONS. The use of the ONS statistical data in this work does not imply the endorsement of the ONS in relation to the interpretation or analysis of the statistical data. This work uses research datasets which may not exactly reproduce National Statistics aggregates.

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List of acronyms

A&E = Accidents and Emergency department

ADR UK = Administrative Data Research UK

CC = Chronic health condition

CSC = Children's social care

CYP = Children and young people

ECHILD = Education and Child Health Insights from Linked Data

EHCP = Education, Health and Care Plan

GPs = General Practitioners

HES = Hospital Episode Statistics

LBW = Low birthweight

NPD = National Pupil Database

NHS = National Health Service

RSV = Respiratory Syncytial Virus

SEN = Special educational needs

SEND = Special educational needs or disability

At a glance

Why we did this study

Children and young people have been affected by the COVID-19 pandemic through unprecedented disruptions to hospital health services and it is likely that vulnerable groups have been more affected than other children. This study aimed to assess changes in hospital contacts during the pandemic among vulnerable children and young people in England compared to their peers.

What we did

We used linked administrative data in the ECHILD Database (1) to look at changes in the rates and numbers of hospital contacts that were planned (outpatient attendances and planned hospital admissions) and unplanned (unplanned hospital admissions) during the first nine months of the pandemic. We compared vulnerable children with their peers in two example groups: children aged 0 to 4 years who were born too early or too small or had a chronic condition; and secondary school pupils who received special educational needs support or children's social care services. We also looked at whether vulnerable children were more or less likely than their peers to have face-to-face outpatient care during the pandemic.

What we found out

- Vulnerable children bore large and disproportionate deficits in hospital contacts during the first nine months of the pandemic. These deficits were greatest for children with multiple vulnerabilities.
- As the pandemic progressed, we observed some 'catch-up' in planned hospital admissions for children aged 0 to 4 years and in outpatient attendances for infants.
- Vulnerable children were less likely than their peers to have face-to-face outpatient care during the pandemic.

Why this is important

The true extent of the deficits in hospital contacts borne by vulnerable children during the pandemic will be greater than our study shows as it focuses on two groups only. Deficits in planned care could have consequences for vulnerable children because of diagnoses or treatments that were delayed or foregone. Childhood is a time of rapid development and delays in treating health issues may hold a child back. Deficits in unplanned care may be positive (i.e. because fewer children needed care for infections or injuries), but could also reflect unmet health needs.

What are the implications

Our findings indicate a need for targeted 'catch-up' funding and resources for child health, particularly for vulnerable children who were affected disproportionately. For example, the ring-fenced resource for 'catch-up' of NHS care (Health and Social Care Levy) might be further targeted for the vulnerable groups that have disproportionally missed out on hospital contacts.

Secondary school pupils receiving special educational needs support or social care services may need to be prioritised for face-to-face outpatient care as it is unclear how effective remote care is for these children.

More research about how delays to treatments for childhood conditions impact children's outcomes is needed. The consequences of the deficits in hospital contacts borne by vulnerable children during the pandemic are difficult to predict, because little is currently known about this topic.

Executive summary

Background

The direct effects of COVID-19 have been relatively low on children and young people, in terms of infections and deaths, compared to the adult population (2,3). But, children have been indirectly affected by the pandemic through unprecedented disruptions to hospital health services, particularly during national lockdowns. Vulnerable children and young people are expected to have had greater reductions in their contacts with hospitals than their peers.

Aim

This study aims to assess changes in hospital contacts during the COVID-19 pandemic among vulnerable children and young people in England compared to their peers.

Research question

What were the changes in hospital contacts during the COVID-19 pandemic for vulnerable children compared with their peers, in terms of:

A. **Rates of planned and unplanned contacts**
B. **Deficits in planned and unplanned contacts**
C. **Mode of outpatient attendances (in-person versus tele/virtual)**

This study looked at hospital contacts that were planned (outpatient attendances and planned hospital admissions) and unplanned (unplanned hospital admissions) and is the first step in quantifying and understanding the deficit in hospital contacts that occurred among vulnerable children during the pandemic, compared to their peers. Further research looking at the types of planned care that were delayed or foregone during the pandemic (such as diagnostic assessments or treatments) is needed to understand the potential consequences for children in the longer term. For example, delays to surgery to repair a child's cleft lip and palate might affect their hearing, and in turn, speech and language development, wellbeing and education.

Methods

Data source

This study used the Education and Child Health Insights from Linked Data (ECHILD) Database (1) which links de-identified administrative health, education and social care records for 14.7 million children and young people in England.

Illustrative examples in this study

There are many different groups of vulnerable children (4). This study focused on two example groups who could be identified in the ECHILD Database and were likely to have been adversely affected by the disruption to health services during the pandemic:

- Children aged 0 to 4 years who had a chronic health condition or were born too early (preterm) or too small (low birth weight)
- Secondary school pupils aged 11 to 16 years who were received special educational needs (SEN) support in schools or children's social care (CSC) services.

Deficit in hospital contacts

We calculated the rates of hospital contacts per 1,000 child-years from 23rd March to 31st December 2015 to 2019. We used this pre-pandemic baseline information to predict the

expected rates of hospital contact in 2020 had the pandemic not happened, assuming any time trends would have continued. We then calculated the *difference between the predicted and observed rates* for 23rd March and 31st December 2020 for vulnerable groups and their peers (primary outcome). We also calculated the *difference between the predicted and observed numbers* of hospital contacts for 23rd March and 31st December 2020 for vulnerable groups and their peers (secondary outcome).

Mode of outpatient attendances

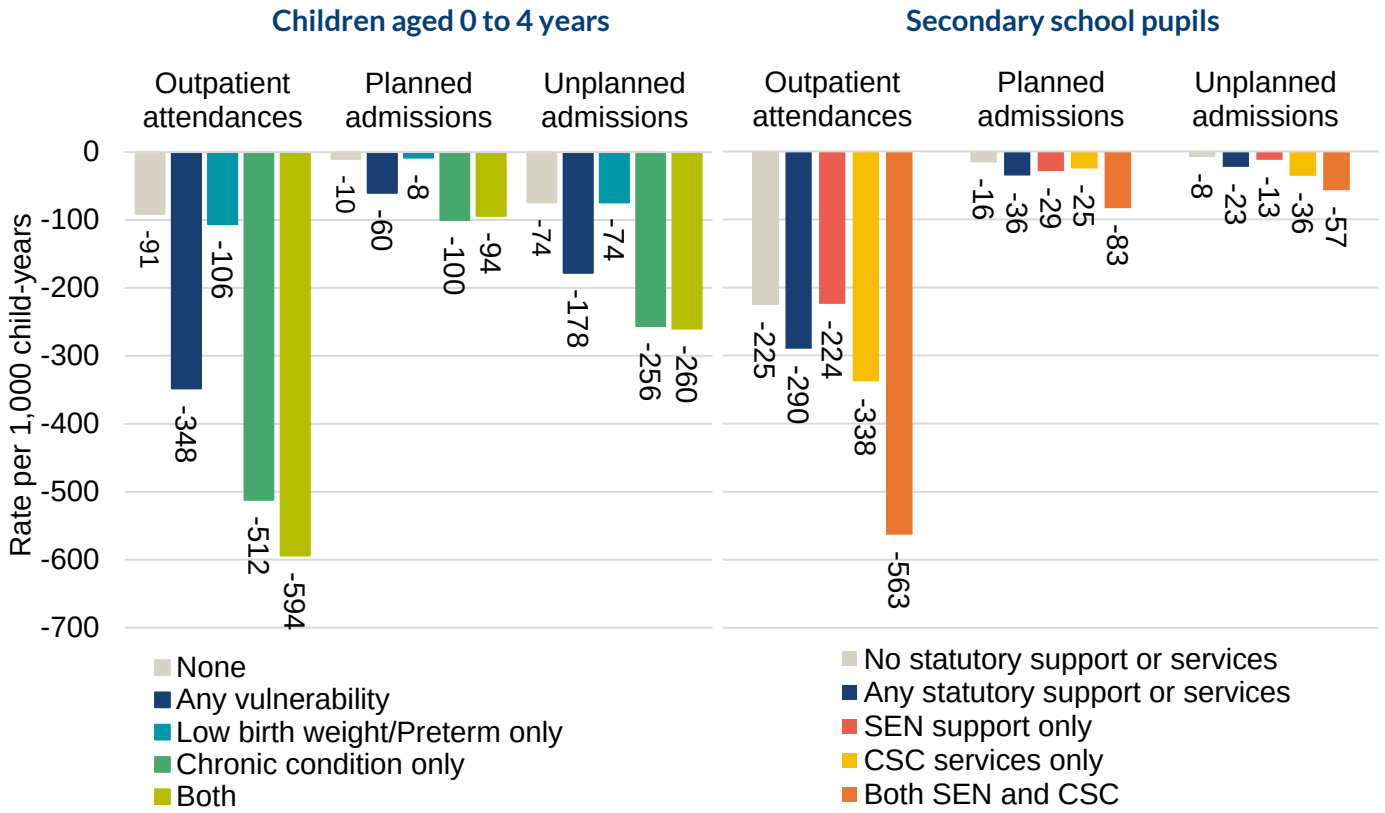
During the pandemic, hospitals adapted through increased use of tele/virtual outpatient appointments. However, the effectiveness and suitability of these appointments for vulnerable groups is unknown.

We looked at differences in the mode of outpatient appointments between vulnerable children and their peers by calculating the percentage of attended appointments that were in-person or tele/virtual.

Results

During the pandemic, the rates of planned and unplanned hospital contacts decreased for all children, but these decreases were greatest for vulnerable children (Figure 1). Children who had multiple vulnerabilities had the largest overall decreases.

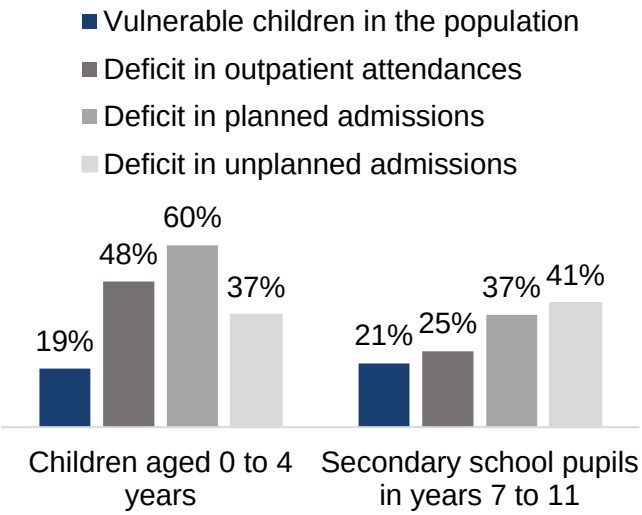
Figure 1: Difference in predicted versus observed rate of hospital contacts per 1,000 child-years among vulnerable children and their peers, by type of vulnerable group.



SEN = special educational needs; CSC = children's social care services.

Vulnerable children bore large and disproportionate deficits in hospital contacts during the pandemic (Figure 2). Deficits in unplanned hospital admissions among children aged 0 to 4 years were the most disproportionate.

Figure 2: Percentage of children who are vulnerable compared to the percentage of the deficit in hospital contacts they experienced.



Vulnerable children were less likely than their peers to have face-to-face outpatient care during the pandemic. For example, vulnerable secondary school pupils were less likely to have an in-person appointment scheduled and also less likely to attend an in-person appointment, with the lowest attendance rates among pupils receiving CSC services only. Without the increased use of tele/virtual appointments, the observed deficit in outpatient attendances during the pandemic would have undoubtedly been much greater. However, the effectiveness of tele/virtual appointments for vulnerable children, in comparison to in-person care, is unknown (5) and health professionals have reported some disadvantages, particularly in relation to safeguarding (for example, not being able to pick up on non-verbal cues or knowing who else is in the room (6)).

Implications of these findings

Our findings indicate a need for targeted 'catch-up' funding and resources for child health, particularly for vulnerable children who were affected disproportionately. For example, the ring-fenced resource for 'catch-up' of NHS care (Health and Social Care Levy) might be further targeted for the vulnerable groups that have disproportionally missed out on hospital contacts. Services should also consider how to mitigate potential adverse effects of delayed or foregone hospital care in the recovery phase of the pandemic.

Secondary school pupils receiving special educational needs support or social care services may need to be prioritised for face-to-face outpatient care as it is unclear how effective remote care is for these children.

More research about how delays to treatments for childhood conditions impact children's outcomes is needed which will require close partnerships between researchers and clinicians providing paediatric services. The likely consequences of the deficits in hospital contacts that occurred among vulnerable children during the pandemic are difficult to predict, because little is currently known about this topic.

Limitations

This study used **simple classifications of vulnerability which do not capture the complexity of vulnerable groups**. Future work could explore the impact of the pandemic on specific sub-groups of vulnerable children to inform more targeted policy making.

