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Explaining the decline in childhood immunisation: socioeconomic, parental, and health system drivers

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Explaining the decline in childhood immunisation: socioeconomic, parental, and health system drivers

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Abstract

Childhood immunisation coverage in New Zealand has fallen since 2016, with the decline accelerating during the COVID-19 pandemic. Using administrative data from Stats NZ's Integrated Data Infrastructure, we examine determinants of immunisation uptake and how these have changed over time. We find that the likelihood of being fully immunised is lower among Māori children, later-born children, and children in lower-income households. We also identify weaker connection to primary care, particularly non-enrolment with a Primary Health Organisation, as an important factor associated with lower uptake. Although observed characteristics changed over time, these changes explain only a small share of the overall decline in uptake, suggesting an important role for unobserved factors. Finally, we find that parental COVID-19 vaccination and maternal vaccinations during pregnancy are strongly associated with children's uptake.

This report was prepared as part of the research project "Beyond the pandemic: Applying complexity science in child immunisation services", funded by the Health Research Council of New Zealand. Disclaimer: Access to the data used in this study was provided by Stats NZ under conditions designed to give effect to the security and confidentiality provisions of the Data and Statistics Act 2022. The results presented in this study are the work of the author, not Stats NZ or individual data suppliers. These results are not official statistics. They have been created for research purposes from the Integrated Data Infrastructure (IDI) which is carefully managed by Stats NZ. For more information about the IDI please visit https://www.stats.govt.nz/integrated-data/. This study received ethics approval from Auckland University of Technology Ethics Committee (ref. 24/378) on 25 August 2025.

1 Introduction

Immunisation is a highly successful and cost-effective public health intervention that protects individuals and communities from vaccine-preventable diseases and limits infectious disease outbreaks. In New Zealand, the National Immunisation Schedule (NIS) is a series of vaccinations offered to babies, children, adolescents, and adults, with each vaccination timed for the best immune response and protection. All children under the age of 18 years are eligible to receive vaccines on the schedule free of charge, typically delivered in general practices by practice nurses or family doctors.

The NIS schedules early childhood immunisations at ages 6 weeks, 3 months, 5 months, 12 months, 15 months, and 4 years (see Appendix Table A1) and since 2005 these immunisation events have been recorded in the National Immunisation Register (NIR, replaced in late 2023 by the Aotearoa Immunisation Register). Health New Zealand uses data from this register to measure and monitor immunisation coverage at the 'milestone ages' of 6, 8, 12, 18, 24, 54 months and 5 years, calculated as the number of children fully immunised for their milestone age over a 12-month period as a proportion of all children of that age (Health New Zealand, 2025a). The success of immunisation programmes relies on high coverage rates both at national and sub-national levels to provide direct protection for individuals and indirect protection for communities through herd immunity.

Beginning in 2009, childhood immunisation coverage in New Zealand began to see steady improvements and declining socioeconomic and ethnic disparities. But by late 2016/early 2017, immunisation rates had begun to fall, and the decline was accelerated by the onset of the COVID-19 pandemic (Immunisation Taskforce, 2023). Decreases in coverage were particularly large for children of Māori and Pacific ethnicity living in the most socioeconomically deprived areas, so equity gaps widened as coverage decreased (Ministry of Health, 2025; Hagedoorn, Anglemyer, and Walls, 2023).

The COVID-19 pandemic disrupted the delivery and uptake of routine childhood immunisations around the world (Shet et al., 2022; Evans and Jombart, 2022). In New Zealand, some health services were postponed or cancelled (Imlach et al., 2022) and vaccination resources and workforce were diverted away from childhood vaccination to support the COVID-19 immunisation programme (Immunisation Taskforce, 2023). Patients avoided or delayed seeking healthcare for fear of being exposed to COVID-19 or not wanting to burden the health system or because of confusion about whether services remained available during lockdown given the stay-at-home orders (Imlach et al., 2022; Wilson et al., 2021). While the initial impact of the pandemic on timely immunisation among New Zealand-born preschool-aged children was estimated to be negligible for infant immunisations, it was large for the 4-year immunisations which saw an immediate reduction in on-time vaccination of 15 percentage points below pre-pandemic levels (Iusitini, Pacheco, and Schober, 2024). Nine months after becoming eligible for immunisations, catch-up vaccination among pandemic-affected children was largely achieved for the infancy immunisations, but 4-year coverage remained six percentage points below pre-pandemic levels and ethnic and socioeconomic inequalities in coverage widened (Iusitini, Pacheco, and Schober, 2024).

In 2024, the New Zealand Government announced that improving childhood immunisation rates would be one of its five key health targets, with the goal of having 95 % of children fully immunised at 24 months of age by 2030, and began implementing initiatives across the entire immunisation system to achieve this (Ministry of Health, 2025). Understanding why childhood immunisation rates have fallen, and which groups of children are missing out in the wake of the COVID-19 pandemic, is important for designing interventions and policies aimed at lifting immunisation rates among targeted populations.

This study investigates the socioeconomic and healthcare-related factors that determine childhood routine vaccine uptake in the aftermath of the COVID-19 pandemic. We begin by using aggregate data to describe recent trends in childhood and maternal immunisation coverage and in the utilisation of early childhood health services. Because visits through programmes such as Well Child Tamariki Ora (WCTO) also provide immunisation information and reminders, changes in their utilisation can indicate whether falling childhood immunisation coverage is part of a broader decline in engagement with preventive child health services or is specific to vaccination. We then use linked administrative data from Stats NZ's Integrated Data Infrastructure (IDI) to analyse the determinants of children's immunisation at key milestone ages and assess whether changes in these factors over time can account for the observed decline in childhood immunisation rates since 2016. We also examine how parental vaccine uptake—receipt of the COVID-19 vaccine as well as maternal vaccinations given in pregnancy—is related to children's uptake of routine vaccines, and explore regional differences in coverage after adjusting for population characteristics.

2 Data

2.1 Aggregate data

We use aggregate data on immunisation coverage from the Aotearoa Immunisation Register to analyse descriptive trends in childhood routine vaccine uptake up to March 2024 (measured as the percentage of children who had received all of the immunisations scheduled under the NIS at each milestone age) and maternal vaccine uptake up to December 2022 (the percentage of pregnant women who received maternal vaccinations). To assess whether the decline in immunisation coverage is part of a broader pattern or specific to vaccination services, we also analyse trends in the utilisation of early childhood health services, using data from the Well Child Tamariki Ora (WCTO) Quality Improvement Framework. WCTO is a government programme of free health visits and support services for children up to 5 years of age, and the Quality Improvement Framework publishes a range of indicators of the quality and reach of this service (Health New Zealand, 2024b).

2.2 Microdata for determinants of vaccine uptake

To analyse the determinants of childhood vaccine uptake, we use population-wide microdata from the NIR linked to other administrative sources, accessed through the Integrated Data Infrastructure (IDI). The IDI is a large research database managed by Stats NZ that contains administrative data linked at the individual level across various government agencies and non-governmental organisations, as well as census and survey data (Stats NZ, 2020). To measure childhood immunisation status, we use NIR data covering the period July 2015 to June 2023 with annual coverage calculated for years ending June. We use data from the earlier NIR rather than the more recent Aotearoa Immunisation Register, because at the time of writing only the former includes information on children's immunisation status at milestone ages.

Our population of interest is derived from births registered in New Zealand with the Department of Internal Affairs. We restrict the analysis to children who were residing in New Zealand at the time they reached the relevant milestone age, based on international travel data. A small number of children who had died before the milestone age are excluded. The birth register also links children to their parents. It includes information on mothers for nearly all births, but details on fathers are occasionally missing. To assess the sensitivity of our results, we provide separate analyses for the full sample of children (including those for whom only one parent is identified) and for the subsample for whom both parents are identified. We also use this data source to determine each child's birth order.

