

Maternal intentions for human papillomavirus (HPV) vaccination of girls and boys in New Zealand

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Executive summary

Introduction

The New Zealand immunisation schedule includes free human papillomavirus (HPV) vaccination for 11- to 12-year old girls and boys. Parental vaccine hesitancy occurs with all vaccines. The HPV vaccine is specifically vulnerable to vaccine hesitancy because of the age when given, and because it prevents sexually transmitted infections.

The research objectives were to:

1. Describe the HPV vaccination intentions of mothers for their 8-year-old children.
2. Identify demographic factors, household characteristics, and social and behavioural factors associated with maternal intentions for HPV vaccination.
3. Identify healthcare factors associated with maternal intentions for HPV vaccination.
4. Describe the relationship of the child's past vaccination experiences with maternal intentions for HPV vaccination.

Methods

At the *Growing Up in New Zealand* study's 8-year data-collection-wave, mothers were asked about their intentions regarding their child receiving the HPV vaccine.

The child's mother was asked:

"Have you decided yet if you will have [child's-name] immunised with the HPV vaccine?"

The response options were:

- Yes, I have decided I will have my child immunised
- Yes, I have decided I will not have my child immunised
- No, I have not yet decided
- I have never heard of the HPV vaccine

Associations of demographic factors, household characteristics, social and behavioural factors, healthcare factors and the child's past vaccination experiences with maternal HPV vaccination intentions were examined using multinomial logistic regression. Associations were described using adjusted odds ratios (aOR) and their 95% confidence intervals (CI).

Results

Children whose mothers completed a child-proxy questionnaire at the 8-year follow-up (n=4,920) were eligible for this analysis. The analytic sample comprises 4,448 of 4,920 children (90%) who met the following criteria: 1)

mothers provided a valid response to the question regarding HPV vaccination intentions; and 2) New Zealand was identified as the child's usual country of residence at the 8-year follow-up.

The maternal intentions for HPV vaccination of their 8-year-old children differed significantly by their child's sex, with the proportion of mothers who stated they would vaccinate their 8-year-olds against HPV being higher for girls than boys, whereas the proportion of mothers who were undecided about HPV vaccination was higher for boys than girls.

For girls, maternal responses regarding HPV vaccination intentions differed by their daughter's ethnic group. Maternal age and maternal status at the 72-month follow-up and belonging to a church at the 9-month follow-up were associated with HPV vaccination intentions for girls but maternal parity, country of birth and area-level socioeconomic deprivation were not.

Mothers whose daughters were of Māori or Pacific ethnicity were less likely to have decided not to vaccinate their daughters against HPV and mothers whose daughters were of Pacific ethnicity were more likely to report that they had not heard about the HPV vaccine compared with mothers of non-Māori non-Pacific girls.

Mothers with lower educational status were more likely to have decided not to vaccinate their daughters, more likely to be undecided about HPV vaccination and more likely to report that they had not heard of the HPV vaccine. Mothers who were younger were more likely to have decided not to vaccinate their daughters against HPV and more likely to report that they had not heard of the HPV vaccine. Mothers who belonged to a church at the 9-month follow-up were more likely to have decided not to vaccinate their daughters against HPV.

For boys, maternal responses regarding HPV vaccination intentions differed by their son's ethnic group. Maternal parity, country of birth, education status at the 72-month follow-up, and frequency of maternal attendance at religious services at the 2-year follow-up were associated with HPV vaccination intentions for boys, but area-level socioeconomic deprivation was not.

Mothers whose sons were of Pacific ethnicity were less likely to have decided not to vaccinate their sons against HPV and less likely to be undecided about HPV vaccination compared with mothers of non-Māori non-Pacific boys. Mothers whose sons were of Māori ethnicity were more likely to report that they had not heard about the HPV vaccine compared with mothers of non-Māori non-Pacific boys.

Mothers whose sons were first-borns were more likely to be undecided about HPV vaccination for their sons, and more likely to report that they had not heard about the HPV vaccine. Mothers with lower educational status were more likely to have decided not to vaccinate their sons, and to report that they had not

heard of the HPV vaccine. Mothers who were not born in New Zealand were more likely to report that they had not heard of the HPV vaccine.

For girls but not for boys, maternal responses regarding HPV vaccination intentions differed significantly by their daughter's access to healthcare prior to the 2-year follow-up, but not for the 12 months prior to the 54-month follow-up.

For girls and boys, maternal HPV vaccination intentions differed significantly by their child uptake and timing of all doses of primary infant immunisation series and uptake of immunisations (full or partial) due at age 15 months and age 4 years.

Conclusions

The maternal intentions for HPV vaccination of their 8-year-old children differed significantly by their child's sex, with the proportion of mothers who stated they would vaccinate their 8-year-olds against HPV being higher for girls than boys, whereas the proportion of mothers who were undecided about HPV vaccination was higher for boys than girls.

Mothers whose daughters were of Māori or Pacific ethnicity or whose sons were of Pacific ethnicity were less likely to have decided not to vaccinate their child against HPV.

While there are HPV specific factors associated with parental intent, there are also more general vaccine-related determinants which also apply to HPV vaccine. Addressing safety concerns regarding HPV vaccine appears necessary for caregivers to have greater confidence in the vaccine. Healthcare provider recommendations for and discussion about the HPV vaccine, along with increasing public awareness are key to improving uptake of the HPV vaccine in children. There appear to be deficits in the resources currently available to New Zealand parents about HPV vaccination for their children.

Before the birth of their child, parents in New Zealand have high intentions for immunisation of their children with only 2% of future mothers intending that their child will not be immunised. Experiences during childhood of difficulties in accessing primary care for their child are associated with an increased odds of parents deciding that their children will not receive the HPV vaccine.

Introduction

Research aims and objectives

Aims

To describe the human papillomavirus vaccination (HPV) intentions of mothers for their 8-year-old daughters and sons and factors associated with these intentions and use this information to benefit the New Zealand (NZ) HPV immunisation programme.

Objectives

1. Describe the HPV vaccination intentions of mothers for their 8-year-old children.
2. Identify demographic factors, household characteristics, and family social behaviours associated with maternal HPV vaccination intentions.
3. Identify healthcare factors associated with maternal HPV vaccination intentions.
4. Describe the relationship of the child's past vaccination experiences with maternal HPV vaccination intentions.

Literature review

The human papillomavirus vaccine

The human papillomavirus (HPV) vaccine provides protection against infection with HPV types that cause cervical, vaginal, vulvar, penile, anal, and oropharyngeal cancers.¹ Despite proven efficacy in cancer prevention for both men and women, and vaccine safety,¹ worldwide completion of recommended HPV vaccine schedules in females aged 10 to 20 years is low, estimated at 32% in developed countries up to 2014,² with an estimate for all age groups of 69% in 2018.³

In New Zealand, between 2008, when the national HPV vaccination programme started, and 2015 there was a 61% reduction in the rate of genital warts.⁴ A population-based cohort study of women, published in 2020, described the impact of HPV vaccination on abnormal cervical cytology and histology rates in young New Zealand women.⁵ The women studied (n=135,273) were born from 1990–1994, with a cervical cytology or histology registered with the National Cervical Screening Programme when aged 20–24 years between 01/01/2010 and 31/12/2015.⁵ Vaccinated women (n=42,435, 41%) were those who received at least one HPV vaccine dose before age 18 years. In vaccinated compared to unvaccinated women, the incidence of high-grade cytology was 8.5 vs 11.3 per 1,000 person-years (incidence rate ratio [IRR] 0.75, 95% confidence interval [CI] 0.70-0.80), and high-grade histology was 6.0 vs 8.7 per 1,000 person-years (IRR 0.69, 95% CI 0.64-0.75).⁵

In New Zealand, Māori and Pacific women have higher cervical cancer incidence and mortality rates than European women.⁶ Among women in New Zealand who have received at least one dose of HPV vaccine before age 18 years, the incidence of high-grade cervical histology does not differ between Māori and non-Māori.⁵

New Zealand was one of the first countries to have HPV vaccine on its schedule of recommended and funded vaccines for both females and males. The New Zealand immunisation schedule includes free HPV vaccination for 11–12-year-old girls and boys.

HPV vaccine is now in the national vaccination schedules for both females and males in a number of countries including Australia,⁷ Canada,⁸ the United Kingdom (UK),⁹ and the United States (US).¹⁰ By 2019 HPV vaccine had been introduced into 107 (55%) of the 194 WHO Member States, with 33 of these countries recommending it for both girls and boys.¹¹

Parental vaccine hesitancy and the HPV vaccine

Vaccine hesitancy is defined as 'delay in acceptance or refusal of vaccination despite availability of vaccination services'.¹² Parental vaccine hesitancy has been evident since the concept of vaccination of humans was first demonstrated in the early 1800s.¹³

In addition to the parental hesitancy associated with all childhood vaccinations, HPV vaccination of children is specifically vulnerable because of the age when given and because the vaccine targets sexually transmitted infections. For example, in a 2017-18 national immunisation survey in the US about vaccines given during adolescence, lack of parental intent was the predominant reason for low HPV vaccine uptake.¹⁴

Parental vaccine hesitancy specific to the HPV vaccine is prevalent. In a nationally representative sample of parents in the US interviewed in 2014-2015, 28% reported refusing and 8% delaying the HPV vaccination of their child.¹⁵ Parents who refused the HPV vaccine had specific concerns about the vaccine, whereas parents who delayed said they did so because they needed more information.¹⁵ In the US, parental hesitancy about the HPV vaccine appears to be increasing with data from the 2012-2018 National Immunization Survey showing that while the proportion of unvaccinated adolescents who were recommended the HPV vaccine by their provider increased (from 27% in 2012 to 49% in 2018), parental lack of intent to initiate the HPV vaccine series for these adolescents also increased from 50% to 64% over the same time interval.¹⁶

In a survey of 769 parents whose daughter attended one of 14 socio-economically diverse schools in New Zealand in 2008, 67% of respondents said they wanted their daughter to receive the HPV vaccine. Parental intent to vaccinate was decreased for those having concerns about their child's reaction to previous vaccines received (odds ratio [OR] 0.47, 95% CI 0.37–0.59), and for

those who wanted more information before deciding on HPV vaccination for their daughter (OR=0.47, 95% CI 0.37–0.59).¹⁷

Vaccination intentions and vaccine information received by parents in New Zealand

In New Zealand, parental intentions for childhood vaccinations are an important determinant of the timeliness of the primary vaccination series given during infancy.¹⁸ The vaccination intentions of mothers and fathers frequently differ, and each are independently associated with the timeliness of vaccinations of infants.¹⁸

Parents receive information that encourages and information that discourages them to have their child vaccinated. Receipt during pregnancy of discouraging information about vaccination is associated with delayed infant vaccinations regardless of whether encouraging information about vaccination was also received.¹⁹ In contrast, receipt of encouraging information is not associated with the timeliness of infant vaccinations.¹⁹

In New Zealand, healthcare providers are the predominant source of information received during pregnancy about childhood vaccinations.¹⁹ For most women (90%) this information encourages childhood vaccination, while 7% of pregnant women receive both encouraging and discouraging information, and 3% receive only discouraging information about vaccination from healthcare providers.¹⁹ Receipt of a recommendation from a health care provider is associated with increased odds of parents initiating the HPV vaccine series.¹⁴

Policy content relevant to the research topic

The policy relevance of parental intentions for HPV vaccination relates to the following issues

1. The relatively low uptake of HPV vaccine globally despite its proven efficacy in cancer prevention and its safety.^{1,2}
2. Māori and Pacific women have higher cervical cancer incidence and mortality rates compared with European women.⁶
3. The limited international data on HPV vaccine intentions for boys, given that New Zealand was one of the first countries to recommend and fund HPV vaccines for both females and males.
4. The specific vulnerability of HPV vaccine to parental vaccine hesitancy.
5. The demonstrated contribution of parental vaccination intentions to the timely receipt of scheduled childhood vaccinations in New Zealand.
6. The central role that healthcare plays in vaccine delivery.
7. The recently increased profile of preventing disease with vaccines created by the COVID-19 pandemic.
8. The increase in disparities in childhood vaccine delivery that have become apparent since the beginning of the COVID-19 pandemic.

Why this project was conducted

This project was conducted to answer the following two research questions.

1. What are the HPV vaccination intentions of mothers for their 8-year-old children, and do their intentions differ for daughters compared to sons?
2. Do HPV vaccination intentions of mothers vary by maternal demographics (e.g., ethnicity), household characteristics (e.g., deprivation), family characteristics (e.g., family social behaviours such as the child attending a religious school), children's past vaccination experiences, and preceding healthcare experiences of mothers and their children?

Methods

Design and methodology

This study was completed using external datasets from the *Growing Up in New Zealand* (GUiNZ) cohort study.²⁰ The GUiNZ cohort was created by the enrolment of 6,822 pregnant women and their partners. To be eligible, pregnant women had to be residing in the geographical region of New Zealand defined by the contiguous District Health Board regions of Auckland, Counties Manukau and Waikato, and have an estimated delivery date between 25 April 2009 and 25 March 2010.²⁰ The child cohort is ethnically and socioeconomically diverse, and broadly generalisable to the national birth cohort from 2007-2010.²¹

The study sample was limited to the 4,926 children for whom a child-proxy questionnaire was completed at the eight-year data-collection-wave.

Research objectives

1. Describe the HPV vaccination intentions of mothers for their 8-year-old children.
2. Identify demographic factors, household characteristics, and family social behaviours associated with maternal HPV vaccination intentions.
3. Identify healthcare factors associated with maternal HPV vaccination intentions.
4. Describe the relationship of the child's past vaccination experiences with maternal HPV vaccination intentions.

Data sources

The variable describing HPV vaccination intentions of mothers for their 8-year-old daughters and sons was obtained from the GUiNZ 8-year dataset. Factors that may be associated with vaccination intentions were identified from preceding datasets (Table 1).

Table 1: Summary of categories of variables measured at each GUiNZ data-collection-wave of relevance to this proposal

Variable categories	Data-collection-wave					
	Antenatal	Child's age at study follow-up (months)				
		9	24	54	72	96
Child demographics		✓	✓	✓	✓	✓
Maternal demographics	✓	✓	✓	✓	✓	✓
Household characteristics	✓	✓	✓	✓	✓	
Family social behaviours*	✓	✓	✓	✓	✓	
Healthcare factors	✓	✓	✓	✓		
Immunisation experiences	✓	✓	✓	✓		

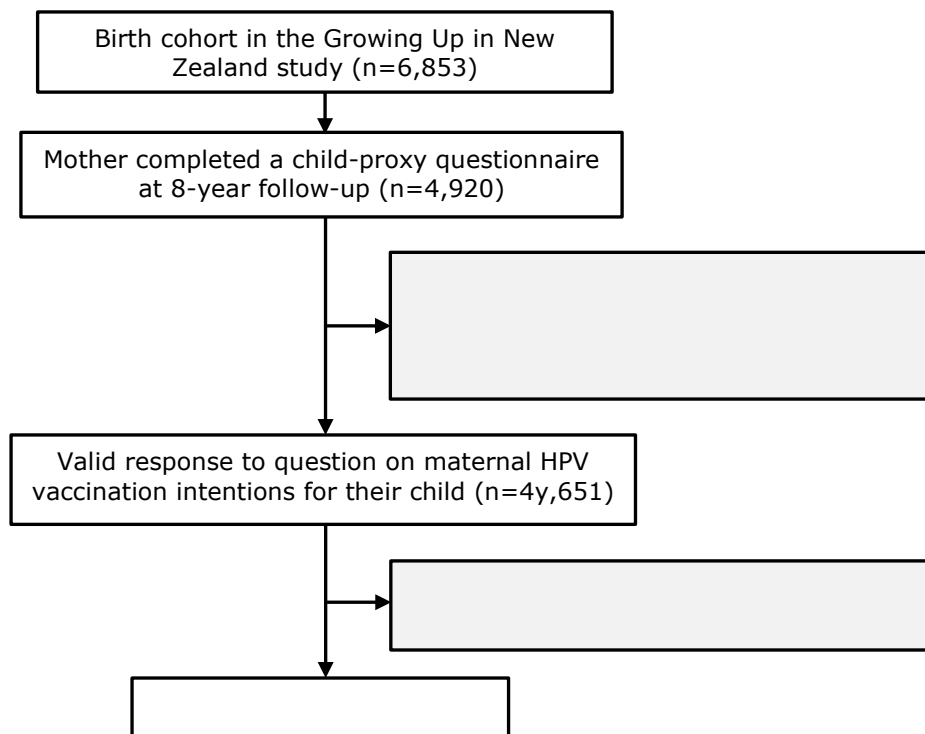
* E.g., the child attending a religious school

Study procedures

Selection of the analytic sample

Figure 1 shows the exclusion procedure used to select the study sample for this analysis. Children whose mothers completed a child-proxy questionnaire at the 8-year follow-up (n=4,920) are eligible for this analysis. The analytic sample comprises 4,448 of 4,920 children (90%) who met the following criteria: 1) mothers provided a valid response to the question regarding HPV vaccination intentions; and 2) New Zealand was identified as the child's usual country of residence at the 8-year follow-up.

Figure 1 Selection of the study sample



Outcome measure (dependent variable)

Maternal intentions to vaccinate girls and boys against HPV was assessed at the 8-year data-collection-wave. The child's mother was asked:

"Have you decided yet if you will have [child's-name] immunised with the HPV vaccine?"

Response options:

- Yes, I have decided I will have my child immunised
- Yes, I have decided I will not have my child immunised
- No, I have not yet decided
- I have never heard of the HPV vaccine

Limitations

No further questions on the HPV vaccine were asked, including why mothers were for, against or undecided about HPV vaccination for 8-year-old girls or boys. Some mothers will only know the HPV vaccine by the brand name Gardasil. This might affect responses to option 4 "I have never heard of the HPV vaccine".

Independent variables of interest

See Appendix 2 for the list of variables (as per the GUiNZ data dictionaries) and Appendix 1 for how the theoretical framework proposed, as shown in Appendix Figure 1, was applied using these variables.

Stratification variables

1. Child's sex
2. Child's sex and ethnic group

Analytical model

The Health Belief Model (HBM) has been used extensively to help explain why people choose to engage in a range of health behaviours, including in studies addressing parental acceptability of HPV vaccination for their children. The HBM has the following dimensions: perceived susceptibility; perceived severity; perceived benefits; perceived barriers; and cues to action.²²⁻²⁴ *Perceived susceptibility* refers to the subjective perception of vulnerability to an illness. *Perceived severity* refers to feelings regarding the seriousness of an illness, including its consequences. *Perceived benefits* imply that choices made depend on one's beliefs in the effectiveness of choices available to reduce a health threat. *Perceived barriers* refer to factors that could hinder a person from undertaking a recommended health behavior.^{22,24} Cues to action are stimuli (internal or external) that trigger the decision-making process, e.g. recommendations by health professionals to take specific actions.²²

With the exception of one question on maternal HPV vaccination intentions for 8-year-old daughters/sons, the GUiNZ study has not collected data on HPV-specific knowledge, attitudes, beliefs, behaviours or experiences as at the 8-year follow-up. Therefore, behavioural models that require data specific to the study outcome (e.g. HBM, Theory of Reasoned Action) could not be applied to this project.

Given this limitation, we proposed to use a Māori model that has a better fit with the data available. *Te Anga o ngā Horopaki Māori: A conceptual framework for considering Māori lived realities* has been developed specifically for GUiNZ.²⁵ *Te Anga o ngā Horopaki Māori* was developed from the Te Whare Tapa Whā model,²⁶ with consideration also of other Māori models of health and wellbeing (the Meihana,²⁷ Te Wheke,²⁸ and Ngā Pou Mana²⁹ models). *Te Anga o ngā*

Horopaki Māori comprises six interconnected domains: Mahi Arataki (Policy and strategy); Te Ao Māori (Cultural identity); Whai rawa (Economic resources and capability); Taiao a hāpori (Environment and community); Whanaungatanga (Family and home); and Hauora (Health and wellbeing).