This study only **looked at deficits in hospital contacts during the first nine months of the pandemic as experienced by children and young people in two age groups whose vulnerabilities could be defined from administrative health, education and social care data.** This means that the true extent of the deficits in hospital contacts that occurred among vulnerable children and young people in the population, throughout the course of the pandemic, will be much greater than this study shows.

Background

The direct effects of COVID-19, in terms of serious infections and deaths, have been relatively low on children and young people, compared to the adult population (2,3). However, they have experienced considerable indirect effects of the pandemic through disruptions to health services and schools.

In response to the pandemic, there have been unprecedented changes in the National Health Service (NHS) to re-purpose services, staff and capacity (7). For example, in hospitals, non-urgent care has been cancelled or delayed, staff have been re-deployed to COVID-critical services and virtual contact with patients (via telephone or video) has been promoted. Since the start of the pandemic, there have been large reductions in hospital contacts in England for both planned (outpatient attendances and planned hospital admissions) and unplanned care (A&E attendances and unplanned hospital admissions). Recent studies have shown that children have experienced much greater relative decreases than adults in planned and unplanned hospital admissions (8) and A&E attendances (9).

Decreases in planned hospital care, which is needed to assess, monitor and treat children's clinical needs, will mean that some health needs have gone unmet. Some of the decreases in unplanned hospital care during the pandemic could be because children were less likely to have conditions that required emergency treatment (for example, fewer injuries or infections (10) because of lockdown restrictions), or because they received treatment in other community health settings. However, some of the decrease in unplanned hospital care will represent missed opportunities to intervene (for example, the chance to refer a child who is admitted to hospital with self-harm to mental health services) and unmet health needs due to changes in health-seeking behaviour during the pandemic (for example, children who did not go to a hospital when they needed to).

The COVID-19 pandemic has highlighted the inequalities in our society and it is likely that the decreases in hospital contacts among children have not been borne equally. Children who are clinically or socially vulnerable due to additional needs for healthcare or social or educational support (11) are likely to have had greater reductions in hospital contacts than their peers.

Aim of this study

This study aims to assess changes in hospital contacts during the COVID-19 pandemic among vulnerable children and young people in England compared to their peers.

Research question

What were the changes in hospital contacts during the COVID-19 pandemic for vulnerable children compared with their peers, in terms of:

A. **Rates of planned and unplanned contacts**
B. **Deficits in planned and unplanned contacts**
C. **Mode of outpatient attendances (in-person versus tele/virtual)**

Scope of this study

This study is the first step in quantifying and understanding the deficit in hospital contacts that occurred among vulnerable children during the pandemic, compared to their peers. Further research looking at the types of planned care that were delayed or foregone during the pandemic (such as diagnostic assessments or treatments) is needed to understand the potential consequences for children in the longer term.

Methods

Data source

This study used the Education and Child Health Insights from Linked Data (ECHILD) Database (1). The ECHILD Database brings together administrative data about health, education and social care for all children in England for the first time. Box 1 summarises the key strengths and limitations of this novel linked administrative data resource.

The ECHILD Database links two existing administrative data sources:

- Hospital Episode Statistics (HES): which includes information on hospital admissions, death registrations, A&E attendances and outpatient appointments in NHS hospitals in England.
- The National Pupil Database (NPD): which includes information about pupils at schools and colleges in England and about contact with children's social care (CSC) services.

The ECHILD Database includes de-identified linked records for 14.7 million children. It does not include any information that could be used to identify a person, such as names, addresses, postcodes, dates of birth, Unique Pupil Numbers or NHS numbers. It was created as part of the ECHILD project, a research study led by University College London, in partnership with NHS Digital and the Department for Education, and funded by ADR UK.

Health data included in the ECHILD Database

The ECHILD Database contains hospital records for all NHS patients in England, including patient demographics and standardised codes for diagnoses, symptoms and procedures relating to the care they have received, which are recorded by clinical coders based on patient discharge records (12).

Education and social care data included in the ECHILD Database

The ECHILD Database includes information about the characteristics of pupils from regular censuses in schools and other educational settings, including termly records of special educational needs (SEN) support. It also includes information about CSC referrals, assessments and interventions from annual censuses of local authorities and other providers.

Illustrative examples chosen for this analysis

Because "vulnerable" is a broad term (4), in this study we focused on two example groups from age groups known to have high levels of hospital healthcare use: children aged 0 to 4 years and secondary school pupils in years 7 to 11 (typically aged 11 to 16 years). Our choice of vulnerable groups was guided by the Childhood Vulnerability and COVID-19 framework developed by Public Health England which describes three types of vulnerability likely to be important during the pandemic. We chose groups that could be readily identified in the ECHILD Database and were likely to have been adversely affected by the disruption to health and other support services during the pandemic (Figure 3).

Box 1: Strengths and limitations of the ECHILD Database

Strengths

- The ECHILD Database is a whole population data source. It includes all children who had contact with NHS hospitals in England. This means it is a reliable source of information for this study that looks at changes in hospital contacts during the pandemic.

- The ECHILD Database includes information related to health, education and social care. This means it can be used to look at outcomes for groups whose vulnerabilities would not be recorded in clinical hospital records (such as children receiving SEN support), and to look at the intersection of these vulnerabilities.

Limitations

- The ECHILD Database includes hospital records only. It does not include data from other types of health providers, such as General Practitioners (GPs) or pharmacies. This means that we could only look at changes in hospital contacts during the pandemic in this study. We could not look at how changes in hospital contacts may have affected contacts with other types of health providers.

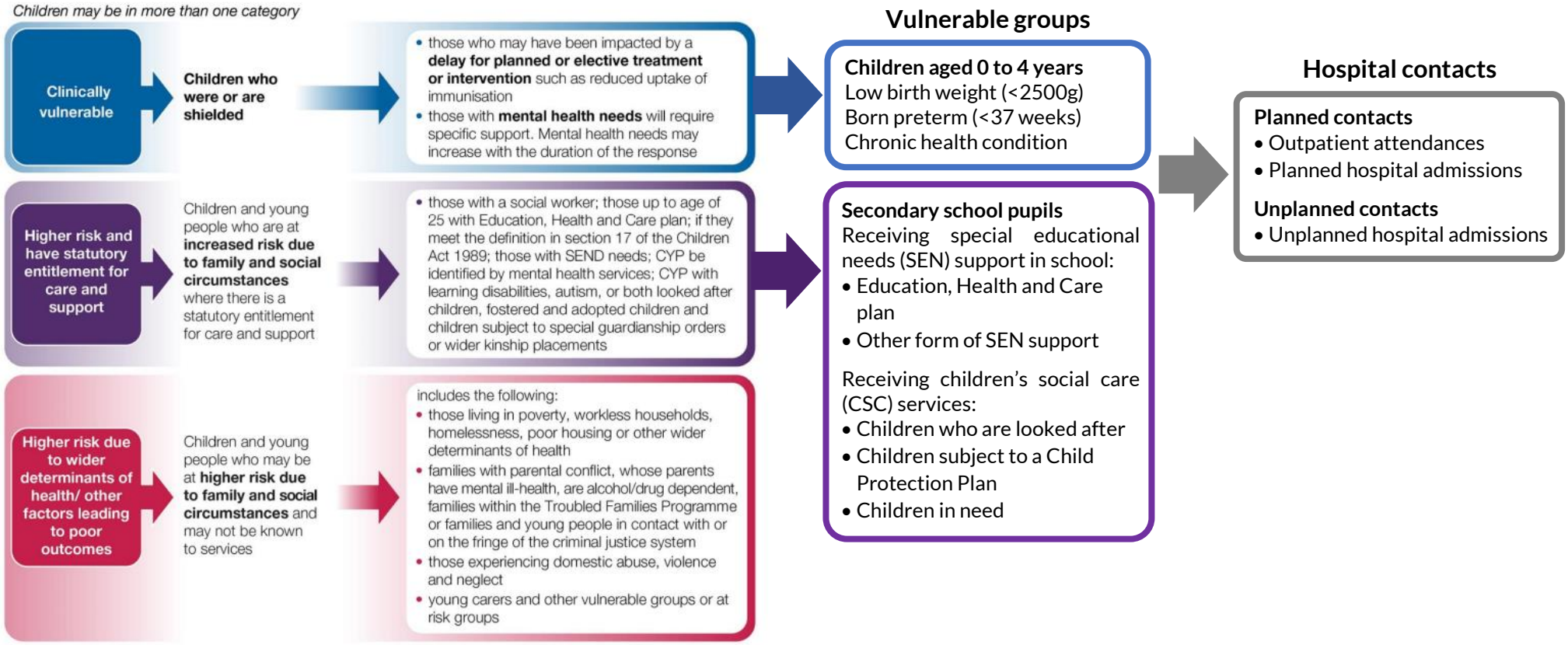
- Due to recent changes in how A&E data are collected in HES, the ECHILD Database currently includes A&E data only up to 31st March 2020. This means that A&E attendances could not be included in this study. As more recent A&E data are linked to the ECHILD Database, it will be possible to look at changes during the pandemic.

- At the time of this study, the ECHILD Database included hospital records up to 31st December 2020 only. This means it was only possible to look at changes to hospital contacts during the first nine months of the pandemic. As more recent data becomes available it will be possible to look at changes during 2021.

- The ECHILD Database does not include information about the small proportion of pupils enrolled in private schools (approximately 7% each year (13)) which means they could not be included in this study.

- The ECHILD Database currently includes data about children's social care services up to 31st March 2019. This means we could identify children who had social care services *before* the pandemic, but we were not able to identify which children had social care services at the time of the pandemic.

Figure 3: Illustrative examples of vulnerable groups included in this study, in relation to the Childhood Vulnerability and COVID-19 framework (11).



CYP = children and young people; SEND = special educational needs or disability.

Defining cohorts of children according to their vulnerability status in the ECHILD Database

Example 1: Children aged 0 to 4 years

We focused on children who were born preterm (<37 weeks of gestation), with a low birth weight (<2500g) or who had a chronic health condition recorded in their hospital records (See Appendix A1 for definition of chronic conditions (14)). Because we aimed to compare hospital contacts for children aged 0 to 4 years during the pandemic with those aged 0 to 4 years in the pre-pandemic period, we defined a cohort of children born in an NHS hospital from 1st January 2010 to 31st December 2020 and followed up to the earliest of their 5th birthday or to the end of 2020. For the outcome measures, only hospital contacts that occurred between 1st January 2015 to 31st December 2020 for these children were considered in our analyses (Figure 4).

We analysed four mutually exclusive groups: (1) non-vulnerable, (2) children born preterm or with low birth weight only, (3) children with a chronic condition only, and (4) children born preterm or with low birthweight and with a chronic condition recorded before age 5 years. A child remained chronic condition free until the age at which any chronic condition was first recorded.

Figure 4: Measuring vulnerability (exposure) and hospital contacts (outcomes) for children aged 0 to 4 years.[1]

						Outcome year					
Year of birth	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020
2010	<1	1	2	3	4	5	6	7	8	9	10
2011		<1	1	2	3	4	5	6	7	8	9
2012			<1	1	2	3	4	5	6	7	8
2013				<1	1	2	3	4	5	6	7
2014					<1	1	2	3	4	5	6
2015						<1	1	2	3	4	5
2016							<1	1	2	3	4
2017								<1	1	2	3
2018									<1	1	2
2019										<1	1
2020											<1

Exposure
- Low birth weight and preterm births
- Chronic conditions
- 2 Age

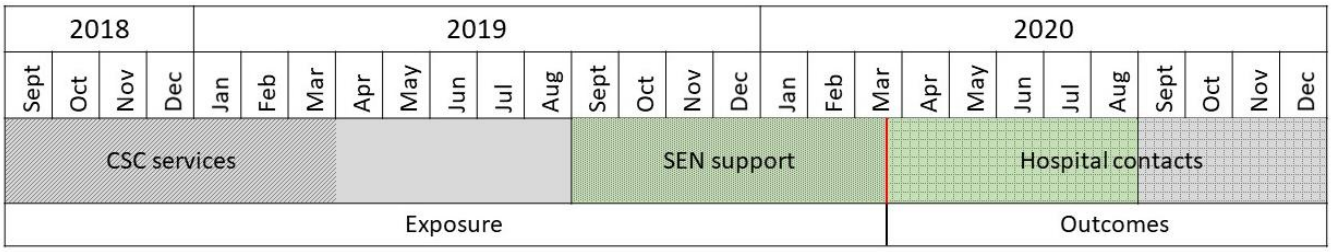
Outcomes
- Not considered
- Partially considered
- Fully considered
- Not yet born

[1] Partially considered: For example, a child born on 1st June 2010 would turn 5 on 1st June 2015 and would therefore contribute data for part of 2015.

