To cite: Marszalek M. Firman N.

MMR vaccination: longitudinal

Wilk M. et al. Household

determinants of delayed

analysis using electronic

London, UK. BMJ Open

bmjopen-2024-097559

Prepublication history

and additional supplemental

available online. To view these

online (https://doi.org/10.1136/

Received 04 December 2024

Check for updates

C Author(s) (or their

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Published by BMJ Group.

Centre for Primary Care,

Wolfson Institute of Population

Health, Faculty of Medicine and

Dentistry, Queen Mary University of London, London, UK

files, please visit the journal

bmjopen-2024-097559).

Accepted 16 April 2025

material for this paper are

health records in North East

2025:15:e097559. doi:10.1136/

BMJ Open Household determinants of delayed MMR vaccination: longitudinal analysis using electronic health records in North East London, UK

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ABSTRACT

Objectives There is a lack of information about household factors associated with delayed measles, mumps and rubella (MMR) vaccination. We examined whether timeliness of first MMR (MMR1) receipt is associated with sharing a household with an older child with non-receipt of MMR1 independent of household composition and size. **Design** Longitudinal observational study using linked electronic health records.

Setting North East London, UK.

Participants The index cohort comprised 71 509 children (51.0% males) eligible to receive MMR1 between 1 January 2014 and 28 February 2020.

Methods The primary outcome was MMR1 receipt between 12 months and 24 months of age. The explanatory variable was non-receipt of MMR1 between age 12 months and 24 months in the oldest child sharing the same household. We examined the likelihood of MMR1 receipt in index children sharing a household with an older child with non-receipt of MMR1 between 12 months and 24 months using logistic regression to estimate ORs and 95% Cls before and after adjustment for individual-level, household-level and area-level covariates. We carried out sensitivity analyses excluding households with an age interval between oldest and youngest child greater than 5 years.

Results 59 851 (83.6%) index children received MMR1 between 12 months and 24 months of age. After adjustment for household composition and size, MMR1 receipt was less likely in index children sharing a household with an older child with non-receipt of MMR1 between 12 months and 24 months of age: OR: 0.19 (95% Cl: 0.18, 0.20). This association strengthened after excluding households with an age interval greater than 5 years: OR: 0.14 (0.13, 0.15).

Conclusions There is strong concordance within households of delay in MMR1 receipt independent of household size and composition. Lack of timely protection within households increases the risk of measles outbreaks. There is a need for household-based interventions to improve MMR1 timeliness.

INTRODUCTION

Childhood vaccinations form an essential part of public health interventions provided

STRENGTHS AND LIMITATIONS OF THIS STUDY

- ⇒ We used a novel method to link individuals into households while maintaining privacy and confidentiality using electronic health records (EHRs) for a large population.
- ⇒ We obtained high-quality, accurately coded and validated measles, mumps and rubella data in the EHR.
- \Rightarrow We used robust statistical methods to assess relationships between the exposure and outcome variables.
- ⇒ Processes of and influences on decision-making about vaccines between the linked younger and older children may have differed. We were not able to examine associations with delayed receipt of primary vaccinations against diphtheria, pertussis, polio, tetanus and *Haemophilus influenzae*.
- ⇒ More granular categorisation of ethnic groups, as suggested by our patient and public involvement group, was not possible due to limited sample size.

by primary care.¹ In England and Wales, it is recommended that children receive a first dose of measles, mumps and rubella (MMR) vaccine between 12 months and 13 months of age²; currently, only 89% receive a first dose by age 24 months, and only 84% receive a second dose by age 5 years.³ This countrywide statistic conceals marked geographic inequalities linked to deprivation. The WHO recommends that 95% of the population are given two MMR doses to achieve herd immunity of and eliminate measles.⁴ The UK lost measles elimination status in 2018 and while this was reinstated in 2021, measles outbreaks in areas with high measles susceptibility in young children in England suggest that this will not be sustained.⁵ Clusters of inequalities in MMR coverage exacerbate existing outbreaks-a large proportion have been in London, an area with both low and profoundly inequitable coverage.³

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In light of these public health concerns, and with the first dose conferring 93% protection against infection, there has been increasing emphasis on the importance of timely receipt of MMR1.⁶ In the UK, national targets to ensure receipt of first MMR (MMR1) between 12 months and 24 months of age have been recently replaced by a 12-18-month target reflecting this emphasis on timeliness.