Statistical analysis

- Statistical analyses were performed using STATA software version 15 (StataCorp LLC) available on the GUiNZ eResearch Platform.
- A 2-tailed P-value < .05 was considered statistically significant.
- Descriptive statistics were presented using counts and percentages for categorical variables, means and standard deviations for normally distributed data, and medians and interquartile ranges for non-normally distributed data. For the analytic sample stratified by child sex and ethnic group, figures were used to present descriptive data showing the nature and number of responses regarding maternal HPV vaccination intentions.
- An independent variable of interest was excluded if:
 - When cross-tabulated with the outcome measure and child sex, it results in small frequencies (cells count of $n < 5$) in one or more categories such that it could not provide meaningful comparisons. This also applied to the analysis stratified by child sex and ethnic group.
 - If there was over 5% missing data for the variable.
- Univariable (unadjusted) analyses, comparisons of maternal HPV vaccination intentions for girls vs boys using chi-squared tests.
- Univariable (unadjusted) analyses, stratified by sex, explored associations between each factor of interest and maternal HPV vaccination intentions using chi-squared tests (for categorical variables), general linear models (for normally distributed variables) and Kruskal-Wallis tests (for non-normally distributed variables).
- Missing values were not reported in the tables because GUiNZ requests that, for the purposes of anonymity, cells are not reported with values of <10.
- Factors of interest with a P-value of < .10 in the unadjusted analysis were considered in the multivariable analysis stratified by sex, whereas a P-value of < .20 was used as the cut-off for analyses stratified by sex and ethnic group, because of the smaller numbers and hence lower power in the stratified analyses.

Multivariable analysis

- **Analysis stratified by sex:** Separately by child sex and using mothers who have decided to vaccinate girls/boys against HPV as the comparison group, multinomial logistic regression models were used to assess adjusted associations between factors of interest and maternal HPV vaccination intentions (4-level nominal variable; see Table 2). Results were summarised using three sets of adjusted odds ratios and their 95% confidence intervals.

- **Analysis stratified by sex and ethnic group:** This comprised separate analyses for girls of Māori ethnicity, girls of Pacific ethnicity, boys of Māori ethnicity, and boys of Pacific ethnicity. Table 2 shows that these four sub-groups have smaller cell counts (fewer responses) for the following outcome measure response options: “Yes, I have decided I will not have my child immunised” and “I have never heard of the HPV vaccine”. As such, multivariable logistic regression models assessed factors associated with mothers being undecided about HPV vaccination for their children with the comparison group being mothers who had decided to vaccinate girls/boys against HPV (dichotomous variable). Results were summarised using adjusted odds ratios and their 95% confidence intervals.
- **Application of Te Anga o ngā Horopaki Māori:** Variables were included in the multivariable model if they were considered essential in describing each domain within Te Anga o nga Horopaki Māori or if they were significant in published studies or when $P < .10$. The multivariable model was constructed hierarchically, beginning with the domain most distal to the mother and child (Mahi Arataki) and adding individual variables stepwise towards the most proximal (Hauora) domain (Appendix Figure 1). Variables were retained for subsequent analysis steps if $P < .10$. If no variables in a domain had $P < .10$, then the variable within each domain with the lowest P -value was retained for the remainder of the analyses. How the variables of interest have been assigned to domains in Te Anga o ngā Horopaki Māori is shown in Appendix 1 and Appendix Figure 1.

For clarity of reading, the presentation of variables in the tables in the results section has been organised into sections which group the variables that describe child factors and those that describe maternal factors.

- **Assessment for multicollinearity:** Multicollinearity was considered between the independent variables in the multivariable models. Multicollinearity was evident between different variables describing religion and different variables that described the relationship with healthcare. The independent variables selected for inclusion in the multivariate models for these two constructs (religion and relationship with healthcare) were chosen because they did not correlate with one another and because, due to the different variables describing religion and relationship with healthcare respectively, they had the strongest univariate associations with the dependent variable.

Results

Descriptive statistics

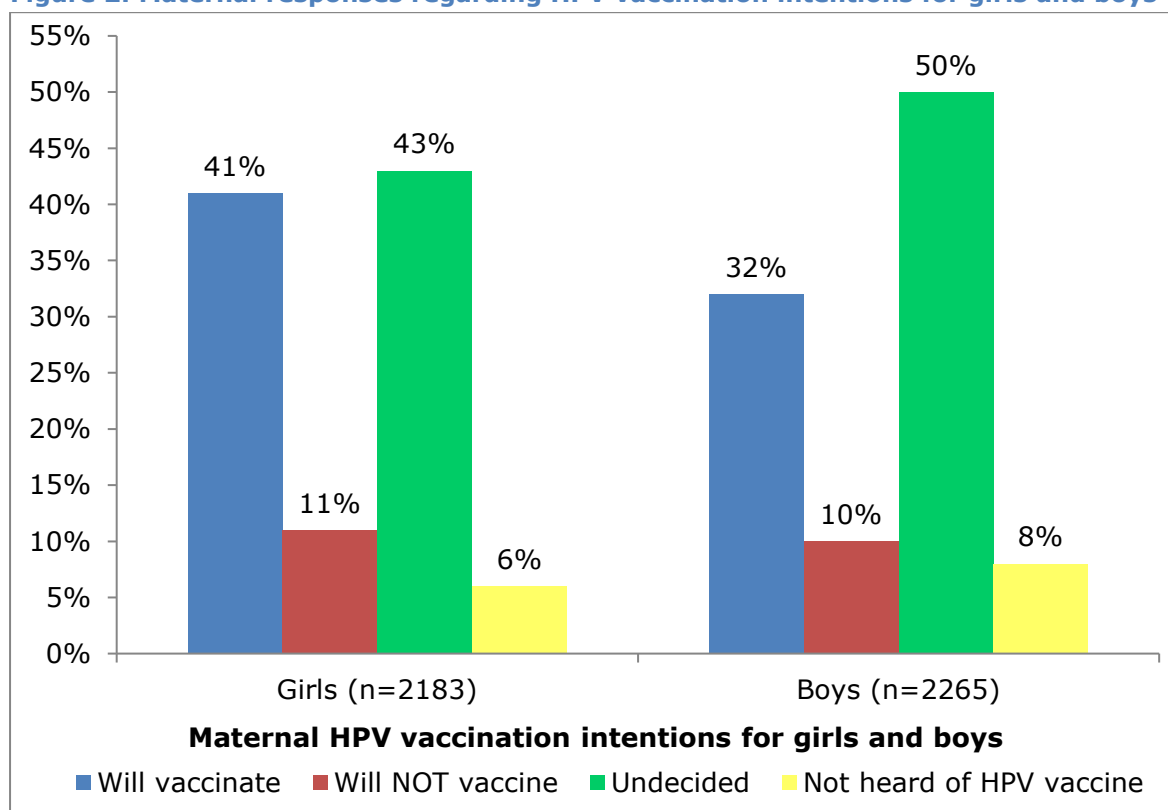
Maternal responses regarding HPV vaccination intentions for 8-year-olds

The nature and number of responses regarding maternal HPV vaccination intentions for girls and boys, overall and stratified by ethnic group, are presented in Table 2.

By child's sex

Maternal responses regarding HPV vaccination intentions for 8-year-olds differed significantly by their child's sex ($P < 0.001$) (**Figure 2, Table 2**). The proportion of mothers who stated they would vaccinate their 8-year-olds against HPV was higher for girls than boys (41% vs 32%), whereas the proportion of mothers who were undecided about HPV vaccination was higher for boys than girls (50% vs 43%).

Figure 2: Maternal responses regarding HPV vaccination intentions for girls and boys*

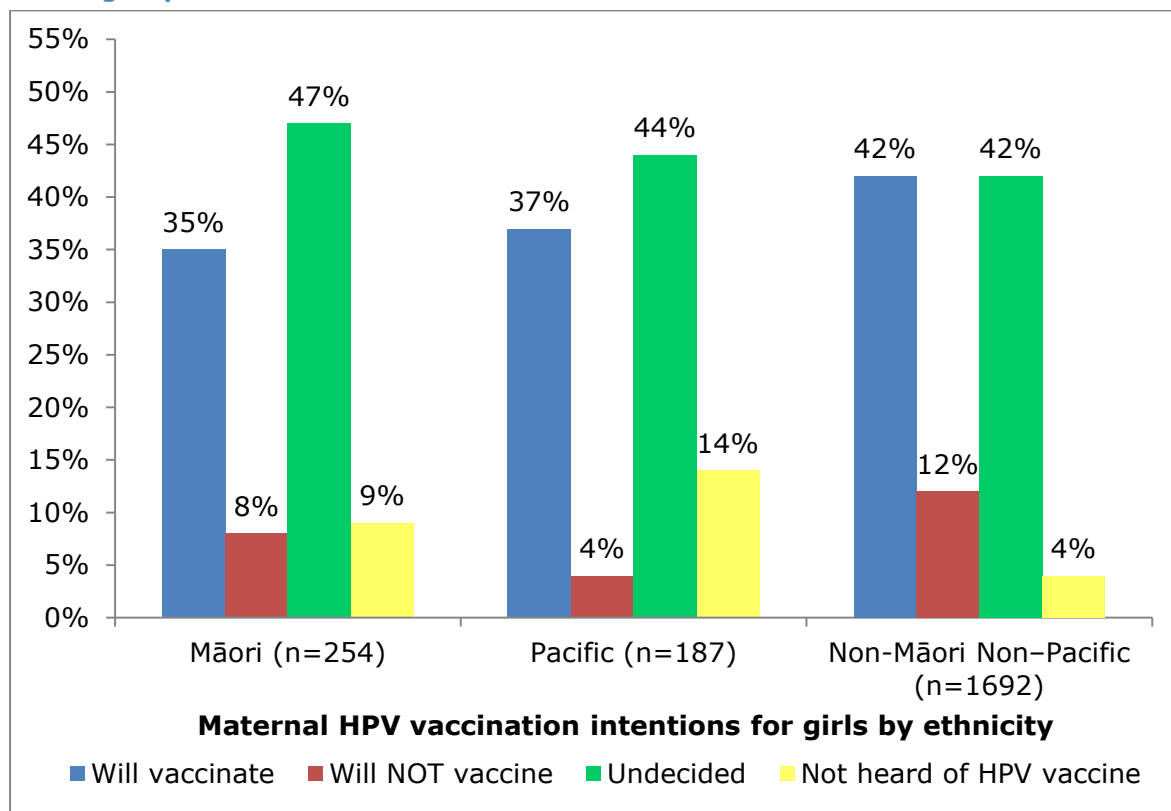


* Percentages may not add up to 100% due to rounding

By child's sex and ethnic group

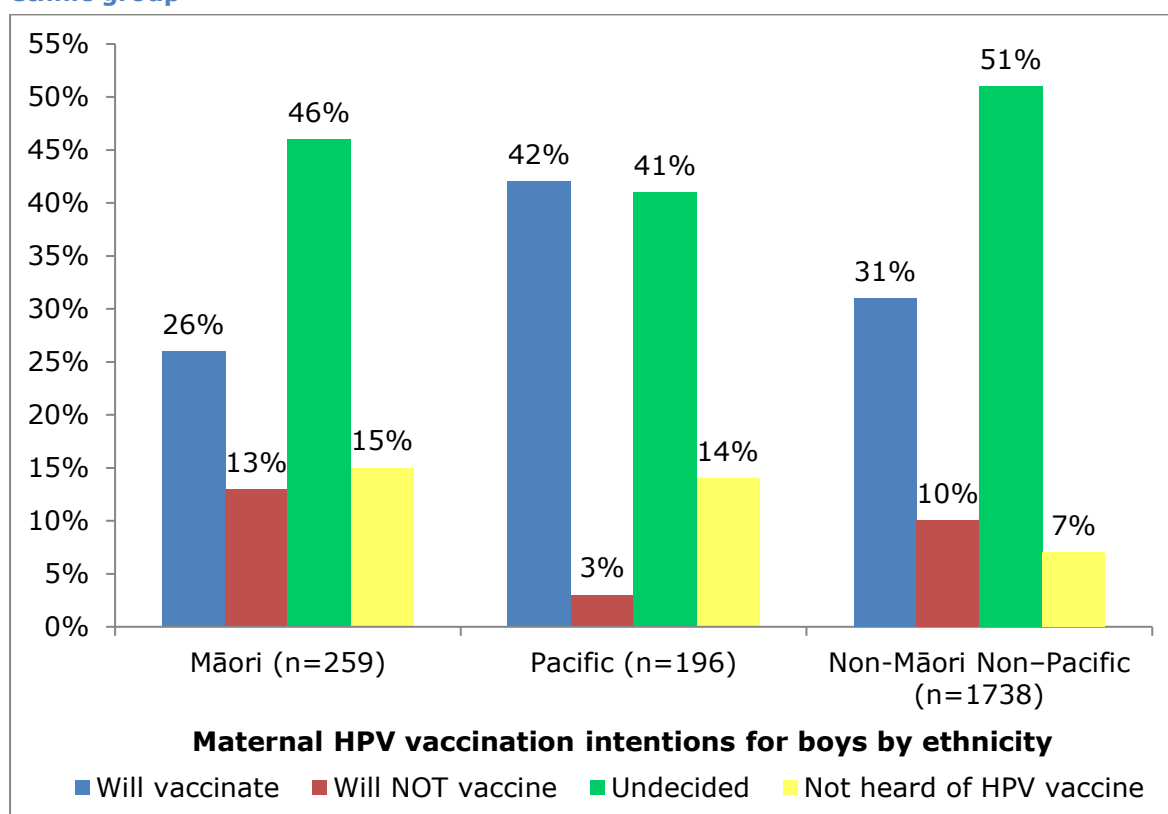
For girls, maternal responses regarding HPV vaccination intentions differed significantly by their daughter's ethnic group ($P < 0.001$) (**Figure 3, Table 2**). The proportion of mothers who stated they would vaccinate their daughters against HPV was higher for non-Māori non-Pacific girls (41%) than Māori (35%) or Pacific (37%) girls. The proportion of mothers who had decided not to vaccinate their daughters against HPV was also higher for non-Māori non-Pacific girls (12%) than Māori (8%) or Pacific (4%) girls, whereas the proportion of mothers who had not heard of the HPV vaccine was higher for Pacific girls (14%) than Māori (9%) or non-Māori non-Pacific (4%) girls.

Figure 3: Maternal responses regarding HPV vaccination intentions for girls, by child's ethnic group



For boys, maternal responses regarding HPV vaccination intentions differed significantly by their son's ethnic group ($P < 0.001$) (**Figure 4, Table 2**). The proportion of mothers who stated they would vaccinate their sons against HPV was higher for Pacific boys (42%) than Māori (26%) or non-Māori non-Pacific (31%) boys. In addition, the proportion of mothers who had not heard of the HPV vaccine was higher for Māori (15%) and Pacific (14%) boys than non-Māori non-Pacific (7%) boys. In contrast, the proportion of mothers who were undecided about HPV vaccination for their sons was higher for non-Māori non-Pacific boys (51%) than Māori (46%) or Pacific (41%) boys.

Figure 4: Maternal responses regarding HPV vaccination intentions of boys, by child's ethnic group



Characteristics of the study population

By child's sex

The boys (n=2,265) and girls (n=2,183) who comprised the analytic sample did not differ significantly with respect to their age at the 8-year follow-up, parity, ethnic group, area-level socioeconomic deprivation, or rurality (**Table 3**). In addition, they did not differ significantly based on their mother's age at the 8-year follow-up, highest education qualification at the 72-month follow-up and partner status at the 54-month follow-up, as well as whether their mother was born in New Zealand.

Both boys and girls had a median (IQR) age of 103 (98-107) months. Both groups also had the same proportion of children who were of Māori (12%) or Pacific (9%) ethnicities, were first-borns (43%), lived in households in the highest quintile of area-level deprivation (17%), and had mothers with a partner at 54-month follow-up (91%). Moreover, a comparable proportion of boys and girls had mothers who were under 35 years old at the 8-year follow-up (19% and 20%, respectively), had a less than a bachelor's degree at the 72-month follow-up (51% and 53%, respectively), or were born in New Zealand (72% and 71%, respectively).

Table 2: Maternal responses regarding HPV vaccination intentions for girls and boys, stratified by child's ethnic group

"Have you decided yet if you will have [child's-name] immunised with the HPV vaccine?"	Girls				Boys			
	Overall	By ethnic group			Overall	By ethnic group		
		Māori	Pacific	Non-Māori Non-Pacific		Māori	Pacific	Non-Māori Non-Pacific
n (%)	n (%)	n (%)	n (%)	n (%)	n (%)	n (%)	n (%)	
Yes, I have decided I will have my child immunised	889 (41)	90 (35)	69 (37)	709 (42)	722 (32)	67 (26)	83 (42)	546 (31)
Yes, I have decided I will not have my child immunised	234 (11)	21 (8)	8 (4)	203 (12)	227 (10)	34 (13)	5 (3)	179 (10)
No, I have not yet decided	928 (43)	120 (47)	83 (44)	709 (42)	1,124 (50)	118 (46)	80 (41)	893 (51)
I have never heard of the HPV vaccine	132 (6)	23 (9)	27 (14)	71 (4)	192 (8)	40 (15)	28 (14)	120 (7)
Total number of responses	2,183	254	187	1,692	2,265	259	196	1,738

Table 3: Characteristics of the study population

Characteristic	By sex (n=4,448)		P-value [†]	By child's ethnic group (n=4,326)			P-value [†]
	Boys	Girls		Māori	Pacific	Non-Māori Non-Pacific	
	(n=2,265)	(n=2,183)		(n=513)	(n=383)	(n=3,430)	
	n (%) [*]	n (%) [*]		n (%) [*]	n (%) [*]	n (%) ^a	
Child's age (in months) at 8-year follow-up (median [IQR])	103 (98-107)	103 (98-107)	0.39	103 (98-107)	103 (99-108)	103 (98-107)	0.21
Parity							
First-born	959 (43)	931 (43)	0.95	193 (39)	121 (32)	1,529 (45)	<0.001
Subsequent child	1,282 (57)	1,240 (57)		308 (61)	260 (68)	1,882 (55)	
Child's ethnicity							
Māori	259 (12)	254 (12)	0.98	N/A	N/A	N/A	N/A
Pacific	196 (9)	187 (9)		N/A	N/A	N/A	
Non-Māori Non-Pacific	1,738 (79)	1,692 (79)		N/A	N/A	N/A	
Socioeconomic deprivation (NZDep2013)							
Deciles 1 and 2 (low)	573 (25)	569 (26)	0.60	52 (10)	16 (4)	1,057 (31)	<0.001
Deciles 3 and 4	501 (22)	441 (20)		57 (11)	31 (8)	831 (24)	
Deciles 5 and 6	437 (19)	431 (20)		83 (16)	43 (11)	719 (21)	
Deciles 7 and 8	352 (16)	356 (16)		117 (23)	81 (21)	490 (14)	
Deciles 9 and 10 (high)	394 (17)	373 (17)		201 (39)	209 (55)	319 (9)	
Rurality (in 2013)							
Urban area	1,986 (88)	1,875 (86)	0.11	450 (88)	375 (99)	2,915 (85)	<0.001
Rural area	271 (12)	295 (14)		60 (12)	5 (1)	501 (15)	
Maternal age at 8-year follow-up							
Less than 35 years	421 (19)	443 (20)	0.46	194 (38)	140 (37)	502 (15)	<0.001
35 to 39 years	598 (26)	581 (27)		135 (26)	111 (29)	895 (26)	
40 to 44 years	771 (34)	728 (33)		111 (22)	85 (22)	1,270 (37)	
45 years or over	472 (21)	429 (20)		73 (14)	45 (12)	760 (22)	

Mother's highest education qualification (antenatal and 72-month follow-up)							
Less than a bachelor's degree	1,116 (51)	1,109 (53)	0.40	343 (70)	294 (79)	1,517 (46)	<0.001
Bachelor's degree or higher	1,058 (49)	999 (47)		149 (30)	80 (21)	1,784 (54)	
Mother had partner at 54-month follow-up							
No	192 (9)	194 (9)	0.67	90 (18)	59 (15)	234 (7)	<0.001
Yes	2,029 (91)	1,958 (91)		418 (82)	323 (85)	3,182 (93)	
Mother was born in New Zealand							
No	638 (28)	639 (29)	0.47	29 (6)	155 (41)	1,043 (31)	<0.001
Yes	1,604 (72)	1,532 (71)		472 (94)	226 (59)	2,369 (69)	

IQR=Interquartile Range; N/A=Not Applicable; NZDep2013=2013 New Zealand Deprivation Index

* Percentages may not add up to 100% due to rounding

† Chi squared test

Table 4: Comparison of the analytical sample to the cohort at enrolment

Characteristic	Cohort at enrolment* n = 6,853, n (%)	Analytical sample n = 4,448, n (%)	P value[†]
Child sex			
Male	3,525 (52)	2,265 (51)	0.54
Female	3,318 (48)	2,183 (49)	
Parity			
First-born	2,852 (42)	1,890 (43)	0.30
Subsequent child	3,963 (58)	2,522 (57)	
Child's ethnicity			
Māori	1,528 (24)	513 (12)	< 0.001
Pacific	940 (15)	383 (9)	
Non-Māori non-Pacific	3,913 (61)	3,430 (79)	
Socioeconomic deprivation (NZDep2006 and NZDep2013)			
Deciles 1 and 2 (low)	1,100 (16)	1,142 (26)	< 0.001
Deciles 3 and 4	1,235 (18)	942 (21)	
Deciles 5 and 6	1,168 (17)	868 (20)	
Deciles 7 and 8	1,426 (21)	708 (16)	
Deciles 9 and 10 (high)	1,891 (28)	767 (17)	
Rurality (in 2013)			
Urban area	5,824 (85)	3,861 (87)	0.006
Rural area	998 (15)	566 (13)	
Mother's highest education qualification [‡]			
Less than a bachelor's degree	4,200 (62)	2,225 (52)	< 0.001
Bachelor's degree or higher	2,603 (38)	2,057 (48)	
Mother was born in New Zealand			
No	2,441 (36)	1,277 (29)	< 0.001
Yes	4,374 (64)	3,136 (71)	

* Based upon data collected at the enrolment interview, the six-week postnatal interview (for child sex) and the nine-month mother interview (for child ethnic group)

† Chi squared test

‡ At enrolment versus at the 72-month follow-up

By child's ethnic group

Children of Māori (n=513), Pacific (n=383) and non-Māori non-Pacific (n=3,430) ethnicities did not differ significantly with respect to their age at the 8-year follow-up (median age: 103 months) (**Table 3**). However, there were significant differences by ethnic group with respect to parity, area-level socioeconomic deprivation, rurality, maternal age at the 8-year follow-up, maternal education at the 72-month follow-up, maternal partner status at the 54-month follow-up, and whether the mother was born in New Zealand. Compared with children of non-Māori non-Pacific ethnicities, a larger proportion of Māori or Pacific ethnicities were a subsequent child (respectively, 61% and 68% vs 55%) and lived in households in the highest quintile of area-level deprivation (respectively, 39% and 55% vs 9%). Furthermore, a larger proportion of children of Māori and Pacific ethnicities (than non-Māori non-Pacific) had mothers who were under 35 years old at the 8-year follow-up (respectively, 38% and 37% vs 15%), had less than a bachelor's degree at the 72-month follow-up (respectively, 70% and 79% vs 46%), and did not have a partner at the 54-month follow-up (respectively, 18% and 15% vs 7%). With respect to maternal country of birth, a larger proportion of Māori children had mothers who were born in New Zealand (94%) than children of Pacific (59%) or non-Māori non-Pacific (69%) ethnicities.