Example 2: Secondary school pupils

We focused on secondary school pupils who were receiving support from statutory services in the form of SEN support in school and/or support from CSC services (including children who were looked after and children on a Child in Need or Child Protection Plan). All pupils in school years 7 to 11 (typically aged 11 to 16 years) in the academic year 2019/20 were included in this analysis. We identified pupils who were receiving support from statutory services *before* the pandemic began based on the most recent education and social care information recorded in the ECHILD Database (Figure 5). We categorised children's vulnerability by the type of support they were receiving at the pandemic began: (1) not currently receiving statutory support, (2) SEN support only, (3) support from CSC services only, or (4) both CSC and SEN support.

Figure 5: Measuring vulnerability (exposure) and hospital contacts (outcomes) for secondary school pupils in years 7 to 11 in 2019/20.



SEN = special educational needs; CSC = children's social care. Green shading indicates the 2019/20 academic year. Red line indicates the beginning of the pandemic (23rd March 2020).

Changes in hospital contacts during the pandemic

Deficit in planned and unplanned hospital contacts

We estimated the deficit in hospital contacts that were planned (outpatient attendances and planned hospital admissions) and unplanned (unplanned hospital admissions) for our vulnerable groups and their peers. The deficit is the absolute difference between the hospital contacts we would have expected children to have during the pandemic (which were predicted from pre-pandemic data) and how much they actually used hospitals during the pandemic. We measured this deficit in two ways: the difference in rates and the difference in the number of hospital contacts.

The primary outcomes for this study were the absolute differences between predicted and observed rates of hospital contacts, according to vulnerability status. Because children can have multiple hospital contacts in a year, looking at changes in the *rates* of hospital contacts (rather than just changes in the number of contacts, or the number of children with a hospital contact) gives a clearer picture of how the level and intensity of contact with hospitals changed during the pandemic.

Measuring the differences between predicted and observed rates of hospital contacts involved three steps. Firstly, we calculated the observed rates of hospital contacts per 1,000 child-years from 23rd March to 31st December in the five years before the pandemic (2015 to 2019) and during the pandemic year (2020) using the following formula:

$$\frac{\text{Number of hospital contacts}}{\text{Child-years}} \times 1{,}000$$

Child-years were calculated by multiplying the number of children in each of the cohorts by the amount of time each child was included in the study. Child-years account for the fact that children

may be included in a study for different lengths of time. For example, babies who were born after the pandemic began were part of this study for less time than children who were born before it. Using child-years as the denominator for our rate calculations (rather than just the number of total children in the study) measures the levels of hospital contacts more accurately.

Secondly, we predicted the rate of hospital contacts that would have been expected among vulnerable and non-vulnerable groups between 23rd March and 31st December 2020 had the pandemic not happened. We calculated these predicted rates using a Poisson model that accounted for observed rates between 2015 and 2019 (stratifying by vulnerability status) and assumed any time trends would have continued in 2020. Thirdly, we calculated the difference between the predicted and observed rates for 23rd March and 31st December 2020 for vulnerable and non-vulnerable groups.

We expected that changes to hospital contacts would have varied during the course of the pandemic. For example, as the pandemic progressed hospitals may have adapted to minimise disruptions to planned care. To look at changes over time during the pandemic, we calculated the difference in predicted and observed rates of hospital contacts for the following three periods:

- 23rd March to 23rd June: first national lockdown
- 24th June to 4th November: easing of restrictions
- 5th November to 31st December: second national lockdown.[2]

For children aged 0 to 4 years, with and without a chronic condition, we also calculated weekly rates of planned and unplanned hospital contacts before and during the pandemic. The purpose of this analysis was to (1) understand changes in the seasonality of hospital contacts, and (2) visualise the decrease and recovery of hospital contacts during the pandemic period, according to vulnerability status and age. We plotted average weekly rates from 1st January to 31st December 2020 and compared them to the average weekly rates for 2015 to 2019 for planned and unplanned hospital contacts.

We calculated the *difference between the predicted and observed numbers* of hospital contacts for 23rd March and 31st December 2020 for vulnerable groups and their peers (secondary outcome). We also calculated the proportion of the total deficit in numbers of hospital contacts that were borne by vulnerable groups.

Mode of outpatient attendances (in-person versus tele/virtual)

Outpatient appointments are the most common type of contact children have with hospitals. This type of proactive, planned care is important to assess children, monitor symptoms and treatment and change clinical management. During the pandemic, hospitals adapted through increased use of tele/virtual outpatient appointments. These appointments may have been preferable to in-person appointments (particularly for children who were clinically or socially vulnerable); however, the effectiveness of tele/virtual appointments for vulnerable groups is unknown. We looked at differences in the mode of outpatient appointments that were scheduled for and attended by vulnerable and non-vulnerable children. We also calculated the percentage of attended appointments that were in-person or tele/virtual.

[2] The second national lockdown ended on 2nd December 2020 and the third national lockdown began on 6th January 2021 (16). We chose to combine 2nd-31st December 2020 with the second national lockdown in our analyses because there were strict restrictions on social distancing in most parts of England during this period, including Tier 4 restrictions (equivalent to a national lockdown) in London and South East England.

Results

Example 1: Children aged 0 to 4 years with a chronic health condition and/or born preterm or with low birth weight

Defining cohorts of children according to vulnerability status in the ECHILD Database

Chronic conditions, and preterm birth or low birth weight were common childhood vulnerabilities and there was a significant overlap in these vulnerabilities. Of 3,181,223 children aged 0 to 4 years and born between 2015 and 2020 in the cohort, 371,426 (11.7%) had a record indicating a chronic condition (including congenital anomalies) before their 5th birthday; 340,526 (10.7%) were born too early (<37 weeks gestation at birth) or too small (birth weight <2500g); and 633,443 (19.9%) had one or more of these vulnerabilities (Figure 6).

Characteristics of the children in the study are presented in Appendix A2. The majority of the cohort were male (51.4%) and of white ethnicity (70.5%). Boys were more likely than girls to have any of the vulnerabilities considered (20.0% vs 18.8%). Children of Asian ethnicity were more likely to have a vulnerability (23.0%) compared to children of white ethnicity (19.7%), children of black ethnicity (21.7%), and children of any other ethnicity (19.3%). Children in the most deprived quintile were most likely to have any of the vulnerabilities considered (22.4% compared to 18.5% for the least deprived quintile).

Figure 6: Prevalence of chronic conditions (including congenital anomalies), and low birth weight or preterm birth in children aged 0 to 4 years in 2020.

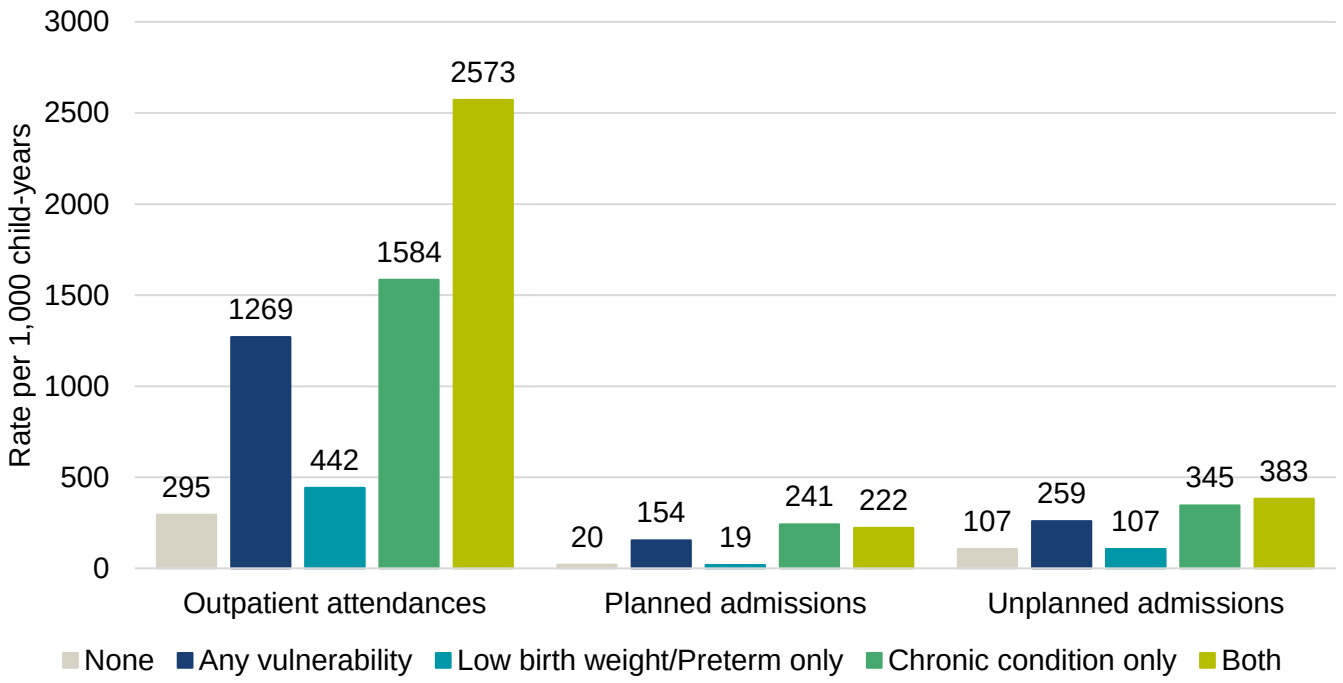
Overall, 10.7% children born preterm or with low birth weight: 2.9% were born at term, but weighed <2500g; 3.5% were born preterm, but weighed 2500g or more; and 4.3% were born preterm weighing <2500g.

Hospital contacts before the pandemic

Before the pandemic, there was considerable variation in rates of hospital contacts among children aged 0 to 4 years. Infants (<1 year) were much more likely to have an outpatient attendance or unplanned hospital admission than children aged 1-4 years, but rates of planned admissions were similar for these age groups (Appendix A3).

Clinically vulnerable children (with a chronic condition or born preterm or with low birth weight) were more likely to attend outpatients than their peers (Figure 7). Those with a chronic condition had higher rates of planned and unplanned hospital admissions than their peers. Children born preterm or with low birth weight who had no record of a chronic condition had similar rates of admissions to their peers with no clinical vulnerability.

Figure 7: Pre-pandemic average rate of hospital contacts per 1,000 child-years among children aged 0 to 4 years (2015 to 2019), by vulnerability group.



On average, between 2015 and 2019, 14.2% of children aged 0 to 4 years who had no evidence of any vulnerability attended at least one outpatient appointment, 1.7% had a planned hospital admission, and 8.8% had an unplanned hospital admission in a year. In comparison, among children aged 0 to 4 years who had any vulnerability, 27.9% attended an outpatient appointment, 8.7% had a planned hospital admission and 15.9% had an unplanned hospital admission in a year.

Changes in hospital contacts during the pandemic

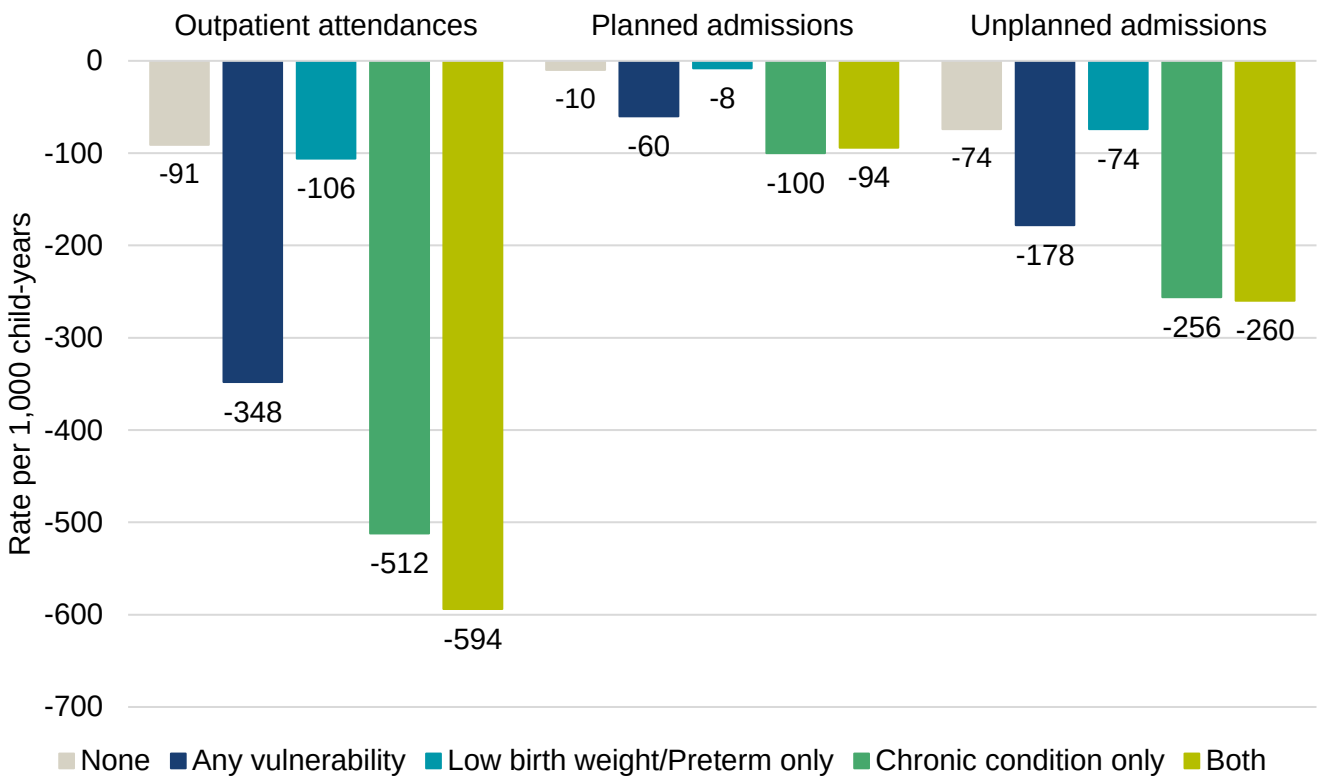
Table 1 shows stark reductions in observed rates of all types of hospital contact compared with predicted rates for children aged 0 to 4 years. Differences between predicted and observed rates of healthcare contacts were much larger for children with a chronic condition than those without, and particularly high for children with a chronic condition who were also born with a low birth weight or preterm (Figure 8).