It is known that equity in vaccination coverage is impacted by social determinants such as deprivation, ethnicity and area-level variation in healthcare services.⁸⁹ There is strong evidence demonstrating that children from more deprived areas are less likely to receive MMR vaccination compared with those living in affluent areas.¹⁰ We and others¹¹ have previously shown that family size is an important determinant of partial or non-immunisation with MMR, suggesting that access to services may play an important role.¹

Identifying factors at a household level can create actionable insights into how services might be tailored to improve receipt of vaccinations.¹⁴ The current pressures on the UK National Health Service have significantly impacted the delivery of vaccinations in primary care. Therefore, new ways of working to vaccinate the most vulnerable children in a resource-tight setting are needed.¹⁵¹⁶ We used electronic health records (EHRs) for an ethnically diverse and disadvantaged population, with among the lowest proportion of children receiving MMR1 by 24 months of age in the UK, to investigate whether non-receipt of MMR1 between 12 months and 24 months of age is clustered in households. Specifically, we hypothesised that children with non-receipt of MMR1 between 12 months and 24 months were more likely to share a household with an older child with non-receipt of MMR1 at these ages, independently of the number of children in the household and household composition.

METHODS

Study design and setting

We conducted a longitudinal observational study using primary care EHRs from 266 general practices in seven North East London (NEL) localities: Barking and Dagenham, City and Hackney, Havering, Newham, Redbridge, Tower Hamlets and Waltham Forest.

Data sources

Pseudonymised data were provided from the NEL Discovery Data Service (DDS), which receives primary care EHR data in near-real time for all general practices (GPs) in NEL.¹⁷ Unique property reference numbers (UPRNs) are allocated to all GP-recorded patient addresses in the DDS using a quality-assured and validated address-matching algorithm.¹⁸ UPRNs are pseudonymised into residential anonymous linking fields (RALF)¹⁹ using a study-specific encryption key. We used RALFs to link children in households for address records and registrations from 2014 onwards, when data flow for

address registrations into NEL DDS commenced. Data were extracted on 23 November 2021.

Study population

The study population comprised 159 300 children registered with a NEL GP at the time of their second birthday and eligible to receive MMR1 between 1 January 2014 and 28 February 2020. We excluded 17 038 children without a RALF, with a non-residential RALF, with a poor-quality RALF match or with more than one RALF at the time of MMR1 or second birthday, leaving 142 262 children eligible for inclusion (online supplemental figure 1).

Identifying children sharing a household

We identified older children sharing a household with the 142 262 index children at the index child's MMR1 date or 24 months of age, whichever is the earliest. Index and older children sharing a RALF at the index child's MMR1 date or at the index child's second birthday were considered to share a household. We identified all children in DDS based on the index children's RALFs and a excluded 52 693 children without an older child in the $\mathbf{\vec{a}}$ household and 15 516 older children who were already **o** included as index children, leaving 71 509 index children **5** with at least one older child sharing their household at **8** the index child's MMR1 date or second birthday (online supplemental figure 2). These 71 509 children are henceforth referred to as the 'linked index cohort' and the older children with whom they share a household as the 'linked older children's cohort'.

The study methodology has been reported against the REporting of studies Conducted using Observational Routinely-collected health Data statement (online supplemental file 2). 2021

Primary outcome

mining, Al The primary outcome is receipt of MMR1 between 12 months and 24 months of age, which is consistent with the Cover of Vaccination Evaluated Rapidly measures in place during the study period.²²

We extracted sociodemographic and area-level data for the linked index and linked older child cohorts, together with all clinical events relating to MMR1 procedures (online supplemental table 1). We derived a proxy date of birth from calendar week, month and year of birth by combining the date of the first day of the week of the calendar week of birth with month and year of birth. We excluded duplicated events and events without correct was no record of MMR1 being given in the primary care set EHR. If a child did not have a record of an MMR1 mation of nation, they were linked to a RALF at the time of their second birthday and were defined as children with nonreceipt of MMR1.

