RESEARCH ARTICLE

Association between living with children, vaccination, and outcomes from COVID-19: an OpenSAFELY cohort study of 12 million adults in England during 2021–22 [version 1; peer review: 1 approved with reservations]

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Abstract

Background: Living with children has been associated with greater risks of SARS-CoV-2 infection, COVID-19 hospitalisation, and COVID-19 death. We examined how these associations varied during 2021–22 and according to the COVID-19 vaccination status of adults.
Methods: We carried out a population-based cohort study, with the approval of NHS England. Primary care data and pseudonymously-linked hospital and death records from England, between 20th December 2020 and 21st February 2022, were used for adults (≥18 years) registered at a general practice on 20th December 2020. Adjusted hazard ratios (HRs) for SARS-CoV-2 infection, COVID-19 hospitalisation, or COVID-19 death, by presence of children in the household were calculated.
Results: The cohort included 9,417,278 adults aged ≤65 years and 2,866,602 adults aged >65 years. Adults aged ≤65 years living with children of any age (*versus* no children) had greater risks of SARS-CoV-

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2 infection and COVID-19 hospitalisation (but not COVID-19 death), both when schools were open and closed (*e.g.* HR=1.50, 95% CI:1.49-1.51, for SARS-CoV-2 infection in the 'Omicron dominant' period, when schools were open, in adults living with children aged 0–11 years only). These associations also existed for adults aged >65 years, and there was some evidence that adults living with children also had greater risks of COVID-19 death. Vaccinated adults living with children had greater risks of SARS-CoV-2 infection, but lower risks of COVID-19 hospitalisation and death, than unvaccinated adults not living with children.
Conclusions: In an era of widespread adult vaccination, adults living with children remained at increased risk of SARS-CoV-2 infection and COVID-19 hospitalisation.

Keywords
COVID-19, SARS-CoV-2, COVID-19 Vaccines, Family Characteristics, Infectious Disease Transmission

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Introduction

SARS-CoV-2 infection is often mild or asymptomatic in children[1]. However, the role of children in population-level transmission and thus the infection of older and more vulnerable people remains unclear[2]. At the start of the COVID-19 pandemic, schools in England were closed, both to decrease child infection and to control transmission in the wider population[3].

Evidence on the impacts of school closures on community transmission of SARS-CoV-2 is mixed[4–6]. Quantifying these impacts is challenging, as closures have occurred alongside other interventions, infection control measures vary across educational settings, and school opening may be associated with behavioural changes. Negative impacts of school closures on the educational, developmental, and mental health of children are undisputed[7–9].

One way of investigating the impact of school closures is by assessing the risk of COVID-19 among adults living with children, during different stages of the pandemic. Studies assessing the risk of SARS-CoV-2 infection among adults living with children, compared to without children, have found results ranging from an increased risk[10] to a decreased risk[11], as well as risk differences that depend upon the age of the children[12].

We aimed to update our previous analysis[10] examining associations between living with children and COVID-19 outcomes, to look at further COVID-19 waves from December 2020 to February 2022. This period saw the reintroduction of school closures, changing dominant virus types, and more adults receiving COVID-19 vaccinations. We therefore also examined associations between adult vaccination status and COVID-19 outcomes.

Methods

Ethical approval

This study was approved by the Health Research Authority (REC reference 20/LO/0651) and by the London School of Hygiene and Tropical Medicine Ethics Board (reference 21863).

Data sources

Primary care records managed by The Phoenix Partnership (TPP), a general practice software provider, were linked to Secondary Uses Service (SUS) hospital admissions, SARS-CoV-2 testing data from the Second Generation Surveillance System (SGSS), and Office for National Statistics (ONS) mortality records through OpenSAFELY, a data analytics platform created on behalf of NHS England to address urgent COVID-19 research questions (https://opensafely.org). OpenSAFELY data include pseudonymised data such as coded diagnoses, medications, and physiological parameters. No free text data are included. All code is shared openly for review and re-use under MIT open license (github.com/opensafely/os-sch-children-2021). Detailed pseudonymised patient data is potentially re-identifiable and therefore not shared.

Study design and population

We carried out a population-based cohort study to investigate whether risks of SARS-CoV-2 infection, COVID-19 hospital admission, and COVID-19 death differed between adults living with and without children between 20th December 2020 and 21st February 2022.

The cohort included adults (≥18 years old) registered at a TPP general practice in England on 20th December 2020, with at least three months of prior registration and no record of a previous SARS-CoV-2 infection. We excluded individuals with missing data on household identifier, ethnicity, sex, or Index of Multiple Deprivation (IMD) and those living in care homes or in households containing more than ten individuals (which may be other institutions)[10]. We excluded households with any individual missing an age record, to avoid misclassifying our main exposure variable (household exposure to children)[10]. Each individual's follow-up was from 20th December 2020 until death from any cause, deregistration from their general practice, or the study end (21st February 2022).