Table 1: Difference in predicted and observed rates of hospital contact from 23rd March to 31st December 2020 among children aged 0 to 4 years, by vulnerability group.

	Percentage of children			Number of hospital contacts				Rate per 1,000 child-years			
Outpatient attendances	**n**	**N**	**%**	**Predicted**	**Observed**	**Difference**	**% change**	**Predicted**	**Observed**	**Difference**	**% change**
Not vulnerable	155,268	2,091,041	7.4%	455,418	308,111	-147,307	-32.4%	281	190	-91	-32.3%
Vulnerable	93,071	501,720	18.6%	548,358	412,845	-135,513	-24.7%	1,409	1,060	-348	-24.7%
• LBW/preterm	20,565	215,110	9.6%	67,708	49,967	-17,741	-26.2%	406	299	-106	-26.2%
• CC	54,886	224,156	24.5%	343,786	254,807	-88,979	-25.9%	1,977	1,465	-512	-25.9%
• Both	17,620	62,454	28.2%	136,864	108,071	-28,793	-21.0%	2,824	2,230	-594	-21.0%
Planned admissions	**n**	**N**	**%**	**Predicted**	**Observed**	**Difference**	**% change**	**Predicted**	**Observed**	**Difference**	**% change**
Not vulnerable	12,246	2,091,041	0.6%	29,167	13,537	-15,630	-53.6%	18	8	-10	-53.6%
Vulnerable	21,195	501,720	4.2%	65,122	41,708	-23,414	-36.0%	167	107	-60	-36.0%
• LBW/preterm	1,119	215,110	0.5%	2,619	1,214	-1,405	-53.7%	16	7	-8	-53.7%
• CC	16,240	224,156	7.2%	51,051	33,595	-17,456	-34.2%	294	193	-100	-34.2%
• Both	3,836	62,454	6.1%	11,452	6,899	-4,553	-39.8%	236	142	-94	-39.8%
Unplanned admissions	**n**	**N**	**%**	**Predicted**	**Observed**	**Difference**	**% change**	**Predicted**	**Observed**	**Difference**	**% change**
Not vulnerable	56,532	2,091,041	2.7%	184,813	64,914	-119,899	-64.9%	114	40	-74	-64.9%
Vulnerable	33,963	501,720	6.8%	119,404	49,982	-69,422	-58.1%	307	128	-178	-58.1%
• LBW/preterm	5,161	215,110	2.4%	18,376	6,079	-12,297	-66.9%	110	36	-74	-66.9%
• CC	23,590	224,156	10.5%	79,833	35,316	-44,517	-55.8%	459	203	-256	-55.8%
• Both	5,212	62,454	8.4%	21,195	8,587	-12,608	-59.5%	437	177	-260	-59.5%

LBW = Low birth weight (<2500g); CC = chronic health condition. Predicted rates were based on models estimating the rates of contacts that would have occurred if the pandemic had not happened. The coloured column highlights the primary outcome of the study: the absolute differences between predicted and observed rates of hospital contacts, according to vulnerability status.

Figure 8: Difference in predicted versus observed rates of hospital contacts per 1,000 child-years among children aged 0 to 4 years for the period March 23rd to December 31st 2020, by vulnerability group.



Predicted rates were based on models estimating the rates of contacts that would have occurred if the pandemic had not happened.

After lockdown, hospital contact rates did not return to predicted levels for children aged 0 to 4 years whether they were clinically vulnerable or not (Table 2). The largest reductions in planned hospital admissions were seen in the first lockdown period between 23rd March and 23rd June 2020. The largest reductions in outpatient attendances and unplanned hospital admissions were seen in the second lockdown (Table 2).

Table 2: Difference in predicted and observed rates of hospital contact per 1,000 child-years among children aged 0 to 4 years from 23rd March to 31st December 2020, by period and vulnerability group.

	23rd Mar to 23rd Jun		24th Jun to 4th Nov		5th Nov to 31st Dec	
Outpatient attendances	**Difference**	**% change**	**Difference**	**% change**	**Difference**	**% change**
Not vulnerable	**-92**	-32.5%	**-66**	-23.5%	**-146**	-53.5%
Any vulnerability	**-361**	-25.5%	**-270**	-19.1%	**-512**	-36.6%
• LBW/preterm	**-95**	-23.0%	**-68**	-17.0%	**-214**	-54.0%
• CC	**-554**	-27.9%	**-415**	-20.9%	**-668**	-34.3%
• Both	**-581**	-20.8%	**-438**	-15.6%	**-981**	-33.9%
Planned admissions						
Not vulnerable	**-14**	-77.5%	**-8**	-44.6%	**-6**	-34.4%
Any vulnerability	**-90**	-53.4%	**-49**	-28.6%	**-37**	-24.0%
• LBW/preterm	**-12**	-73.7%	**-7**	-45.7%	**-2**	-37.9%
• CC	**-153**	-51.5%	**-80**	-26.9%	**-61**	-22.3%
• Both	**-135**	-57.0%	**-78**	-32.4%	**-63**	-28.4%
Unplanned admissions						
Not vulnerable	**-65**	-63.9%	**-63**	-60.3%	**-113**	-73.3%
Any vulnerability	**-165**	-57.4%	**-152**	-53.3%	**-261**	-67.3%
• LBW/preterm	**-65**	-65.5%	**-60**	-61.3%	**-120**	-76.7%
• CC	**-243**	-55.6%	**-224**	-51.7%	**-352**	-63.4%
• Both	**-234**	-57.4%	**-209**	-53.0%	**-425**	-72.0%

LBW = low birth weight (<2500g); CC = chronic health condition. Grey shading indicates periods of national lockdowns in England. Predicted rates were based on models estimating the rates of contacts that would have occurred if the pandemic had not happened. Bold figures are the primary outcome of the study: the absolute differences between predicted and observed rates of hospital contacts, according to vulnerability status.

Changes in hospital contact rates by age group

The difference in rates of hospital contacts during the pandemic varied by age (Appendix A4). Among infants, there was higher rate of outpatient attendances in the first lockdown and when restrictions were eased than was predicted which suggests there were efforts to prioritise or 'catch-up' on planned care for this age group (Appendix A5), whereas this was not seen for 1- to 4-year-olds. There was a decrease in planned and unplanned hospital admissions for both age groups, and the decreases were largest for children aged 1 to 4 years (Appendix A4 & A5).

Deficits among vulnerable groups

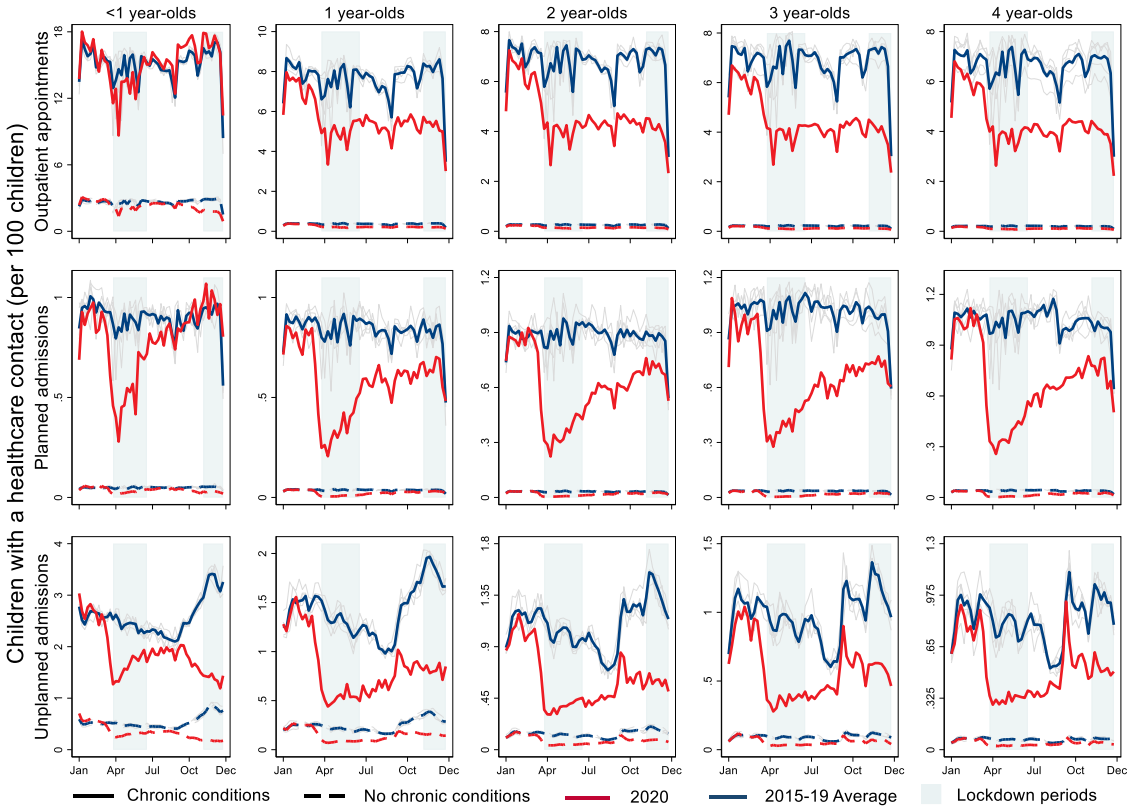
A large number of outpatient attendances and hospital admissions were deferred or foregone during the pandemic. Among children age 0 to 4 years there were 511,185 fewer hospital contacts than predicted between 23rd March to 31st December 2020. This deficit comprised 282,820 fewer outpatient attendances, 39,044 fewer planned hospital admissions, and 189,321 fewer unplanned hospital admissions. These deficits disproportionately affected children who were clinically vulnerable. The 20% of children with a chronic condition, born preterm or with low birth weight accounted for 48% of the deficit in

outpatient attendances, 60% of the deficit in planned hospital admissions, and 37% of the deficit in unplanned hospital admissions.

Weekly healthcare contacts during the pandemic

Figure 9 compares the weekly rate of hospital contacts in 2020 to the average weekly rate in 2015 to 2019 by year of age for children with and without a chronic condition. The plots show higher rates of hospital contacts for children with a chronic condition compared to those without. There were also steep reductions in hospital contacts in the weeks before the first lockdown in March 2020 (compared with average rates for the same weeks in 2015-19) in all groups, with the least difference for outpatient attendances among infants. Among children with a chronic condition, rates of planned hospital contact recovered to rates in pre-pandemic years for infants, but not for older children. Among children aged 1 to 4 years old, rates of planned hospital admissions appeared to recover more than outpatient attendances during 2020, but neither reached pre-pandemic levels. The autumn-winter peak in unplanned hospital admissions observed in previous years was attenuated in 2020. This likely reflects reduced exposure to Respiratory Syncytial Virus (RSV) and other viral infections (Figure 9).

Figure 9: Weekly rates of hospital contacts among children aged 0 to 4 years in 2020 and on average from 2015-2019,[3] by age and presence of a chronic condition or not.



[3] We compared observed weekly rates of hospital contacts to historic 5-year averages as they illustrate seasonal trends more clearly than predicted weekly rates for 2020, which are smoothed out by the prediction model.