Explanatory variable

The main explanatory variable was non-receipt of MMR1 in the linked older child defined as no record of MMR1 given between 12 months and 24 months of age.

Covariates

Individual-level

Individual-level covariates were sex and ethnic group. We categorised the ethnic group of the index children using the National Health Service 5+1 classification using information recorded in the EHR.²³ We created five mutually exclusive ethnic groups: white ('white British', 'white Irish' or 'any other white background'); black ('black African', 'black Caribbean' or 'any other black background'); South Asian ('Indian', 'Pakistani', 'Bangladeshi' or 'Sri Lankan'); mixed/other ('any other ethnic background', 'mixed ethnicity', 'Chinese' or 'Asian other'); and missing category (ethnicity code in the primary care record missing or 'not stated' category selected).

Household-level

All household members sharing a household at the index child's MMR1 date were identified. We excluded households with more than 10 members, only one child or no adults (aged ≥18.0 years). Household information was available for 65 308 households containing index and linked older children.

We categorised household composition using an adapted Harper and Mayhew method²⁴ into one of three mutually exclusive categories: working-age adults (aged 18-64 years) with children; single working-age adult with children or at least one working-age and one older adult (aged >65 years) with children (three-generation household). We included households with at least one older adult with children but no working-age adult (skipped generation households) in the three-generation household group.

We calculated the total number of household members, as well as the number of children within a household at the index child's MMR1 date or 24 months of age for those with no MMR1 date.

Area-level

We merged the 2019 Index of Multiple Deprivation (IMD) decile²⁵ into the datafile using the 2011 Lower layer Super Output Area, an area with an average population of 1500 people or 650 households, as the linkage field. IMD deciles were concatenated into quintiles from most (1) to least deprived (5).

We compared the linked index cohort $(n=71\ 509)$ with the cohort of eligible children (n=70 753) not linked to another older child (online supplemental table 2). The linked sample had a lower proportion with receipt of MMR1 between 12 and 24 months of age, were less likely to be from a white ethnic background, from smaller households or from households with two or more working age adults.

Statistical methods

We calculated the proportion of the linked index and older child cohorts receiving MMR1 between 12 months and 24 months of age. We examined