Study measures

All study measures are described fully elsewhere[10]. The main exposure variable was the age groups of any children who lived in an adult's household. These age groups reflected school stages and were derived using child ages at the start of the study period: (1) no children aged <18 years in the household; (2) only children aged 0–11 years; (3) only children aged 12–17 years; or (4) at least one child aged 0–11 years and at least one aged 12–17 years.

The three outcomes were: (1) SARS-CoV-2 infection recorded in SGSS or general practice records; (2) hospital admission for COVID-19 defined as a COVID-19 ICD-10 code in the primary diagnosis field (ascertained from SUS data); and (3) COVID-19 related death defined as a COVID-19 ICD-10 code anywhere on the death certificate (ascertained from ONS death certificate data)[10]. Individuals could experience more than one study outcome in the analysis unless COVID-19 death was the first outcome recorded.

Covariates included age in years, sex, body mass index (BMI; kg/m^2), smoking status, IMD, ethnicity, geographic area, total number of adults in the household, and comorbidities associated with the risk of severe COVID-19 outcomes[13]. We assumed that adults with no recorded BMI values were non-obese and those with no recorded smoking history were non-smokers[13]. All covariates were derived from general practice records, as were the dates of each dose of any recorded COVID-19 vaccine type[14].

Statistical analysis

We estimated associations separately for adults aged 18–65 years, who are those most likely to be parents or primary caregivers and be of working age, and adults aged over 65 years. We used Cox proportional hazards modelling to estimate adjusted hazard ratios (HRs) for each outcome, using robust standard errors to account for clustering by household and stratifying by geographic area (through the Sustainability and Transformation Partnership, an NHS administrative region) to allow for geographical variation in infection rates. Data management was performed using Python 3.8 and analysis was carried out using Stata v16.1.

Analysis by time period. We examined associations in six time periods with changes in school opening/closure and dominant SARS-CoV-2 variant (Figure 1). Due to the time taken for outcomes to occur and be recorded after infection, we assigned outcomes to the prior time period if they occurred within seven days of the end of a period when the outcome was SARS-CoV-2 infection and within 14 days when the outcome was COVID-19 hospital admission or death.

Analysis by vaccination status. We also examined associations based on how many vaccine doses each adult had received. We stratified the study period by an individual's time when they had no vaccine doses, or one, two, or three doses; the beginning of each period started seven days after each dose, to allow time for the vaccination to begin providing protection against COVID-19[15].

Secondary analyses. We investigated the role of testing behaviour by using a control outcome of ever having a COVID-19 test, and we re-analysed the data according to whether children in the household were vaccinated or not (see 'Methods' in the 'extended data' for detail)[16].

Results

The cohort included 9,417,278 adults aged ≤65 years. Of these adults, 5,978,347 (63%) did not live with children at the start of the study; 1,809,116 (19%) lived with children under 12 years old only; 928,457 (10%) lived with children aged 12–17 years only; and 701,358 (7%) lived with children of both age groups. The cohort included 2,866,602 adults aged over 65 years, 2,774,814 (97%) of whom did not live with any children.

In both adult age groups, adults living without children were broadly older and were more likely to be of 'White' ethnicity (Table 1; full details of the cohort are given in Tables S1 and S2 in the 'Extended data'). The percentages of adults aged ≤65 years and >65 years, respectively, who had the outcomes were: 20.0% (n=1,880,868) and 6.9% (199,066) for SARS-CoV-2 infection; 0.3% (28,314) and 0.8% (23,031) for COVID-19 hospital admission; and 0.04% (3,350) and 0.5% (13,733) for COVID-19 death.

Associations by time period

Adults aged ≤65 years living with children of any age had greater risks of SARS-CoV-2 infection and COVID-19 hospital admission (Figure 2; Table S3), both when schools were closed or open to most pupils. The associations were typically smallest in magnitude in 'period 1' when schools were closed (for example, HR = 1.14, 95% confidence interval [CI]: 1.13 to 1.16, for infection of adults living with children aged 12-17 years only). There were no consistent associations with COVID-19 death across periods.

Associations were similar for adults aged >65 years (Figure S1; Table S3). There was also evidence that these adults who lived with children were at greater risk of COVID-19 death.

Associations by vaccination status

Within strata of child age in the household, adults aged ≤65 years with one or two vaccine doses had greater risks of SARS-CoV-2 infection than those with no doses, though the direction of this association was inconsistent after three doses (Figure 3). Vaccination was associated with lower risks of COVID-19 hospitalisation and death in all strata (with or without children in the household). The magnitudes of these associations were greatest after two or three vaccine doses (for example, with no children in the household, HR = 0.12, 95% CI: 0.11-0.13, for COVID-19 hospital admission after three doses versus none).