In comparison to the cohort at enrolment

In comparison to the cohort at enrolment, the analytical sample differed with respect to the child's ethnicity, area-level socioeconomic deprivation, rurality, maternal education, residential rurality and whether the mother was born in New Zealand (**Table 4**).

In comparison to the cohort at enrolment, the analytical sample included smaller proportions of children of Māori or Pacific ethnicity, smaller proportions of children living in areas of greater socioeconomic deprivation, a larger proportion living in urban areas, and a larger proportion whose mothers had a bachelor's degree or higher and a larger proportion whose mother was born in New Zealand (**Table 4**).

Factors associated with maternal HPV vaccination intentions for girls

Univariable analysis

Child factors

In the unadjusted analysis, maternal HPV vaccination intentions for girls were associated with the child's: ethnicity; access to a GP or doctor 12 months prior to the 54-month and 2-year follow-ups; uptake of immunisations (full or partial) due at age 4 years and age 15 months; and uptake and timing of all doses of

the 6-week, 3-month and 5-month immunisations (**Table 5A**). However, maternal HPV vaccination intentions for girls were not associated with whether the child mostly saw their regular doctor when sick at the 2-year follow-up.

Compared with mothers who had decided to vaccinate their daughters against HPV, a larger proportion of mothers who had not heard of the HPV vaccine had daughters of Māori (19% vs 10%) or Pacific (22% vs 8%) ethnicities. In addition, a larger proportion of mothers who had not heard of the HPV vaccine had daughters who had not seen a GP or doctor when needed during the 12 months prior to the 54-month follow-up (7% vs 4%), as did mothers who were undecided about HPV vaccination (7% vs 4%).

Furthermore, compared with mothers who had decided to vaccinate their daughters against HPV, a larger proportion of mothers who had decided not to vaccinate their daughters against HPV had daughters who had: not received immunisations (full or partial) due at age 4 years (45% vs 8%) and age 15 months (33% vs 1%); not received all doses of the 6-week, 3-month and 5-month immunisations in full (43% vs 3%) and on time (59% vs 20%); and not seen a GP or doctor when needed during the 12 months prior to the 2-year follow-up (7% vs 3%).

Maternal factors

The following maternal factors were associated with maternal HPV vaccination intentions for girls in the unadjusted analysis: parity; country of birth (New Zealand vs other countries); area-level socioeconomic deprivation; age at the 8-year follow-up; education status at the 72-month follow-up; duration of being part of a religion at the 2-year follow-up; frequency of attending religious services at the 2-year follow-up; and belonging to a church at the 9-month follow-up (**Table 5B**). On the other hand, belonging to a religion or denomination at the 2-year follow-up and belonging to a Christian religion at the 2-year follow-up were not associated with maternal HPV vaccination intentions for girls. Partner status at the 54-month and 2-year follow-ups, taking the child to same GP or GP practice at the 2-year follow-up as when the child was 9 months old, and satisfaction with child's usual GP at 2-year follow-up were also not associated with maternal HPV vaccination intentions for girls.

Compared with mothers who had decided to vaccinate their daughters against HPV, a larger proportion of mothers who had not heard of the HPV vaccine were under 35 years old at the 8-year follow-up (31% vs 16%), and were mothers of girls who were first-borns (52% vs 40%) and lived in households in the three highest deciles of area-level deprivation (42% vs 22%).

Mothers who had decided not to vaccinate their daughters against HPV were largely born in New Zealand compared with mothers who had decided to vaccinate their daughters against HPV (91% vs 68%). In addition, a larger proportion of mothers who had decided not to vaccinate their daughters against HPV had less than a bachelor's degree at the 72-month follow-up (62% vs

46%), as were mothers who had not heard of the HPV vaccine (65% vs 46%) and mothers who were undecided about HPV vaccination (55% vs 46%).

Compared with mothers who had decided to vaccinate their daughters against HPV, a larger proportion of mothers who had decided not to vaccinate their daughters against HPV attended religious services at least monthly at the 2-year follow-up (27% vs 20%) or belonged to a church at the 9-month follow-up (31% vs 21%). Similarly, a larger proportion of mothers who had not heard of the HPV vaccine attended religious services at least monthly at the 2-year follow-up (31% vs 20%) or belonged to a church at the 9-month follow-up (30% vs 21%).

Table 5A: Child factors potentially associated with maternal HPV vaccination intentions for GIRLS (unadjusted analysis)

Variable	Whether mothers have decided to vaccinate daughters against HPV (n=2,183)				P-value [†]
	Will vaccinate (n=889)	Will NOT vaccinate (n=234)	Undecided (n=928)	Not heard of HPV vaccine (n=132)	
	n (%) [*]	n (%) [*]	n (%) [*]	n (%) [*]	
Child's ethnicity (n=2133)					
Māori	90 (10)	21 (9)	120 (13)	23 (19)	<0.001
Pacific	69 (8)	8 (3)	83 (9)	27 (22)	
Non-Māori Non-Pacific	709 (82)	203 (88)	709 (78)	71 (59)	
Child needed to see GP/doctor 12 months prior to 54-month follow, but not able to (n=2,157)					
Yes	34 (4)	10 (4)	62 (7)	9 (7)	0.03
No	845 (96)	223 (96)	858 (93)	116 (93)	
Child received immunisations (full or partial) due at age 4 years (n=2,151)					
No	70 (8)	106 (45)	99 (11)	13 (10)	<0.001
Yes	808 (92)	128 (55)	816 (89)	111 (90)	
Child mostly saw regular doctor when sick (2-year follow-up) (n=2,140)					
No	240 (27)	70 (30)	264 (29)	38 (30)	0.73
Yes	637 (73)	160 (70)	643 (71)	88 (70)	
Child needed to see GP/doctor 12 months prior to 2-year follow, but not able to (n=2,151)					
Yes	25 (3)	16 (7)	35 (4)	7 (6)	0.03
No	855 (97)	217 (93)	877 (96)	119 (94)	
Child received immunisations (full or partial) due at age 15 months (n=2,149)					
Yes	871 (99)	155 (67)	876 (96)	121 (96)	<0.001
No	8 (1)	77 (33)	36 (4)	5 (4)	

Child received all doses of the 6-week, 3-month and 5-month immunisations (n=2,134)

Yes (all doses given)	845 (97)	130 (57)	827 (91)	119 (92)	<0.001
No (all doses not given)	27 (3)	97 (43)	78 (9)	11 (8)	

Child received all doses of the 6-week, 3-month and 5-month immunisations on time (n=2,134)

Yes (all doses given on time)	698 (80)	94 (41)	672 (74)	99 (76)	<0.001
No (not all doses given on time)	174 (20)	133 (59)	233 (26)	31 (24)	

GP=General Practitioner; HPV=Human Papillomavirus

* Percentages may not add up to 100% due to rounding

† Chi squared test

Table 5B: Maternal factors potentially associated with maternal HPV vaccination intentions for GIRLS (unadjusted analysis)

Variable	Whether mothers have decided to vaccinate daughters against HPV (n=2183)				P-value†
	Will vaccinate (n=889)	Will NOT vaccinate (n=234)	Undecided (n=928)	Not heard of HPV vaccine (n=132)	
	n (%)*	n (%)*	n (%)*	n (%)*	
Parity (n=2,171)					
First-born	356 (40)	81 (35)	427 (46)	67 (52)	0.001
Subsequent child	529 (60)	153 (65)	496 (54)	62 (48)	
Mother was born in New Zealand (n=2,171)					
No	287 (32)	44 (19)	258 (28)	50 (39)	<0.001
Yes	598 (68)	190 (91)	665 (72)	79 (61)	
Socioeconomic deprivation (NZDep2013) (n=2,170)					
Low (deciles 1-3)	351 (40)	69 (30)	330 (36)	31 (24)	<0.001
Moderate (deciles 4-7)	339 (38)	111 (48)	343 (37)	45 (35)	
High (deciles 8-10)	196 (22)	53 (23)	248 (27)	54 (42)	
Maternal age at 8-year follow-up (n=2,181)					
Less than 35 years	146 (16)	54 (23)	203 (22)	40 (31)	<0.001
35 to 39 years	219 (25)	61 (26)	263 (28)	38 (29)	
40 to 44 years	324 (36)	66 (28)	301 (32)	37 (28)	
45 years or over	200 (23)	53 (23)	160 (17)	16 (12)	
Mother's highest education qualification (antenatal and 72-month follow-up) (n=2,108)					
Less than a bachelor's degree	389 (46)	141 (62)	498 (55)	81 (65)	<0.001
Bachelor's degree or higher	462 (54)	87 (38)	406 (45)	44 (35)	
Mother had partner at 54-month follow-up (n=2,152)					
No	69 (8)	24 (10)	88 (10)	13 (11)	0.47
Yes	807 (92)	210 (90)	831 (90)	110 (8)	
Mother had partner at 2-year follow-up (n=2,145)					

No	70 (8)	19 (8)	67 (7)	11 (9)	0.92
Yes	808 (92)	214 (92)	843 (93)	113 (91)	
Takes child to same GP or GP practice at 2-year follow-up as when child was 9 months old (n=2,089)					
No	94 (11)	32 (14)	111 (13)	18 (15)	0.34
Yes	768 (89)	189 (86)	775 (87)	102 (85)	
Satisfaction with child's usual GP at 2-year follow-up (n=2,084)					
Less than satisfied	60 (7)	25 (11)	72 (8)	12 (10)	0.09
Fairly satisfied	199 (23)	54 (24)	223 (25)	29 (25)	
Very satisfied	357 (42)	77 (35)	386 (44)	49 (42)	
Completely satisfied	244 (28)	65 (29)	204 (23)	28 (24)	
Belonged to religion/denomination at 2-year follow-up (n=2,143)					
No	496 (57)	138 (59)	551 (61)	65 (52)	0.91
Yes	380 (43)	95 (41)	359 (39)	59 (48)	
Belonged to Christian religion at 2-year follow-up (n=2,138)					
No	577 (66)	147 (64)	609 (67)	84 (68)	0.77
Yes	298 (34)	84 (36)	299 (33)	40 (32)	
Duration of being part of a religion at 2-year follow-up (n=2,143)					
Not religious	496 (57)	138 (59)	551 (61)	65 (52)	0.01
All of the mother's life	305 (35)	60 (26)	270 (30)	46 (37)	
Less than mother's lifetime	75 (9)	35 (15)	89 (10)	13 (10)	
Frequency of attending religious services at 2-year follow-up (n=2,143)					
Not religious	496 (57)	138 (59)	551 (61)	65 (52)	0.002
Daily to monthly	179 (20)	62 (27)	184 (20)	39 (31)	
Not often or never	201 (23)	33 (14)	175 (19)	20 (16)	
Belongs to a church at 9-month follow-up (n=2,136)					
No	685 (79)	160 (69)	726 (80)	87 (70)	0.001

Yes	187 (21)	72 (31)	182 (20)	37 (30)	
Mother had partner at 9-month follow-up (n=2,136)					
No	55 (6)	21 (9)	74 (8)	9 (7)	0.37
Yes	817 (94)	211 (91)	834 (92)	115 (93)	
Had family doctor or GP before becoming pregnant (n=2,171)					
No	85 (10)	22 (9)	95 (10)	16 (12)	0.76
Yes	800 (90)	212 (91)	828 (90)	113 (88)	

GP=General Practitioner; HPV=Human Papillomavirus; NZDep2013=2013 New Zealand Deprivation Index

* Percentages may not add up to 100% due to rounding

† Chi squared test

Table 6: Multivariable analysis of factors associated with maternal HPV vaccination intentions for GIRLS

Variable	Whether mothers have decided to vaccinate daughters against HPV (n=1,891)					
	Will NOT vaccinate (n=203)		Undecided (n=810)		Not heard of HPV vaccine (n=102)	
	Adjusted OR	P-value*	Adjusted OR	P-value	Adjusted OR	P-value*
	(95% CI)*		(95% CI)*		(95% CI)*	
Child factors						
Child's ethnicity						
Māori	0.39 (0.21-0.75)	0.005	1.11 (0.79-1.57)	0.55	1.58 (0.80-3.12)	0.19
Pacific	0.20 (0.08-0.48)	<0.001	0.95 (0.63-1.42)	0.79	2.54 (1.34-4.81)	0.004
Non-Māori Non-Pacific	Reference		Reference		Reference	
Child needed to see GP/doctor 12 months prior to 54-month follow, but not able to						
Yes	0.68 (0.27-1.73)	0.42	1.60 (1.00-2.55)	0.05	0.88 (0.32-2.41)	0.80
No	Reference		Reference		Reference	
Child needed to see GP/doctor 12 months prior to 2-year follow, but not able to						
Yes	2.92 (1.32-6.47)	0.01	1.41 (0.79-2.49)	0.24	2.17 (0.87-5.44)	0.10
No	Reference		Reference		Reference	
Child received immunisations (full or partial) due at age 4 years						
No	3.43 (2.16-5.45)	<0.001	1.09 (0.76-1.56)	0.64	1.39 (0.69-2.82)	0.35
Yes	Reference		Reference		Reference	
Child received immunisations (full or partial) due at age 15 months						
Yes	Reference		Reference		Reference	
No	16.16 (6.67-39.18)	<0.001	3.96 (1.68-9.36)	0.002	4.83 (1.24-18.88)	0.02
Child received all doses of the 6-week, 3-month and 5-month immunisations on time						
Yes (all doses given on time)	Reference		Reference		Reference	
No (not all doses given on time)	2.04 (1.35-3.09)	0.001	1.23 (0.95-1.59)	0.12	0.93 (0.53-1.65)	0.81

Maternal factors						
Parity						
First-born	0.97 (0.66-1.43)	0.88	1.23 (0.99-1.53)	0.06	1.55 (0.97-2.46)	0.06
Subsequent child	Reference		Reference		Reference	
Mother was born in New Zealand						
No	0.74 (0.48-1.15)	0.19	0.92 (0.73-1.17)	0.51	1.56 (0.97-2.52)	0.07
Yes	Reference		Reference		Reference	
Socioeconomic deprivation (NZDep2013)						
Low (deciles 1-3)	Reference		Reference		Reference	
Moderate (deciles 4-7)	1.35 (0.90-2.04)	0.15	0.97 (0.77-1.23)	0.80	1.15 (0.67-1.98)	0.61
High (deciles 8-10)	1.31 (0.78-2.19)	0.31	1.06 (0.79-1.43)	0.69	1.27 (0.68-2.36)	0.45
Maternal age at 8-year follow-up						
Less than 35 years	2.27 (1.26-4.08)	0.01	1.42 (1.00-2.04)	0.05	2.43 (1.10-5.37)	0.03
35 to 39 years	1.37 (0.81-2.33)	0.24	1.31 (0.97-1.78)	0.08	1.76 (0.83-3.77)	0.14
40 to 44 years	1.11 (0.67-1.84)	0.68	1.11 (0.83-1.47)	0.48	1.78 (0.86-3.69)	0.12
45 years or over	Reference		Reference		Reference	
Mother's highest education qualification (antenatal and 72-month follow-up)						
Less than a bachelor's degree	1.94 (1.33-2.83)	0.001	1.42 (1.15-1.76)	0.001	1.80 (1.12-2.90)	0.02
Bachelor's degree or higher	Reference		Reference		Reference	
Satisfaction with child's usual GP at 2-year follow-up						
Less than satisfied	1.03 (0.53-2.00)	0.94	1.17 (0.77-1.79)	0.47	1.75 (0.80-3.83)	0.16
Fairly satisfied	0.77 (0.48-1.25)	0.30	1.25 (0.94-1.66)	0.13	1.13 (0.61-2.08)	0.70
Very satisfied	0.75 (0.49-1.15)	0.18	1.24 (0.97-1.59)	0.09	1.08 (0.63-1.86)	0.78
Completely satisfied	Reference		Reference		Reference	
Frequency of attending religious services at 2-year follow-up						
Not religious	Reference		Reference		Reference	
Daily to monthly	0.98 (0.51-1.86)	0.94	0.93 (0.64-1.34)	0.70	1.54 (0.77-3.06)	0.22

Not often or never	0.60 (0.36-1.01)	0.06	0.79 (0.60-1.02)	0.08	0.74 (0.40-1.38)	0.35
Belongs to a church at 9-month follow-up						
No	Reference		Reference		Reference	
Yes	1.96 (1.08-3.54)	0.03	0.96 (0.68-1.35)	0.80	0.96 (0.51-1.82)	0.91

CI=Confidence Interval; GP=General Practitioner; HPV=Human Papillomavirus; NZDep2013=2013 New Zealand Deprivation Index; OR=Odds Ratio

* Multinomial logistic regression models with mothers who have decided to vaccinate GIRLS against HPV (n=776) as the reference/baseline group.

Multivariable analysis

In the multivariable analysis, after adjustment for other child and for maternal factors, maternal HPV vaccination intentions for girls were associated with the child's: ethnicity; access to a GP or doctor 12 months prior to 2-year follow-up; uptake of immunisations (full or partial) due at age 4 years and age 15 months; and uptake and timing of all doses of the 6-week, 3-month and 5-month immunisations (**Table 6**). On the other hand, maternal HPV vaccination intentions for girls were not associated with the child's access to a GP or doctor 12 months prior to the 54-month follow-up.

In the multivariable analysis, after adjustment for child and other maternal factors, maternal age at the 8-year follow-up, education status at the 72-month follow-up, and belonging to a church at the 9-month follow-up were associated with HPV vaccination intentions for girls in the multivariable analysis (**Table 6**). However, maternal HPV vaccination intentions for girls were not associated with the following factors: parity; country of birth (New Zealand vs other countries); area-level socioeconomic deprivation; satisfaction with child's usual GP at 2-year follow-up; and frequency of attending religious services at the 2-year follow-up.