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| 6 |
|---|
| |

| | Vaccina | ted | | Non-vaccinated | | | All linke | d index | children |
|--|--|------|------------|---|------|------------|-----------|---------|------------|
| | n=59851 (83.6%) Received first MMR between 12 months and 24 months of age | | | n=11658 (16.4%) Did not receive first MMR between 12 months and 24 months of age | | | | | |
| | | | | | | | n=71 509 | | |
| | Ν | % | 95% CI | Ν | % | 95% CI | Ν | % | 95% CI |
| MMR1 status of oldest child | | | | | | | | | |
| Vaccinated | 53 198 | 88.4 | 88.1, 88.6 | 6987 | 11.6 | 11.3, 11.9 | 60 185 | 84.2 | 83.9, 84.4 |
| Non-vaccinated | 6653 | 58.8 | 57.8, 59.7 | 4671 | 41.2 | 40.3, 42.2 | 11 324 | 15.8 | 15.6, 16.1 |
| Individual covariates | | | | | | | | | |
| Ethnic background | | | | | | | | | |
| South Asian | 16 963 | 88.0 | 87.6, 88.5 | 2305 | 12.0 | 11.5, 12.4 | 19 268 | 25.5 | 25.1, 25.8 |
| White | 16 625 | 83.8 | 83.3, 84.3 | 3219 | 16.2 | 15.7, 16.7 | 19 844 | 28.3 | 27.9, 28.6 |
| Black or Black-British | 5703 | 82.2 | 81.2, 83.1 | 1238 | 17.8 | 16.9, 18.7 | 6941 | 10.0 | 9.8, 10.2 |
| Mixed and other | 4847 | 78.8 | 77.8, 79.8 | 1303 | 21.2 | 20.8, 22.2 | 6150 | 8.5 | 8.3, 8.7 |
| Missing* | 15 713 | 81.4 | 80.8, 81.9 | 3593 | 18.6 | 18.1, 19.2 | 19 306 | 27.7 | 27.4, 28.1 |
| Sex | | | | | | | | | |
| Female | 29 399 | 84.0 | 83.6, 84.3 | 5614 | 16.0 | 15.6, 16.4 | 35 013 | 48.9 | 48.5, 49.3 |
| Male | 30 452 | 83.4 | 83.0, 83.8 | 6044 | 16.6 | 16.2, 16.9 | 36 496 | 51.1 | 50.7, 51.4 |
| Household-level covariates | | | | | | | | | |
| Household size | | | | | | | | | |
| 3–4 | 18 695 | 86.1 | 85.7, 86.6 | 2976 | 13.9 | 13.4, 14.3 | 21 671 | 30.3 | 30.0, 30.6 |
| 5–7 | 26 867 | 84.0 | 83.6, 84.4 | 5097 | 16.0 | 15.6, 16.4 | 31 964 | 44.8 | 44.4, 45.2 |
| 8–10 | 9397 | 80.6 | 79.9, 81.3 | 2264 | 19.4 | 18.7, 20.1 | 11 661 | 16.3 | 16.0, 16.6 |
| Missing* | 4881 | 78.7 | 77.7.79.7 | 1320 | 21.3 | 20.3. 22.3 | 6201 | 8.6 | 8.4. 8.8 |
| Household composition | | | , | | | , | | | , |
| Two working age adults with children | 42 380 | 84.6 | 84.3, 84.9 | 7713 | 15.4 | 15.1, 15.7 | 50 093 | 76.7 | 76.4, 77.0 |
| Single working age adult with children | 7699 | 81.5 | 80.7, 82.3 | 1747 | 18.5 | 17.7, 19.3 | 9446 | 14.5 | 14.2, 14.7 |
| Three-generational household | 4891 | 84.8 | 83.8, 85.7 | 878 | 15.5 | 14.5, 16.4 | 5769 | 8.8 | 8.6, 9.0 |
| Missing* | 4881 | 78.7 | 77.7, 79.7 | 1320 | 21.3 | 20.3, 22.3 | 6201 | 8.6 | 8.4, 8.8 |
| Number of children in househol | d | | | | | | | | |
| 2–3 | 43 968 | 85.4 | 85.0, 85.7 | 7527 | 14.6 | 14.3, 14.9 | 51 495 | 72 | 71.7, 72.3 |
| 4–6 | 10 669 | 80.2 | 79.5, 80.8 | 2629 | 19.8 | 19.2, 20.5 | 13 298 | 18.7 | 18.4, 19.0 |
| 7–9 | 333 | 64.7 | 60.4, 68.8 | 182 | 35.3 | 31.2, 39.6 | 515 | 0.7 | 0.6, 0.8 |
| Missing* | 4881 | 78.7 | 77.7, 79.7 | 1320 | 21.3 | 20.3, 22.3 | 6201 | 8.6 | 8.4, 8.8 |
| Area level covariates | | | | | | | | | |
| Index of Multiple Deprivation Q | uintile | | | | | | | | |
| 1 (most deprived) | 23 861 | 83.9 | 83.5, 84.3 | 4587 | 16.1 | 15.7, 16.5 | 28 448 | 40 | 39.7, 40.3 |
| 2 | 23 512 | 82.3 | 81.7, 82.8 | 5052 | 17.7 | 17.2, 18.1 | 28 564 | 39.8 | 39.5, 40.1 |
| 3 | 7600 | 83.9 | 83.2, 84.7 | 1454 | 16.1 | 15.3, 16.8 | 9054 | 12.6 | 12.4, 12.8 |
| 4 | 3345 | 88.9 | 87.9, 89.9 | 417 | 11.1 | 10.1, 12.1 | 3762 | 5.2 | 5.0, 5.4 |
| 5 (least deprived) | 1533 | 91.2 | 89 7 92 5 | 148 | 8.8 | 75 102 | 1681 | 23 | 22 24 |