Type of outpatient attendances during the pandemic

During the pandemic, the rate of tele/virtual outpatient attendances increased, representing adaptation of the healthcare system to the pandemic (Appendix A6). Clinically vulnerable children were less likely than their peers to have an in-person outpatient appointment scheduled (76.6% of scheduled appointments versus 83.5%; Appendix A7). Although there was no difference in attendance rates for in-person appointments between clinically vulnerable children and their peers (Appendix A8), clinically vulnerable children had a greater proportion of tele/virtual outpatient attendances than their peers overall (Table 3).

Table 3: Type of outpatient attendances among children aged 0 to 4 years from 23rd March to 31st December 2020, by vulnerability group.

	Total	In-person		Tele/virtual	
	N	n	%	n	%
Not vulnerable	308,111	248,921	80.8%	59,190	19.2%
Any vulnerability	412,845	300,924	72.9%	111,921	27.1%
• LBW/preterm	49,967	38,570	77.2%	11,397	22.8%
• CC	254,807	183,266	71.9%	71,541	28.2%
• Both	108,071	79,088	73.2%	28,983	26.8%

LBW = low birth weight (<2500g); CC = chronic health condition.

Limitations of this analysis

It is likely that **we will have missed some children with chronic conditions as we could only identify chronic conditions using information recorded in hospital records.** This means we will have missed chronic conditions in children that were managed entirely in the community (i.e. we can identify the more severe cases). Also, some of the younger children in our study will not have had a chance to be diagnosed with a chronic condition yet (unlike older children who had a longer time to be diagnosed) and this is particularly true during the pandemic when contact with services was lower. Overall, the proportion of children with a chronic health condition reported in our analysis is likely to underestimate the true proportion in the population.

Our findings rely on a prediction model which introduces some level of uncertainty and likely underestimates the true rates of healthcare contacts had the pandemic not occurred. Our estimates in reductions are therefore conservative.

Key findings related to children aged 0 to 4 years

1. **Disproportionately greater deficits in hospital contacts occurred among clinically vulnerable children aged 0 to 4 years compared to their peers.** Overall, the 20% of children who were categorised as clinically vulnerable accounted for 48% of the deficit in outpatient attendances, 60% of the deficit in planned hospital admissions and 37% of the deficit in unplanned hospital admissions.

2. **Children with multiple vulnerabilities had the greatest deficits of hospital contacts.** The deficits in predicted versus observed rates of hospital contacts were highest for children with a chronic condition who were also born preterm or with low birth weight.

3. **Part of the deficit in unplanned hospital admissions is likely to reflect lower rates of viral infections during winter, but may also reflect limited access to hospitals.** Plots of weekly rates of unplanned hospital admissions for children aged 0 to 4 years with and without a chronic condition, show marked reductions in the winter peak, especially among infants.

4. **As the pandemic progressed, we observed some 'catch-up' in planned hospital admissions for children aged 0 to 4 years and in outpatient attendances for infants**. Weekly rates of planned hospital admissions among children aged 0 to 4 years with a chronic condition declined sharply from March 2020, but increased later in the year. By late 2020, outpatient attendance rates for infants exceeded the average for previous years, but a similar recovery in rates was not observed for 1- to 4-year-olds.

5. **We saw evidence of health system adaptation to the pandemic.** Rates of tele/virtual outpatient attendances increased for children aged 0 to 4 years during the pandemic, but did not exceed in-person attendances.

Implications for policy and further research

- **Evidence of compensatory increases in rates of planned outpatient and inpatient care for infants were less evident for older children, even with virtual outpatient appointments taken into consideration.** A concerted effort focused on 'catch-up' of planned hospital care may be needed for children with chronic conditions.

- **Further research is needed to identify specific conditions and types of care (for example, diagnostic procedures or treatments) affected by deficits in planned hospital contacts** to assess the evidence of adverse consequences and potential for mitigation of any harm.

- **Research is also needed into the potential benefits as well as harms of the deficit in unplanned hospital admissions.** Some of this deficit may be due to less exposure to infection and injury as a result of less mixing and activity outside the home, but it could also represent missed opportunities to detect and respond to conditions that may have long term consequences.

Example 2: Secondary school pupils supported by statutory services

Defining cohorts of children according to vulnerability status in the ECHILD Database

Receiving SEN support in schools or CSC services is common among secondary school pupils in years 7 to 11. Of the 3,030,235 pupils included in this analysis, 621,137 (20.5%) were receiving some form of SEN support and/or CSC services (Figure 9). Overall, 1 in 37 children (2.7%) were receiving both SEN support in schools and CSC services.

Characteristics of the children in school years 7 to 11 in 2019/20 included in the study are given in Appendix B1. Overall, boys were more likely than girls to receive SEN support or CSC services. Children who were of White, Black or Mixed ethnicity were more likely to receive SEN support or CSC services than children of Asian or other ethnicity. Children who were eligible for free school meals were more likely to receive SEN support or CSC services than children who were not eligible.

Figure 10: Prevalence of statutory support and services among secondary school pupils in 2019/20 in school years 7 to 11 (aged 11 to 16 years).

SEN = special educational needs support; CSC = children's social care services. N = 3,030,235. Overall, in the 2019/20 academic year, 16.9% of pupils in school years 7 to 11 received SEN support in schools: 2.7% had an Education, Health and Care Plan and 14.2% were receiving lower levels of SEN support. In terms of CSC services, the highest level of intervention was being looked after for 0.8% of children overall, being subject to a child protection plan for 0.5% and being a child in need for 5.0%.

Hospital contacts before the pandemic

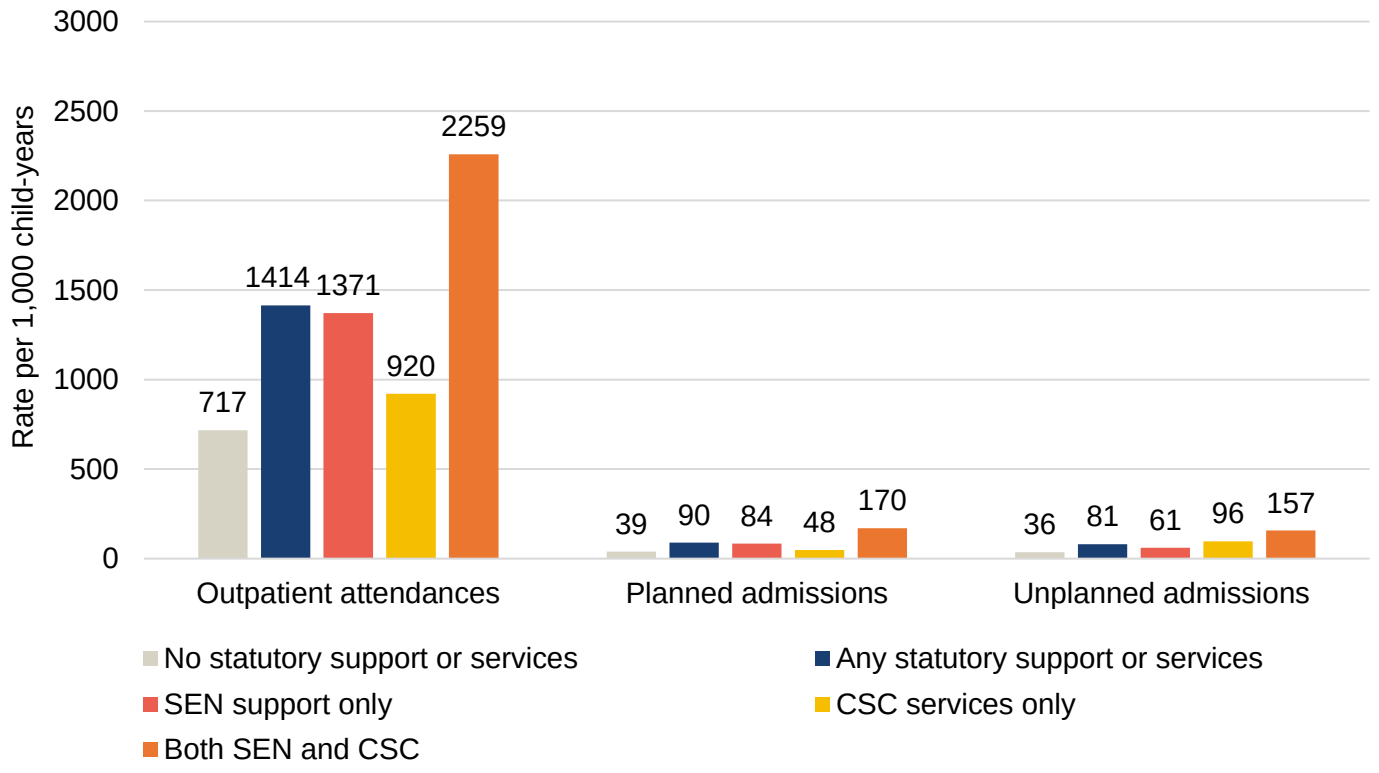
Before the pandemic, pupils receiving SEN support or CSC services had more contact with hospitals than their peers, with the highest levels among those who were being supported both by schools for SEN and by CSC services (Figure 11).

On average, between 2015 and 2019, 22.3% of secondary school pupils who were not receiving SEN support or CSC services attended an outpatient appointment, 2.6% had a planned hospital admission, and 2.8% had an unplanned hospital admission in a year.

In comparison, among secondary school pupils who were receiving SEN support or CSC services, 34.4% attended an outpatient appointment, 4.6% had a planned hospital admission, and 5.4% had an unplanned hospital admission in a year.

The higher levels of hospital healthcare use by young people receiving SEN support or CSC services mean that disruptions to healthcare access during the pandemic are likely to have disproportionately affected them. This group is also likely to have been affected by disruptions and changes to their SEN support through schools and from CSC services during the pandemic.

Figure 11: Pre-pandemic average rate of hospital contacts per 1,000 child-years among pupils in school years 7 to 11 (2015 to 2019), by type of statutory support or service.



SEN = special educational needs; CSC = children's social care services.

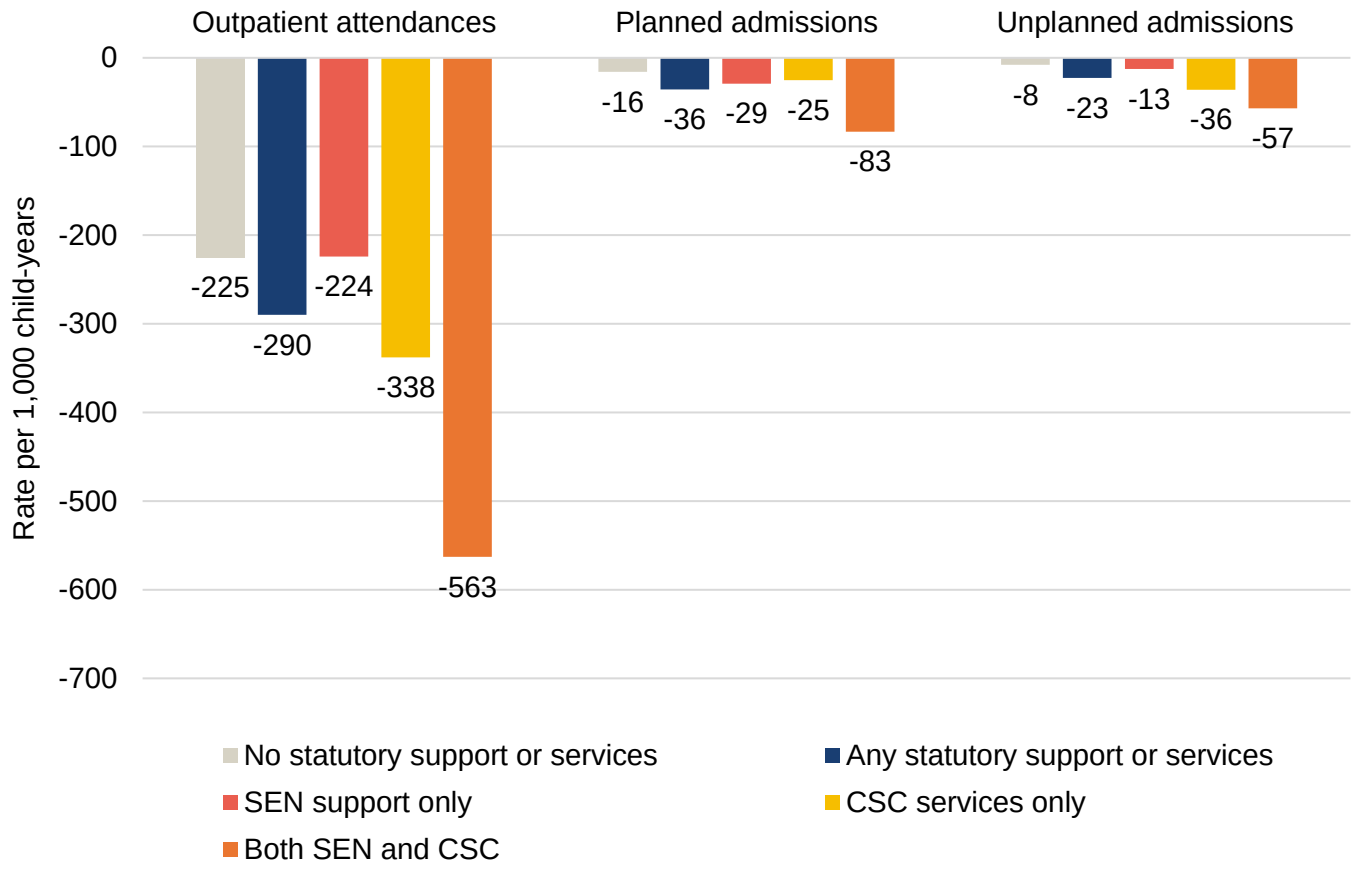
Changes in hospital contacts during the pandemic

During the pandemic, all types of hospital contact decreased among secondary school pupils. Overall, between 23rd March and 31st December 2020, the rate of outpatient appointment attendances was 28% lower than predicted, the rate of planned hospital admissions was 40% lower, and the rate of unplanned hospital admissions was 25% lower (Appendix B2).