Child sex, ethnicity, and place of residence are derived from the IDI central tables collated by Stats NZ. We use 20 districts of residence as our regional classification, corresponding to the former District Health Board (DHB) boundaries. Place of residence is matched at the Statistical Area 1 level to the New Zealand Index of Deprivation 2023 (NZDep2023), which combines nine variables from the 2023 Census to produce a scale from 1 to 10 measuring levels of socioeconomic deprivation of small areas (Atkinson et al., 2024). Information on whether a child has an overseas-born parent comes from the Administrative Population Census, which itself combines data from the census, birth registrations, visa applications, and border movements (Stats NZ, 2021).

Data on income are sourced from Inland Revenue and the Ministry of Social Development. For each birth parent, we aggregate their income from all sources over the tax year in which their child reaches a given milestone age. Then, if both parents of a child are observed in the data, we take an average of the two incomes, but if only one parent is observed in the data, we use that parent's income alone. We then categorise the resulting parental income into five quintiles. For parental education, we use the highest recorded educational attainment from any of the available Census years (2013, 2018, or 2023) and the Administrative Population Census. Educational attainment is grouped into three categories: 'Bachelor or higher', 'Level 3 to 6 certificate', and 'Lower than Level 3'. In the New Zealand Qualifications Framework, Level 3 corresponds to the senior secondary school qualification that students typically aim to achieve when leaving school.

We use two indicators of parental health status, derived from Ministry of Health data. The first follows the approach of Richmond-Rakerd et al. (2021), who use hospital diagnosis records to identify a range of chronic and severe physical conditions, including coronary heart disease, gout, chronic obstructive pulmonary disease, diabetes, cancer, traumatic brain injury, stroke, and myocardial infarction. The second indicator is based on the method used by Social Investment Agency (2019), drawing on data from mental health service use and outcomes, hospital records, and pharmaceutical dispensing to identify mental health conditions. These include attention deficit hyperactivity disorder, autism, dementia, eating disorders, intellectual disability, mood and anxiety disorders, personality disorders, schizophrenia, and substance use disorders.

The National Maternity Collection contains data on health care during pregnancy and childbirth (Ministry of Health, 2019). We use information on the type of lead maternity carer, as well as whether the mother's general practitioner (GP) and Well Child services were notified of the birth by the lead maternity carer, as indicators of quality of maternity care. In addition, we use data on whether a child is enrolled in a Primary Health Organisation (PHO, a group of health providers providing primary care services) at the relevant milestone age as a proxy for access to primary health care.

Data on parental uptake of the COVID-19 vaccine are drawn from the COVID Immunisation Register and maternal uptake of pregnancy vaccinations is from the NIR. In line with Stats NZ confidentiality requirements, all counts are randomly rounded to base 3.

3 Aggregate trends

3.1 Childhood vaccine uptake

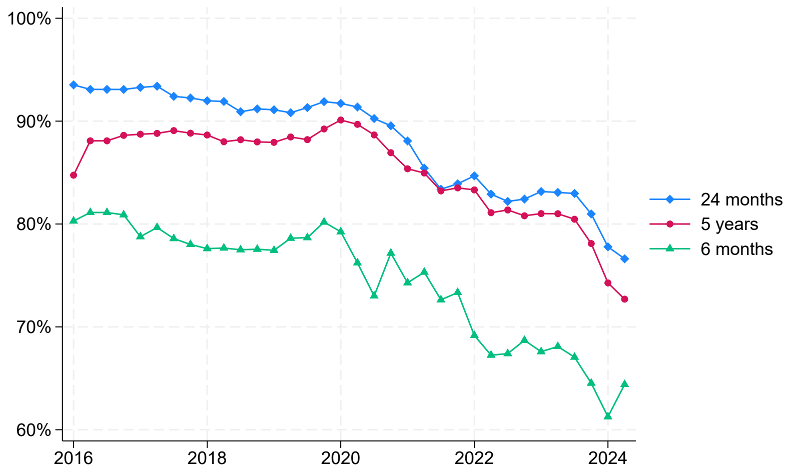

Figure 1: Percentage of fully immunised children at selected milestone ages

Figure 1 shows the development of immunisation coverage over time, highlighting the percentage of fully immunised children who reach selected milestone ages—6 months, 24 months, and 5 years—during each respective quarter. There is a considerable decrease in immunisation uptake after 2020. The share of fully immunised children at 24 months of age dropped from over 93 % in 2016 to 88 % at the beginning of 2021, and then to 78 % at the start of 2024. Immunisation coverage is therefore significantly below the target of 95 % of children being fully immunised at 24 months of age.[1]

A similar decline in coverage is evident at the milestone ages of 6 months and 5 years. Between the first quarter of 2016 and the first quarter of 2024, the share of fully immunised

[1] Health New Zealand (2024a) highlight that part of the decrease observed in the most recent quarters can be attributed to a change in the data source. From 2024 onwards, immunisation coverage is measured using data from the Aotearoa Immunisation Register, which includes a larger number of eligible children. This results in a larger denominator and consequently lower immunisation rates. However, Health New Zealand (2024a) emphasise that the Aotearoa Immunisation Register provides a more accurate estimate of immunisation coverage than the previously used NIR.

children decreased by 19 percentage points at 6 months and by 10 percentage points at 5 years. The 6-month milestone consistently has a lower proportion of fully immunised children. This is primarily because the NIS recommends vaccinations at 6 weeks, 3 months, and 5 months, leaving limited time for children to receive all recommended doses before reaching 6 months. In contrast, the last scheduled immunisation before the 24-month milestone is at 15 months, providing a longer window for catch-up vaccinations.

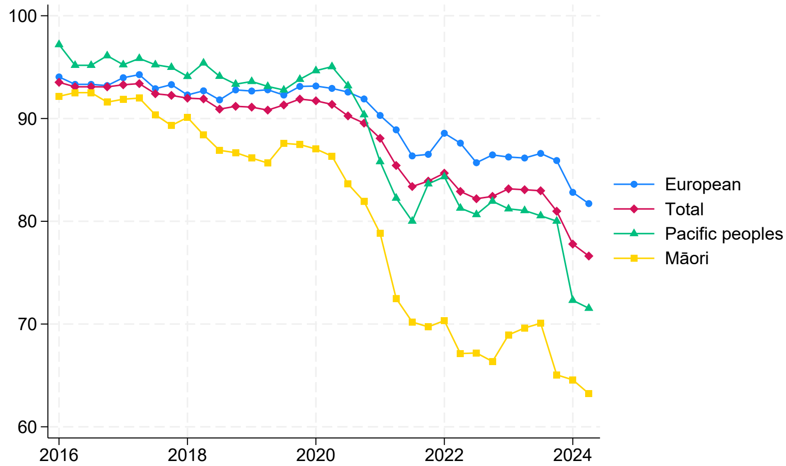

Figure 2: Percentage of fully immunised children by ethnicity at 24 months

Figure 2 shows immunisation coverage by ethnicity at 24 months. Although immunisation rates have declined across all groups, the decrease is most pronounced among Māori children. Specifically, the proportion of fully immunised Māori children fell from 92 % in the first quarter of 2016 to 65 % in the first quarter of 2024. During the same period, the share of fully immunised Pacific children declined from 97 % to 72 %, while coverage among European children decreased from 94 % to 81 %.

3.2 Maternal immunisation uptake

To gain a more comprehensive understanding of immunisation patterns, we next examine maternal immunisation over time. Maternal immunisation is a key public health strategy for protecting both pregnant women and their infants from infectious diseases. Vaccines against whooping cough (pertussis) and influenza, recommended during pregnancy in many countries, can protect infants during the critical period before they can receive their own vaccinations and are at risk of severe and potentially fatal disease. This protection is achieved through the transfer of maternal antibodies, which occurs during pregnancy via transplacental transport or after delivery through breastfeeding (Maertens, Orije, Van Damme, and Leuridan, 2020). New Zealand introduced the influenza vaccine for pregnant women in 2010. Since 2013, the Tdap (tetanus, diphtheria, and pertussis) vaccine has also been recommended for pregnant women, and from 2021, COVID-19 vaccination has been included in the recommendations (Health New Zealand, 2025b).