Forest Plot of MMR1 vaccination ORs and 95% CIs between 12 months and 24 months of age using stepwise binary Figure 1 logistic regression. †Model 1: vaccination status of older child sharing household with index child. Model 2: model 1 + sex + ethnicity of index child. Model 3: model 2 + household size. Model 4: model 3 + household composition. Model 5: model 4 + number of children in the household. Model 6: model 5 + Index of Multiple Deprivation quintile. Vaccinated, signifies receipt of MMR1 between 12 months and 24 months of age. MMR1, first measles, mumps and rubella dose.

RESULTS

The index cohort comprised 71 509 children (51% boys) of whom 11 658 (16.4%) had not received MMR1 vaccine between 12 months and 24 months of age. Children in the index cohort who did not receive MMR1 between 12 months and 24 months of age were more likely to live with a linked older child who similarly had not received MMR1 between 12 months and 24 months of age (table 1). Index children receiving MMR1 between 12 months and 24 months of age were more likely to be from South Asian ethnic groups or living in households with fewer adults and fewer children, or in households with two or more working age adults or three-generation households. Children in single adult households or in households with a larger number of children were less likely to receive MMR1 between 12 months and 24 months. There was a marked gradient in timely MMR1 receipt by IMD quintile with an absolute difference of 7.3% in MMR1 receipt between 12 months and 24 months of age between the least and most deprived quintiles.

In the unadjusted model, MMR1 receipt between 12 months and 24 months of age was less likely among children in the linked index cohort sharing a household with a linked older child with no MMR1 receipt between 12 months and 24 months of age (OR: 0.19, 95% CI: 0.18,

В 0.20). The effect size and direction did not change after stepwise introduction of individual-level, household-level and area-level covariates, resulting in an adjusted OR ≥ of 0.20 (0.19,0.21) in the final model (figure 1; online supplemental table 3).

In sensitivity analyses (figure 2), the proportion of Bu index children with MMR1 receipt between 12 months and 18 months of age (79.2%; 95% CI: 78.9, 79.5) was, as expected, lower than the proportion with MMR1 receipt between 12 months and 24 months (83.6%; 95% CI: 83.3, 83.9) (online supplemental table 4). Associations were weaker in sensitivity analyses using this measure as the primary outcome (OR: 0.24; 0.23, 0.25) (online supple-101 mental table 5). By contrast, associations were stronger in sensitivity analyses restricted to households containing index children and linked older cohort children with an age gap of less than 5 years: OR: 0.14 (0.13,0.15) (online supplemental table 6). Sensitivity analyses extending the age range for MMR1 receipt to 11-25 months did not change the main findings: OR: 0.18 (0.17,0.19) (online supplemental table 7).

While our study focused on MMR1 receipt within the UK recommended age range at the time of the study, it is possible that children were vaccinated before or after the recommended age range. We searched for MMR1 dates

data



Figure 2 Forest plot of MMR1 vaccination ORs and 95% Cls from main model and from sensitivity analyses. Vaccinated, signifies receipt of MMR1 between 12 months and 24 months of age. MMR1, first measles, mumps and rubella dose.

for those with no MMR1 date within the 12-24 month age range. Of the 11 658 index children with no MMR1 receipt between 12-24 months, 516 (4.4%) had a MMR1 record before age 12 months, 2893 (24.8%) between 25 months and 40 months of age (equivalent to 3 years and 4 months when children become eligible for the second dose), 749 (6.4%) received MMR1 after 40 months of age and 7500 (64.3%) had no record of MMR1 receipt in the EHR by November 2021 when data were extracted (table 2). This suggests that just over one third of index children did eventually receive MMR1 but significantly later than the recommended age. Almost half (47%) of the linked older children without MMR1 receipt between 12 months and 24 months of age also eventually received MMR1, and this was also significantly later than the recommended age.