Mothers who had decided not to vaccinate girls against HPV compared with mothers who had decided to vaccinate girls against HPV

In the adjusted analysis, mothers whose daughters were of Māori ethnicity (aOR, 0.39; 95% CI, 0.21-0.75; $P = 0.005$) or Pacific ethnicity (aOR, 0.20; 95% CI, 0.08-0.48; $P < 0.001$) were less likely to have decided not to vaccinate their daughters against HPV compared with mothers of non-Māori non-Pacific girls (**Table 6**). Furthermore, the likelihood of mothers deciding not to vaccinate their daughters against HPV was greater if their daughters had: not received immunisations (full or partial) due at age 4 years (aOR, 3.43; 95% CI, 2.16-5.45; $P < 0.001$) and age 15 months (aOR, 16.16; 95% CI, 6.67-39.18; $P < 0.001$); not received all doses of the 6-week, 3-month and 5-month immunisations on time (aOR, 2.04; 95% CI, 1.35-3.09; $P = 0.001$); and not seen a GP or doctor when needed during the 12 months prior to the 2-year follow-up (aOR, 2.92; 95% CI, 1.32-6.47; $P = 0.01$).

In the adjusted analysis, mothers with less than a bachelor's degree at the 72-month follow-up (aOR, 1.94; 95% CI, 1.33-2.83; $P = 0.001$) were also more likely to have decided not to vaccinate their daughters against HPV, as were mothers aged under 35 years at the 8-year follow-up (aOR, 2.27; 95% CI, 1.26-4.08; $P = 0.01$) compared with mothers aged 45 years or over. In addition, the likelihood of mothers deciding not to vaccinate their daughters against HPV was greater if they belonged to a church at the 9-month follow-up (aOR, 1.96; 95% CI, 1.08-3.54; $P = 0.03$).

Mothers who were undecided about HPV vaccination for girls compared with mothers who had decided to vaccinate girls against HPV

In the adjusted analysis, the likelihood of mothers being undecided about HPV vaccination for girls was greater if their daughters had not received immunisations (full or partial) due at age 15 months (aOR, 3.96; 95% CI, 1.68-9.36; P = 0.002), or if mothers had less than a bachelor's degree at the 72-month follow-up (aOR, 1.42; 95% CI, 1.15-1.76; P = 0.001) (**Table 6**).

Mothers who had not heard about the HPV vaccine compared with mothers who had decided to vaccinate girls against HPV

In the adjusted analysis, mothers whose daughters were of Pacific ethnicity (aOR, 2.54; 95% CI, 1.34-4.81; P = 0.004) were more likely to report that they had not heard about the HPV vaccine compared with mothers of non-Māori non-Pacific girls (**Table 6**). In addition, the likelihood of mothers stating that they had not heard about the HPV vaccine was greater if their daughters had not received immunisations (full or partial) due at age 15 months (aOR, 4.83; 95% CI, 1.24-18.88; P = 0.02). Mothers with less than a bachelor's degree at the 72-month follow-up (aOR, 1.80; 95% CI, 1.12-2.90; P = 0.02) were also more likely to report that they had not heard of the HPV vaccine, as were mothers aged under 35 years at the 8-year follow-up (aOR, 2.43; 95% CI, 1.10-5.37; P = 0.03) compared with mothers aged 45 years or over.

Factors associated with maternal HPV vaccination intentions for boys

Univariable analysis

Child factors

In the unadjusted analysis, maternal HPV vaccination intentions for boys were associated with the child's: ethnicity; uptake of immunisations (full or partial) due at age 4 years and age 15 months; and uptake and timing of all doses of the 6-week, 3-month and 5-month immunisations (**Table 7A**). However, maternal HPV vaccination intentions for boys were not associated with the child's access to a GP or doctor 12 months prior to the 54-month and 2-year follow-ups, as well as whether the child mostly saw their regular doctor when sick at the 2-year follow-up.

Compared with mothers who had decided to vaccinate their sons against HPV, a larger proportion of mothers who had not heard of the HPV vaccine had sons of Māori ethnicity (21% vs 10%), as did mothers who had decided not to vaccinate their sons against HPV (16% vs 10%). In contrast, compared with mothers who had decided to vaccinate their sons against HPV, a smaller proportion of mothers who decided not to vaccinate their sons against HPV had sons of Pacific ethnicity

(2% vs 12%), as did mothers who were undecided about HPV vaccination (7% vs 12%).

In addition, compared with mothers who had decided to vaccinate their sons against HPV, a larger proportion of mothers who had decided not to vaccinate their sons against HPV had sons who had not received immunisations (full or partial) due at age 4 years (43% vs 8%) and age 15 months (29 % vs 1%), as well as all doses of the 6-week, 3-month and 5-month immunisations in full (38% vs 6%) and on time (56% vs 21%).

Maternal factors

The following maternal factors were associated with maternal HPV vaccination intentions for boys in the unadjusted analysis: parity; country of birth (New Zealand vs other countries); area-level socioeconomic deprivation; education status at the 72-month follow-up; partner status at the 2-year and 9-month follow-ups; and access to a family doctor or GP before becoming pregnant (**9b**).

Furthermore, maternal HPV vaccination intentions for boys were associated with: belonging to a religion or denomination at the 2-year follow-up; belonging to a Christian religion at the 2-year follow-up; duration of being part of a religion at the 2-year follow-up; frequency of attending religious services at the 2-year follow-up; and belonging to a church at the 9-month follow-up. However, maternal age at the 8-year follow-up and partner status at the 54-month follow-up were not associated with their HPV vaccination intentions for boys. Taking the child to same GP or GP practice at the 2-year follow-up as when the child was 9 months old and satisfaction with child's usual GP at the 2-year follow-up were also not associated with maternal HPV vaccination intentions for boys.

Compared with mothers who had decided to vaccinate their sons against HPV, a larger proportion of those who had not heard of the HPV vaccine were mothers of boys who were first-borns (50% vs 39%) or lived in households in the three highest deciles of area-level deprivation (33% vs 26%). In addition, compared with mothers who had decided to vaccinate their sons against HPV, a larger proportion of mothers who had not heard of the HPV vaccine had less than a bachelor's degree at the 72-month follow-up (64% vs 47%), as did mothers who had decided not to vaccinate their sons against HPV (57% vs 47%).

Furthermore, a larger proportion of mothers who had not heard of the HPV vaccine had a partner at the 2-year follow-up (12% vs 8%), as did mothers who had decided not to vaccinate their sons against HPV (11% vs 8%). Comparably, a larger proportion of mothers who had not heard of the HPV vaccine had a partner at the 9-month follow-up compared with mothers who had decided to vaccinate their sons against HPV (10% vs 7%)

With respect to maternal country of birth, the proportion of those who were born in New Zealand was larger among mothers who had decided not to vaccinate their sons against HPV compared with mothers who had decided to vaccinate

their sons against HPV (79% vs 69%), but was smaller among mothers who had not heard of the HPV vaccine (59% vs 69%).

Compared with mothers who had decided to vaccinate their sons against HPV, a larger proportion of mothers who had decided not to vaccinate their sons against HPV attended religious services at least monthly at the 2-year follow-up (34% vs 25%), belonged to a Christian religion at the 2-year follow-up (46% vs 38%), or belonged to a church at the 9-month follow-up (29% vs 25%). In contrast, compared with mothers who had decided to vaccinate their sons against HPV, a larger proportion of mothers who were undecided about HPV vaccination for their sons were non-religious at the 2-year follow-up (61% vs 53%) or did not belong to a church at the 9-month follow-up (80% vs 75%).

With respect to maternal access to healthcare before pregnancy, the proportion of those who did not have a family doctor or GP before becoming pregnant was larger among mothers who had not heard of the HPV vaccine compared with mothers who had decided to vaccinate their sons against HPV (14% vs 8%), as well as among mothers who had decided not to vaccinate their sons against HPV (12% vs 8%).

Multivariable analysis

In the multivariable analysis, after adjustment for other child and maternal factors, maternal HPV vaccination intentions for boys were associated with the child's: ethnicity; uptake of immunisations (full or partial) due at age 4 years and age 15 months; and uptake and timing of all doses of the 6-week, 3-month and 5-month immunisations (**Table 8**).

With respect to maternal factors, after adjustment for child and other maternal factors, the following were associated with their HPV vaccination intentions for boys in the multivariable analysis: parity; country of birth (New Zealand vs other countries); education status at the 72-month follow-up; and frequency of attending religious services at the 2-year follow-up (**Table 8**). However, maternal HPV vaccination intentions for boys were not associated with area-level socioeconomic deprivation or maternal access to a family doctor or GP before becoming pregnant.

Mothers who had decided not to vaccinate boys against HPV compared with mothers who had decided to vaccinate boys against HPV

In the adjusted analysis, mothers whose sons were of Pacific ethnicity (aOR, 0.15; 95% CI, 0.06-0.40; P <0.001) were less likely to have decided not to vaccinate their sons against HPV compared with mothers of non-Māori non-Pacific boys (**Table 8**). In addition, the likelihood of mothers deciding not to vaccinate their sons against HPV was greater if their sons had not received immunisations (full or partial) due at age 4 years (aOR, 3.26; 95% CI, 2.05-5.17; P <0.001) and age 15 months (aOR, 8.52; 95% CI, 3.64-19.94; P <0.001), as well as all doses of the 6-week, 3-month and 5-month

immunisations on time (aOR, 2.09; 95% CI, 1.39-3.13; $P < 0.001$). Furthermore, mothers with less than a bachelor's degree at the 72-month follow-up (aOR, 1.46; 95% CI, 1.02-2.09; $P = 0.04$) were more likely to have decided not to vaccinate their sons against HPV, as were mothers who attended religious services at least monthly at the 2-year follow-up (aOR, 2.09; 95% CI, 1.36-3.21; $P = 0.001$) compared with non-religious mothers.

Mothers who were undecided about HPV vaccination for boys compared with mothers who had decided to vaccinate boys against HPV

In the adjusted analysis, mothers whose sons were of Pacific ethnicity (aOR, 0.63; 95% CI, 0.42-0.92; $P = 0.02$) were less likely to be undecided about HPV vaccination compared with mothers of non-Māori non-Pacific boys, whereas mothers whose sons were first-borns (aOR, 1.31; 95% CI, 1.06-1.61; $P = 0.01$) were more likely to be undecided about HPV vaccination for their sons (**Table 8**). Moreover, the likelihood of mothers being undecided about HPV vaccination for boys was greater if their sons had not received immunisations (full or partial) due at age 15 months (aOR, 3.04; 95% CI, 1.37-6.77; $P = 0.01$), as well as all doses of the 6-week, 3-month and 5-month immunisations on time (aOR, 1.33; 95% CI, 1.04-1.72; $P = 0.03$).

Mothers who had not heard about the HPV vaccine compared with mothers who had decided to vaccinate boys against HPV

In the adjusted analysis, mothers whose sons were of Māori ethnicity (aOR, 2.50; 95% CI, 1.48-4.23; $P = 0.001$) were more likely to report that they had not heard about the HPV vaccine compared with mothers of non-Māori non-Pacific boys, as were mothers whose sons were first-borns (aOR, 1.81; 95% CI, 1.27-2.58; $P = 0.001$) (**Table 8**). The likelihood of mothers stating that they had not heard about the HPV vaccine was also greater if their sons had not received immunisations (full or partial) due at age 15 months (aOR, 3.12; 95% CI, 1.02-9.54; $P = 0.04$). In addition, mothers who were not born in New Zealand (aOR, 1.85; 95% CI, 1.26-2.71; $P = 0.002$) were more likely to report that they had not heard of the HPV vaccine, as were mothers with less than a bachelor's degree at the 72-month follow-up (aOR, 2.02; 95% CI, 1.40-2.93; $P < 0.001$).

Table 7A: Child factors potentially associated with maternal HPV vaccination intentions for BOYS (unadjusted analysis)

Variable	Whether mothers have decided to vaccinate sons against HPV (n=2,265)				P-value [†]
	Will vaccinate (n=722)	Will NOT vaccinate (n=227)	Undecided (n=1,124)	Not heard of HPV vaccine (n=192)	
	n (%) [*]	n (%) [*]	n (%) [*]	n (%) [*]	
Child's ethnicity (n=2193)					
Māori	67 (10)	34 (16)	118 (11)	40 (21)	<0.001
Pacific	83 (12)	5 (2)	80 (7)	28 (15)	
Non-Māori Non-Pacific	546 (78)	179 (82)	893 (82)	120 (64)	
Child needed to see GP/doctor 12 months prior to 54-month follow, but not able to (n=2,234)					
Yes	33 (5)	7 (3)	63 (6)	7 (4)	0.30
No	675 (95)	218 (97)	1,048 (94)	183 (96)	
Child received immunisations (full or partial) due at age 4 years (n=2,229)					
No	58 (8)	97 (43)	117 (11)	19 (10)	<0.001
Yes	648 (92)	128 (57)	994 (89)	168 (90)	
Child's vaccination status at age 4 years (n=2,228)					
Fully vaccinated at age 4 years	644 (91)	120 (53)	984 (89)	163 (87)	<0.001
Not fully vaccinated, but mother intends to organise it	42 (6)	26 (12)	73 (7)	11 (6)	
Not fully vaccinated and mother has no intention to	20 (3)	79 (35)	53 (5)	13 (7)	
Child mostly saw regular doctor when sick (2-year follow-up) (n=2,224)					
No	204 (29)	72 (33)	324 (29)	50 (26)	0.50
Yes	506 (71)	146 (67)	782 (71)	140 (74)	
Child needed to see GP/doctor 12 months prior to 2-year follow, but not able to (n=2,239)					
Yes	31 (4)	12 (5)	57 (5)	13 (7)	0.57

No	682 (96)	212 (95)	1,054 (95)	178 (93)	
Child received immunisations (full or partial) due at age 15 months (n=2,240)					
Yes	706 (99)	160 (71)	1,065 (96)	183 (96)	<0.001
No	8 (1)	64 (29)	46 (4)	8 (4)	
Child received all doses of the 6-week, 3-month and 5-month immunisations (n=2,217)					
Yes (all doses given)	666 (94)	136 (62)	997 (91)	172 (91)	<0.001
No (all doses not given)	44 (6)	83 (38)	101 (9)	18 (9)	
Child received all doses of the 6-week, 3-month and 5-month immunisations on time (n=2,217)					
Yes (all doses given on time)	564 (79)	96 (44)	808 (74)	148 (78)	<0.001
No (not all doses given on time)	146 (21)	123 (56)	290 (26)	42 (22)	

GP=General Practitioner; HPV=Human Papillomavirus

* Percentages may not add up to 100% due to rounding

† Chi squared test

Table 7B: Maternal factors potentially associated with maternal HPV vaccination intentions for BOYS (unadjusted analysis)

Variable	Whether mothers have decided to vaccinate sons against HPV (n=2,265)				P-value [†]
	Will vaccinate (n=722)	Will NOT vaccinate (n=227)	Un-decided (n=1,124)	Not heard of HPV vaccine (n=192)	
	n (%) [*]	n (%) [*]	n (%) [*]	n (%) [*]	
Parity (n=2,241)					
First-born	281 (39)	72 (32)	513 (46)	93 (50)	<0.001
Subsequent child	432 (61)	152 (68)	604 (54)	94 (50)	
Mother was born in New Zealand (n=2,242)					
No	222 (31)	47 (21)	293 (26)	76 (41)	<0.001
Yes	492 (69)	177 (79)	824 (74)	111 (59)	
Socioeconomic deprivation (NZDep2013) (n=2,257)					
Low (deciles 1-3)	282 (39)	87 (38)	415 (37)	55 (29)	0.02
Moderate (deciles 4-7)	250 (35)	79 (35)	452 (40)	73 (38)	
High (deciles 8-10)	185 (26)	61 (27)	256 (23)	62 (33)	
Maternal age at 8-year follow-up (n=2,262)					
Less than 35 years	130 (18)	42 (19)	202 (18)	47 (24)	0.11
35 to 39 years	178 (25)	71 (31)	302 (27)	47 (24)	
40 to 44 years	246 (34)	67 (30)	403 (36)	55 (29)	
45 years or over	166 (23)	47 (21)	216 (19)	43 (22)	
Mother's highest education qualification (antenatal and 72-month follow-up) (n=2,172)					
Less than a bachelor's degree	323 (47)	124 (57)	550 (51)	119 (64)	<0.001
Bachelor's degree or higher	369 (53)	93 (43)	530 (49)	66 (36)	
Mother had partner at 54-month follow-up (n=2,221)					
No	67 (10)	15 (7)	88 (8)	22 (12)	0.19
Yes	635 (90)	208 (93)	1,021 (92)	165 (88)	
Mother had partner at 2-year follow-up (n=2,222)					

No	58 (8)	25 (11)	78 (7)	23 (12)	0.03
Yes	650 (92)	197 (89)	1,028 (93)	163 (88)	
Takes child to same GP or GP practice at 2-year follow-up as when child was 9 months old (n=2,170)					
No	91 (13)	27 (12)	139 (13)	25 (14)	0.98
Yes	600 (87)	190 (88)	940 (87)	158 (86)	
Satisfaction with child's usual GP at 2-year follow-up (n=2,167)					
Less than satisfied	61 (9)	28 (13)	91 (8)	18 (10)	0.47
Fairly satisfied	157 (23)	46 (21)	269 (25)	49 (27)	
Very satisfied	264 (38)	88 (41)	420 (39)	64 (35)	
Completely satisfied	207 (30)	55 (25)	298 (28)	52 (28)	
Belonged to religion/denomination at 2-year follow-up (n=2,219)					
No	372 (53)	109 (49)	679 (61)	99 (53)	<0.001
Yes	334 (47)	113 (51)	426 (39)	87 (47)	
Belonged to Christian religion at 2-year follow-up (n=2,215)					
No	435 (62)	119 (54)	749 (68)	124 (67)	<0.001
Yes	269 (38)	103 (46)	354 (32)	62 (33)	
Duration of being part of a religion at 2-year follow-up (n=2,218)					
Not religious	372 (53)	109 (49)	679 (61)	99 (53)	<0.001
All of the mother's life	253 (36)	72 (32)	329 (30)	65 (35)	
Less than mother's lifetime	80 (11)	41 (18)	97 (9)	22 (12)	
Frequency of attending religious services at 2-year follow-up (n=2,217)					
Not religious	372 (53)	109 (49)	679 (61)	99 (53)	<0.001
Daily to monthly	175 (25)	75 (34)	208 (19)	51 (28)	
Not often or never	158 (22)	38 (17)	218 (20)	35 (19)	
Belongs to a church at 9-month follow-up (n=2,201)					
No	525 (75)	158 (71)	879 (80)	134 (74)	0.004

Yes	176 (25)	65 (29)	218 (20)	46 (26)	
Mother had partner at 9-month follow-up (n=2,200)					
No	46 (7)	21 (9)	61 (6)	18 (10)	0.04
Yes	655 (93)	202 (91)	1,035 (94)	162 (90)	
Had family doctor or GP before becoming pregnant (n=2,240)					
No	60 (8)	26 (12)	97 (9)	27 (14)	0.04
Yes	652 (92)	198 (88)	1,020 (91)	160 (86)	

GP=General Practitioner; HPV=Human Papillomavirus; NZDep2013=2013 New Zealand Deprivation Index

* Percentages may not add up to 100% due to rounding

† Chi squared test

Table 8: Multivariable analysis of factors associated with maternal HPV vaccination intentions for BOYS

Variable	Whether mothers have decided to vaccinate sons against HPV (n=2,026)					
	Will NOT vaccinate (n=197)		Undecided (n=1,014)		Not heard of HPV vaccine (n=175)	
	Adjusted OR (95% CI)*	P-value	Adjusted OR (95% CI)*	P-value	Adjusted OR (95% CI)*	P-value*
Child factors						
Child's ethnicity						
Māori	1.12 (0.65-1.92)	0.69	1.07 (0.75-1.52)	0.73	2.50 (1.48-4.23)	0.001
Pacific	0.15 (0.06-0.40)	<0.001	0.63 (0.42-0.92)	0.02	1.36 (0.77-2.39)	0.29
Non-Māori Non-Pacific	Reference		Reference		Reference	
Child received immunisations (full or partial) due at age 4 years						
No	3.26 (2.05-5.17)	<0.001	0.93 (0.65-1.34)	0.69	1.06 (0.58-1.92)	0.85
Yes	Reference		Reference		Reference	
Child received immunisations (full or partial) due at age 15 months						
Yes	Reference		Reference		Reference	
No	8.52 (3.64-19.94)	<0.001	3.04 (1.37-6.77)	0.01	3.12 (1.02-9.54)	0.04
Child received all doses of the 6-week, 3-month and 5-month immunisations on time						
Yes (all doses given on time)	Reference		Reference		Reference	
No (not all doses given on time)	2.09 (1.39-3.13)	<0.001	1.33 (1.04-1.72)	0.03	1.05 (0.68-1.64)	0.81
Maternal factors						
Parity						
First-born	0.97 (0.67-1.42)	0.89	1.31 (1.06-1.61)	0.01	1.81 (1.27-2.58)	0.001
Subsequent child	Reference		Reference		Reference	
Mother was born in New Zealand						
No	0.71 (0.46-1.10)	0.12	0.88 (0.70-1.12)	0.30	1.85 (1.26-2.71)	0.002

Yes	Reference		Reference		Reference	
Socioeconomic deprivation (NZDep2013)						
Low (deciles 1-3)	Reference		Reference		Reference	
Moderate (deciles 4-7)	0.90 (0.60-1.37)	0.63	1.19 (0.94-1.50)	0.15	1.33 (0.87-2.02)	0.18
High (deciles 8-10)	1.06 (0.65-1.73)	0.81	0.98 (0.73-1.32)	0.89	1.10 (0.67-1.81)	0.72
Mother's highest education qualification (antenatal and 72-month follow-up)						
Less than a bachelor's degree	1.46 (1.02-2.09)	0.04	1.21 (0.98-1.50)	0.07	2.02 (1.40-2.93)	<0.001
Bachelor's degree or higher	Reference		Reference		Reference	
Frequency of attending religious services at 2-year follow-up						
Not religious	Reference		Reference		Reference	
Daily to monthly	2.09 (1.36-3.21)	0.001	0.79 (0.60-1.03)	0.09	1.13 (0.72-1.76)	0.60
Not often or never	1.10 (0.69-1.75)	0.69	0.80 (0.62-1.04)	0.09	0.91 (0.57-1.43)	0.68
Had family doctor or GP before becoming pregnant						
No	1.36 (0.75-2.47)	0.31	1.00 (0.70-1.45)	0.98	1.60 (0.94-2.72)	0.08
Yes	Reference		Reference		Reference	

CI=Confidence Interval; GP=General Practitioner; HPV=Human Papillomavirus; NZDep2013=2013 New Zealand Deprivation Index; OR=Odds Ratio

* Multinomial logistic regression models with mothers who have decided to vaccinate BOYS against HPV (n=640) as the reference/baseline group.