Figure 3 shows the share of pregnant women receiving maternal immunisations over time, highlighting an increase in uptake of both the pertussis (Tdap) and influenza vaccines between

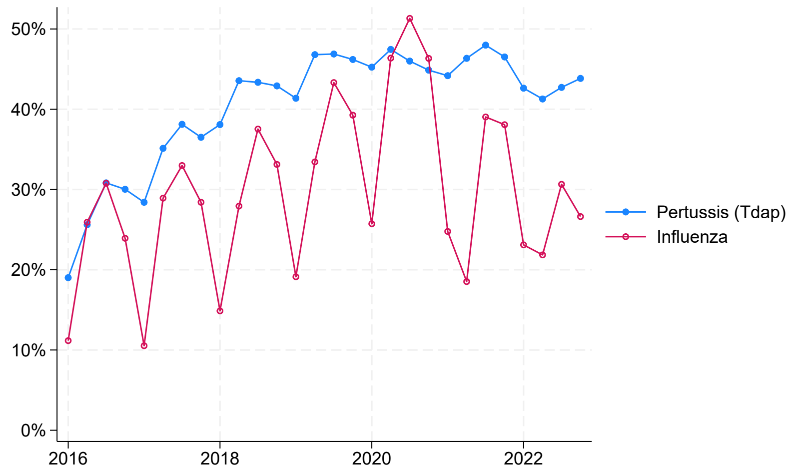

Figure 3: Percentage of pregnant women receiving maternal immunisation by quarter of child's birth

2016 and 2020.[2] This trend aligns with findings from Howe et al. (2020), who report that in 2018, 43.6 % of pregnancies were covered by the pertussis vaccine and 30.9 % by the influenza vaccine—up from 10.2 % and 11.2 % in 2013, respectively.

The findings indicate that uptake was initially low but gradually increased in subsequent years. Influenza uptake also follows a clear seasonal pattern, reflecting the timing of the vaccine's availability in New Zealand. After 2020, there is a notable decline in uptake. Averaging over calendar years to smooth seasonal variation, influenza uptake fell from a peak of 42.5 % in 2020 to 25.5 % in 2022. The decline in pertussis uptake was more modest, decreasing from a high of 46.3 % in 2021 to 42.6 % in 2022.

3.3 Well Child Tamariki Ora visits

The Well Child Tamariki Ora (WCTO) programme provides a series of free health visits and support for all families with children from around 6 weeks to 5 years of age (Health New Zealand, 2024c). These visits include monitoring of child growth and development, oral health checks, and a 'B4 School Check' (B4SC) at around age 4 years which checks for health, behavioural, social, or developmental concerns and includes vision and hearing assessments. WCTO visits also provide immunisation information, meaning that reduced engagement with WCTO could be linked to declines in childhood immunisation uptake.

Figure 4 shows trends for three indicators related to participation in WCTO. The percentage of newborns who received their first WCTO core contact before reaching 50 days of age declined from over 90 % in 2016 to 76 % in the second half of 2020 but then rose again to 86 % by the end of the observation period. In contrast, the percentage of children who received all WCTO core contacts during their first year of life decreased more substantially over this period. Even before the pandemic, only around 75 % of children completed all contacts, and this figure fell to 40 % in

[2] The percentages shown in Figure 3 under-estimate actual maternal vaccine coverage, as some vaccinations received in pharmacies or through work-based influenza programmes were not captured in the immunisation register during the observation period (Howe et al., 2020). However, our focus is on the trend in maternal vaccine uptake rather than the level.

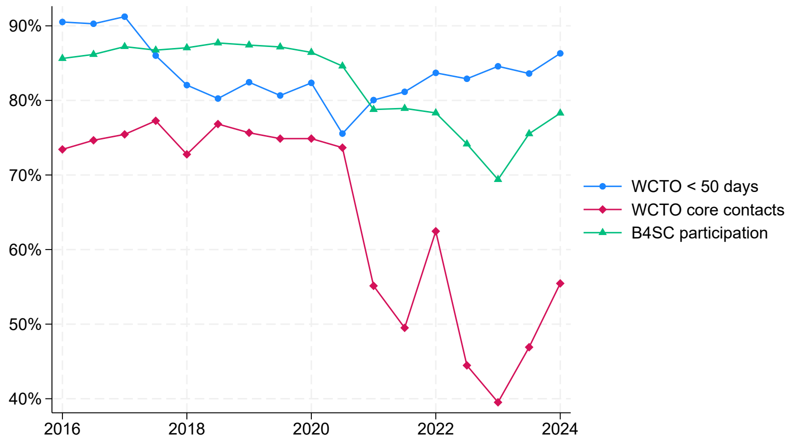

Figure 4: Trends in Well Child Tamariki Ora Quality Improvement Framework Indicators

the first half of 2023. It is important to note that while this figure is reported for the March 2023 reporting period, it actually refers to children born between 4 May 2021 and 2 November 2021, meaning that their first year of life may have been affected by COVID-19-related lockdowns. Subsequently, WCTO contacts increased somewhat, reaching 56 % at the start of 2024.

Figure 4 also presents participation in the B4SC, specifically the percentage of children who received their B4SC before reaching 4.5 years of age. Participation in the B4SC declined from over 85 % before the pandemic to below 80 % in 2021, reaching a low of 67 % at the start of 2023. Similar to the trend observed for WCTO contacts, this decline was followed by an increase in participation towards the end of the observation period. However, as of early 2024, participation remained significantly below pre-pandemic levels.[3]

4 Explaining childhood vaccine uptake

4.1 Determinants of vaccine uptake

This section uses IDI microdata to analyse the determinants of childhood vaccine uptake. We begin with a cross-sectional analysis of vaccine uptake at the 24-month milestone for children who reached this age between July 2022 and June 2023. Our outcome variable is an indicator for whether a child is fully immunised at 24 months, which we regress on child, parental, and household characteristics using a linear probability model.

Table 1 shows the regression results. We first discuss results for all children (columns 1-2), and then contrast the results with findings when we restrict the sample to those for whom both parents are observed in the data (columns 3-4). Sample means of the included covariates are provided in Appendix Tables A2 and A3.

Consistent with the aggregate analysis in Section 3.1, ethnicity remains a significant determinant of childhood vaccine uptake in the multivariable analysis, which controls for other characteristics. We apply a 'total response' classification, meaning that children can be recorded

[3]Note that the Quality Improvement Framework reports indicate that the entire WCTO data collection is undergoing a data quality improvement process, meaning the numbers reported here are subject to change in future updates.

under multiple ethnicities. The results show that Asian children have a 7.5 percentage point higher probability of being fully immunised compared to non-Asian children. In contrast, Māori children have an 8 percentage point lower probability of full immunisation relative to non-Māori. Among Pacific children, the probability of being fully immunised is not significantly different from all other children. We also observe a higher probability of vaccine uptake among children identified as European or of Other ethnicity. These differences are smaller than the raw differences in uptake by ethnicity reported in Section 3.1, suggesting that part of the variation can be attributed to differences in underlying characteristics. The findings for the sample of children where both parents are observed (columns 3-4) are very similar to the baseline results.