DISCUSSION

We have shown that 16% of children from an English urban, disadvantaged and multiethnic population with

low MMR1 coverage do not receive MMR1 between the recommended age interval of 12 months and 24 months, and that they are less likely to do so if they share a household with an older child who did not receive MMR1 between age 12 months and 24 months. This association text was independent of ethnic group, number of children in the household, household composition and arealevel deprivation and was strengthened when analyses were confined to household children with an age gap of a less than 5 years. We also found that children in single adult households or in households with a larger number of children are less likely to receive MMR1 between 12 months and 24 months of age, consistent with findings from previous studies reporting household characteristics of children with delayed or non-MMR1 receipt. These findings suggest that caregivers' actions related to attendance for child vaccinations may be consistent across children in the household, particularly among children who are close in age.

| Table 2 MMR1 receipt in linked index and older children without MMR1 receipt between 12 months and 24 months of age | | | | | | | | | | | |
|---|---------------------------|-------|---------------------------|-------|--|--|--|--|--|--|--|
| Non-vaccinated groups | Index child (n=11 658) | % | Older child (n=11 324) | % | | | | | | | |
| MMR1 receipt <12 months of age | 516 | 4.4 | 993 | 8.8 | | | | | | | |
| MMR1 receipt between 24 months and 40 months of age | 2893 | 24.8 | 2642 | 23.3 | | | | | | | |
| MMR1 receipt >40 months of age | 749 | 6.4 | 1689 | 14.9 | | | | | | | |
| No record of MMR1 receipt in period of follow-up | 7500 | 64.3 | 6000 | 53.0 | | | | | | | |
| Total | 11 658 | 100.0 | 11 324 | 100.0 | | | | | | | |
| MMR1 first measles, mumps and rubella dose | | | | | | | | | | | |

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While we examined MMR1 receipt within the UK recommended age range of 12 months to 24 months in place at the time of our study, we were able to show that one third of index children did receive MMR1 at both younger and older ages. There are a number of explanations for this. UK vaccine guidance states that MMR1 may be given under 12 months of age in the context of outbreaks or exposure to measles. However, as there is evidence that this doesn't produce a strong antibody response, it is recommended that MMR1 must be given again within the scheduled age range.² Parents may not agree to a second MMR1, especially if this was given close to the first birthday. Furthermore, a proportion of MMR1 events under 12 months of age were assigned an improbable date (eg, given at birth date), and we are aware that GP practices may use this to record vaccines given in other countries for which the caregiver is unable to provide a date. London includes a significant proportion of children who are non-UK born and who migrate after the age of primary immunisations, many of whom anecdotally also spend periods back in their country of birth.^{29 30} This complicates administration and recording of vaccines and may create different expectations among parents or caregivers regarding vaccine schedules. Opportunistic catch-up of MMR1 has also been initiated on a number of occasions, and appointments for the second dose may be the opportunity to give the first dose: almost one quarter of index and linked older children were given MMR1 between 24 months and 40 months of age. So, while we were unable to confirm MMR1 receipt in two-thirds of index and one half of linked older children, a significant proportion were delayed rather than never immunised.

This is to our knowledge the first study to examine associations within households of MMR1 timeliness, so direct comparisons with existing literature are not possible. Previous studies have found that vaccine coverage is lower in families with larger numbers of children and in singleparent households.^{31 32} It has been suggested that the main drivers of vaccination delay in these households are access-based, with vaccination services and appointments less suitable for families with larger numbers of children or for parents requiring more flexible clinic appoint-ments.^{12 33} Vaccination delay may also be non-intentional: parents may delay vaccinations due to a child's illness.³⁴ This may explain some of the factors driving delayed MMR1 receipt in our study.