Analysis stratified by the child's sex and ethnic group

Maternal HPV vaccination intentions for girls and boys of Māori ethnicity

Girls of Māori ethnicity

Among girls of Māori ethnicity, the univariable analysis showed no significant associations of child and maternal factors with maternal HPV vaccination intentions for their daughters (**Table 9A** and **Table 9B**). In addition, none of the factors examined in the multivariable analysis were associated with maternal HPV vaccination intentions for girls of Māori ethnicity (**Table 11**).

Boys of Māori ethnicity

Except for parity, the univariable analysis showed no significant associations of child and maternal factors with maternal HPV vaccination intentions for boys of Māori ethnicity (**Table 10A** and **Table 10B**). Compared with mothers who had decided to vaccinate Māori boys against HPV, a larger proportion of those who were undecided about HPV vaccination were mothers of Māori boys who were first-borns (39% vs 23%). However, none of the factors examined in the multivariable analysis were associated with maternal HPV vaccination intentions for boys of Māori ethnicity (**Table 11**).

Table 9A: Child factors potentially associated with maternal HPV vaccination intentions for Māori GIRLS (unadjusted analysis)

Variable	Whether mothers have decided to vaccinate daughters against HPV (n=210)		P-value [†]
	Will vaccinate (n=90)	Undecided (n=120)	
	n (%) [*]	n (%) [*]	
Child needed to see GP/doctor 12 months prior to 54-month follow, but not able to (n=210)			
Yes	5 (6)	11 (9)	0.33
No	85 (94)	109 (91)	
Child received immunisations (full or partial) due at age 4 years (n=209)			
No	13 (14)	19 (16)	0.76
Yes	77 (86)	100 (84)	
Child mostly saw regular doctor when sick (2-year follow-up) (n=207)			
No	40 (44)	37 (32)	0.06
Yes	50 (56)	80 (68)	
Child needed to see GP/doctor 12 months prior to 2-year follow, but not able to (n=207)			
Yes	5 (6)	6 (5)	0.87
No	84 (94)	112 (95)	
Child received all doses of the 6-week, 3-month and 5-month immunisations (n=205)			
Yes (all doses given)	84 (94)	106 (91)	0.41
No (all doses not given)	5 (6)	10 (9)	
Child received all doses of the 6-week, 3-month and 5-month immunisations on time (n=205)			
Yes (all doses given on time)	57 (64)	81 (70)	0.38
No (not all doses given on time)	32 (36)	35 (30)	

GP=General Practitioner; HPV=Human Papillomavirus

* Percentages may not add up to 100% due to rounding

† Chi squared test

Table 9B: Maternal factors potentially associated with maternal HPV vaccination intentions for Māori GIRLS (unadjusted analysis)

Variable	Whether mothers have decided to vaccinate daughters against HPV (n=210)		P-value [†]
	Will vaccinate (n=90)	Undecided (n=120)	
	n (%) [*]	n (%) [*]	
Parity (n=206)			
First-born	31 (36)	56 (47)	0.10
Subsequent child	56 (64)	63 (53)	
Socioeconomic deprivation (NZDep2013) (n=210)			
Low (deciles 1-3)	21 (23)	20 (17)	0.38
Moderate (deciles 4-7)	24 (27)	40 (33)	
High (deciles 8-10)	45 (50)	60 (50)	
Maternal age at 8-year follow-up (n=210)			
Less than 35 years	34 (38)	49 (41)	0.18
35 to 39 years	21 (23)	37 (31)	
40 to 44 years	19 (21)	24 (20)	
45 years or over	16 (18)	10 (8)	
Mother's highest education qualification (antenatal and 72-month follow-up) (n=202)			
Less than a bachelor's degree	54 (64)	90 (76)	0.06
Bachelor's degree or higher	30 (36)	28 (24)	
Mother had partner at 54-month follow-up (n=208)			
No	11 (13)	21 (18)	0.32
Yes	77 (88)	99 (83)	
Mother had partner at 2-year follow-up (n=206)			
No	14 (16)	14 (12)	0.40
Yes	74 (84)	104 (88)	
Takes child to same GP or GP practice at 2-year follow-up as when child was 9 months old (n=200)			
No	12 (14)	17 (15)	0.90
Yes	73 (86)	98 (85)	
Satisfaction with child's usual GP at 2-year follow-up (n=200)			
Less than satisfied	12 (14)	14 (12)	0.44
Fairly satisfied	18 (21)	34 (30)	
Very satisfied	35 (41)	48 (42)	
Completely satisfied	20 (24)	19 (17)	
Belonged to religion/denomination at 2-year follow-up (n=205)			
No	52 (60)	77 (65)	0.42

Yes	35 (40)	41 (35)	
Belonged to Christian religion at 2-year follow-up (n=203)			
No	55 (63)	82 (71)	0.26
Yes	32 (37)	34 (29)	
Duration of being part of a religion at 2-year follow-up (n=205)			
Not religious	52 (60)	77 (65)	0.55
All of the mother's life	22 (25)	29 (25)	
Less than mother's lifetime	13 (15)	12 (10)	
Frequency of attending religious services at 2-year follow-up (n=205)			
Not religious	52 (60)	77 (65)	0.71
Daily to monthly	17 (20)	19 (16)	
Not often or never	18 (21)	22 (19)	
Belongs to a church at 9-month follow-up (n=203)			
No	74 (86)	97 (83)	0.54
Yes	12 (14)	20 (17)	
Mother had partner at 9-month follow-up (n=203)			
No	10 (12)	17 (15)	0.55
Yes	76 (88)	100 (85)	
Had family doctor or GP before becoming pregnant (n=206)			
No	11 (13)	9 (8)	0.22
Yes	76 (87)	110 (92)	

GP=General Practitioner; HPV=Human Papillomavirus; NZDep2013=2013 New Zealand Deprivation Index

* Percentages may not add up to 100% due to rounding

† Chi squared test

Table 10A: Child factors potentially associated with maternal HPV vaccination intentions for Māori BOYS (unadjusted analysis)

Variable	Whether mothers have decided to vaccinate sons against HPV (n=185)		P-value [†]
	Will vaccinate (n=67)	Undecided (n=118)	
	n (%) [*]	n (%) [*]	
Child needed to see GP/doctor 12 months prior to 54-month follow, but not able to (n=185)			
Yes	6 (9)	12 (10)	0.79
No	61 (91)	106 (90)	
Child received immunisations (full or partial) due at age 4 years (n=185)			
No	8 (12)	20 (17)	0.36
Yes	59 (88)	98 (83)	
Child mostly saw regular doctor when sick (2-year follow-up) (n=182)			
No	15 (23)	31 (26)	0.67
Yes	49 (77)	87 (74)	
Child received all doses of the 6-week, 3-month and 5-month immunisations (n=183)			
Yes (all doses given)	60 (91)	100 (85)	0.29
No (all doses not given)	6 (9)	17 (15)	
Child received all doses of the 6-week, 3-month and 5-month immunisations on time (n=183)			
Yes (all doses given on time)	46 (70)	72 (62)	0.27
No (not all doses given on time)	20 (30)	45 (38)	

GP=General Practitioner; HPV=Human Papillomavirus

* Percentages may not add up to 100% due to rounding

† Chi squared test

Table 10B: Maternal factors potentially associated with maternal HPV vaccination intentions for Māori BOYS (unadjusted analysis)

Variable	Whether mothers have decided to vaccinate sons against HPV (n=185)		P-value [†]
	Will vaccinate (n=67)	Undecided (n=118)	
	n (%) [*]	n (%) [*]	
Parity (n=183)			
First-born	15 (23)	46 (39)	0.03
Subsequent child	50 (77)	72 (61)	
Mother was born in New Zealand (n=183)			
No	5 (8)	10 (8)	0.85
Yes	60 (92)	108 (92)	
Socioeconomic deprivation (NZDep2013) (n=185)			
Low (deciles 1-3)	11 (16)	16 (14)	0.26
Moderate (deciles 4-7)	15 (22)	40 (34)	
High (deciles 8-10)	41 (61)	62 (53)	
Maternal age at 8-year follow-up (n=185)			
Less than 35 years	23 (34)	42 (36)	0.80
35 to 39 years	14 (21)	31 (26)	
40 to 44 years	18 (27)	27 (23)	
45 years or over	12 (18)	18 (15)	
Mother's highest education qualification (antenatal and 72-month follow-up) (n=180)			
Less than a bachelor's degree	49 (77)	73 (63)	0.06
Bachelor's degree or higher	15 (23)	43 (37)	
Mother had partner at 54-month follow-up (n=184)			
No	18 (27)	18 (15)	0.05
Yes	48 (73)	100 (85)	
Mother had partner at 2-year follow-up (n=183)			
No	11 (17)	15 (13)	0.44
Yes	54 (83)	103 (87)	
Takes child to same GP or GP practice at 2-year follow-up as when child was 9 months old (n=176)			
No	12 (19)	17 (15)	0.54
Yes	52 (81)	95 (85)	
Satisfaction with child's usual GP at 2-year follow-up (n=176)			
Less than satisfied	5 (8)	11 (10)	0.60
Fairly satisfied	16 (25)	37 (33)	
Very satisfied	23 (36)	32 (29)	
Completely satisfied	20 (31)	32 (29)	

Belonged to religion/denomination at 2-year follow-up (n=183)			
No	35 (54)	70 (59)	0.47
Yes	30 (46)	48 (41)	
Belonged to Christian religion at 2-year follow-up (n=183)			
No	36 (55)	76 (64)	0.23
Yes	29 (45)	42 (36)	
Duration of being part of a religion at 2-year follow-up (n=183)			
Not religious	35 (54)	70 (59)	0.72
All of the mother's life	22 (34)	37 (31)	
Less than mother's lifetime	8 (12)	11 (9)	
Frequency of attending religious services at 2-year follow-up (n=183)			
Not religious	35 (54)	70 (59)	0.56
Daily to monthly	14 (22)	18 (15)	
Not often or never	16 (25)	30 (25)	
Belongs to a church at 9-month follow-up (n=182)			
No	52 (80)	100 (85)	0.34
Yes	13 (20)	17 (15)	
Mother had partner at 9-month follow-up (n=181)			
No	11 (17)	14 (12)	0.36
Yes	54 (83)	102 (88)	

GP=General Practitioner; HPV=Human Papillomavirus; NZDep2013=2013 New Zealand Deprivation Index

* Percentages may not add up to 100% due to rounding

† Chi squared test

Table 11: Multivariable analysis of factors associated with maternal HPV vaccination intentions for girls and boys of Māori ethnicity

Variable	Mother is undecided regarding HPV vaccination of daughter/son			
	Māori girls (n=199)		Māori boys (n=180)	
	Adjusted OR (95% CI)*	P-value*	Adjusted OR (95% CI)†	P-value†
Child mostly saw regular doctor when sick (2-year follow-up)				
No	Reference		N/A	N/A
Yes	1.67 (0.92-3.02)	0.09	N/A	
Parity				
First-born	1.62 (0.90-2.92)	0.11	1.79 (0.88-3.64)	0.11
Subsequent child	Reference		Reference	
Mother's highest education qualification (antenatal and 72-month follow-up)				
Less than a bachelor's degree	1.81 (0.97-3.40)	0.06	0.63 (0.31-1.30)	0.21
Bachelor's degree or higher	Reference		Reference	
Mother had partner at 54-month follow-up				
No	N/A	N/A	0.61 (0.28-1.31)	0.20
Yes	N/A		Reference	

CI=Confidence Interval; HPV=Human Papillomavirus; N/A= Not Applicable; OR=Odds Ratio

* Logistic regression models with mothers who have decided to vaccinate GIRLS of Māori ethnicity against HPV as the reference group

† Logistic regression models with mothers who have decided to vaccinate BOYS of Māori ethnicity against HPV as the reference group

Maternal HPV vaccination intentions for girls and boys of Pacific ethnicity

Girls of Pacific ethnicity

In the unadjusted analysis, maternal HPV vaccination intentions for girls of Pacific ethnicity were associated with the child's uptake of immunisations (full or partial) due at age 4 years and the mother's partner status at the 9-month follow-up, but not with other child and maternal factors (**Table 12A** and **Table 12B**). Compared with mothers who had decided to vaccinate Pacific girls against HPV, a larger proportion of mothers who were undecided about HPV vaccination had daughters of Pacific ethnicity who had not received immunisations (full or partial) due at age 4 years (19% vs 7%). In addition, a smaller proportion of mothers who were undecided about HPV vaccination for Pacific girls had a partner at the 9-month follow-up compared with mothers who had decided to vaccinate Pacific girls against HPV (76% vs 90%). Nevertheless, none of the factors examined in the multivariable analysis were associated with maternal HPV vaccination intentions for girls of Pacific ethnicity (**Table 14**).

Boys of Pacific ethnicity

In the unadjusted analysis, maternal HPV vaccination intentions for boys of Pacific ethnicity were associated with belonging to a Christian religion at the 2-year follow-up, but not with other child and maternal factors (**Table 13A** and **Table 13B**). Compared with mothers who had decided to vaccinate Pacific boys against HPV, a smaller proportion of mothers who were undecided about HPV vaccination for Pacific boys belonged to a Christian religion at the 2-year follow-up (62% vs 77%). However, none of the factors examined in the multivariable analysis were associated with maternal HPV vaccination intentions for girls of Pacific ethnicity (**Table 14**).

Table 12A: Child factors potentially associated with maternal HPV vaccination intentions for Pacific GIRLS (unadjusted analysis)

Variable	Whether mothers have decided to vaccinate daughters against HPV (n=152)		P-value [†]
	Will vaccinate (n=69)	Undecided (n=82)	
	n (%) [*]	n (%) [*]	
Child needed to see GP/doctor 12 months prior to 54-month follow, but not able to (n=152)			
Yes	5 (7)	7 (8)	0.79
No	64 (93)	76 (92)	
Child received immunisations (full or partial) due at age 4 years (n=150)			
No	5 (7)	15 (19)	0.04
Yes	64 (93)	66 (81)	
Child mostly saw regular doctor when sick (2-year follow-up) (n=146)			
No	19 (29)	18 (22)	0.33
Yes	46 (71)	63 (78)	
Child received all doses of the 6-week, 3-month and 5-month immunisations on time (n=150)			
Yes (all doses given on time)	49 (72)	53 (65)	0.33
No (all doses not given on time)	19 (28)	29 (35)	

GP=General Practitioner; HPV=Human Papillomavirus

* Percentages may not add up to 100% due to rounding

† Chi square test

Table 12B: Maternal factors potentially associated with maternal HPV vaccination intentions for Pacific GIRLS (unadjusted analysis)

Variable	Whether mothers have decided to vaccinate daughters against HPV (n=152)		P-value [†]
	Will vaccinate (n=69)	Undecided (n=82)	
	n (%) [*]	n (%) [*]	
Parity (n=150)			
First-born	22 (32)	31 (38)	0.42
Subsequent child	47 (68)	50 (62)	
Mother was born in New Zealand (n=150)			
No	30 (43)	34 (42)	0.85
Yes	39 (57)	47 (58)	
Socioeconomic deprivation (NZDep2013) (n=151)			
Low (deciles 1-3)	9 (13)	7 (9)	0.07
Moderate (deciles 4-7)	23 (33)	16 (20)	
High (deciles 8-10)	37 (54)	59 (72)	
Maternal age at 8-year follow-up (n=151)			
Less than 35 years	21 (30)	36 (44)	0.28
35 to 39 years	21 (30)	20 (24)	
40 to 44 years	20 (29)	16 (20)	
45 years or over	7 (10)	10 (12)	
Mother's highest education qualification (antenatal and 72-month follow-up) (n=147)			
Less than a bachelor's degree	55 (81)	67 (85)	0.53
Bachelor's degree or higher	13 (19)	12 (15)	
Mother had partner at 54-month follow-up (n=151)			
No	8 (12)	18 (22)	0.09
Yes	61 (88)	64 (78)	
Mother had partner at 2-year follow-up (n=145)			
No	9 (14)	15 (19)	0.43
Yes	56 (86)	65 (81)	
Takes child to same GP or GP practice at 2-year follow-up as when child was 9 months old (n=143)			
No	7 (11)	6 (8)	0.49
Yes	57 (89)	73 (92)	
Belonged to religion/denomination at 2-year follow-up (n=145)			
No	16 (25)	18 (23)	0.77
Yes	49 (75)	62 (78)	
Belonged to Christian religion at 2-year follow-up (n=145)			

No	18 (28)	19 (24)	0.59
Yes	47 (72)	61 (76)	
Duration of being part of a religion at 2-year follow-up (n=145)			
Not religious	16 (25)	18 (23)	0.54
All of the mother's life	37 (57)	41 (51)	
Less than mother's lifetime	12 (18)	21 (26)	
Frequency of attending religious services at 2-year follow-up (n=145)			
Not religious	16 (25)	18 (23)	0.92
Daily to monthly	36 (55)	44 (55)	
Not often or never	13 (20)	18 (23)	
Belongs to a church at 9-month follow-up (n=145)			
No	30 (45)	41 (53)	0.35
Yes	37 (55)	37 (47)	
Mother had partner at 9-month follow-up (n=145)			
No	7 (10)	19 (24)	0.03
Yes	60 (90)	59 (76)	
Had family doctor or GP before becoming pregnant (n=150)			
No	9 (13)	5 (6)	0.15
Yes	60 (87)	76 (94)	

GP=General Practitioner; HPV=Human Papillomavirus; NZDep2013=2013 New Zealand Deprivation Index

* Percentages may not add up to 100% due to rounding

† Chi square test

Table 13A: Child factors potentially associated with maternal HPV vaccination intentions for Pacific BOYS (unadjusted analysis)

Variable	Whether mothers have decided to vaccinate sons against HPV (n=163)		P-value [†]
	Will vaccinate (n=83)	Undecided (n=80)	
	n (%) [*]	n (%) [*]	
Child needed to see GP/doctor 12 months prior to 54-month follow, but not able to (n=163)			
Yes	8 (10)	7 (9)	0.84
No	75 (90)	73 (91)	
Child received immunisations (full or partial) due at age 4 years (n=163)			
No	7 (8)	8 (10)	0.73
Yes	76 (92)	72 (90)	
Child mostly saw regular doctor when sick (2-year follow-up) (n=160)			
No	25 (30)	26 (33)	0.70
Yes	57 (70)	52 (67)	
Child received all doses of the 6-week, 3-month and 5-month immunisations (n=158)			
Yes (all doses given)	72 (89)	68 (88)	0.91
No (all doses not given)	9 (11)	9 (12)	
Child received all doses of the 6-week, 3-month and 5-month immunisations on time (n=158)			
Yes (all doses given on time)	55 (68)	55 (71)	0.63
No (all doses not given on time)	26 (32)	22 (29)	