We also observe significant differences in immunisation uptake by birth order, with later-born children being substantially less likely to be fully immunised. For example, on average, third-born children have an 8.8 percentage point lower probability of being fully immunised compared to first-born children. Similar patterns have been documented in studies from other countries, where lower uptake among later-born children has been attributed to parental resource constraints and differences in caregiving behaviour (Pruckner, Schneeweis, Schober, and Zweimüller, 2021; Lin, Pham, Rosenthal, and Milanaik, 2022). Parental age also appears to play a role. A one-year increase in the parents' average age is associated with a 0.4 percentage point increase in the probability that a child is fully immunised. In contrast, we find no significant difference in immunisation uptake between male and female children. Again, we find the same patterns when we restrict the analysis to children for whom both parents are observed in the data.

We find that children of parents with higher income and education are more likely to be fully immunised. Using income quintiles, we observe a clear gradient in uptake across the income distribution. For example, children in the middle income quintile are 5.1 percentage points more likely to be fully immunised than those in the lowest quintile, while children in the highest quintile are 7.7 percentage points more likely to be immunised. Regarding education, having a parent with a bachelor's degree or higher is associated with a 3.8 percentage point increase in the probability that the child is fully immunised. We find similar patterns for income and education in both analysed samples.

Having an overseas-born parent is associated with a 2 percentage point increase in the probability that a child is fully immunised. In contrast, there is no statistically significant relationship between parental health—measured using indicators for chronic conditions or mental health conditions—and children's immunisation uptake.

The regression includes indicators for the type of lead maternity carer (LMC) providing maternity services during pregnancy and childbirth. Appendix Table A2 shows that while most women choose a midwife as their LMC, some opt for an obstetrician, or for another or unknown provider, or receive DHB-funded primary maternity services. Regression results in Table 1 show that having a midwife compared to DHB-provided services is associated with a small but statistically significant decrease in children's immunisation uptake. There are no statistically significant effects for choosing an obstetrician or an other/unknown provider.

We further analyse the relationship between vaccine uptake and indicators of access to primary health care, including enrolment in a Primary Health Organisation (PHO), and information from the National Maternity Collection on whether the mother's GP and Well Child services were notified of the birth. Appendix Table A2 shows that nearly all children in the sample (97 %) are enrolled in a PHO. However, those who are not enrolled have a significantly lower likelihood of being fully immunised. Enrolment in a PHO is associated with a 33 percentage point increase in the probability of a child being fully immunised. Vaccine uptake is also positively associated with the GP and WCTO service being notified of the child's birth, although the magnitude of the effects are considerably smaller. These results indicate that access to primary health care is an important determinant of vaccine uptake.

4.2 Parental vaccine uptake

During the COVID-19 pandemic, immunisation became a central topic of public discourse, with widespread attention to its value, effectiveness, and societal importance. In New Zealand, this debate was further shaped by the introduction of vaccine mandates in certain settings, prompting broader discussions around personal choice, public health, and trust in vaccination programmes. These developments may have influenced general attitudes toward immunisation within families. To explore this, we examine whether there is a correlation between children's immunisation status and parental vaccine uptake, using data on COVID-19, influenza, and Tdap vaccinations among parents.

Table 2 shows the results when we add parental immunisations to the regression explaining children's vaccine uptake. There is a strong correlation between parental and childhood vaccine uptake. If at least one parent received a COVID-19 vaccination (columns 1–2), children are 38.8 percentage points more likely to be fully immunised. When mothers and fathers are examined separately (columns 3–4), the uptake of both parents matters, but interestingly, the mother's uptake appears to be more influential: having a vaccinated father is associated with a 14.3 percentage point increase, while a vaccinated mother is associated with a 27.1 percentage point increase in the child's likelihood of being fully immunised.

Maternal uptake of recommended vaccines during pregnancy is also positively associated with childhood immunisation. Maternal influenza vaccination is linked to a 4.8 percentage point increase (4.1 percentage points in the two-parent sample), and maternal Tdap vaccination to a 7.4 percentage point increase (6.1 percentage points in the two-parent sample), in children being fully immunised. These findings suggest that parental engagement with vaccination may reflect broader health-seeking behaviours that positively influence childhood immunisation outcomes.

Compared to the baseline results in Table 1, the coefficients for many socio-economic background variables are smaller in Table 2. This suggests that parental vaccine uptake is influenced by similar factors as children's vaccine uptake. However, several family and child characteristics remain significantly associated with children's immunisation, even after accounting for parental immunisation status. For example, children in the highest income quintile are 3.7 percentage points more likely to be fully immunised than those in the lowest quintile, down from 7.7 percentage points in the baseline model. Similarly, Māori children have a 6.5 percentage point lower probability of being fully immunised compared to non-Māori, down from 8 percentage points in the model without parental immunisation controls.

4.3 Vaccine uptake at other milestone ages

To assess the consistency of our findings across different stages of early childhood, we also estimate regression models for vaccine uptake at 6 months, 12 months, and 5 years of age. Results for these milestone ages are shown in Table 3, where we restrict the analysis to samples where both parents are observed.

The results reveal similar overall patterns to those observed at the 24-month milestone, particularly with respect to ethnicity, income, birth order, and primary health care access. For example, Māori children consistently have lower immunisation rates across all milestone ages, the difference compared to non-Māori children is 9 percentage points at the 6-month milestone, 4.3 percentage points at 12 months, and 6.6 percentage points at 5 years.

Many associations between vaccine uptake and socio-economic characteristics are more pronounced at the early 6-month milestone (notably birth order, which has much larger effects at 6 months than at any other milestone age). This is likely related to the fact that the share of fully immunised children at this age is lower compared to later milestones (see Section 3.1), making absolute differences between groups more pronounced.

4.4 Explaining declining vaccine uptake

Given that the previous section demonstrated strong associations between various child and parental characteristics and a child's immunisation status at the 24-month milestone, an important question is whether changes in these underlying factors can help explain the observed decline in immunisation rates in recent years.

To explore this, we first examine how these characteristics have changed over time. Appendix Table A2 compares the characteristics of children born between July 2022 and June 2023 (analysed in Section 4.1 above) with those of children born between July 2015 and June 2016 (the start of our observation period).

There are several notable shifts in child and parental characteristics between the birth cohorts. Ethnic composition has changed slightly, with an increase in the share of Asian children (from 14.8 % to 19.7 %) and a small decline in the share of European children (from 67.8 % to 65.3 %). Parents are, on average, slightly older (32.5 to 33.0 years), and levels of educational attainment have risen substantially: the proportion of parents with a qualification below Level 3 dropped from 18.3 % to 9.7 %, while the share with a Bachelor's degree or higher rose from 39.9 % to 49.8 %.

There has also been an increase in the share of children with an overseas-born parent (from 36.5 % to 42.0 %) and small increases in reported parental chronic conditions (from 5.7 % to 7.5 %) and mental health conditions (from 8.9 % to 9.6 %). The share of births attended by midwives increased (from 80.7 % to 87.9 %), while those attended by DHB providers declined (from 10.6 % to 3.7 %). Indicators of connection to primary health care services declined modestly: birth notification to the mother's GP fell from 89.1 % to 85.7 %, and Well Child notifications dropped from 91.0 % to 85.9 %.

Next, we assess whether the changes in average characteristics can account for the observed decline in vaccine uptake at 24 months. To do this, we estimate a regression model using data on all children born between July 2015 and June 2023, including the covariates discussed in

Section 4.1. We group the covariates into socioeconomic characteristics (child's sex, ethnicity, birth order, parents' age, education, income, overseas-born status, health conditions) and primary health care (mother's GP notified of birth, child enrolled at a PHO, Well Child notified of birth, and mother's LMC). We then estimate annual vaccine uptake rates (for years ending in June) under the counterfactual scenario that the selected characteristics had remained at their 2016 levels.