Although the overall rates of contact with hospitals decreased during the pandemic, pupils receiving SEN support or CSC services continued to be more likely than their peers to use both planned and unplanned hospital healthcare (Table 4).

The decreases in rates of hospital contact during the pandemic were greater for children supported by statutory services than for their peers (Figure 12).

Figure 12: Difference in predicted versus observed rates of hospital contacts per 1,000 child-years among pupils in school years 7 to 11 for the period 23rd March to 31st December 2020, by type of statutory support or service.



SEN = special educational needs; CSC = children's social care services. Predicted rates were based on models estimating the rates of contacts that would have occurred if the pandemic had not happened.

Table 4: Difference in predicted and observed rates of hospital contact from 23rd March to 31st December 2020 among pupils in school years 7 to 11, by type of statutory support or service.

	Percentage of children			Number of hospital contacts				Rate per 1,000 child-years			
Outpatient attendances	**n**	**N**	**%**	**Predicted**	**Observed**	**Difference**	**% change**	**Predicted**	**Observed**	**Difference**	**% change**
No support/services	352,958	2,409,098	14.7%	1,345,303	928,549	-416,754	-31.0%	726	501	-225	-31.0%
Any support/services	160,725	621,137	25.9%	668,851	530,593	-138,258	-20.7%	1,400	1,110	-290	-20.7%
• SEN only	114,244	428,964	26.6%	440,318	366,207	-74,111	-16.8%	1,334	1,110	-224	-16.8%
• CSC only	17,915	110,390	16.2%	79,370	50,674	-28,696	-36.2%	935	597	-338	-36.2%
• Both SEN and CSC	28,566	81,783	34.9%	149,163	113,712	-35,451	-23.8%	2,371	1,808	-563	-23.7%
Planned admissions	**n**	**N**	**%**	**Predicted**	**Observed**	**Difference**	**% change**	**Predicted**	**Observed**	**Difference**	**% change**
No support/services	24,294	2,409,098	1.0%	73,379	43,867	-29,512	-40.2%	40	24	-16	-40.4%
Any support/services	12,323	621,137	2.0%	42,516	25,504	-17,012	-40.0%	89	53	-36	-40.5%
• SEN only	8,357	428,964	1.9%	27,057	17,410	-9,647	-35.7%	82	53	-29	-35.4%
• CSC only	1,195	110,390	1.1%	4,185	2,060	-2,125	-50.8%	49	24	-25	-50.7%
• Both SEN and CSC	2,771	81,783	3.4%	11,274	6,034	-5,240	-46.5%	179	96	-83	-46.3%
Unplanned admissions	**n**	**N**	**%**	**Predicted**	**Observed**	**Difference**	**% change**	**Predicted**	**Observed**	**Difference**	**% change**
No support/services	42,288	2,409,098	1.8%	68,894	53,103	-15,791	-22.9%	37	29	-8	-21.5%
Any support/services	19,757	621,137	3.2%	38,777	27,910	-10,867	-28.0%	81	58	-23	-28.3%
• SEN only	11,693	428,964	2.7%	20,090	15,964	-4,126	-20.5%	61	48	-13	-21.4%
• CSC only	3,596	110,390	3.3%	8,089	4,973	-3,116	-38.5%	95	59	-36	-37.8%
• Both SEN and CSC	4,468	81,783	5.5%	10,598	6,973	-3,625	-34.2%	168	111	-57	-33.8%

SEN = special educational needs support; CSC = children's social care services. Predicted rates were based on models estimating the rates of contacts that would have occurred if the pandemic had not happened. The coloured column highlights the primary outcome of the study: the absolute differences between predicted and observed rates of hospital contacts, according to vulnerability status.

The greatest decreases in all types of hospital contacts happened in the first national lockdown (Appendix B2). For planned hospital contacts (outpatient attendances and planned admissions), the decrease in rates compared to the predicted level was smaller during the second national lockdown than during the period between national lockdowns (Table 4). This could indicate that as the pandemic progressed hospitals were able to adapt and minimise disruptions to planned healthcare. In contrast, the decreases in unplanned admissions were greater during both national lockdowns than during the period in between them when restrictions eased.

Relative decreases in planned admissions were similar between children receiving SEN support or CSC services and their peers throughout the pandemic. For outpatient attendances, the relative decreases were persistently greater throughout the pandemic for children receiving CSC services than for children who received no support or services, or received SEN support only (Table 5).

Table 5: Difference in predicted and observed rates of hospital contact per 1,000 child-years among pupils in school years 7 to 11 from 23rd March to 31st December 2020, by period and by type of statutory support or service.

	23rd Mar to 23rd Jun		24th Jun to 4th Nov		5th Nov to 31st Dec	
Outpatient attendances	**Difference**	**% change**	**Difference**	**% change**	**Difference**	**% change**
No support/services	**-333**	-47.5%	**-182**	-24.9%	**-153**	-20.2%
Any support/services	**-470**	-33.5%	**-220**	-15.8%	**-160**	-11.4%
• SEN only	**-408**	-30.7%	**-154**	-11.6%	**-94**	-6.9%
• CSC only	**-456**	-49.7%	**-302**	-32.5%	**-231**	-24.5%
• Both SEN and CSC	**-812**	-33.6%	**-455**	-19.4%	**-412**	-17.5%
Planned admissions						
No support/services	**-23**	-61.6%	**-14**	-34.4%	**-9**	-22.9%
Any support/services	**-54**	-61.2%	**-29**	-32.5%	**-20**	-23.1%
• SEN only	**-47**	-58.2%	**-23**	-28.2%	**-14**	-17.2%
• CSC only	**-33**	-69.1%	**-23**	-46.5%	**-15**	-31.6%
• Both SEN and CSC	**-121**	-65.5%	**-68**	-37.8%	**-58**	-34.5%
Unplanned admissions						
No support/services	**-18**	-46.7%	**-3**	-8.5%	**-7**	-16.3%
Any support/services	**-41**	-47.7%	**-13**	-16.3%	**-17**	-20.8%
• SEN only	**-26**	-42.4%	**-4**	-7.3%	**-10**	-14.4%
• CSC only	**-64**	-59.0%	**-24**	-25.2%	**-22**	-29.5%
• Both SEN and CSC	**-86**	-48.0%	**-42**	-25.7%	**-49**	-29.7%

SEN = special educational needs support; CSC = children's social care services. Grey shading indicates periods of national lockdowns in England. Predicted rates were based on models estimating the rates of contacts that would have occurred if the pandemic had not happened. Bold figures are the primary outcome of the study: the absolute differences between predicted and observed rates of hospital contacts, according to vulnerability status.

Deficits attributable to vulnerable groups

Between 23rd March and 31st December 2020, a large deficit in planned healthcare occurred among secondary school pupils. Overall, there were 555,012 fewer outpatient attendances than predicted and 46,524 fewer planned hospital admissions. There were also 26,658 fewer unplanned hospital admissions than predicted. The decrease in unplanned admissions could be viewed as a positive change with fewer unplanned admissions because children were less likely to have injuries and conditions that required unplanned treatment. However, some of the decrease in unplanned admissions could represent unmet need (for example, children who needed care did not go to a hospital because of the pandemic) and missed opportunities to intervene (for example, the chance to refer a child who is admitted to hospital with self-harm to mental health services).

The deficits in hospital contacts during the pandemic disproportionately affected young people who were receiving SEN support or CSC services. Although only 21% of the secondary school pupils were receiving SEN support or CSC services, they accounted for 25% of the deficit in outpatient attendances, 37% of the deficit in planned hospital admissions and 41% of the deficit in unplanned hospital admissions.

Type of outpatient attendances during the pandemic

During the pandemic, pupils receiving SEN support or CSC services were less likely than their peers to have an in-person outpatient appointment scheduled (74.0% of scheduled appointments versus 76.9%; Appendix B3) and were also less likely to attend an in-person appointment than their peers (85.1% of scheduled in-person appointments attended versus 86.7%; Appendix B4). Overall, this means that children who were receiving SEN support or CSC services had a greater proportion of tele/virtual outpatient attendances than their peers (Table 6).

Children receiving CSC services only had the lowest attendance rates for both in-person and tele/virtual outpatient appointments (Appendix B4).

Table 6: Type of outpatient attendances among pupils in school years 7 to 11 from 23rd March to 31st December 2020, by type of statutory support or service.

	Total (N)	In-person		Tele/virtual	
		n	%	n	%
No support/services	1,135,391	858,259	75.6%	277,132	24.4%
Any support/services	636,498	459,700	72.2%	176,798	27.8%
• SEN only	440,910	318,326	72.2%	122,584	27.8%
• CSC only	60,457	45,023	74.5%	15,434	25.5%
• Both SEN and CSC	135,131	96,351	71.3%	38,780	28.7%

SEN = special educational needs support; CSC = children's social care services.

Limitations of this analysis

In this analysis, children's vulnerability was categorised as receiving SEN support only, CSC services only, or both. This **simple classification of statutory support and services** ensured that the sub-groups of vulnerable children were large enough to make robust comparisons between them and their peers, including during the different periods of the pandemic. However, this simple classification does not account for the different types of SEN support in schools or CSC services, or their duration. It also does not account for the reasons for the support or service, such as the type of special educational need a child has or the reason a child is looked after. Future work could explore the impact of the pandemic on more specific sub-groups of children receiving statutory support and services.

Information about CSC services was not available in the ECHILD Database for the 2019/20 academic year (as described in Box 1: Strengths and limitations of the ECHILD Database). This data lag meant that **we could not identify children who were receiving CSC services at the time of the pandemic and instead looked at those who had services in 2018/19.** Many of the children who received CSC services in 2018/19 are likely to have also been receiving services in 2019/20. For example, Department for Education statistics show that half (52.3%) of children who were looked after in 2019/20 had been in care for one year or more, 1 in 6 (16.8%) children who were subject to a child protection plan in 2019/20 had the plan in place for one year or more, and almost half (48.5%) of children in need in 2019/20 had been in need for one year or more (15).

However, there will also be some children who have been classified as receiving CSC services during the pandemic, but were not - these children might be thought of as having a history of vulnerability. There will be other children who were receiving CSC services in 2019/20 who have been misclassified as not currently receiving services. This misclassification is likely to mean that the rates of hospital contacts for children receiving CSC services that we calculated in this analysis are slight underestimations, and that the deficit in hospital contacts that they bore during the pandemic, compared to their peers, is actually larger. As more recent CSC data becomes available in the ECHILD Database, it will be possible to accurately identify which groups of children services at the time of the pandemic and update the preliminary findings from this analysis.

Key findings related to pupils receiving statutory services

1. **Pupils receiving SEN support or CSC services were disproportionately affected by deficits in hospital contacts during the pandemic.** Overall, 25% of the deficit in outpatient attendances, 37% of the deficit in planned hospital admissions and 41% of the deficit in unplanned hospital admissions during the pandemic occurred in the 21% of pupils receiving SEN support or CSC services.
2. **Large deficits in planned and unplanned healthcare occurred among pupils receiving SEN support or CSC services during the pandemic.** In total, during the first nine months of the pandemic, they had 138,258 fewer outpatient attendances, 17,012 fewer planned hospitals admissions and 10,867 fewer unplanned hospital admissions than would have been expected had the pandemic not happened.
3. **Pupils receiving CSC services had the largest deficits in hospital contacts, particularly for outpatient attendances.** The greater decreases in rates of hospital contacts among children receiving CSC services persisted even when national lockdowns were not in force.
4. **Pupils receiving SEN support or CSC services were less likely than their peers to have an in-person outpatient attendance during the pandemic.** Without the increased use of tele/virtual outpatient appointments, the

observed deficit in outpatient attendances during the pandemic would have undoubtedly been much greater. Previous research has found that virtual GP consultations are safe and effective for the small fraction of patients who are considered "suitable" for this type of consultation by their clinicians (5). However, the effectiveness of this type of remote health care for vulnerable children is unclear. Online consultations can be difficult for some families to access because of a lack of required resources (e.g., high speed internet). Remote consultations can also have disadvantages (for example, the potential for misunderstandings and difficulties building relationships and rapport between health professionals and patients), and there are particular concerns in relation to safeguarding vulnerable children, such as health professionals not being able to pick up on non-verbal cues or not knowing who else is in the room (6).