GP=General Practitioner; HPV=Human Papillomavirus

* Percentages may not add up to 100% due to rounding

† Chi squared test

Table 13B: Maternal factors potentially associated with maternal HPV vaccination intentions for Pacific BOYS (unadjusted analysis)

Variable	Whether mothers have decided to vaccinate sons against HPV (n=163)		P-value [†]
	Will vaccinate (n=83)	Undecided (n=80)	
	n (%) [*]	n (%) [*]	
Parity (n=163)			
First-born	26 (31)	21 (26)	0.48
Subsequent child	57 (69)	59 (74)	
Mother was born in New Zealand (n=163)			
No	33 (40)	25 (31)	0.26
Yes	50 (60)	55 (69)	
Socioeconomic deprivation (NZDep2013) (n=161)			
Low (deciles 1-3)	6 (7)	9 (11)	0.10
Moderate (deciles 4-7)	11 (14)	20 (25)	
High (deciles 8-10)	64 (79)	51 (64)	
Maternal age at 8-year follow-up (n=162)			
Less than 35 years	34 (41)	24 (30)	0.13
35 to 39 years	18 (22)	29 (36)	
40 to 44 years	21 (26)	15 (19)	
45 years or over	9 (11)	12 (15)	
Mother's highest education qualification (antenatal and 72-month follow-up) (n=159)			
Less than a bachelor's degree	64 (78)	55 (71)	0.34
Bachelor's degree or higher	18 (22)	22 (29)	
Mother had partner at 54-month follow-up (n=163)			
No	14 (17)	12 (15)	0.75
Yes	69 (83)	68 (85)	
Mother had partner at 2-year follow-up (n=160)			
No	15 (18)	14 (18)	0.96
Yes	67 (82)	64 (82)	
Satisfaction with child's usual GP at 2-year follow-up (n=155)			
Less than satisfied	12 (15)	5 (7)	0.27
Fairly satisfied	25 (31)	20 (27)	
Very satisfied	23 (29)	25 (33)	
Completely satisfied	20 (25)	25 (33)	
Belonged to religion/denomination at 2-year follow-up (n=159)			
No	18 (22)	25 (32)	0.14
Yes	64 (78)	52 (68)	

Belonged to Christian religion at 2-year follow-up (n=158)			
No	19 (23)	29 (38)	0.04
Yes	63 (77)	47 (62)	
Duration of being part of a religion at 2-year follow-up (n=159)			
Not religious	18 (22)	25 (32)	0.33
All of the mother's life	44 (54)	36 (47)	
Less than mother's lifetime	20 (24)	16 (21)	
Frequency of attending religious services at 2-year follow-up (n=159)			
Not religious	18 (22)	25 (32)	0.32
Daily to monthly	49 (60)	39 (51)	
Not often or never	15 (18)	13 (17)	
Belongs to a church at 9-month follow-up (n=155)			
No	28 (35)	34 (46)	0.15
Yes	53 (65)	40 (54)	
Mother had partner at 9-month follow-up (n=155)			
No	12 (15)	11 (15)	0.99
Yes	69 (85)	63 (85)	

GP=General Practitioner; HPV=Human Papillomavirus; NZDep2013=2013 New Zealand Deprivation Index

* Percentages may not add up to 100% due to rounding

† Chi squared test

Table 14: Multivariable analysis of factors associated with maternal HPV vaccination intentions for girls and boys of Pacific ethnicity

Variable	Mother is undecided regarding HPV vaccination of daughter/son			
	Pacific girls (n=142)		Pacific boys (n=155)	
	Adjusted OR (95% CI)*	P-value*	Adjusted OR (95% CI)†	P-value†
Child received immunisations (full or partial) due at age 4 years				
No	2.73 (0.91-8.23)	0.07	N/A	N/A
Yes	Reference		N/A	
Socioeconomic deprivation (NZDep2013)				
Low (deciles 1-3)	Reference		Reference	
Moderate (deciles 4-7)	1.11 (0.33-3.74)	0.87	1.25 (0.33-4.73)	0.74
High (deciles 8-10)	1.78 (0.59-5.37)	0.31	0.56 (0.18-1.82)	0.34
Mother had partner at 9-month follow-up				
No	2.62 (1.00-6.88)	0.05	N/A	N/A
Yes	Reference		N/A	
Maternal age at 8-year follow-up				
Less than 35 years	N/A	N/A	0.49 (0.17-1.42)	0.19
35 to 39 years	N/A		1.41 (0.47-4.22)	0.54
40 to 44 years	N/A		0.43 (0.14-1.36)	0.15
45 years or over	N/A		Reference	
Belonged to Christian religion at 2-year follow-up				
No	N/A	N/A	Reference	
Yes	N/A		0.49 (0.23-1.02)	0.06

CI=Confidence Interval; HPV=Human Papillomavirus; NZDep2013=2013 New Zealand Deprivation Index; N/A= Not Applicable; OR=Odds Ratio

* Logistic regression models with mothers who have decided to vaccinate GIRLS of Pacific ethnicity against HPV as the reference group

† Logistic regression models with mothers who have decided to vaccinate BOYS of Pacific ethnicity against HPV as the reference group

Discussion

Statement of principal findings

The maternal intentions for HPV vaccination of their 8-year-old children differed significantly by their child's sex, with the proportion of mothers who stated they would vaccinate their 8-year-olds against HPV being higher for girls than boys, whereas the proportion of mothers who were undecided about HPV vaccination was higher for boys than girls.

For girls, maternal responses regarding HPV vaccination intentions differed by their daughter's ethnic group. Maternal age and maternal status at the 72-month follow-up and belonging to a church at the 9-month follow-up were associated with HPV vaccination intentions for girls but maternal parity, country of birth and area-level socioeconomic deprivation were not.

For boys, maternal responses regarding HPV vaccination intentions differed by their son's ethnic group. Maternal parity, country of birth, education status at the 72-month follow-up, and frequency of maternal attendance at religious services at the 2-year follow-up were associated with HPV vaccination intentions for boys, but area-level socioeconomic deprivation was not.

For girls but not for boys, maternal responses regarding HPV vaccination intentions differed significantly by their daughter's access to healthcare prior to the 2-year follow-up, but not for the 12 months prior to the 54-month follow-up.

For girls and boys, maternal HPV vaccination intentions differed significantly by their child uptake and timing of all doses of primary infant immunisation series and uptake of immunisations (full or partial) due at age 15 months and age 4 years.

Limitations and future directions

Strengths and weaknesses of the study

This project was completed within a cohort study in which many research constructs were considered. The cohort study was not designed to be specifically about HPV immunisation, nor more generally about immunisation. This decreased the potential for immunisation-related biases in terms of participation in the cohort or in responses to the questions asked about immunisation and specifically about HPV intentions. However, it has limited the scope of the investigation reported here.

Of note, no further questions on HPV vaccines were asked, including why mothers were for, against or undecided about HPV vaccination for 8-year-old girls or boys. Factors that have been identified in studies in the US and Europe include parental perceptions that they lack information about the vaccine, safety concerns about the vaccine, mistrust of health authorities and health workers and of new vaccines, concerns about the potential impact of the vaccine on their child's sexual behaviours, a perceived low risk of HPV infection, social influences and access to healthcare.^{14,30,31} Parents consistently cite healthcare professional recommendations as one of the most important factors in parental decision making regarding their child receiving the HPV vaccine.³⁰

The study was limited by its sample size. This resulted in us being unable to make all the comparisons intended in the stratified analyses.

Multiple comparisons were made, in part because the outcome variable had four categories. This increases the potential risk of type 1 errors (false positive results).

The analytical sample included 4,448 children, with the cohort size at enrolment being 6,853 children. In comparison with the children who participated in the eight-year data-collection-wave, the children who did not participate in this data-collection-wave had mothers who were younger, had lower educational status, identified with an ethnic group other than European and were more likely to live in areas of high deprivation. Missing data will also have introduced bias, however we minimised the effect of this by only including variables with small amounts of missing data.

The demographic differences between the cohort at enrolment compared with those cohort members included in the analytical sample results in bias, although none related to child sex.

As a result of the smaller proportion of mothers whose daughters were of Māori or Pacific ethnicity in the analytical sample, it is likely that the proportion of mothers of daughters in the complete cohort who were undecided about HPV vaccination and the proportion who had not heard about the HPV vaccine would

have been larger; and the proportion of mothers who had decided not to vaccinate their daughters would have been smaller.

As a result of the smaller proportion of mothers whose sons were of Pacific ethnicity in the analytical sample, it is likely that the proportion of mothers of sons in the complete cohort who had decided not to vaccinate their sons against HPV and the proportion who were undecided about HPV vaccination would have been smaller.

As a result of the smaller proportion of mothers whose sons were of Māori ethnicity in the analytical sample, it is likely that the proportion of mothers of sons in the complete cohort who had not heard about the HPV vaccine would have been larger.

Findings from this study in relation to other studies

This study of maternal intentions sought these at a younger child age than published studies from other countries and well before the scheduled age of HPV vaccine receipt in New Zealand of 11 to 12 years.³² In this context, the findings about vaccination intentions for the population being studied are not influenced by some of the children having already received HPV vaccine. In such a scenario, parental intentions can be about their intent for their child to complete the HPV vaccine series rather than to initiate it. Intentions for these two actions are not necessarily the same.¹⁴

Mothers who had decided not to vaccinate girls against HPV compared with mothers who had decided to vaccinate girls against HPV

Mothers whose daughters were of Māori or Pacific ethnicity or whose sons were of Pacific ethnicity were less likely to have decided not to vaccinate their daughters against HPV. These intentions are consistent with earlier data on vaccination intentions from this cohort, which showed that maternal Pacific ethnicity was associated with increased odds of intending full infant vaccination.¹⁸

For mothers of both daughters and sons, receipt of previous scheduled vaccines was associated with the intentions for their child to receive the HPV vaccine. Thus, while there are HPV-specific factors associated with parental intent, there are also more general vaccine-related determinants which also apply to HPV vaccine. It is important to consider the delivery of the childhood vaccine series as an integrated component of care rather than considering each vaccine and vaccine preventable disease separately. Numerous previous examples of this exist, for example the impact of concerns about MMR vaccine on the update of other components of childhood immunisation schedules.³³

Lower maternal education status was associated with increased odds of having decided not to vaccinate daughters or sons. The maternal education – HPV vaccine intention relationship differs between countries. The associations seen in

this study are consistent with findings reported from the US.³⁴ In contrast, in Canada and Norway, higher maternal education has been shown to be associated with a decreased odds of initiating HPV vaccination for daughters.^{35,36}

Parental religious beliefs appear to have stronger relationships with intentions for HPV vaccine relative to other vaccines in the childhood schedule. Some religious practices are associated with an increased likelihood of perceptions of non-severity of 'childhood' diseases, fear of vaccine side-effects, and the need for more information about the risk of vaccination.³⁷ In addition, some religious practices are associated specifically with negative perceptions about the HPV vaccine because of sexual behaviour-related concerns.³⁸ The relationship with religion is complex through, with for example negative associations between Christian non-Catholic religions and intentions for HPV vaccination in Argentina,³⁸ but parents with a Catholic religious faith being more likely than non-religious parents to have their daughters receive HPV vaccine in the US.³⁹

In this study stronger parental religious beliefs were associated with an increased likelihood of having decided to not vaccinate daughters (if they belonged to a church at the 9-month follow-up) and sons (if mothers attended religious services at least monthly at the 2-year follow-up compared with non-religious mothers). More detailed exploration of specific religious associations with HPV vaccination in New Zealand would appear necessary for strategies to be developed to encourage HPV vaccine uptake by children of parents with stronger religious beliefs.

Mothers who were undecided about HPV vaccination for girls compared with mothers who had decided to vaccinate girls against HPV

Vaccine hesitancy, defined as being undecided about but not necessarily opposed to a vaccine, has been associated with outbreaks of vaccine preventable diseases in several countries in recent decades.⁴⁰ Vaccine hesitancy is believed to be one of the strongest reasons for low uptake of the HPV vaccine.⁴¹

In this cohort, mothers were more likely to be undecided about HPV vaccination for their daughters and sons if they had not received immunisations (full or partial) due at age 15 months; more likely to be undecided for their daughters if they had lower education status and more likely to be undecided for their sons if their son was their first-born child. Mothers whose sons were of Pacific ethnicity were less likely to be undecided about HPV vaccination compared with mothers of non-Māori non-Pacific boys.

Despite vaccine safety surveillance data in the US showing decreasing rates of HPV vaccine-associated adverse events in recent years, rates of parental refusal of HPV vaccine for their children because of safety concerns is increasing.⁴² Decreases in uptake of HPV vaccine in several countries in recent years for example Japan (2013),⁴³ Ireland (2014),⁴⁴ Denmark (2015),⁴⁵ and Colombia (2015),⁴⁶ have been attributed to vaccine safety concerns.

Addressing safety concerns regarding HPV vaccine appears necessary for caregivers to have greater confidence in HPV vaccine.⁴² Healthcare provider recommendations for and discussion of HPV vaccine,⁴⁷ and increasing public awareness appear to be key to improving uptake of HPV vaccine in children.⁴⁸

Mothers who had not heard about the HPV vaccine compared with mothers who had decided to vaccinate their child against HPV

Mothers whose daughters were of Pacific ethnicity were more likely to report that they had not heard about the HPV vaccine compared with mothers of non-Māori non-Pacific girls. In addition, the likelihood of mothers stating that they had not heard about the HPV vaccine was greater if their daughters had not received immunisations (full or partial) due at age 15 months. Mothers with lower educational status at the 72-month follow-up were also more likely to report that they had not heard of the HPV vaccine, as were mothers aged under 35 years at the 8-year follow-up compared with mothers aged 45 years or over.

Mothers whose sons were of Māori ethnicity were more likely to report that they had not heard about the HPV vaccine compared with mothers of non-Māori non-Pacific boys, as were mothers whose sons were their first-born children. The likelihood of mothers stating that they had not heard about the HPV vaccine was also greater if their sons had not received immunisations (full or partial) due at age 15 months. In addition, mothers who were not born in New Zealand were more likely to report that they had not heard of the HPV vaccine, as were mothers with lower educational status at the 72-month follow-up.

Some mothers will only have known the HPV vaccine by the brand name Gardasil. This might have affected responses to the HPV intentions questions option 4 "I have never heard of the HPV vaccine". However, the mothers reporting not having heard about the HPV vaccine varied by maternal demographics which may be an indicator of deficits in the currently available resources that parents in New Zealand can access about HPV vaccination for their children. Differences in awareness of HPV and HPV vaccine by ethnic group and English proficiency have been reported from the US.⁴⁹

Meaning of the study: possible mechanisms and implications for clinicians or policymakers

Maternal responses regarding HPV vaccination intentions for 8-year-olds

The overall low percentage of mothers with intentions for their child at age 8 years to receive the HPV vaccine, relative to the HPV vaccine coverage being sought at age 11-12 years, is noteworthy. Parental intentions for childhood vaccinations do not equate with actual receipt of vaccines by children. As shown previously in this cohort, antenatal parental intentions for the 6-week, 3-month, 5-month immunisation series were highest for those women living in the most

deprived quintile of neighbourhoods in New Zealand, but completion of this primary immunisation series was lowest for the children of these women.⁵⁰

Healthcare practice and practitioner characteristics explain much of the variance in immunisation coverage achieved for different primary care practices in New Zealand.⁵¹ The child needing to see the GP/doctor during the 12 months prior to 54-month follow-up but not being able to, was independently associated with increased odds of deciding not to have daughters vaccinated in this study. Thus, variance in healthcare practice, using access as the example primary care characteristic, is associated with parental immunisation intentions.

By child's sex

Maternal intentions for their 8-year-old child to receive the HPV vaccine differed by their child's sex, being lower for boys than girls but were low for both sexes (boys 32%, girls 41%). A larger proportion of mothers were undecided about HPV vaccination for their sons (50%) than their daughters (43%) but the proportion who were undecided was high for both sexes.

The proportion of mothers of the children in this cohort intending for their child to receive HPV vaccination (36%) was considerably lower than the proportion who had antenatal intentions for their infant to receive all vaccines scheduled during infancy (81%).¹⁸ And the proportion of mothers who were undecided about HPV vaccine was considerably higher than the proportion who had been undecided about the vaccines given during infancy (46% vs 13%).¹⁸

Initiation and completion of the HPV vaccination series is dependent upon parental intent.¹⁴ The factors that determine intentions to initiate HPV vaccination and intentions to complete HPV vaccination once initiated are not the same.¹⁴

Lack of parental intent for HPV vaccine to be given to their children is a major current public health concern. The parents of 82,297 adolescents 13 to 17 years old in the US participated in the 2017-2018 National Immunization Survey.¹⁴ In the US, HPV vaccination is recommended at age 11 to 12 years but can start at age nine years.⁵² Thirty-seven percent of the children in the survey were unvaccinated and 11% had received only one dose of HPV. The parents of 58% of the unvaccinated adolescents had no intention for their child's HPV vaccination series to be initiated.¹⁴

In this US study, the most common reason for lack of intent to initiate the vaccine were safety concerns.¹⁴ Having received a recommendation from a healthcare provider was associated with increased odds of parental intent to initiate HPV vaccination.¹⁴ However, while 46% of parents of unvaccinated children had reported receiving a recommendation for HPV vaccination from a healthcare professional, 61% of those who had received this recommendation had no intention to initiate HPV vaccination.¹⁴ Lack of a recommendation from a healthcare provider was the most frequently cited reason for not intending to

complete the HPV vaccination series for those children who had received one dose of HPV vaccine.¹⁴

Unanswered questions and future research

Internationally, coverage of the HPV vaccination remains low. For example, the US Centers for Disease Control estimated that in 2018 nearly half of the adolescents who were eligible for the HPV vaccination had not completed this vaccine series, and 32% were unvaccinated.⁵³ Parental vaccination behaviour is the primary focus for vaccine-promoting interventions.^{54,55} Data from Europe indicates that the determinants of confidence in HPV vaccine vary between countries and population groups.³¹ There is a need to develop context-specific interventions to improve confidence in HPV vaccination and for community specific engagement strategies to be developed.

Actual HPV vaccination uptake is frequently lower than intended uptake.⁵⁶ Shared decision making between the child and parent is believed to be important, with discordance in intention between the child and parent believed to result in lower uptake.⁵⁷ However, a recently published study from Amsterdam, showed that for Dutch parent-daughter dyads, both the parent and the child intentions were associated with HPV vaccine uptake, whereas for non-Dutch parent-child dyads only the child's intentions were associated with vaccine uptake.⁵⁷ Thus, the role of the child needs to be considered in future interventions that seek to improve uptake. It will be important to understand the relative importance of parental and child intentions for parent-son dyads and by ethnic group and parental country of birth.

Conclusions and recommendations

- The maternal intentions for HPV vaccination of their 8-year-old children differed significantly by their child's sex, with the proportion of mothers who stated they would vaccinate their 8-year-olds against HPV being higher for girls than boys, whereas the proportion of mothers who were undecided about HPV vaccination was higher for boys than girls.
- Mothers whose daughters were of Māori or Pacific ethnicity or whose sons were of Pacific ethnicity were less likely to have decided not to vaccinate their child against HPV.
- While there are HPV specific factors associated with parent intent, there are also more general vaccine-related determinants which also apply to HPV vaccine.
- Addressing safety concerns regarding HPV vaccine appears necessary for caregivers to have greater confidence in HPV vaccine. Healthcare provider recommendations for and discussion of HPV vaccine, and increasing public awareness are key to improving uptake of HPV vaccine in children.
- There appear to be deficits in the currently available resources that parents in New Zealand can access about HPV vaccination for their children.
- Before the birth of their child, parents in New Zealand have high intentions for immunisation of their children with only 2% of future mothers intending that their child will not be immunised. Experiences during childhood of difficulties in accessing primary care for their child are associated with increased odds of parents deciding that their children will not receive the HPV vaccine.