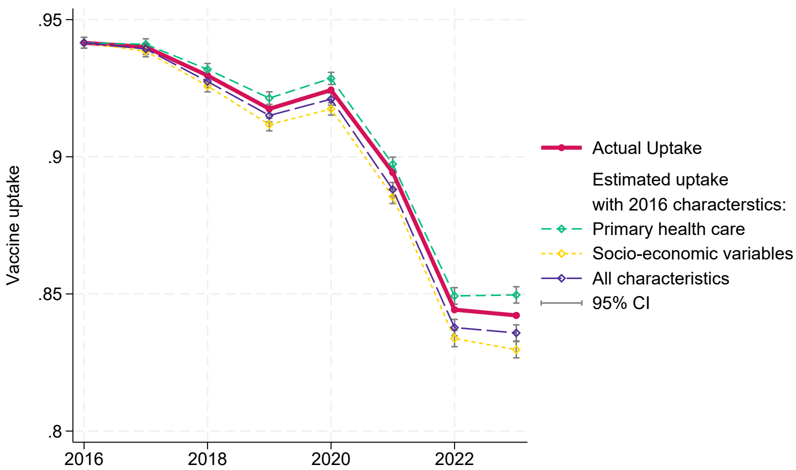

Figure 5: Predicted vaccine uptake at the 24-month milestone based on 2016 characteristics

Figure 5 summarises the regression results and suggests that changes in observed characteristics explain only a small part of the decline in immunisation coverage. As a first step, we set indicators related to primary health care (enrolment in a PHO, notification of the mother's GP, and notification of Well Child services) to their 2016 levels. We find that the estimated uptake in 2023 would have been slightly higher if these levels had been maintained. This reflects the fact that, for example, PHO enrolment is a strong predictor of vaccine uptake, and enrolment has declined since 2016. However, even under this scenario, the share of fully immunised children in 2023 would only reach 85 %—just 0.8 percentage points higher than the actual rate.

In contrast, if socioeconomic variables such as ethnicity and education had remained at their 2016 levels, estimated immunisation coverage would have been even lower. In this scenario, the predicted uptake in 2023 is 83 %, reflecting the fact that several factors associated with higher uptake—such as increased educational attainment—have improved over time. Similarly, when we fix all characteristics (both socioeconomic and primary health care variables) to their 2016 levels, the estimated uptake is lower than the actual observed rate.

Overall, this exercise suggests that changes in observable characteristics account for only a small part of the decline in vaccine uptake over time. This implies that the observed decrease is driven by unobserved factors not captured in the available data.

4.5 Regional differences in vaccine uptake

We now examine regional variation in childhood vaccine uptake. The left-hand side of Figure 6 shows the share of fully immunised children at the 24-month milestone across regions of New Zealand for the year ended June 2023. We use 20 districts of residence—based on the former

DHB boundaries—as the regional classification. There is considerable variation across districts, with the Southern district (92.6 %) and Canterbury (91.6 %) showing the highest uptake, while Northland (69 %) and Lakes (71.7 %) record the lowest rates. The Northland and central North Island regions (notably the Lakes district) have long been identified as areas with lower childhood immunisation coverage (Marek et al., 2021; Mueller et al., 2012).

Analogous to the analysis of trends over time, we examine how much of the regional variation in immunisation uptake can be explained by observed characteristics. To do this, we use the regression results from Section 4.1 to predict immunisation rates while holding all characteristics constant at the levels observed in the Southern district—the region with the highest uptake. The right-hand side of Figure 6 presents the corresponding estimates.

By construction, the predicted uptake for the Southern region remains unchanged. In all other regions, predicted uptake differs from the actual values. For example, in Northland, the predicted uptake is 77.1 %, suggesting that part—but not all—of the regional difference can be attributed to differences in observed background characteristics of the respective populations. Overall, regional variation is reduced once we account for these characteristics. Moreover, predicted uptake in most regions exceeds actual uptake, indicating that, relative to the Southern district, their underlying population characteristics are generally less favourable to immunisation.

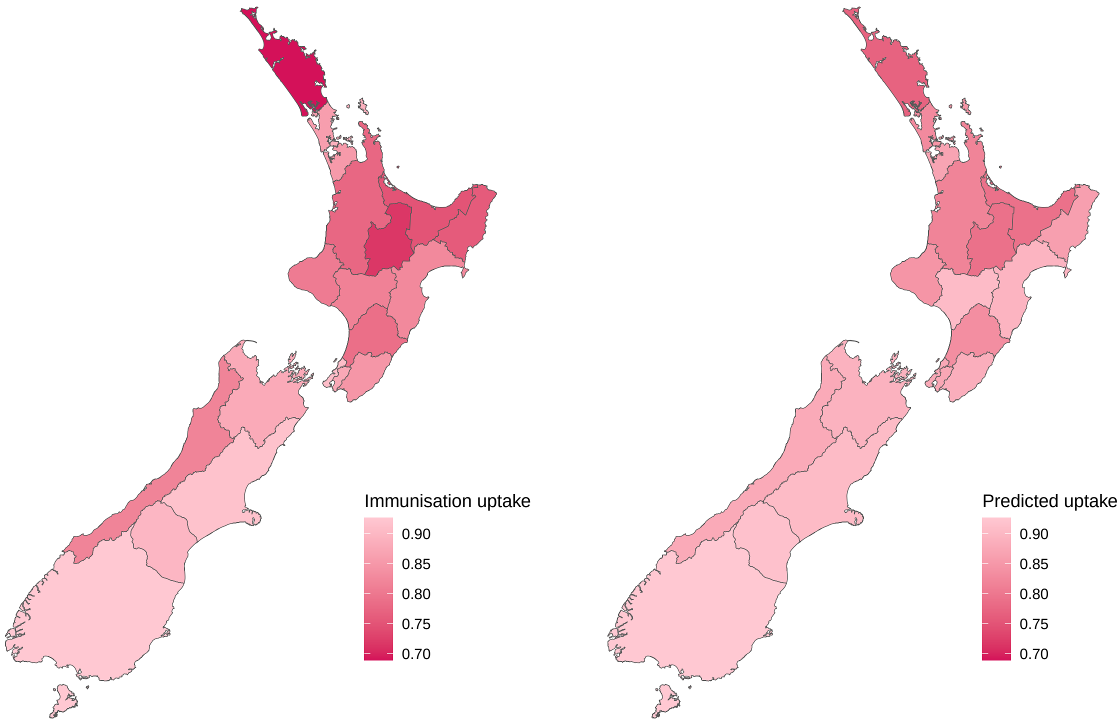

Figure 6: Actual (left) and estimated (right) immunisation uptake at the 24-month milestone age using population characteristics of the Southern district.

5 Discussion

We find that, in the aftermath of the COVID-19 pandemic, children's immunisation status in New Zealand continues to be linked to their socioeconomic circumstances and their access to primary health care, but that changes in these factors account for only a small portion of the decline in immunisation coverage that has occurred in New Zealand since 2016. We also find that parental uptake of maternal (pregnancy) vaccines and, especially, the COVID-19 vaccine, are strongly related to children's immunisation.

We find that the likelihood of being fully immunised is lower among Māori children and higher among Asian and European children at all milestone ages, based on a set of binary indicators for each ethnic group. We also find that, with the exception of the 6-month milestone, Pacific children are either equally likely (at 24 months) or slightly more likely (at 12 months and 5 years) to be fully immunised compared to non-Pacific children. Previous studies, which use the European ethnic group as the reference category and control for demographic and socioeconomic characteristics, have similarly found that Māori preschool-aged children are less likely to be routinely immunised on time compared to European children (Charania, Kirkpatrick, Paynter, and Turner, 2023; Lewycka et al., 2023) and Pacific and Asian pregnant women have higher intention to immunise their child and higher postpartum uptake of child vaccinations compared to European women (Grant, Chen, et al., 2016; Lewycka et al., 2023). While survey evidence has found that Māori adults have lower levels of confidence in the safety of routine childhood vaccinations than other ethnic groups (Lee, Duck, and Sibley, 2017; Lee and Sibley, 2020b), their confidence increases with better self-reported access to healthcare and higher satisfaction with their GP (Lee and Sibley, 2020b). Other studies find that under-vaccination of Māori children is not due to Māori parents holding anti-vaccination attitudes per se, but rather due to negative experiences with healthcare professionals and a mistrust of the healthcare system (Brown, Toki, and Clark, 2021; Roberts et al., 2017). Specifically, some Māori mothers report feeling disrespected, patronised, coerced, judged, and shamed when interacting with healthcare professionals about immunising their children (Brown, Toki, and Clark, 2021). They want healthcare professionals who take the time to engage with them in honest conversations about vaccination in which their concerns are taken seriously (rather than dismissed) and responded to in a non-judgmental and respectful way without coercing or pressuring them into taking any particular action. They do not want to be rushed, 'talked down to', or made to feel like bad parents (Brown, Toki, and Clark, 2021).