This pattern of associations was similar in adults aged >65 years with only slight differences (Figure S2 in the extended data[16]). For example, within three of the four

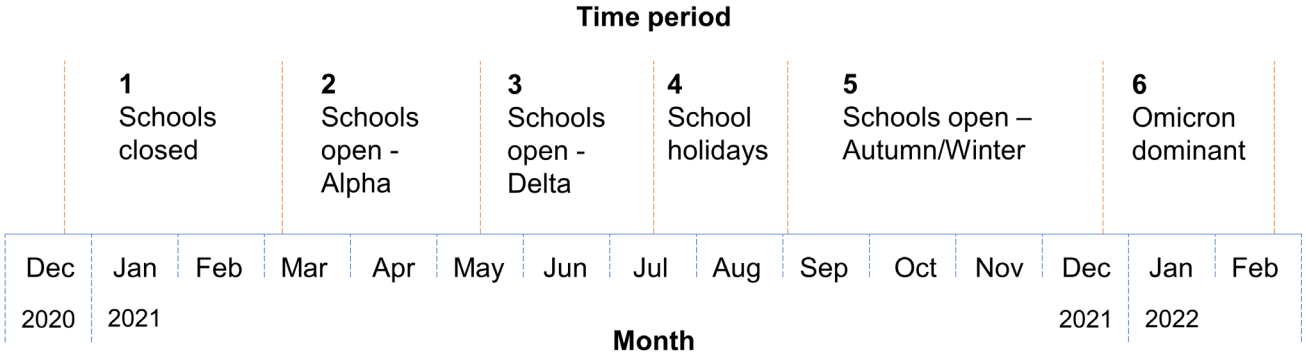

Figure 1. Six time periods used to examine differences in associations between living with children and COVID-19 outcomes by time. *Period,* 1: schools closed to most pupils (20th December 2020 to 7th March 2021), 2: schools open and most sequenced cases were Alpha variant (to 15th May), 3: schools open and most sequenced cases were Delta variant (to 16th July), 4: school summer holidays (to 2nd September), 5: schools open (Autumn/Winter term, to 20th December), 6: schools open and most sequenced cases were Omicron variant (to 21st February 2022).

Table 1. Cohort description by adult age group and age of any children in the household. Values are numbers (percentages).