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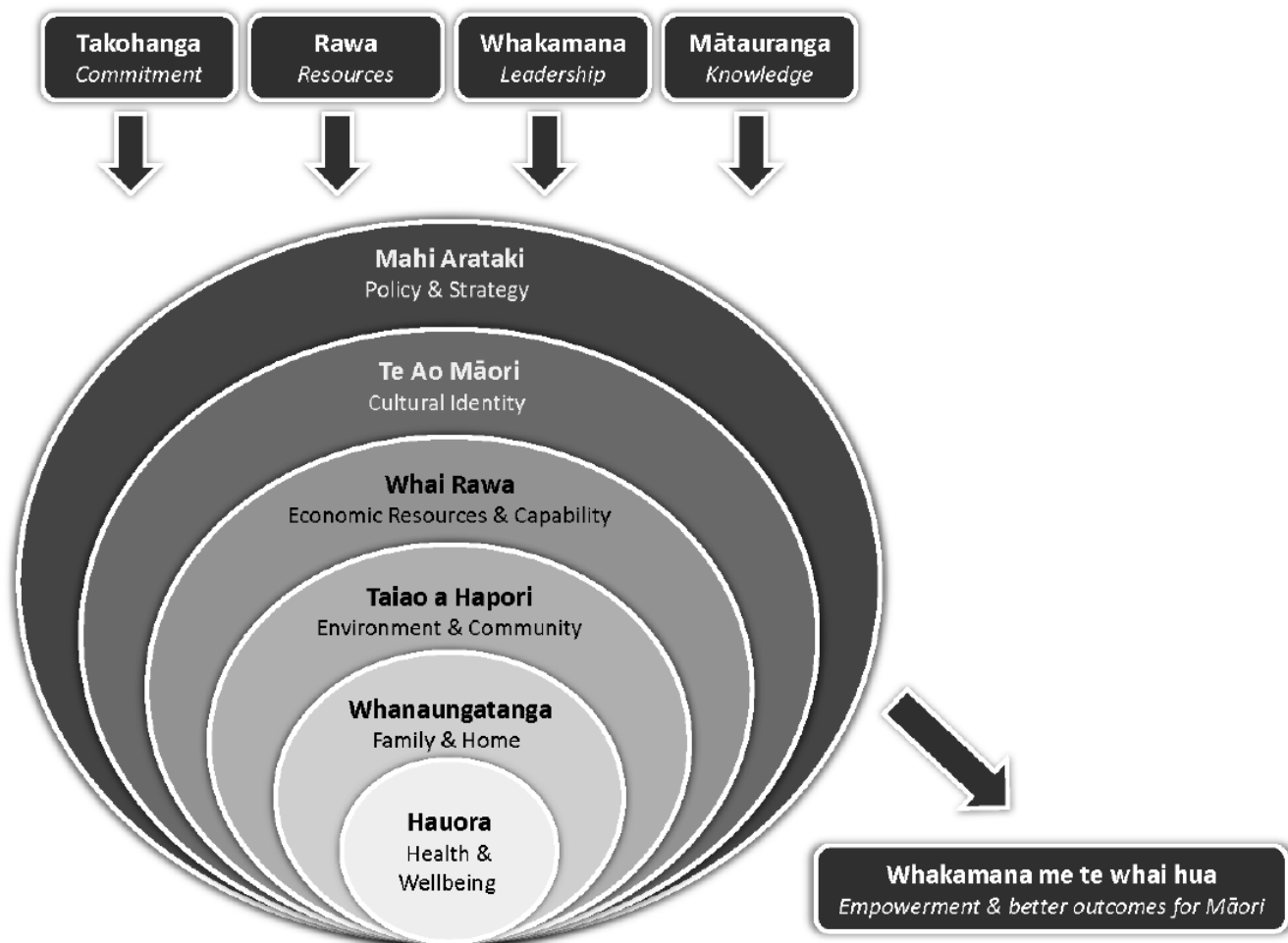
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Appendix 1: Te Anga o ngā Horopaki Māori: *A conceptual framework for considering Māori circumstances or environments.*

Appendix Figure 1. Te Anga o ngā Horopaki Māori: A conceptual framework for considering Māori lived realities.

Comprises six interconnected domains: Mahi Arataki (Policy and strategy); Te Ao Māori (Cultural identity); Whai Rawa (Economic resources and capability); Taiao a Hapori (Environment and community); Whanaungatanga (Family and home); and Hauora (Health and wellbeing).²⁵



Application for the investigation of factors related to whether or not the child's caregiver has decided yet if they will have their child immunised with the HPV vaccine

Te Anga o ngā Horopaki Māori Domain	<i>Growing Up in New Zealand</i> research domain	Constructs examined	Tools and variables used
Mahi Arataki (Policy and Strategy)	Policy and strategy	Have you decided yet if you will have your child fully immunised?	Mother <ul style="list-style-type: none"> • Antenatal: PRG34_AM Partner <ul style="list-style-type: none"> • Antenatal: PRG34_AP
	Knowledge resources	Information about immunisation	Antenatal information sources about infant immunisations Mother <ul style="list-style-type: none"> • Antenatal (PRG35_AM, NPRG36_1_AM, NPRG36_2_AM, NPRG36_3_AM, NPRG36_4_AM, NPRG36_5_AM, NPRG36_6_AM, NPRG36_7_AM, NPRG36_8_AM, NPRG36_9_AM, NPRG36_10_AM, NPRG36_11_AM, NPRG36_12_AM, NPRG36_13_AM, PRG37_AM, NPRG38_1_AM, NPRG38_2_AM, NPRG38_3_AM, NPRG38_4_AM, NPRG38_5_AM, NPRG38_6_AM, NPRG38_7_AM, NPRG38_8_AM, NPRG38_9_AM, NPRG38_10_AM, NPRG38_11_AM, NPRG38_12_AM, NPRG38_13_AM) Partner <ul style="list-style-type: none"> • Antenatal: (PRG35_AP, NPRG36_1_AP, NPRG36_2_AP, NPRG36_3_AP, NPRG36_4_AP, NPRG36_5_AP, NPRG38_6_AP, NPRG36_7_AP, NPRG36_8_AP, NPRG36_9_AP, NPRG36_10_AP, NPRG36_11_AP, NPRG36_12_AP, NPRG36_13_AP, PRG37_AP, NPRG38_1_AP, NPRG38_2_AP, NPRG38_3_AP, NPRG38_4_AP, NPRG38_5_AP, NPRG38_6_AP, NPRG38_7_AP, NPRG38_8_AP, NPRG38_9_AP, NPRG38_10_AP, NPRG38_11_AP, NPRG38_12_AP, NPRG38_13_AP)
Te Ao Māori (Cultural Identity)	Cultural identity	Parental country of birth and when first arrived in NZ	<ul style="list-style-type: none"> • Antenatal: Mother: (OL1_AM, AGETONZ_AM) Partner: (OL1_AP, AGETONZ_AP, TIMEINNZ_AP)

	Parental country of residence	<ul style="list-style-type: none"> 2-year: Mother: (RESIDENTIALCOUNTRY_Y2CO, RESIDENTIALCOUNTRY_Y2M) Partner: RESIDENTIALCOUNTRY_Y2P 54-month: COUNTRY_M54M 72-month: COUNTRYM_M72M 8-year: COUNTRYMGP_Y8M 	
	Child's usual country of residence	<ul style="list-style-type: none"> 54-month: COUNTRY_M54CM 72-month: COUNTRYC_M72M 8-year: COUNTRYCGP_Y8CM 	
	Ethnicity	Parental ethnicity	<ul style="list-style-type: none"> Antenatal Mother: (ETH4_E_AM, ETH4_M_AM, ETH4_P_AM, ETH4_A_AM, ETH4_MELA_AM, ETH4_O_AM, ETH4_NZDER_AM, SELF_PROETH_AM) Partner: (ETH4_E_AP, ETH4_M_AP, ETH4_P_AP, ETH4_A_AP, ETH4_MELA_AP, ETH4_O_AP, ETH4_NZDER_AP, SELF_PROETH_AP)
		Child prioritised ethnicity & child's main ethnic group (reported by mother) -Māori, Pacific	<ul style="list-style-type: none"> CSELF_PROETH_M54CM, CETH1_M_M54CM, CETH1_P_M54CM
		Religion and spirituality	<ul style="list-style-type: none"> 2-year: Mother: (RA1_Y2M, NRA2_Y2M, RA3_Y2M, RA4_Y2M, RA5_Y2M) Partner: RA1_Y2P, NRA2_Y2P, RA3_Y2P, RA4_Y2P, RA5_Y2P
		Type of school child will attend	<ul style="list-style-type: none"> 54-month: (SS3_M54M, SS4_1_M54M, SS4_2_M54M, SS4_3_M54M, SS4_4_M54M, SS4_6_M54M, SS4_7_M54M, SS4_8_M54M, SS4_9_M54M, SS4_97_M54M, SS4_99_M54M, SS4_98_M54M)
		Child attending primary school	<p>Attending primary school & reasons not attending primary school:</p> <ul style="list-style-type: none"> 72-month: (SS31_M72M, NSS32_M72M)
Type of primary school attending	<ul style="list-style-type: none"> 72-month: (SS35_1_M72M, SS35_2_M72M, SS35_3_M72M, SS35_4_M72M, SS35_5_M72M, SS35_6_M72M, SS35_7_M72M, SS35_8_M72M, SS35_9_M72M, SS35_10_M72M, SS35_11_M72M, SS35_97_M72M, SS35_99_M72M, SS35_98_M72M) 		

		How important were these factors when deciding which school your Growing Up in New Zealand study child/children attends? The school values align with our preferred religious practices or activities	<ul style="list-style-type: none"> 72-month: SS44_M72M
	Cultural heritage	Experiences of racist or discriminatory sentiments or behaviour or being treated unfairly based upon gender, age, spiritual beliefs, weight, skin colour, ethnicity, sexual orientation, socioeconomic status, physical disability, for having children, marital status, other.	<ul style="list-style-type: none"> Antenatal: Mother: (ETH9_1_AM, ETH9_2_AM, ETH9_3_AM, ETH9_4_AM) Partner: (ETH8_1_AP, ETH8_2_AP, ETH8_3_AP) 2-year: Mother: (NDIS0_1_Y2M, NDIS0_2_Y2M, NDIS0_3_Y2M, NDIS0_4_Y2M, NDIS0_5_Y2M, NDIS0_6_Y2M, NDIS0_7_Y2M, NDIS0_8_Y2M, NDIS0_9_Y2M, NDIS0_10_Y2M, NDIS0_11_Y2M, NDIS0_13_Y2M, NDIS0_97_Y2M, NDIS1_6_Y2M, NDIS2_6_Y2M, NDIS3_6_Y2M, NDIS4_6_Y2M, NDIS5_6_Y2M, NDIS6_6_Y2M, NDIS8_6_Y2M, NDIS10_6_Y2M, NDIS11_6_Y2M, NDIS12_6_Y2M) Partner: (DIS0_1_Y2P, NDIS0_2_Y2P, NDIS0_3_Y2P, NDIS0_4_Y2P, NDIS0_5_Y2P, NDIS0_6_Y2P, NDIS0_7_Y2P, NDIS0_8_Y2P, NDIS0_9_Y2P, NDIS0_10_Y2P, NDIS0_11_Y2P, NDIS0_13_Y2P, NDIS0_97_Y2P, NDIS1_6_Y2P, NDIS2_6_Y2P, NDIS3_6_Y2P, NDIS4_6_Y2P, NDIS5_6_Y2P, NDIS6_6_Y2P, NDIS8_6_Y2P, NDIS10_6_Y2P, NDIS11_6_Y2P, NDIS12_6_Y2P)

Whai Rawa (Economic Resources and Capability)	Economic resources and capability	Socioeconomic deprivation	New Zealand Index of Deprivation (NZDep06) ⁵⁸ - combines nine socioeconomic characteristics from 2006 census data collected at aggregations of approximately 100 people and assigned to individual households based on geo-coded address data NZDep2006 <ul style="list-style-type: none"> • Antenatal: Mother: NZDEP2006_AM Partner: NZDEP2006_AP • 9-month: Mother: NZDEP2006_M9M Partner: NZDEP2006_M9P • 2-year: Mother: NZDEP2006_Y2M Partner: NZDEP2006_Y2P NZDep2013 <ul style="list-style-type: none"> • 54-month: NZDEP2013_M54M • 72-month: NZDEP2013_M72M • 8-year: DHBGP_2013_Y8M
			Not enough money for food, heating, clothing, food grants/banks, charity <ul style="list-style-type: none"> • 54-month: (DP1_M54M, DP2_M54M, DP3_M54M, DP4_M54M, DP5_M54M, DP6_M54M)

	Access to organisations and services	Rurality and DHB	<p>Rurality code</p> <ul style="list-style-type: none"> • Antenatal: Mother: RURALITYGP_AM Partner: RURALITYGP_AP • 9-month: Mother: RURALITYGP_M9M Partner: RURALITYGP_M9P • 2-year: Mother: RURALITYGP_Y2M Partner: RURALITYGP_Y2P • 54-month: RURALITYGP13_M54M • 8-year: RURALITYGP_2013_Y8M <p>District health board of maternal domicile</p> <ul style="list-style-type: none"> • Antenatal: Mother: DHB_AM Partner: DHBGP_AP • 9-month: Mother: DHB_M9M Partner: DHB_M9P • 2-year: Mother: DHB_Y2M Partner: DHBGP_Y2P • 54-month: DHB_2013_M54M • 8-year: DHBGP_2013_Y8M
		Availability and access to health services including delay in access to maternity care ⁵⁹	<p>Developed within <i>Growing Up in New Zealand</i></p> <ul style="list-style-type: none"> • Antenatal GP and LMC care: (PRG17_AM, PRG18_AM, PRG19_AM, PRG20_AM, PRG21_AM, PRG22_AM, PRG23_AM, PRG24_AM, NPRG25_1_AM, NPRG25_2_AM, NPRG25_3_AM, NPRG25_4_AM, NPRG25_5_AM, PRG26_AM, PRG27_AM) • Any difficulties accessing GP for child at 9-months (HC1_M9M, NHC4_1_M9M, NHC4_2_M9M, NHC4_3_M9M, NHC4_4_M9M, NHC4_97_M9M, HC5_M9M) • Use of and access to GP for child at age 2-years (GP2_Y2CM, GP4_Y2CM) (NHC1_Y2M, HC3_Y2M, NHC8_Y2M, HC9_Y2M, HC10_Y2M, HC11_Y2M, HC11_YEARS_Y2M, HC11_MONTHS_Y2M, NHC12_Y2M, HC5_Y2M) • Use of and access to GP for child at age 54-months (GP12_M54CM, GP21_M54CM, GP21S_M54CM, GP4_M54CM, GP5_M54CM, GP6_M54CM)

	Education	Parent education	<p>Statistics New Zealand 2006 national census⁶⁰ Statistics New Zealand 2008 General Social Survey⁶¹</p> <ul style="list-style-type: none"> • Antenatal: Highest completed secondary school qualification Mother: (NNE18_2_AM) Partner: (EDALL_AP) • 72-month: new educational qualification since your Growing Up in New Zealand study child was/children were born? (ED10_M72M, ED11_1_M72M, ED11_2_M72M, ED11_3_M72M, ED11_4_M72M, ED11_5_M72M, ED11_6_M72M, ED11_7_M72M, ED11_97_M72M, ED11_99_M72M, ED11_98_M72M)
Taiao me te Hapori (Environment and Community)	Community belonging	Parental community belonging	<ul style="list-style-type: none"> • Some people feel they belong to a community because of things like family ties, a school, where they live or maybe a church or club do you feel you belong to any communities at the moment? • Antenatal: Mother (NE17_AM) • What is the community or communities of people to which you belong based around: religion? • Antenatal: Mother (NNE18_2_AM) Partner: NNE18_2_AP • Do you belong to any of the social networks and groups or organisations: Church spiritual group? • 9-months: Mother: NBL7_2_M9M Partner: NBL7_2_M9P
Whanaungatana (Family and Home)	Parental relationship dynamics	Partner	<p>Current partner</p> <ul style="list-style-type: none"> • Antenatal: Mother: REL1_AM • 9-month: Mother PQ5_M9M Partner: PQ5_M9P • 2-year: PQ5_Y2M • 54-month: PQ5_M54M <p>Does partner live with you and your children</p> <ul style="list-style-type: none"> • 54-month: PQ6_M54M <p>In relationship with same partner as at age 2-years?</p> <ul style="list-style-type: none"> • 54-month: PQ5A_M54M

	Household dynamics	Number & relationship of household members	<ul style="list-style-type: none"> • Antenatal: How many people are in the household, and their relationship Mother (HH2_AM, HHST_AM) Partner (HH2_AP, REL2_AP) • 72-months includes age of children: (HH46_M72M, HH46S_M72M, HHA1_1_M72M, HHA1_2_M72M)
		Household mobility	<ul style="list-style-type: none"> • 23-month: Moved house & number of moves since your CHILD/CHILDREN was 9 months old: (NE19A_M23M, NE19A_NUMBEROFMOVES_M23M) • 72-month: Moved house since age 54-months: NE31_M72M
Hauora (Health and Wellbeing)	Health and wellbeing	Parental health	<p>Maternal age</p> <ul style="list-style-type: none"> • At antenatal interview (AGE_AM) • At 9 month interview (AGE_M9M) • At 24 month interview (AGE_Y2M) • At 54-month interview (AGE_M54M) • At 72-month: AGE_M72M • At 8-year: AGE_Y8M <p>Maternal gender</p> <ul style="list-style-type: none"> • At 54-month interview (GENDER_M54M)
			<p>Partner age</p> <ul style="list-style-type: none"> • At antenatal interview (AGE_AP) • At 9-month interview (AGE_M9P) • At 24-month interview (AGE_Y2P)
	Health status and behaviours	Health behaviours	<ul style="list-style-type: none"> • Were the 6-week, 3-month and 5-month immunisations all given and were they given on time? (VAC_ALL6_NUM_NIR1, VAC_ALL6_ONTIME_NIR1) • 2-year immunisations received, and reasons not received (CH61_Y2CM, CH62_Y2CM, NCH64_8_Y2CM) • 4-year immunisations received and reasons 4-year immunisations not received (CH107_M54CM, CH109_1_M54CM, CH109_2_M54CM, CH109_3_M54CM, CH109_4_M54CM, CH109_5_M54CM, CH109_6_M54CM, CH109_7_M54CM, CH109_8_M54CM, CH109_9_M54CM, CH109_10_M54CM, CH109_11_M54CM, CH109_12_M54CM, CH109_13_M54CM, CH109_14_M54CM, CH109_15_M54CM, CH109_97_M54CM, CH109_99_M54CM, CH109_98_M54CM)

	Child health		<ul style="list-style-type: none"> • Antenatal: ETH9_4_AM • CHILD_AM: (Is this your first child?) • Child sex: GENDER_PDL • 72-months: (HHG1_1_M72M, HHG1_2_M72M)
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Appendix 2: Variables of interest

The content presented in this appendix (including any typos!) is as extracted from the GUINZ external data dictionaries which are available here: <https://www.growingup.co.nz/available-data-2>

1.1 Child: 9-month data

Questionnaire number	Question	Variable name	Variable type	Notes
	Child ID	IDN_CHILD	Identification key	Randomly generated child ID. Allows linking to other datasets
Q2	Baby's gender	GENDER_PDL	Raw	Harmonised information with perinatal data
	Mother ID (at 6 week data collection)	IDN_W6M	Identification key	Randomly generated mother ID at six week interview. Allows linking to other datasets
	Child's age at 6 weeks data collection	AGE_WK6	Derived	Age in weeks
	Mother ID (at 9 month data collection)	IDN_M9M	Identification key	Randomly generated mother ID at nine month interview. Allows linking to other datasets
	Partner ID (at 9 month data collection)	IDN_M9P	Identification key	Randomly generated partner ID at nine month interview. Allows linking to other datasets
	Child's age at 9 month data collection	AGE_M9CM	Derived	Age in weeks
	Were the 6-week, 3-month and 5-month immunisations all given?	VAC_ALL6_NUM_NIR1	Derived	Participants were linked with National Immunisation Register data and then the information was derived.
	Were the 6-week, 3-month and 5-month immunisations all given on time?	VAC_ALL6_ONTIME_NIR1	Derived	Participants were linked with National Immunisation Register data and then the information was derived.