We find immunisation uptake differs by child's birth order but not by child's sex, consistent with previous New Zealand research which has found infant vaccine uptake is significantly higher among first-born compared to subsequent-born children (Lewycka et al., 2023; Paterson, Schluter, Percival, and Carter, 2006) and sex differences in children's timely vaccine uptake are small or non-existent (depending on the vaccine) (Charania, Kirkpatrick, Paynter, and Turner, 2023). Of the socioeconomic variables we analyse, birth order tends to have the largest effects on vaccine uptake, with particularly large effects at the 6-month milestone. These birth order effects likely reflect parental resource constraints; research with New Zealand parents has found that a lack of child-minding for older siblings and logistical and financial barriers that compound with the number of children (such as lack of transport or money to travel to appointments and inconvenient clinic opening hours) are barriers to getting children immunised (Litmus Limited, 2013; Paterson, Percival, Butler, and Williams, 2004).

The likelihood of being fully immunised increases with parents' age and income and is higher among children with parents who hold degree qualifications and are overseas-born. On the other hand, parents' health status – whether they have a chronic physical condition or a mental health condition – is generally unrelated to children's immunisation status. Previous New Zealand studies have found that children are more likely to be immunised if they have foreign-born parents (compared to New Zealand-born) (Hashemi et al., 2024; Lewycka et al., 2023) and live in higher-income households (Lewycka et al., 2023). We note that the positive effect on vaccine uptake of having parents with higher education is eliminated or even reversed once parental vaccine uptake is taken into account. In part, this may reflect differences in attitudes towards vaccination among people with different levels of education. For example, a survey of the attitudes of New Zealand adults found that confidence in the safety of routine childhood vaccinations is lower among respondents with lower levels of education, controlling for other demographic and socioeconomic differences (Lee, Duck, and Sibley, 2017; Lee and Sibley, 2020b).

We find the likelihood of being fully immunised is slightly lower among children of mothers whose LMC was a midwife (compared to children of mothers with a DHB-provided LMC), but this effect is only found at the 24-month and 5-year milestones. An analysis of NIR and other administrative datasets that record maternal vaccinations delivered between 2013 and 2018 found that both influenza and pertussis vaccine uptake by pregnant women was significantly higher among women whose LMC was a GP or obstetrician compared to women whose LMC was a midwife (Howe et al., 2020). Howe and colleagues note that women under the care of an obstetrician often have higher-risk pregnancies or are of higher socioeconomic status (with better health literacy and access to services) and consequently are more likely to immunise, while those under the care of a GP are also more likely to immunise because general practices administer vaccinations while midwives generally do not. These same factors may also affect the ability of women under the care of a midwife to immunise their children.

In terms of primary health care, we find that children who are enrolled with a PHO at the relevant milestone age are substantially more likely (between 26 and 41 percentage points) to be fully immunised compared to children who are not enrolled. In addition, children whose birth was notified to Well Child services by their mother's LMC have a modestly higher probability of being fully immunised compared to children whose birth was not notified in this way. The Immunisation Taskforce (2023) identified that childhood immunisation coverage is hampered by flaws in the system for enrolling newborns with a primary healthcare provider, resulting in some children not enrolling or being unenrolled if their 'pre-enrolment' status lapses, meaning their parents will not receive proactive pre-calls and recalls for vaccination from a general practice. Moreover, a survey of general practices in New Zealand found that those practices with higher rates of childhood immunisation coverage tend to enrol children early in life (and are staffed at a sufficient and stable level by healthcare professionals who are cognisant of the access barriers affecting their patient populations and who prioritise immunisation services by, for example, allowing dedicated time for immunisation follow-up) (Grant, Turner, et al., 2010; Grant, Petousis-Harris, et al., 2011; Petousis-Harris, Grant, et al., 2012).

We find that parental uptake of vaccinations is predictive of children's immunisation status, especially parental uptake of the COVID-19 vaccine. This suggests parental engagement with vaccination reflects broader health-seeking behaviours that positively influence childhood immunisation. A previous analysis of New Zealand immunisation register data found that parents' uptake of the COVID-19 vaccine is linked to children's uptake of the COVID-19 vaccine; the likelihood of receiving at least one paediatric COVID vaccination was significantly higher among children whose parents had received two or more doses of the COVID vaccine, compared to children whose parents had received one or no doses, controlling for other demographic and socioeconomic determinants of vaccine uptake, with the authors concluding "[p]arental COVID-19 vaccination status was the strongest predictor of paediatric COVID-19 vaccination status" (Charania, Kirkpatrick, and Paynter, 2023).

We find that mothers' receipt of the COVID-19 vaccine is a stronger predictor of children being fully immunised than fathers' receipt. This finding is consistent with results from a New Zealand study of 68 mother-father couples pooled from annual surveys over 2015 to 2017 that asked respondents about their confidence in the safety of routine childhood vaccinations and their children's vaccination status (Lee, Overall, and Sibley, 2020). The study found that mothers', but not fathers', vaccine confidence predicted whether their children were fully vaccinated, suggesting that "paternal attitudes are largely excluded from the vaccination decision-making process, with the mothers' attitudes taking preference over the fathers" (Lee, Overall, and Sibley, 2020).

Broader attitudes towards vaccination in general, and levels of trust in institutions, are likely to influence parents' uptake of vaccines for both themselves and their children. Concerns about the safety, potential side-effects, and effectiveness of vaccines have long been identified as barriers to children's immunisation in New Zealand (Litmus Limited, 2013; Ministry of Health, 2021; Petousis-Harris, Goodyear-Smith, Godinet, and Turner, 2002). A survey of the attitudes of 58,654 New Zealand adults found that, across the population as a whole, confidence in the safety of routine childhood vaccines increased in the years leading up to the COVID-19 pandemic (Hayes et al., 2024). However, the same survey found that about 30 % of New Zealand adults became increasingly concerned about childhood vaccine safety and these 'vaccine sceptics' were characterised by lower levels of education, socioeconomic deprivation, and Māori and Pacific ethnicity (Lee and Sibley, 2020a). Since the onset of the pandemic, panel respondents from the same survey who had reported lower levels of trust in science and the police prior to the pandemic in 2019 were more likely to be unvaccinated for COVID-19 by late 2021 (Marques et al., 2022). A different study analysing the relationship between New Zealanders' levels of trust in various social institutions before the pandemic (when surveyed over 2014 to 2018) and their subsequent uptake of the COVID-19 vaccine by October 2021 found that higher levels of institutional trust (especially in the police) were associated with greater propensity and promptness of uptake of the COVID-19 vaccine (Blamey and Noy, 2025). A qualitative study that interviewed Māori and Pacific parents found that, for some participants, the pandemic created a climate of uncertainty and weariness towards vaccines generally (Charania, Tonumaipe'a, et al., 2024) and there is also evidence from the United States that attitudes toward the COVID-19 vaccine 'spilled over' to views on vaccination more broadly (Lunz Trujillo et al., 2024).