Implications for policy and further research

- **Our findings indicate a need for targeted 'catch-up' funding and resources for child health, particularly for vulnerable children who were affected disproportionately.** For example, the ring-fenced resource for 'catch-up' of NHS care (Health and Social Care Levy) might be further targeted for the vulnerable groups that have disproportionally missed out on hospital contacts. Services should also consider how to mitigate potential adverse effects of delayed or foregone hospital care in the recovery phase of the pandemic.

- **CSC services and schools may need to encourage young people (and their families and carers) to re-engage with health care services** to ensure they receive the health care they need, including supporting them to attend in-person outpatient appointments.

- **Secondary school pupils receiving SEN support or CSC services may need to be prioritised for face-to-face outpatient care** during the recovery phase of the pandemic as it is unclear how effective remote care is for these children.

- **More research about how delays to treatments for childhood conditions impact children's outcomes is needed.** The consequences of the deficits in hospital contacts borne by vulnerable children during the pandemic are difficult to predict, because little is known about this topic. Further assessment of the deficit in hospital contacts and the likely consequences of potential unmet need will require close involvement of the clinicians providing paediatric services working in partnership with researchers.

Concluding remarks

This study highlighted the large and disproportionate deficits in hospital care that were borne by vulnerable children during the COVID-19 pandemic. However, this study only looked at deficits in hospital contacts during the first nine months of the pandemic as experienced by children and young people in two age groups whose vulnerabilities could be defined from administrative health, education and social care data. The true extent of the deficits in hospital contacts that occurred among all vulnerable children and young people, throughout the course of the pandemic, will be much greater.

Our findings suggest that child health services are likely to require targeted funding and resources during the recovery phase of the pandemic to 'catch-up' on and mitigate the consequences of the large deficits in hospital contacts that occurred. For example, the ring-fenced resource for 'catch-up' of NHS care (Health and Social Care Levy) might be further targeted for the vulnerable groups that have disproportionally missed out on hospital contacts.

The consequences of deficits in hospital contacts will vary for different vulnerable groups (which are very heterogenous) and across the life course. Consequences are difficult to predict because there is limited evidence to show how diagnoses or treatments that are deferred or foregone in children might influence their health. Studies in adults have clearly shown the harms of delays to planned hospital care (such as cancer treatment), but few such studies have been conducted for the diverse clinical problems that children experience.

Childhood is a period of rapid development, especially for neurological, behavioural and social development, when delays in treating sensory or physical problems may hold back development at critical times and have long-lasting impacts on children's health and wellbeing. Although some of the deferred or forgone planned hospital care may not have been needed, some of it will have been necessary to manage children's clinical needs. This means that some of the large deficits in planned care (outpatient attendances and planned admissions) represent unmet health need among vulnerable children and young people. Vulnerable groups, who were disproportionately affected by deficits in planned care compared to their peers, may need to be prioritised for 'catch-up care' during the recovery phase of the pandemic. Services should also consider what extra help might be needed to re-engage and rebuild relationships with socially vulnerable groups, such as those supported by children's social care services.

Part of the deficit in unplanned care (unplanned hospital admissions) will be due to reduced need in the population; for example, children may have been less likely to contract infections or be injured due to changes in behaviour during the pandemic. However, part of the reduction will represent unmet need due to changes in health-seeking behaviour of people and thresholds for admission to hospital during the pandemic. Fewer unplanned hospital admissions may also represent missed opportunities to detect and respond to conditions that may have long term consequences; for example, the chance to refer a child who is admitted to hospital with self-harm to mental health services.

More research that examines the impact of delays to planned treatments for childhood conditions on a range of health, education and social outcomes, and the impacts of reductions in unplanned care, is needed. The consequences of the deficits in hospital contacts that occurred among vulnerable children during the pandemic are difficult to predict, because little is known about this topic. Further assessment of the deficit in hospital contacts among vulnerable children and the likely consequences of potential unmet need will require close involvement of the clinicians providing paediatric services working in partnership with researchers.

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Appendix

Appendix A1: Definition of chronic health conditions.

Chronic health conditions were defined as any condition likely to require follow-up for more than a year where this follow-up could be through hospital admissions, outpatient appointments, or the use of support services. We used the Hardelid code list which was developed to identify children with chronic conditions (including congenital anomalies) based on information recorded in administrative health data. The Hardelid list includes nine groups:

1) Mental or behavioural
2) Cancer or blood
3) Chronic infections
4) Respiratory
5) Endocrine, metabolic, digestive, renal, or genitourinary
6) Musculoskeletal or skin
7) Neurological or sensory
8) Cardiac conditions
9) Not specific enough to classify.

These groups are not mutually exclusive which means a child can be included in more than one group.

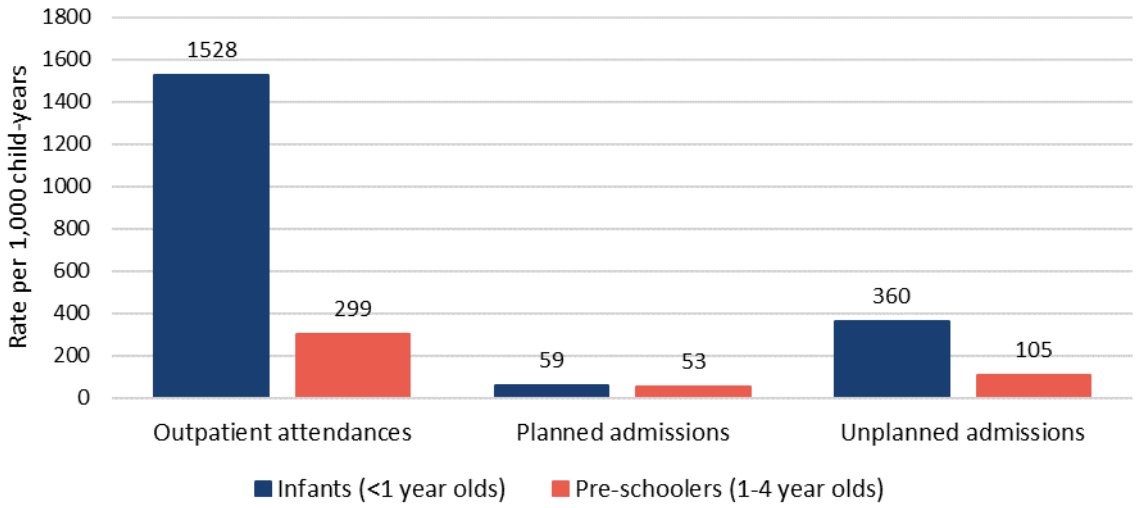
In our study, chronic conditions were identified in all hospital admission records up to a child's 5th birthday. Children were considered to have a chronic health condition if they were included in one or more of the groups from the Hardelid list. Children who had multiple chronic conditions were only counted once.

Appendix A2: Characteristics of children born between 1st January 2015 and 31st December 2020, by vulnerability status.

	Total (N=3,181,223)		None (N=2,547,780; 80.1%)		LBW/Preterm (N=262,017; 8.2%)		Chronic condition (N=292,917, 9.2%)		Both (N=78,509; 2.5%)	
Gender	**n**	**%**	**n**	**%**	**n**	**%**	**n**	**%**	**n**	**%**
Boys	1,634,010	51.4%	1,291,209	50.7%	125,959	48.1%	173,209	59.1%	43,633	55.6%
Girls	1,545,859	48.6%	1,255,754	49.3%	135,759	51.8%	119,586	40.8%	34,760	44.3%
Missing	1,354	0.04%	817	0.03%	299	0.1%	122	0.04%	116	0.2%
Ethnicity										
White/White British	2,243,119	70.5%	1,800,426	70.7%	172,251	65.7%	215,272	73.5%	55,170	70.3%
Black/Black British	147,919	4.7%	115,776	4.5%	14,440	5.5%	13,325	4.6%	4,378	5.6%
Asian/Asian British	348,454	11.0%	268,256	10.5%	38,628	14.7%	31,381	10.7%	10,189	13.0%
Any other ethnic group	270,960	8.5%	218,621	8.6%	22,525	8.6%	23,578	8.1%	6,236	7.9%
Missing	170,771	5.4%	144,701	5.7%	14,173	5.4%	9,361	3.2%	2,536	3.2%
IMD quintile										
1 (Most deprived)	725,527	22.8%	562,677	22.1%	70,134	26.8%	70,468	24.1%	22,248	28.3%
2	591,682	18.6%	469,540	18.4%	51,965	19.8%	54,729	18.7%	15,448	19.7%
3	514,735	16.2%	414,567	16.3%	41,303	15.8%	46,629	15.9%	12,236	15.6%
4	452,738	14.2%	368,693	14.5%	34,116	13.0%	39,963	13.6%	9,966	12.7%
5 (Least deprived)	878,841	27.6%	716,552	28.1%	63,336	24.2%	80,526	27.5%	18,427	23.5%
Missing	17,700	0.6%	15,751	0.6%	1,163	0.4%	602	0.2%	184	0.2%
Birth year										
2015	588,462	18.5%	456,739	17.9%	46,907	17.9%	68,761	23.5%	16,055	20.5%
2016	599,883	18.9%	471,553	18.5%	49,378	18.9%	62,943	21.5%	16,009	20.4%
2017	585,802	18.4%	466,358	18.3%	49,798	19.0%	54,657	18.7%	14,989	19.1%
2018	552,087	17.4%	443,920	17.4%	47,788	18.2%	46,774	16.0%	13,605	17.3%
2019	525,207	16.5%	432,571	17.0%	41,891	16.0%	39,233	13.4%	11,512	14.7%
2020	329,782	10.4%	276,639	10.9%	26,255	10.0%	20,549	7.0%	6,339	8.1%

LBW = low birth weight; IMD = Index of Multiple Deprivation. Percentages may not sum to 100% due to rounding.

Appendix A3: Average rate of hospital contacts per 1,000 child-years for children aged 0 to 4 years (2015 to 2019), by age group.



Appendix A4: Difference in predicted and observed rates of hospital contact among children aged 0 to 4 years from 23rd March to 31st December 2020, by age.

	Percentage of children			Number of hospital contacts				Rate per 1,000 child-years			
Outpatient attendances	**n**	**N**	**%**	**Predicted**	**Observed**	**Difference**	**% change**	**Predicted**	**Observed**	**Difference**	**% change**
Infants (<1 year)	203,175	486,473	41.8%	463,569	525,645	+ 62,076	+13.4%	1,228	1,393	+164	+13.4%
Pre-schoolers (1-4 years)	97,749	2,502,326	3.9%	589,650	358,988	-230,662	-39.1%	304	185	-119	-39.1%
Planned admissions	**n**	**N**	**%**	**Predicted**	**Observed**	**Difference**	**% change**	**Predicted**	**Observed**	**Difference**	**% change**
Infants (<1 year)	12,832	486,473	2.6%	18,134	18,449	+ 315	+1.7%	48	49	+1	+1.7%
Pre-schoolers (1-4 years)	35,026	2,502,326	1.4%	100,314	58,890	-41,424	-41.3%	52	30	-22	-41.3%
Unplanned admissions	**n**	**N**	**%**	**Predicted**	**Observed**	**Difference**	**% change**	**Predicted**	**Observed**	**Difference**	**% change**
Infants (<1 year)	64,088	486,473	13.2%%	118,832	83,699	-35,133	-29.6%	315	222	-93	-29.6%
Pre-schoolers (1-4 years)	83,088	2,502,326	3.3	221,924	103,594	-118,330	-53.3%	114	53	-61	-53.3%