	Adults aged 18–65 years					Adults aged over 65 years				
	Total cohort (n=9417278)	**No children (n=5978347)**	**Only children aged 0–11 (n=1809116)**	**Only children aged 12–17 (n=928457)**	**Children aged 0–11 and 12–17 (n=701358)**	**Total cohort (n=2866602)**	**No children (n=2774814)**	**Only children aged 0–11 (n=44519)**	**Only children aged 12–17 (n=31107)**	**Children aged 0–11 and 12–17 (n=16162)**
Age (years):										
18–29	1883371 (20.0)	1299693 (21.7)	320562 (17.7)	176921 (19.1)	86195 (12.3)	-	-	-	-	-
30–39	2230436 (23.7)	1069428 (17.9)	832328 (46.0)	96348 (10.4)	232332 (33.1)	-	-	-	-	-
40–49	2056361 (21.8)	904048 (15.1)	490703 (27.1)	357750 (38.5)	303860 (43.3)	-	-	-	-	-
50–59	2143529 (22.8)	1680258 (28.1)	126399 (7.0)	269611 (29.0)	67261 (9.6)	-	-	-	-	-
60–65	1103581 (11.7)	1024920 (17.1)	39124 (2.2)	27827 (3.0)	11710 (1.7)	-	-	-	-	-
66–69	-	-	-	-	-	664546 (23.2)	631387 (22.8)	17840 (40.1)	9606 (30.9)	5713 (35.4)
70–79	-	-	-	-	-	1461882 (51.0)	1416747 (51.1)	21282 (47.8)	15882 (51.1)	7971 (49.3)
80+	-	-	-	-	-	740174 (25.8)	726680 (26.2)	5397 (12.1)	5619 (18.1)	2478 (15.3)
Female sex	4805589 (51.0)	2869363 (48.0)	1035469 (57.2)	508706 (54.8)	392051 (55.9)	1542190 (53.8)	1493443 (53.8)	23393 (52.6)	16227 (52.2)	9127 (56.5)
Ethnicity:										
White	7838500 (83.2)	5131365 (85.8)	1440336 (79.6)	749792 (80.8)	517007 (73.7)	2710876 (94.6)	2649034 (95.5)	29493 (66.3)	23121 (74.3)	9228 (57.1)
Mixed	159748 (1.7)	96095 (1.6)	33538 (1.9)	15546 (1.7)	14569 (2.1)	10493 (0.4)	9359 (0.3)	551 (1.2)	368 (1.2)	215 (1.3)
South Asian	818128 (8.7)	394972 (6.6)	213040 (11.8)	102821 (11.1)	107295 (15.3)	92990 (3.2)	71014 (2.6)	11166 (25.1)	5541 (17.8)	5269 (32.6)
Black	307429 (3.3)	169916 (2.8)	62740 (3.5)	35740 (3.9)	39033 (5.6)	28772 (1.0)	24957 (0.9)	1744 (3.9)	1254 (4.0)	817 (5.1)
Other	293473 (3.1)	185999 (3.1)	59462 (3.3)	24558 (2.7)	23454 (3.3)	23471 (0.8)	20450 (0.7)	1565 (3.5)	823 (2.7)	633 (3.9)
IMD fifth:										
1 (least deprived)	1789467 (19.0)	1117822 (18.7)	354262 (19.6)	201650 (21.7)	115733 (16.5)	713496 (24.9)	696735 (25.1)	8010 (18.0)	6157 (19.8)	2594 (16.1)
2	1881242 (20.0)	1231352 (20.6)	348347 (19.3)	185540 (20.0)	116003 (16.5)	681426 (23.8)	663714 (23.9)	8587 (19.3)	6249 (20.1)	2876 (17.8)
3	1944944 (20.7)	1278516 (21.4)	357491 (19.8)	180973 (19.5)	127964 (18.3)	615900 (21.5)	596542 (21.5)	9560 (21.5)	6588 (21.2)	3210 (19.9)
4	2034824 (21.6)	1299235 (21.7)	389078 (21.5)	187589 (20.2)	158922 (22.7)	506794 (17.7)	486368 (17.5)	10050 (22.6)	6566 (21.1)	3810 (23.6)
5 (most deprived)	1766801 (18.8)	1051422 (17.6)	359938 (19.9)	172705 (18.6)	182736 (26.1)	348986 (12.2)	331455 (12.0)	8312 (18.7)	5547 (17.8)	3672 (22.7)
3+ adults in household	3325341 (35.3)	2111687 (35.3)	503084 (27.8)	449156 (48.4)	261414 (37.3)	413635 (14.4)	342801 (12.4)	35382 (79.5)	21716 (69.8)	13736 (85.0)
Any comorbidity*	2930356 (31.1)	1970251 (33.0)	481788 (26.6)	281530 (30.3)	196787 (28.1)	1769618 (61.7)	1713541 (61.8)	26747 (60.1)	19381 (62.3)	9949 (61.6)

Full information on cohort is in Table S1/S2. IMD: Index of Multiple Deprivation. *Any comorbidity includes: chronic respiratory disease, asthma, chronic cardiac disease, diabetes, cancer, end-stage renal disease, chronic liver disease, stroke or dementia, other neurological disease, other transplant, asplenia, Rheumatoid/Lupus/Psoriasis or other immunosuppressive condition.