Taken together, the results from these studies suggest childhood immunisation is strongly influenced by parental attitudes to vaccination in general and levels of trust in the health system and wider government. National survey evidence indicates that trust in the health system has fallen over the past decade. Data from the NZ General Social Survey show average trust in the health system was 6.1 out of 10 in 2023, down from 6.9 in 2018 and 7.0 in 2014 and 2016 (Ministry of Health, 2024). There has long existed a minority of the population who are suspicious or distrustful of healthcare professionals, believing that they have a 'pro-immunisation' agenda and parrot a biased government view on immunisation instead of providing balanced and impartial information (Litmus Limited, 2013; Charania, Tonumaipe'a, et al., 2024; Petousis-Harris, Goodyear-Smith, Godinet, and Turner, 2002; Young et al., 2023). Parents' exposure to information has a strong influence on children's immunisation, with New Zealand studies finding that children are less likely to be immunised if their mother received information during pregnancy that discouraged child immunisations (Lewycka et al., 2023; Veerasingam et al., 2017; Grant, Turner, et al., 2010; Grant, Petousis-Harris, et al., 2011; Petousis-Harris, Grant, et al., 2012). On the other hand, research has also found that receiving a clear recommendation to immunise from healthcare providers increases vaccine uptake (Duckworth, 2015; Young et al., 2022; Gauld et al., 2016; Hill, Burrell, and Walls, 2018; Priday et al., 2023).

A limitation of our analysis is that the administrative data do not contain direct measures of parents' attitudes, beliefs, or levels of trust in vaccines and the health system. The strong correlation we observe between parental and childhood vaccine uptake should therefore not be interpreted solely as evidence of shared attitudes towards vaccination within families. It may also reflect unobserved factors that influence both parental and child uptake, including 'supply-side' characteristics such as the availability and accessibility of immunisation providers, practice-level systems for enrolment and recall, and local configurations of primary care and outreach services.

6 Conclusion

We conclude that the decline in childhood immunisation coverage that has occurred in New Zealand since 2016 is not attributable to changes in the demographic and socioeconomic composition of New Zealand's child population and is only marginally attributable to decreases in access to primary care (notably, an increase in children unable to enrol with a general practice). Nevertheless, all of these factors still exert influence on children's immunisation at the present. This study provides insights into which groups of children are currently missing out on routine immunisations, notably children of Māori ethnicity, of higher birth order, with lower family incomes, who are not enrolled with a general practice, and whose parents do not get vaccinated themselves. These insights can be used to help target resources to specific under-vaccinated populations, including through locally designed interventions, health promotion campaigns, and community-led actions fronted by trusted community advocates aimed at lifting childhood immunisation rates. The New Zealand Government is currently expanding the vaccinator workforce and the locations at which immunisations can be obtained, such as community pharmacies, proactive outreach immunisation services, walk-in centres, and through midwives (Health New Zealand, 2025c). The findings of this study can inform strategies and actions designed to encourage parents to utilise these expanded child immunisation services.

Table 1: Determinants of children's vaccine uptake at 24-month milestone for year ended June 2023

	Full sample		Both parents observed	
	(1) Estimate	(2) S.E.	(3) Estimate	(4) S.E.
Female	0.004	(0.003)	0.001	(0.003)
Ethnicity				
Asian	0.075	(0.005)***	0.072	(0.005)***
European	0.019	(0.005)***	0.018	(0.005)***
Māori	-0.080	(0.004)***	-0.074	(0.004)***
Other	0.015	(0.008)*	0.012	(0.008)
Pacific peoples	0.003	(0.005)	0.006	(0.006)
Birth order *(Base: First born)*				
Second born	-0.046	(0.003)***	-0.044	(0.003)***
Third born	-0.088	(0.005)***	-0.084	(0.005)***
Fourth born or higher	-0.157	(0.007)***	-0.170	(0.007)***
Parents' age	0.004	(0.000)***	0.004	(0.000)***
Parent's highest qualification *(Base: Lower than Level 3)*				
Level 3 to 6 certificate	0.010	(0.006)	-0.005	(0.007)
Bachelor or higher	0.038	(0.006)***	0.021	(0.007)**
Parental incomes quintiles *(Base: Lowest)*				
Low	0.034	(0.005)***	0.042	(0.006)***
Middle	0.051	(0.005)***	0.061	(0.005)***
High	0.068	(0.005)***	0.079	(0.005)***
Highest	0.077	(0.005)***	0.085	(0.005)***
Overseas born parent	0.020	(0.004)***	0.015	(0.004)***
Parental health				
Chronic condition	-0.008	(0.006)	-0.008	(0.006)
Mental health condition	-0.003	(0.005)	-0.003	(0.005)
Lead maternity carer *(Base: DHB)*				
Midwife	-0.022	(0.008)**	-0.020	(0.008)*
Obstetrician	-0.007	(0.009)	-0.008	(0.009)
Other or unknown	-0.007	(0.011)	-0.002	(0.012)
Primary health care				
Mother's GP notified of birth	0.017	(0.005)***	0.015	(0.005)**
Child enrolled at a PHO	0.334	(0.012)***	0.333	(0.013)***
LMC notified Well Child services	0.022	(0.005)***	0.022	(0.005)***
N	55,641		50,175	

Notes: Columns 1 (point estimate) and 2 (robust standard error) include all children with available data, columns 3-4 only those for whom we observe both parents. Regressions additionally control for the district of residence (former DHBs) and the New Zealand Index of Deprivation 2023 (10 levels). $^{*}\,p < 0.05$, $^{**}\,p < 0.01$, $^{***}\,p < 0.001$.

Table 2: Determinants of children's vaccine uptake at 24-month milestone for year ended June 2023 including parental vaccine uptake

	Full sample		Both parents observed	
	(1) Estimate	(2) S.E.	(3) Estimate	(4) S.E.
Female	0.002	(0.003)	0.000	(0.003)
Ethnicity				
Asian	0.060	(0.005)***	0.054	(0.005)***
European	0.025	(0.004)***	0.026	(0.005)***
Māori	-0.065	(0.004)***	-0.056	(0.004)***
Other	0.021	(0.007)**	0.020	(0.007)**
Pacific peoples	-0.001	(0.005)	0.001	(0.005)
Birth order *(Base: First born)*				
Second born	-0.031	(0.003)***	-0.030	(0.003)***
Third born	-0.057	(0.005)***	-0.056	(0.005)***
Fourth born or higher	-0.098	(0.006)***	-0.111	(0.007)***
Parents' age	0.003	(0.000)***	0.003	(0.000)***
Parent's highest qualification *(Base: Lower than Level 3)*				
Level 3 to 6 certificate	-0.010	(0.006)	-0.016	(0.007)*
Bachelor or higher	0.000	(0.006)	-0.012	(0.007)
Parental incomes quintiles *(Base: Lowest)*				
Low	0.016	(0.005)**	0.016	(0.005)**
Middle	0.019	(0.005)***	0.017	(0.005)***
High	0.030	(0.005)***	0.025	(0.005)***
Highest	0.037	(0.005)***	0.031	(0.005)***
Overseas born parent	0.014	(0.003)***	0.009	(0.003)*
Parental health				
Chronic condition	-0.009	(0.006)	-0.007	(0.006)
Mental health condition	-0.003	(0.005)	-0.002	(0.005)
Lead maternity carer *(Base: DHB)*				
Midwife	-0.010	(0.008)	-0.004	(0.008)
Obstetrician	-0.004	(0.009)	0.004	(0.009)
Other or unknown	0.000	(0.011)	0.009	(0.011)
Primary health care				
Mother's GP notified of birth	0.016	(0.005)**	0.011	(0.005)*
Child enrolled at a PHO	0.252	(0.011)***	0.234	(0.012)***
LMC notified Well Child services	0.007	(0.005)	0.008	(0.005)
Parental vaccine uptake				
Parent received COVID-19 vaccination	0.388	(0.008)***		
Father received COVID-19 vaccination			0.143	(0.008)***
Mother received COVID-19 vaccination			0.271	(0.008)***
Maternal influenza vaccination	0.048	(0.002)***	0.041	(0.003)***
Maternal Tdap vaccination	0.074	(0.003)***	0.061	(0.003)***
N	55,641		50,046	

Notes: Columns 1 (point estimate) and 2 (robust standard error) include all children with available data, columns 3-4 only those for whom we observe both parents. Regressions additionally control for the district of residence (former DHBs) and the New Zealand Index of Deprivation 2023 (10 levels). $^{*}\, p < 0.05$, $^{**}\, p < 0.01$, $^{***}\, p < 0.001$.