There may be other reasons for delayed MMR1 receipt. Qualitative research around reasons for delayed, partial or non-vaccination of children highlights the importance for parents of shared decision-making with clinicians and the strong association between trust in healthcare professionals and vaccine hesitancy in parents or caregivers. Parents or caregivers who have some trust in the information given by healthcare professionals may delay rather than completely refuse a child's vaccination, and this may be a consistent factor for all children in the household.³⁵ One study looking at decision-making between adults and adolescents in a household for the MenACWY vaccination

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vaccinations.⁴³ We have shown that a quality improvement programme that aims to improve timeliness and equity of preschool immunisations in NEL, focussing on dataenabled call and recall for immunisation, is effective.⁴⁴

Future research

We have shown that non-receipt of MMR1 between 12 months and 24 months of age is clustered in households. However, a significant proportion of children in our study ultimately received MMR1 in the preschool years and later childhood, with no clear evidence of MMR1 receipt in the remainder. Qualitative research is needed to understand the decision-making processes underlying this heterogeneous group. Similar research in demographically different areas of the UK may help understand the extent to which these findings are generalisable to households in a different socioeconomic context.

Strengths and limitations

The strengths of our study include the use of a novel method to create households securely while maintaining privacy, as well as having access to a large population with EHRs for a geographically contiguous area. Additionally, we have access to high-quality MMR data that are recorded accurately in the EHR through data recording templates.⁴⁵ The codeset used to identify MMR1 in the EHR was validated. We used robust statistical methods to assess relationships between the exposure and outcome variables, and we selected a time period before lockdowns due to the Coronavirus pandemic disrupted access to healthcare in England (March 2020).

We were not able to examine associations with delayed receipt of primary vaccinations against diphtheria, pertussis, polio, tetanus and *H.influenzae*. More granular categorisation of ethnic groups, as suggested by our patient and public involvement group, was not possible due to limited sample size. Processes of decision-making about vaccines may have differed between the linked index and older children. However, associations between the vaccination status of a younger and linked older child strengthened when restricted to children with an age interval of less than 5 years.

CONCLUSION

There is strong concordance in MMR1 vaccine delay or non-receipt between children sharing the same household in a region with the lowest MMR vaccination coverage in the UK.³ These findings have implications for the planning and delivery of vaccination services that consider children in their household context.

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Acknowledgements We are grateful to general practitioners in North East London for making electronic health record data available through the Discovery Data Service. We thank colleagues within the Clinical Effectiveness Group for their support in extracting and expertise in using general practice data. This research uses data provided by patients and collected by the NHS as part of their care and support. We would also like to acknowledge our PPI participants for their invaluable insights into patient perspectives around dissemination of our research to the wider community.

Contributors As per CrEdit accreditation, significant contributors are listed as follows: conceptualisation: MM, CD, NF and MW, methodology: MM, CD, MW and NF, resources: CD and AG, Data Curation: MM, AG, NF, MW and KS, data analysis: MM, NF and CD, writing-original draft: MM and CD, review and editing: MM, AG, NF, MW, KS and CD, formal analysis: MM and CD, validation: AG and MM, visualisation: MM, supervision: CD and funding acquisition: MM and CD. CD is the guarantor for this research paper.

Funding This research was supported by grants from Barts Charity (ref: G-002256, MGU0419 and MGU0504). This study was also funded by the National Institute for Health and Care Research (NIHR) School for Primary Care Research (Project reference 664).

Disclaimer The views expressed are those of the author(s) and not necessarily those of the NIHR or the Department of Health and Social Care.

Competing interests None declared.

Patient and public involvement Patients and/or the public were involved in the design, conduct, reporting or dissemination plans of this research. Refer to the Methods section for further details.

Patient consent for publication Not applicable.

Ethics approval Not applicable.

Provenance and peer review Not commissioned; externally peer reviewed.

Data availability statement Data may be obtained from a third party and are not publicly available. Access to general practice data are enabled by data sharing agreements between the Discovery Data Service and general practice data controllers. The Discovery Programme Board has approved data access by the REAL Child Health programme.

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