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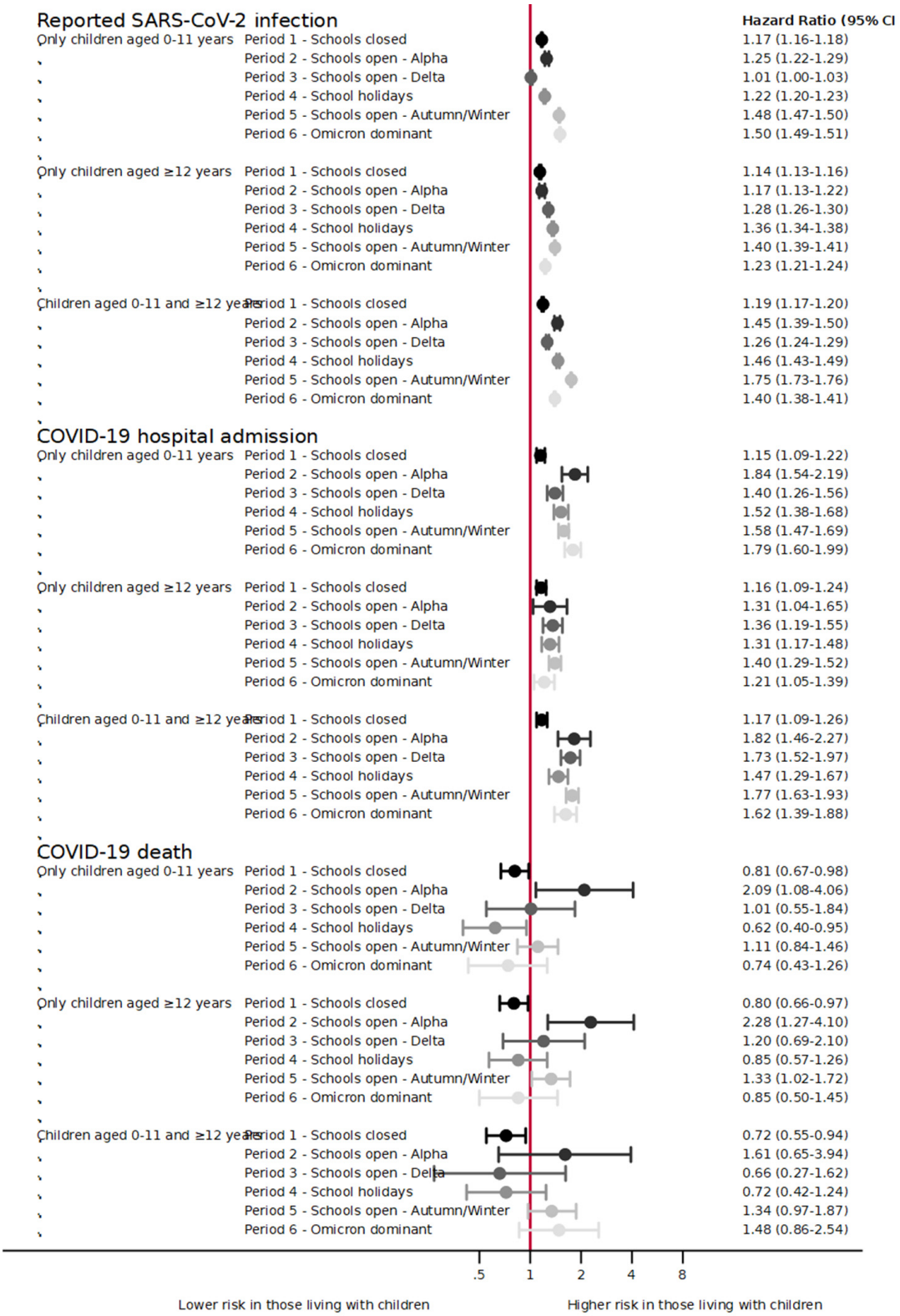

Figure 2. Adjusted* hazard ratios (HRs) for SARS-CoV-2 infection, COVID-19 hospital admission, and COVID-19 death, among adults aged ≤65 years, between 20th December 2020 and 21st February 2022 (versus adults with no children in the household).
*Adjusted for age, sex, ethnicity, number of adults in household, IMD, BMI, smoking, hypertension or high blood pressure, chronic respiratory disease, asthma, cancer, chronic liver disease, stroke or dementia, other neurological disease, reduced kidney function, end-stage renal disease, solid organ transplant, asplenia, rheumatoid, lupus or psoriasis, other immunosuppressive condition.