Table 3: Determinants of children's vaccine uptake at different milestone ages for year ended June 2023

	6 months		12 months		5 years	
	(1) Estimate	(2) S.E.	(3) Estimate	(4) S.E.	(5) Estimate	(6) S.E.
Female	0.006	(0.004)	-0.000	(0.002)	-0.001	(0.003)
Ethnicity						
Asian	0.091	(0.006)***	0.039	(0.004)***	0.073	(0.006)***
European	0.028	(0.006)***	0.008	(0.004)*	0.015	(0.005)**
Māori	-0.090	(0.005)***	-0.043	(0.003)***	-0.066	(0.004)***
Other	0.007	(0.010)	0.005	(0.006)	0.000	(0.009)
Pacific peoples	-0.028	(0.007)***	0.014	(0.005)**	0.017	(0.006)**
Birth order *(Base: First born)*						
Second born	-0.109	(0.004)***	-0.028	(0.003)***	-0.021	(0.004)***
Third born	-0.212	(0.006)***	-0.063	(0.004)***	-0.054	(0.005)***
Fourth born or higher	-0.312	(0.008)***	-0.120	(0.007)***	-0.115	(0.007)***
Parents' age	0.006	(0.000)***	0.002	(0.000)***	0.003	(0.000)***
Parent's highest qualification *(Base: Lower than Level 3)*						
Level 3 to 6 certificate	0.032	(0.008)***	0.005	(0.006)	-0.002	(0.007)
Bachelor or higher	0.071	(0.009)***	0.014	(0.006)*	0.023	(0.007)**
Parental incomes quintiles *(Base: Lowest)*						
Low	0.037	(0.006)***	0.019	(0.005)***	0.035	(0.006)***
Middle	0.069	(0.006)***	0.035	(0.004)***	0.047	(0.006)***
High	0.079	(0.006)***	0.047	(0.004)***	0.080	(0.005)***
Highest	0.088	(0.006)***	0.052	(0.004)***	0.090	(0.006)***
Overseas born parent	0.017	(0.005)***	0.013	(0.003)***	0.007	(0.004)
Parental health						
Chronic condition	-0.011	(0.007)	-0.003	(0.005)	-0.004	(0.006)
Mental health condition	-0.008	(0.006)	0.009	(0.004)*	-0.002	(0.005)
Lead maternity carer *(Base: DHB)*						
Midwife	0.010	(0.015)	-0.011	(0.008)	-0.032	(0.008)***
Obstetrician	0.019	(0.017)	-0.005	(0.008)	-0.012	(0.009)
Other or unknown	0.022	(0.017)	-0.001	(0.010)	-0.001	(0.012)
Primary health care						
Mother's GP notified of birth	0.002	(0.004)	0.012	(0.003)***	-0.005	(0.008)
Child enrolled at a PHO	0.261	(0.007)***	0.256	(0.009)***	0.405	(0.015)***
LMC notified Well Child services	0.051	(0.008)***	0.023	(0.004)***	0.033	(0.008)***
N	47,979		49,998		48,159	

Notes: All columns relate to samples of children for whom both parents are observed. Regressions additionally control for the district of residence (former DHBs) and the New Zealand Index of Deprivation 2023 (10 levels). $^{*}\ p < 0.05$, $^{**}\ p < 0.01$, $^{***}\ p < 0.001$.

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A Appendix

Table A1: Vaccines for children under 5 years on New Zealand's National Immunisation Schedule

	DTaP-IPV-HepB/Hib	PCV	RV	MenB	MMR	Hib	VV	DTaP-IPV
6 weeks	•	•	•					
3 months	•		•	•				
5 months	•	•		•				
12 months		•		•	•			
15 months					•	•	•	
4 years								•

Notes: DTaP-IPV-HepB/Hib = diphtheria, tetanus, acellular pertussis, inactivated polio, hepatitis B and *Haemophilus influenzae* type b vaccine; PCV = pneumococcal conjugate vaccine; RV = rotavirus vaccine; MenB = meningococcal B vaccine; Hib = *Haemophilus influenzae* type b (booster dose at 15 months); MMR = measles, mumps and rubella vaccine; VV = varicella (chickenpox) vaccine; DTaP-IPV = diphtheria, tetanus, acellular pertussis and inactivated polio vaccine.

Table A2: Child and parental characteristics for children reaching the 24-month milestone age during the years ended June 2016 and June 2023

	2016	2023
Female	48.5	48.5
Ethnicity		
Asian	14.8	19.7
NZ European	67.8	65.3
Maori	30.5	30.5
Other	2.8	3.4
Pacific People	14.9	15.2
Birth order		
First born	39.6	41.5
Second born	33.9	33.1
Third born	15.3	14.4
Fourth born or higher	11.2	11.0
Parents' age	32.5	33.0
Highest qualification		
Lower than level 3	18.3	9.7
Level 3 certificate	41.8	40.5
Bachelor or higher	39.9	49.8
Overseas born parent	36.5	42.0
Parental health		
Chronic condition	5.7	7.5
Mental health condition	8.9	9.6
Lead maternity carer		
DHB	10.6	3.7
Midwife	80.7	87.9
Obstetrician	5.3	4.1
Other or unknown	3.3	4.3
Primary health care		
Mother's GP notified of birth	89.1	85.7
Enrolled at a PHO	98.4	97.2
LMC notified Wellchild services of birth	91.0	85.9
Parental vaccine uptake		
Parental COVID-19 vaccination		91.9
Father received COVID-19 vaccination		87.7
Mother received COVID-19 vaccination		86.0
Maternal influenza vaccination	2.9	34.7
Maternal Tdap vaccination	2.4	45.2

Notes: Characteristics of children who reached the 24-month milestone during the periods July 2015 to June 2016 and July 2022 to June 2023.

Table A3: Share of children at the 24-month milestone age by region and deprivation level in 2016 and 2023

	2016	2023
Region		
Northland	3.9	4.0
Hawke's Bay	3.9	3.7
Whanganui	1.5	1.5
MidCentral	3.8	4.0
Hutt Valley	3.3	3.5
Capital and Coast	5.9	4.9
Wairarapa	0.9	1.0
Nelson Marlborough	2.6	2.7
West Coast	0.6	0.5
Canterbury	10.2	11.4
South Canterbury	1.2	1.1
Waitemata	12.9	12.7
Southern	6.1	5.9
Auckland	9.2	7.5
Counties Manukau	13.4	13.8
Waikato	9.3	9.9
Lakes	2.5	2.6
Bay of Plenty	4.9	5.6
Tairawhiti	1.2	1.3
Taranaki	2.7	2.7
Deprivation level		
1	6.7	8.4
2	7.7	8.7
3	8.3	8.7
4	9.0	8.9
5	9.3	9.1
6	10.0	9.5
7	10.5	10.2
8	10.8	10.6
9	12.3	11.6
10	15.4	14.3

Notes: Region and deprivation level of children who reached the 24-month milestone during the periods July 2015 to June 2016 and July 2022 to June 2023.