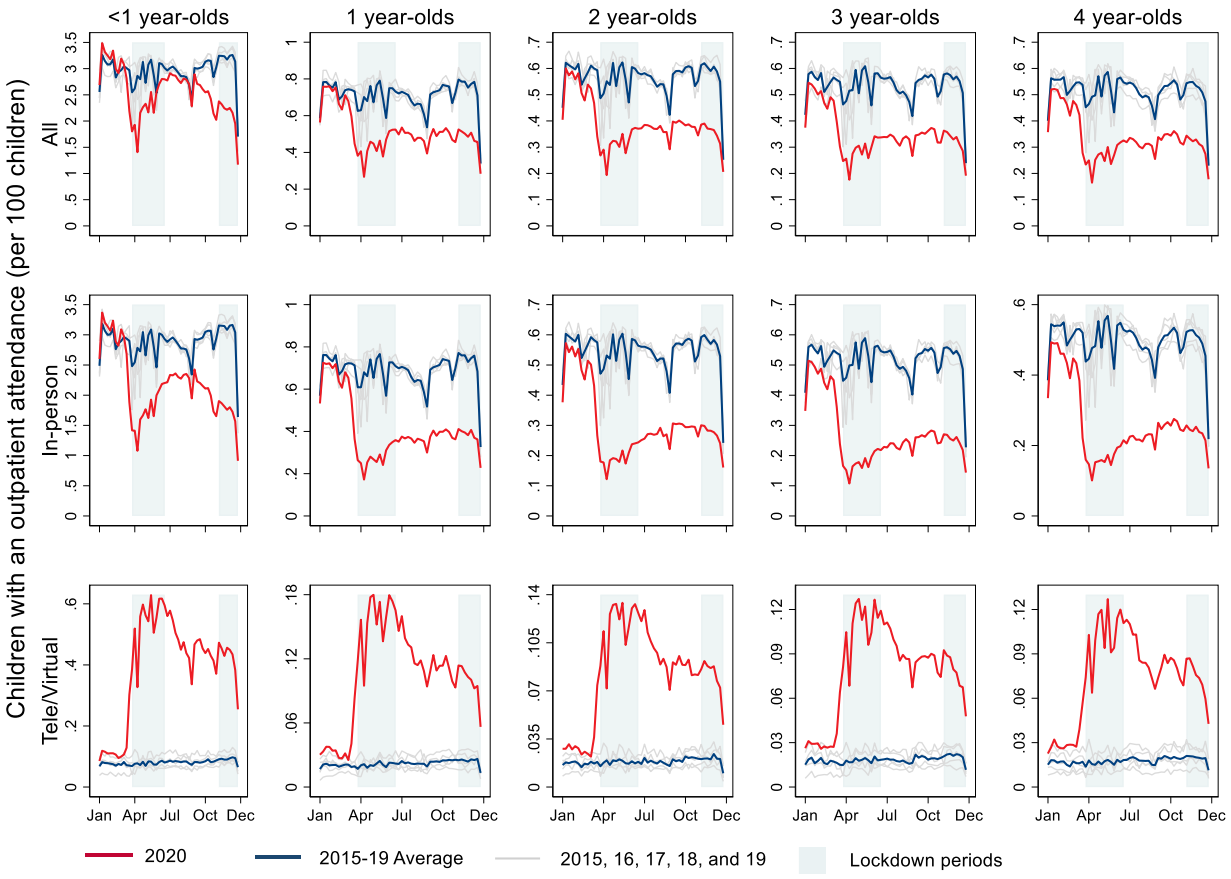
Predicted rates were based on models estimating the rates of contacts that would have occurred if the pandemic had not happened. The coloured column highlights the primary outcome of the study: the absolute differences between predicted and observed rates of hospital contacts, according to vulnerability status.

Appendix A5: Difference in predicted and observed rates of hospital contact per 1,000 child-years among children aged 0 to 4 years from 23rd March to 31st December 2020, by period and age.

	23rd Mar to 23rd Jun		24th Jun to 4th Nov		5th Nov to 31st Dec	
Outpatient attendances	**Difference**	**% change**	**Difference**	**% change**	**Difference**	**% change**
Infants (<1 year)	**72**	+18.0%	**159**	+27.4%	**-67**	-26.8%
Pre-schoolers (1-4 years)	**-44**	-44.2%	**-50**	-35.0%	**-24**	-40.5%
Planned admissions	**Difference**	**% change**	**Difference**	**% change**	**Difference**	**% change**
Infants (<1 year)	**-2**	-12.8%	**4**	+17.4%	**-1**	-12.8%
Pre-schoolers (1-4 years)	**-11**	-64.8%	**-8**	-33.0%	**-2**	-21.1%
Unplanned admissions	**Difference**	**% change**	**Difference**	**% change**	**Difference**	**% change**
Infants (<1 year)	**-13**	-13.4%	**-18**	-13.1%	**-63**	-73.1%
Pre-schoolers (1-4 years)	**-21**	-62.4%	**-23**	-45.1%	**-17**	-57.0%

Grey shading indicates periods of national lockdowns in England. Predicted rates were based on models estimating the rates of contacts that would have occurred if the pandemic had not happened. Bold figures are the primary outcome of the study: the absolute differences between predicted and observed rates of hospital contacts, according to vulnerability status.

Appendix A6: Weekly rates of outpatient attendances among children aged 0 to 4 years in 2020 and on average during 2015-2019, by type of appointment (in-person and tele/virtual).



Appendix A7: Type of scheduled outpatient appointments among children aged 0 to 4 years from 23rd March to 31st December 2020, by vulnerability status.

	Total	In-person		Tele/virtual	
	N	n	%	n	%
Not vulnerable	398,995	333,102	83.5%	65,893	16.5%
Any vulnerability	525,486	402,683	76.6%	122,803	23.4%
• LBW/preterm	65,282	52,436	80.3%	12,846	19.7%
• CC	322,970	244,834	75.8%	78,136	24.2%
• Both	137,234	105,413	76.8%	31,821	23.2%

LBW = Low birth weight (<2500g); CC = chronic health condition.

Appendix A8: Attendance of scheduled outpatient appointments among children aged 0 to 4 years from 23rd March to 31st December 2020, by vulnerability status and type of appointment.

	All			In-person			Tele/virtual		
	Attended	**Scheduled**	**% attended**	**Attended**	**Scheduled**	**% attended**	**Attended**	**Scheduled**	**% attended**
Not vulnerable	308,111	398,995	77.2%	248,921	333,102	74.7%	59,190	65,893	89.8%
Any vulnerability	412,845	525,486	78.6%	300,924	402,683	74.7%	111,921	122,803	91.1%
• LBW/preterm	49,967	65,282	76.5%	38,570	52,436	73.6%	11,397	12,846	88.7%
• CC	254,807	322,970	78.9%	183,266	244,834	74.9%	71,541	78,136	91.6%
• Both	108,071	137,234	78.8%	79,088	105,413	75.0%	28,983	31,821	91.1%

LBW = Low birth weight (<2500g); CC = chronic health condition.

Appendix B1: Characteristics of pupils in school years 7 to 11 in 2019/20, by type of statutory support or service.

	Overall (N=3,030,235)		Not supported or receiving services		Supported or receiving services		SEN only		CSC only		Both SEN and CSC	
Type of statutory support or services			**N**	**%**	**N**	**%**	**N**	**%**	**N**	**%**	**N**	**%**
			2,409,098	79.5%	621,137	20.5%	428,964	14.2%	110,390	3.6%	81,783	2.7%
School year group	**n**	**%**	**n**	**%**	**n**	**%**	**n**	**%**	**n**	**%**	**n**	**%**
Year 7	644,073	21.3%	504,108	20.9%	139,965	22.5%	100,976	23.5%	22,453	20.3%	16,536	20.2%
Year 8	620,524	20.5%	492,987	20.5%	127,537	20.5%	89,995	21.0%	21,771	19.7%	15,771	19.3%
Year 9	601,119	19.8%	480,987	20.0%	120,132	19.3%	81,936	19.1%	22,230	20.1%	15,966	19.5%
Year 10	590,050	19.5%	472,898	19.6%	117,152	18.9%	78,915	18.4%	21,904	19.8%	16,333	20.0%
Year 11	574,469	19.0%	458,118	19.0%	116,351	18.7%	77,142	18.0%	22,032	20.0%	17,177	21.0%
Gender												
Boys	1,553,539	51.3%	1,172,080	48.7%	381,459	61.4%	280,761	65.5%	48,075	43.6%	52,623	64.3%
Girls	1,476,236	48.7%	1,236,679	51.3%	239,557	38.6%	148,131	34.5%	62,293	56.4%	29,133	35.6%
Ethnic group												
Asian	327,228	10.8%	280,719	11.7%	46,509	7.5%	32,495	7.6%	9,602	8.7%	4,412	5.4%
Black	176,468	5.8%	140,624	5.8%	35,844	5.8%	22,886	5.3%	8,010	7.3%	4,948	6.1%
Mixed	172,723	5.7%	134,375	5.6%	38,348	6.2%	23,510	5.5%	8,952	8.1%	5,886	7.2%
White	2,214,274	73.1%	1,743,155	72.4%	471,119	75.8%	331,211	77.2%	77,672	70.4%	62,236	76.1%
Other	68,071	2.2%	57,909	2.4%	10,162	1.6%	7,146	1.7%	2,027	1.8%	989	1.2%
Unknown	71,471	2.4%	52,316	2.2%	19,155	3.1%	11,716	2.7%	4,127	3.7%	3,312	4.0%
Free school meals eligibility												
No	2,491,209	82.2%	2,081,712	86.4%	409,497	65.9%	312,703	72.9%	56,521	51.2%	40,273	49.2%
Yes	539,026	17.8%	327,386	13.6%	211,640	34.1%	116,261	27.1%	53,869	48.8%	41,510	50.8%

SEN = special educational needs support; CSC = children's social care services.

Appendix B2: Predicted and observed rates of hospital contacts among pupils in school years 7 to 11 from 23rd March to 31st December 2020.

Outpatient attendances	Predicted	Observed	Difference	% change
23rd March to 23rd June	640,346	366,707	-273,639	-42.7%
24th June to 4th November	959,062	749,340	-209,722	-21.9%
5th November to 31st December	414,906	343,905	-71,001	-17.1%
Overall (23rd Mar to 31st Dec)	2,014,314	1,459,952	-554,362	-27.5%
Rate per 1,000 child-years	864	626	-238	-27.5%
Planned admissions	**Predicted**	**Observed**	**Difference**	**% change**
23rd March to 23rd June	35,931	13,857	-22,074	-61.4%
24th June to 4th November	56,576	37,492	-19,084	-33.7%
5th November to 31st December	23,391	18,022	-5,369	-23.0%
Overall (23rd Mar to 31st Dec)	115,898	69,371	-46,527	-40.1%
Rate per 1,000 child-years	50	30	-20	-40.1%
Unplanned admissions	**Predicted**	**Observed**	**Difference**	**% change**
23rd March to 23rd June	36,292	19,205	-17,087	-47.1%
24th June to 4th November	48,537	43,053	-5,484	-11.3%
5th November to 31st December	22,843	18,755	-4,088	-17.9%
Overall (23rd Mar to 31st Dec)	107,672	81,013	-26,659	-24.8%
Rate per 1,000 child-years	46	35	-11	-24.8%

Grey shading indicates periods of national lockdowns in England in 2020. Predicted rates were based on models estimating the rates of contacts that would have occurred if the pandemic had not happened.

Appendix B3: Type of scheduled outpatient appointments among pupils in school years 7 to 11 from 23rd March to 31st December 2020, by type of statutory support or service.

	Total (N)	In-person		Tele/virtual	
		n	%	n	%
Not receiving support or services	1,287,546	990,357	76.9%	297,189	23.1%
Any support or services	729,854	540,287	74.0%	189,567	26.0%
• SEN only	502,107	371,082	73.9%	131,025	26.1%
• CSC only	71,865	54,890	76.4%	16,975	23.6%
• Both SEN and CSC	155,882	114,315	73.3%	41,567	26.7%

SEN = special educational needs support; CSC = children's social care services. The difference between the percentage of in-person appointments scheduled for children not receiving support or services (76.9%) and those receiving any support or services (74.0%) was statistically significant (p<0.001).

Appendix B4: Attendance of scheduled outpatient appointments among pupils in school years 7 to 11 from 23rd March to 31st December 2020, by type of statutory support or service and type of appointment.

	All			In-person			Tele/virtual		
	Attended	**Scheduled**	**% attended**	**Attended**	**Scheduled**	**% attended**	**Attended**	**Scheduled**	**% attended**
Not receiving support or services	1,135,391	1,287,546	88.2%	858,259	990,357	86.7%	277,132	297,189	93.3%
Any support or services	636,498	729,854	87.2%	459,700	540,287	85.1%	176,798	189,567	93.3%
• SEN only	440,910	502,107	87.8%	318,326	371,082	85.8%	122,584	131,025	93.6%
• CSC only	60,457	71,865	84.1%	45,023	54,890	82.0%	15,434	16,975	90.9%
• Both SEN and CSC	135,131	155,882	86.7%	96,351	114,315	84.3%	38,780	41,567	93.3%

SEN = special educational needs support; CSC = children's social care services. The difference between the percentage of in-person appointments attended by children not receiving support or services (86.7%) and by those receiving any support or services (85.1%) was statistically significant (p<0.001).