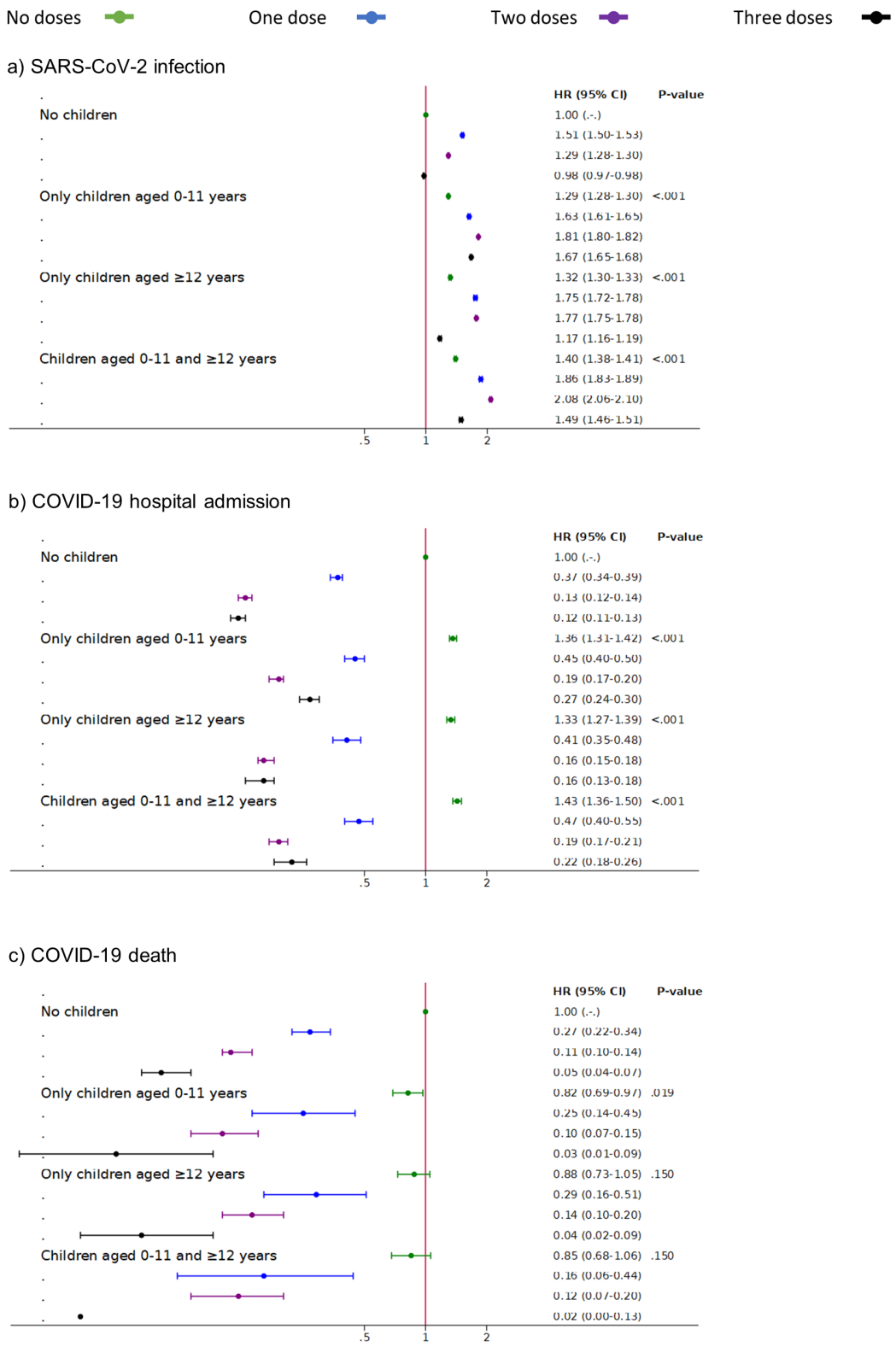

Figure 3. Adjusted* hazard ratios (HRs) for SARS-CoV-2 infection, COVID-19 hospital admission, and COVID-19 death (versus no children in the household and being unvaccinated) in adults aged ≤65 years (from 20th December 2020 to 21st February 2022), by number of vaccine doses. *For age, sex, ethnicity, number adults in household, IMD, BMI, smoking, hypertension/high blood pressure, chronic respiratory disease, asthma, cancer, chronic liver disease, stroke or dementia, other neurological disease, reduced kidney function, end-stage renal disease, solid organ transplant, asplenia, rheumatoid, lupus or psoriasis, other immunosuppressive condition.

strata of child age, adults with three doses had lower risks of SARS-CoV-2 infection than those with no doses (for example, with no children in the household, HR = 0.71, 95% CI: 0.69-0.73, after three doses).

Secondary analyses

The patterns of association between living with children, vaccination status, and COVID-19 outcomes in adults aged ≤65 years were similar to those described above before and after all 12-17 year olds in a household had been double-vaccinated (Figure S3 in the extended data[16]).

From the summer holidays of 2021 (period 4: 17th July to 2nd September) onwards, adults aged ≤65 years who lived with children were more likely to have received or recorded a COVID-19 test, regardless of outcome (Figure S4 in the extended data[16]).

Discussion

In England, throughout 2021 until February 2022, adults living with children had persistently greater risks of SARS-CoV-2 infection and COVID-19 hospital admission, compared to adults not living with children. This was consistent across age groups of adults and children, as well as during periods of school closures and holidays. The highest risk of SARS-CoV-2 infection among adults living with children was during the 2021 Autumn/Winter term, when schools were fully open. Adults who lived with children and were fully vaccinated continued to experience higher risks of SARS-CoV-2 infection, compared to non-vaccinated adults living without children, but had lower risks of hospital admission or death from COVID-19.

Strengths and weaknesses of the study

We used linked electronic health records from a large, representative sample of the general population, providing power to investigate associations with a range of COVID-19 outcomes in multiple time periods and subgroups[17]. Our linked datasets allowed us to analyse household occupancy together with COVID-19 vaccination, of both adults and children, while adjusting for a wide range of demographic and clinical characteristics.

COVID-19 testing may have varied between adults living with and without children: the UK government advised that secondary school children (11–18 years old) have regular tests regardless of symptoms[18], which may have led to parents testing more. However, our finding of greater risks of SARS-CoV-2 infection for adults living with children was consistent in direction across all child age groups, unlike the association with testing. This suggests that results are not fully explained by ascertainment bias.

Parents are known to have lower all-cause mortality than people without children[19,20], which suggests that adults living with children may be healthier overall. This could bias the associations between living with children and COVID-19 hospital admission or COVID-19 death towards the null, unless this source of confounding was fully accounted for by model covariates. Adding comorbidities as covariates had a limited impact on model results, suggesting that residual confounding by underlying health may be minor.

Associations between vaccine doses and COVID-19 outcomes will be partly explained by changes in the prevalence of COVID-19 and dominant variants over time. For example, the Omicron variant drove a new wave of cases towards the end of 2021 after the rollout of 'booster' (third) vaccine doses started in September 2021.

Strengths and weaknesses in relation to other studies

Greater risks of SARS-CoV-2 infection and COVID-19 hospital admission in adults living with children were also found in our previous analysis for the period from September to December 2020[10]. Our results show that this association persisted over a longer period, in 2021-22, even after COVID-19 vaccination of adults started in December 2020[21].

Unlike our previous analysis, we were able to examine both living with children and COVID-19 vaccination in relation to COVID-19 outcomes. Our finding of greater risks of SARS-CoV-2 infection among vaccinated adults living with children, compared to unvaccinated adults living without children, shows that the greater risk of SARS-CoV-2 infection associated with living with children can persist even in a fully vaccinated population.

In a secondary analysis, we examined differences in results between the periods before and after all children aged 12–17 years in a household were double-vaccinated. A limitation of this analysis was that the study period covered a relatively early point in the child vaccination programme, such that households with all eligible children double-vaccinated are unlikely to be representative. This analysis is also affected by the rise of the Omicron variant in winter 2021–22 as double-vaccination of non-high-risk children started from September 2021[22].

Studies in other countries examined COVID-19 outcomes and living with children in specific population subgroups. For example, a cohort study in Scotland assessed living with 0–11 year olds and COVID-19 outcomes among 310,000 adults in healthcare worker households between March and October 2020[11]. This study suggests lower risks of SARS-CoV-2 infection and COVID-19 hospital admission in adults living with young children. In contrast, in a cohort study of 1.5 million men who had been in the Swedish military, directions of association varied by age of children in the household[12].

Implications for policy and research

There are various possible explanations for why adults living with children had higher risks of SARS-CoV-2 infection in all time periods, including during periods of school closures and holidays. These include school attendance increasing risk of SARS-CoV-2 transmission, as well as different behaviours among adults living with children, such as more

frequent shopping or more social contacts due to after-school activities.

While absolute rates of hospitalisation and death remain low, infection may still have serious consequences in terms of acute illness, inability to work during periods of both adult and child illness, and long-term sequelae including long COVID[23].

All children aged 5–11 years became eligible for vaccination after the study period, in April 2022[24]. As more 5–11 year olds and 12–17 year olds were vaccinated, this will provide further opportunities to examine whether associations between living with children and adult COVID-19 outcomes differ by child vaccination status. Longitudinal surveys[25] with repeat SARS-CoV-2 testing of individuals regardless of symptoms may also be useful in investigating asymptomatic infection of children in relation to adult COVID-19 outcomes.

By February 2022 (the end of the study period), 71% of individuals in England had been infected with SARS-CoV-2 since April 2020, and rates of reinfection increased substantially in 2022 after the Omicron variant became dominant[26]. In this context, future research could examine associations between reinfection and living with children. As well as greater risks of a first infection, adults living with children may have more reinfections. It is also unknown whether greater risks of COVID-19 hospital admission persist.

Conclusion

In England, adults living with children have experienced persistently greater risks of SARS-CoV-2 infection and COVID-19 hospital admission. The disproportionate economic and health impacts of infection on working-age adults who live with children, even in a highly-vaccinated population, will need to be considered in future health policy.

Consent

NHS England is the data controller for OpenSAFELY-TPP; TPP is the data processor and the researchers on OpenSAFELY are acting with the approval of NHS England. This implementation of OpenSAFELY is hosted within the TPP environment which is accredited to the ISO 27001 information security standard and is NHS IG Toolkit compliant[27]; patient data has been pseudonymised for analysis and linkage using industry standard cryptographic hashing techniques; all pseudonymised datasets transmitted for linkage onto OpenSAFELY are encrypted; access to the platform is via a virtual private network (VPN) connection, restricted to a small group of researchers; the researchers hold contracts with NHS England and only access the platform to initiate database queries and statistical models; all database activity is logged; only aggregate statistical outputs leave the platform environment following best practice for anonymisation of results such as statistical disclosure control for low cell counts[28].

The OpenSAFELY research platform adheres to the obligations of the UK General Data Protection Regulation (GDPR) and the Data Protection Act 2018. In March 2020, the Secretary of State for Health and Social Care used powers under the UK Health Service (Control of Patient Information) Regulations 2002 (COPI) to require organisations to process confidential patient information for the purposes of protecting public health, providing healthcare services to the public and monitoring and managing the COVID-19 outbreak and incidents of exposure; this sets aside the requirement for patient consent[29]. This was extended in July 2022 for the NHS England OpenSAFELY COVID-19 research platform[30]. In some cases of data sharing, the common law duty of confidence is met using, for example, patient consent or support from the Health Research Authority Confidentiality Advisory Group[31]. Taken together, these provide the legal bases to link patient datasets on the OpenSAFELY platform. GP practices, from which the primary care data are obtained, are required to share relevant health information to support the public health response to the pandemic, and have been informed of the OpenSAFELY analytics platform.

This study was approved by the Health Research Authority (REC reference 20/LO/0651) and by the LSHTM Ethics Board (reference 21863).

Data availability

Underlying data

Access to the underlying identifiable and potentially re-identifiable pseudonymised electronic health record data is tightly governed by various legislative and regulatory frameworks, and restricted by best practice. The data in OpenSAFELY is drawn from general practice data across England where TPP is the data processor. TPP developers initiate an automated process to create pseudonymised records in the core OpenSAFELY database, which are copies of key structured data tables in the identifiable records. These pseudonymised records are linked onto key external data resources that have also been pseudonymised via SHA-512 one-way hashing of NHS numbers using a shared salt. Bennett Institute for Applied Data Science developers and PIs holding contracts with NHS England have access to the OpenSAFELY pseudonymised data tables as needed to develop the OpenSAFELY tools. These tools in turn enable researchers with OpenSAFELY data access agreements to write and execute code for data management and data analysis without direct access to the underlying raw pseudonymised patient data, and to review the outputs of this code. All code for the full data management pipeline, from raw data to completed results for this analysis, and for the OpenSAFELY platform as a whole is available for review at github.com/OpenSAFELY.

Extended data

Zenodo: Extended data - Association between living with children, vaccination, and outcomes from COVID-19: an OpenSAFELY cohort study of 12 million adults in England during 2021-22. https://doi.org/10.5281/zenodo.7867309[16].

Analysis code available from: https://github.com/opensafely/os-sch-children-2021

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Open Peer Review

Current Peer Review Status: ?

Version 1

Reviewer Report 24 January 2024

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In their manuscript entitled “Association between living with children, vaccination, and outcomes from COVID-19: an OpenSAFELY cohort study of 12 million adults in England during 2021-22” the authors use primary care data from the UK to conduct a population based cohort study looking at COVID acquisition in households with or without children, during periods when schools were closed compared to periods when schools were open. They also looked at the impact of being vaccinated, as the study encompasses the initial roll-out of the vaccines until the first booster (Dec 2020-Feb 2022).

This manuscript is clear and easy to read. The objectives and findings are clearly documented. The is important in that it again demonstrates that living with children is a risk factor for the acquisition of COVID and hospitalization with COVID, and in older adults, an increased risk of death.

Major comments:
- The age ranges for the children in this study, while it conforms with the age ranges of the children in the prior study (Forbes et al BMJ 2021), doesn’t make as much sense when looking at the impact of schools reopening on infection rates, as infants and toddlers do not attend school. Their inclusion can confound the data about school closures. If the age strata can’t be further refined (0-5, 6-11, 12 and older), it would be good to put this as a limitation in the discussion.

-The window for COVID infections to cause infection, hospitalizations or deaths in relation to school status seems appropriate for infections and hospitalizations (1 and 2 weeks) but too short for deaths (2 weeks). In my experience, deaths from COVID rarely happen within 2 weeks of infection, and that often the illness is prolonged, so death can occur several weeks or months after infection. This may be harder to associate with school status.

-Results: while adults without children were more likely to be older and white, was there increased

COVID rates in adults with kids based on ethnicity? Socioeconomic status?

Minor comments:
--Abstract, Results: I would add “older” in front of the “adult” in the sentence:
“...there was some evidence that adults living with children also had
greater risks of COVID-19 death”.

--Is there a way to determine at what point during the study period the majority of adults in each age group were vaccinated?

Is the work clearly and accurately presented and does it cite the current literature?
Yes

Is the study design appropriate and is the work technically sound?
Yes

Are sufficient details of methods and analysis provided to allow replication by others?
Yes

If applicable, is the statistical analysis and its interpretation appropriate?
I cannot comment. A qualified statistician is required.

Are all the source data underlying the results available to ensure full reproducibility?
No

Are the conclusions drawn adequately supported by the results?
Yes

Competing Interests: No competing interests were disclosed.

Reviewer Expertise: Vaccine clinical trials, Infectious Diseases

I confirm that I have read this submission and believe that I have an appropriate level of expertise to confirm that it is of an acceptable scientific standard, however I have significant reservations, as outlined above.