1.2 Child: 2-year data

Questionnaire number	Question	Variable name	Variable type	Notes
	Child ID	IDN_CHILD	Identification key	Randomly generated child ID. Allows linking to other datasets
	Mother ID (Linkable to other datasets)	IDN_Y2CM	Identification key	Randomly generated mother ID at 24 month interview. Allows linking to other datasets
	Interview date	AGE_Y2CM	Derived	Values derived from interview date (Interview_Date_Y2CM) and date of birth (CDOB_PDL) and converted to months
C101	When child is sick and goes to the doctor, how often do you see [his/her] regular doctor?	GP2_Y2CM	Raw	
C103	In the last 12 months, has there been any time when child needed to see a GP or family doctor about [his/her] health, but didn't get to see any doctor at all?	GP4_Y2CM	Raw	
C223	Has your child received the immunisations due at age 15 months (this includes partial or full immunisations)?	CH61_Y2CM		
C224	Did child receive all the immunisations due at 15 months, or just some of them?	CH62_Y2CM	Raw	
C226	Which of the following were reasons for your child not having been immunised: concerns about the risk of side-effects and complications from immunisations?	NCH64_8_Y2CM	Raw	
	Partner ID (Linkable to other datasets)	IDN_Y2CP	Identification key	Randomly generated partner ID at 24 month interview. Allows linking to other datasets
	Age of child at 24 month child observations interview in months	CHILD_AGE_Y2CO	Derived	
	Country of residence	RESIDENTIALCOUNTRY_Y2CO	Categorised	Countries other than New Zealand grouped as 'Other'

1.3 Child: 54-month data

Questionnaire number	Question	Variable name	Variable type	Notes
	Child ID at 54 month interview	IDN_CHILD	Identification key	Randomly generated child ID at 54 month interview. Allows linking to other datasets
	Mother ID at 54 month interview (Linkable to other datasets)	IDN_M54M	Identification key	Randomly generated mother ID at 54 month interview. Allows linking to other datasets
0.1	Relationship to child	PQ103_M54CM	Categorised	Mothers other than Biological mother grouped as 'Other (Please specify)'
0.2	Child's usual country of residence	COUNTRY_M54CM	Categorised	Countries other than New Zealand grouped as 'Other countries'
	Ceth1-level 1. Prioritised ethnicity (reported by mother)?	CSELF_PROETH_M54CM	Re-classified	Level 1 -single response ethnicity
	Ceth1-level 1. Child's main ethnic group (reported by mother) -Māori?	CETH1_M_M54CM	Re-classified	Re-classified to Statistics New Zealand Level 1 classification of ethnicity
	Ceth1-level 1. Child's main ethnic group (reported by mother) -Pacific?	CETH1_P_M54CM	Re-classified	Re-classified to Statistics New Zealand Level 1 classification of ethnicity
3.1	Which practice (or doctor) is ⁶² enrolled with?	GP12_M54CM	Raw	
3.2	In the past 12 months, how many times has ⁶² seen a GP or family doctor?	GP21_M54CM	Raw	
3.2.1	In the past 12 months, how many times has ⁶² seen a GP or family doctor? (Specify)	GP21S_M54CM	Categorised	Categorise upper extreme at 25+
3.4	In the last 12 months, has there been any time when ⁶² needed to see a GP or family doctor about {his/her} health, but didn't get to see any doctor at all?	GP4_M54CM	Raw	
3.5	How many times has this happened in the past 12 months?	GP5_M54CM	Raw	

Questionnaire number	Question	Variable name	Variable type	Notes
3.6	The last time ⁶² was not able to see a GP when {he/she} needed to, what was the main reason {he/she} wasn't able to see a GP?	GP6_M54CM	Categorised	Combined low cell counts of 'Lack of Childcare' with 'Other(Please specify)'
6.1	Has ⁶² received the immunisations due at four years (this includes partial or full immunisation)?	CH107_M54CM	Raw	
6.3.1	For which of the following reasons was ⁶² not immunised, or only partially immunised at four years - child unwell when immunisations due?	CH109_1_M54CM	Raw	
6.3.2	For which of the following reasons was ⁶² not immunised, or only partially immunised at four years - inconvenient clinic hours?	CH109_2_M54CM	Raw	
6.3.3	For which of the following reasons was ⁶² not immunised, or only partially immunised at four years - unable to get appointment at GP practice?	CH109_3_M54CM	Raw	
6.3.4	For which of the following reasons was ⁶² not immunised, or only partially immunised at four years - unable to afford visit to GP practice?	CH109_4_M54CM	Raw	
6.3.5	For which of the following reasons was ⁶² not immunised, or only partially immunised at four years - lack of transport to GP practice?	CH109_5_M54CM	Raw	
6.3.6	For which of the following reasons was ⁶² not immunised, or only partially immunised at four years - nurse advised immunisation be delayed or not given?	CH109_6_M54CM	Raw	
6.3.7	For which of the following reasons was ⁶² not immunised, or only partially immunised at four years - doctor advised immunisation be delayed or not given?	CH109_7_M54CM	Raw	
6.3.8	For which of the following reasons was ⁶² not immunised, or only partially immunised at four years - concerns about the risk of side-effects and complications from immunisations?	CH109_8_M54CM	Raw	

Questionnaire number	Question	Variable name	Variable type	Notes
6.3.9	For which of the following reasons was ⁶² not immunised, or only partially immunised at four years - concerns regarding child's immune system?	CH109_9_M54CM	Raw	
6.3.10	For which of the following reasons was ⁶² not immunised, or only partially immunised at four years - diseases not severe enough to justify immunisation?	CH109_10_M54CM	Raw	
6.3.11	For which of the following reasons was ⁶² not immunised, or only partially immunised at four years - concerns about the effectiveness of immunisations ?	CH109_11_M54CM	Raw	
6.3.12	For which of the following reasons was ⁶² not immunised, or only partially immunised at four years - having or knowing a child thought to have suffered an adverse effect from an immunisation?	CH109_12_M54CM	Raw	
6.3.13	For which of the following reasons was ⁶² not immunised, or only partially immunised at four years - work commitments?	CH109_13_M54CM	Raw	
6.3.14	For which of the following reasons was ⁶² not immunised, or only partially immunised at four years - difficult to organise care for other children?	CH109_14_M54CM	Raw	
6.3.15	For which of the following reasons was ⁶² not immunised, or only partially immunised at four years - intend to but not yet organised?	CH109_15_M54CM	Raw	
6.3.97	For which of the following reasons was ⁶² not immunised, or only partially immunised at four years - other specify?	CH109_97_M54CM	Raw	
6.3.99	For which of the following reasons was ⁶² not immunised, or only partially immunised at four years - DK	CH109_99_M54CM	Raw	
6.3.98	For which of the following reasons was ⁶² not immunised, or only partially immunised at four years - Ref	CH109_98_M54CM	Raw	

1.4 Child: 8-year data

Questionnaire number	Question	Variable name	Variable type	Notes
	Child ID at 8 years interview (linkable to other datasets)	IDN_CHILD	Identification key	Randomly generated child ID at 8 years interview. Allows linking to other datasets
	Mother ID at 8 years interview (linkable to other datasets)	IDN_Y8M	Identification key	Randomly generated mother ID at 8 years interview. Allows linking to other datasets
	Child age at 8 year interview (months)	AGE_Y8CM	Derived	Child's age in years at 8 years interview
0.1	Please confirm that your relationship to ⁶² is (Choose one only)	PQ103_Y8CM	Categorised	Mothers other than Biological mother grouped as 'Other (Please specify)'
0.2	What is ⁶² 's usual country of residence?	COUNTRYCGP_Y8CM	Categorised	Countries other than New Zealand grouped as 'Other countries
6.13	Have you decided yet if you will have ⁶² immunised with the HPV vaccine? (Choose one only)	CH134_Y8CM	Raw	

1.5 Mother: Antenatal data

Questionnaire number	Question	Variable name	Variable type	Notes
ID	ID	IDN_AM	Identification key	Randomly generated mother ID at antenatal interview. Allows linking to other datasets
BG1	Age (years) of mother at antenatal interview	AGE_AM	Derived	Values converted to years. Extreme values categorised
PRG17	Did you have a family doctor or GP before you became pregnant?	PRG17_AM	Raw	
PRG18	Have you seen any family doctor or GP since you became pregnant?	PRG18_AM	Raw	
PRG19	Is this the same family doctor or GP as the one you saw before you became pregnant?	PRG19_AM	Raw	
PRG20	Do you know who the family doctor or GP will be for your baby after s/he is born?	PRG20_AM	Raw	
PRG21	Is this the same family doctor or GP as the one you saw before you became pregnant?	PRG21_AM	Raw	
PRG22	Do you have a lead maternity caregiver (LMC)?	PRG22_AM	Raw	
PRG23	Did you have a choice of midwife or other lead maternity caregiver (LMC) during this pregnancy?	PRG23_AM	Raw	
PRG24	How long did it take you to find a lead maternity caregiver (LMC) from the time you began looking?	PRG24_AM	Raw	
PRG25	What type of lead maternity caregiver (LMC) do you have: GP (family doctor)?	NPRG25_1_AM	Raw	
	What type of lead maternity caregiver (LMC) do you have: independent midwife?	NPRG25_2_AM	Raw	
	What type of lead maternity caregiver (LMC) do you have: hospital midwife?	NPRG25_3_AM	Raw	
	What type of lead maternity caregiver (LMC) do you have: obstetrician?	NPRG25_4_AM	Raw	
	What type of lead maternity caregiver (LMC) do you have: shared care GP and midwife?	NPRG25_5_AM	Raw	

Questionnaire number	Question	Variable name	Variable type	Notes
PRG26	Was this type of LMC your first choice?	PRG26_AM	Raw	
PRG27	If you had a choice, who would you most prefer as your primary carer in this pregnancy?	PRG27_AM	Raw	
PRG34	Have you decided yet if you will have your child fully immunised?	PRG34_AM	Raw	
PRG35	During this pregnancy have you received or been told any information that is encouraging you to immunise this child once s/he is born?	PRG35_AM	Raw	
PRG36	Where did you get this information from: family/whanau?	NPRG36_1_AM	Raw	
	Where did you get this information from: friends?	NPRG36_2_AM	Raw	
	Where did you get this information from: GP (family doctor)?	NPRG36_3_AM	Raw	
	Where did you get this information from: midwife?	NPRG36_4_AM	Raw	
	Where did you get this information from: obstetrician?	NPRG36_5_AM	Raw	
	Where did you get this information from: dietician/nutritionist?	NPRG36_6_AM	Raw	
	Where did you get this information from: alternative health practitioner?	NPRG36_7_AM	Raw	
	Where did you get this information from: antenatal class?	NPRG36_8_AM	Raw	
	Where did you get this information from: the internet?	NPRG36_9_AM	Raw	
	Where did you get this information from: radio?	NPRG36_10_AM	Raw	
	Where did you get this information from: TV?	NPRG36_11_AM	Raw	
	Where did you get this information from: books, magazines, newspapers?	NPRG36_12_AM	Raw	
	Where did you get this information from: other?	NPRG36_13_AM	Raw	
PRG37	During this pregnancy have you received or been told any information that is discouraging you to immunise this child once s/he is born?	PRG37_AM	Raw	
PRG38	Where did you get this information from: family/whanau?	NPRG38_1_AM	Raw	
	Where did you get this information from: friends?	NPRG38_2_AM	Raw	
	Where did you get this information from: GP (family doctor)?	NPRG38_3_AM	Raw	
	Where did you get this information from: midwife?	NPRG38_4_AM	Raw	
	Where did you get this information from: obstetrician?	NPRG38_5_AM	Raw	

Questionnaire number	Question	Variable name	Variable type	Notes
	Where did you get this information from: dietician/nutritionist?	NPRG38_6_AM	Raw	
	Where did you get this information from: alternative health practitioner?	NPRG38_7_AM	Raw	
	Where did you get this information from: antenatal class?	NPRG38_8_AM	Raw	
	Where did you get this information from: the internet?	NPRG38_9_AM	Raw	
	Where did you get this information from: radio?	NPRG38_10_AM	Raw	
	Where did you get this information from: TV?	NPRG38_11_AM	Raw	
	Where did you get this information from: books, magazines, newspapers?	NPRG38_12_AM	Raw	
	Where did you get this information from: other?	NPRG38_13_AM	Raw	
HH2	How many people are in the household, not counting yourself?	HH2_AM	Categorised	Upper extremes categorised
HH2B	Person in the household: relationship 1 to relationship 7	HHST_AM	Categorised	Values categorised
HH3A	First, do you have a spouse or partner whom you consider to be a member of your family/whanau?	HH3A_AM	Raw	
REL1	Do you have a current partner?	REL1_AM	Raw	
ETH1	Which country were you born in?	OL1_AM	Re-classified	Birth countries categorised into regions
ETH2	When did you first arrived to live in New Zealand?	AGETONZ_AM	Derived and Categorised	Values converted to years. Upper extremes categorised
ETH4	Eth4-level 1. Main ethnicity - European	ETH4_E_AM	Re-classified	Re-classified to Statistics New Zealand Level 1 classification of ethnicity
	Eth4-level 1. Main ethnicity - Māori	ETH4_M_AM	Re-classified	Re-classified to Statistics New Zealand Level 1 classification of ethnicity
	Eth4-level 1. Main ethnicity - Pacific	ETH4_P_AM	Re-classified	Re-classified to Statistics New Zealand Level 1 classification of ethnicity
	Eth4-level 1. Main ethnicity - Asian	ETH4_A_AM	Re-classified	Re-classified to Statistics New Zealand Level 1 classification of ethnicity

Questionnaire number	Question	Variable name	Variable type	Notes
	Eth4-level 1. Main ethnicity - MELAA	ETH4_MELA_AM	Re-classified	Re-classified to Statistics New Zealand Level 1 classification of ethnicity
	Eth4-level 1. Main ethnicity - Other	ETH4_O_AM	Re-classified	Re-classified to Statistics New Zealand Level 1 classification of ethnicity
	Eth4-level 1. All ethnicities - New Zealander	ETH4_NZDER_AM	Re-classified	Re-classified to Statistics New Zealand Level 1 classification of ethnicity
	Self prioritised ethnicity	SELF_PROETH_AM	Re-classified	Level 1 - single response ethnicity
ETH9	Have you ever felt you have been treated unfairly, e g , treated differently, kept waiting, by a health professional, e g , doctor, nurse, dentist etc. , because of your ethnicity in New Zealand: yes, within the past 12 months?	ETH9_1_AM	Raw	
	Have you ever felt you have been treated unfairly, e g , treated differently, kept waiting, by a health professional, e g , doctor, nurse, dentist etc. , because of your ethnicity in New Zealand: yes, more than 12 months ago?	ETH9_2_AM	Raw	
	Have you ever felt you have been treated unfairly, e g , treated differently, kept waiting, by a health professional, e g , doctor, nurse, dentist etc. , because of your ethnicity in New Zealand: no?	ETH9_3_AM	Raw	
	Have you ever felt you have been treated unfairly, e g , treated differently, kept waiting, by a health professional, e g , doctor, nurse, dentist etc. , because of your ethnicity in New Zealand: not applicable?	ETH9_4_AM	Raw	
OCC30	Is this your first child?	CHILD_AM	Derived	
NE17	Some people feel they belong to a community because of things like family ties, a school, where they live or maybe a church or club do you feel you belong to any communities at the moment?	NE17_AM	Raw	
NE18	What is the community or communities of people to which you belong based around: religion?	NNE18_2_AM	Raw	
	What is your highest completed secondary school qualification?	EDALL_AM	Re-classified	

Questionnaire number	Question	Variable name	Variable type	Notes
	NZDep2006	NZDEP2006_AM	Raw	New Zealand deprivation index 2006 classification
	District health board of maternal domicile	DHB_AM	Raw	
	Rurality code	RURALITYGP_AM	Categorised	
	Mother interview date	INTERVIEW_AM	Categorised	

1.6 Mother: 9-month data

Questionnaire number	Question	Variable name	Variable type	Notes
	Mother ID at nine month interview	IDN_M9M	Identification key	Randomly generated mother ID at nine month interview. Allows linking to other datasets
	Age (years) of mother at 9 month interview	AGE_M9M	Derived	Values derived from interview date(STTIME_M9M/ENDTIME_M9M) and date of birth (BG1A_AM) and converted to years. Lower and upper extremes categorised
PQ5	Do you have a current partner?	PQ5_M9M	Raw	
M45	With regard to your baby's[babies] health care, which of the statements below best describes your situation?	HC1_M9M	Raw	
M48	Did you have difficulties finding a GP for your baby [babies]: No difficulties?	NHC4_1_M9M	Raw	
	Did you have difficulties finding a GP for your baby [babies]: Difficulty finding a GP I was happy with?	NHC4_2_M9M	Raw	
	Did you have difficulties finding a GP for your baby [babies]: Practices were not taking new patients?	NHC4_3_M9M	Raw	
	Did you have difficulties finding a GP for your baby [babies]: Moved to new area and did not know local services?	NHC4_4_M9M	Raw	
	Difficulties finding a GP - could not find a GP who spoke my language			Combined low cell count responses of NHC4_5_M9M with 'Other' HC4_97_M9M
	Did you have difficulties finding a GP for your baby [babies]: Other?	NHC4_97_M9M	Re-classified	Combined low cell count responses of NHC4_5_M9M with 'Other' NHC4_97_M9M
M49	All things considered, how satisfied are you with your baby's [babies'] usual GP practice?	HC5_M9M	Raw	
M226	Do you belong to any of the social networks and groups or organisations: Church spiritual group?	NBL7_2_M9M	Raw	
	NZDep2006 Index of Deprivation	NZDEP2006_M9M	Raw	
	Rurality	RURALITYGP_M9M	Raw	
	District health board group	DHB_M9M	Categorised	

1.7 Mother: 2-year data

Questionnaire number	Question	Variable name	Variable type	Notes
	Mother ID at 16 month interview (Linkable to other datasets)	IDN_M16M	Identification key	Randomly generated mother ID at 24 month interview. Allows linking to other datasets
	Mother ID at 23 month interview (Linkable to other datasets)	IDN_M23M	Identification key	Randomly generated mother ID at 24 month interview. Allows linking to other datasets
M5	Have you moved house since your CHILD/CHILDREN was 9 months old?	NE19A_M23M	Raw	
	Number of moves: Have you moved house since your CHILD/CHILDREN was 9 months old?	NE19A_NUMBEROFMOVES_M23M	Categorised	Upper extremes categorised
	Mother ID at 24 month interview (Linkable to other datasets)	IDN_Y2M	Identification key	Randomly generated mother ID at 24 month interview. Allows linking to other datasets
	Age (years) of mother at 24 month interview	AGE_Y2M	Derived	Values derived from interview date (Interview_Date_Y2M) and date of birth(BG1A_AM) and converted to years. Lower and upper extremes categorised
	Do you have a current partner?	PQ5_Y2M	Raw	
M48	With regard to your [child's/children's] health care, which of these statements best describes your situation?	NHC1_Y2M	Raw	
M49	Is this the same health practitioner or service that you usually go to first when you are feeling unwell?	HC3_Y2M	Raw	
M50	What is the main reason you have never had a GP or GP practice for your [child/children]?	NHC8_Y2M	Raw	

Questionnaire number	Question	Variable name	Variable type	Notes
M51	Is this the same GP or GP practice that you were using when your [child/children] was nine months old?	HC9_Y2M	Raw	
M52	How many times have you changed GP or GP practice since your [child/children] was nine months old?	HC10_Y2M	Raw	
M53	How long have you taken your [child/children] to this GP or GP practice?	HC11_Y2M	Raw	
	Number of years: taken your [child/children] to this GP or GP practice	HC11_YEARS_Y2M	Raw	
	Number of months: taken your [child/children] to this GP or GP practice	HC11_MONTHS_Y2M	Raw	
M54	What is the main reason you have changed the GP or GP practice you take your [child/children] to?	NHC12_Y2M	Raw	
M57	All things considered, how satisfied are you with your [child/children]'s usual GP practice?	HC5_Y2M	Raw	
M244	Do you consider yourself as currently belonging to any particular religion or denomination?	RA1_Y2M	Raw	
M245	Belonging to any particular religion or denomination	NRA2_Y2M	Re-classified	Re-classified to Statistics New Zealand Level 1 classificaion of religious affiliation
M246	How long have you had this particular faith?	RA3_Y2M	Raw	
M247	Apart from special occasions such as weddings and funerals, about how often do you attend religious services nowadays?	RA4_Y2M	Raw	
M248	Regardless of whether you belong to a particular religion, how spiritual would you say you are?	RA5_Y2M	Raw	
M276	Have you felt, been treated unfairly or discriminated against: your gender?	NDIS0_1_Y2M	Raw	
	Have you felt, been treated unfairly or discriminated against: your age?	NDIS0_2_Y2M	Raw	
	Have you felt, been treated unfairly or discriminated against: your religious or spiritual beliefs?	NDIS0_3_Y2M	Raw	
	Have you felt, been treated unfairly or discriminated against: your weight?	NDIS0_4_Y2M	Raw	

Questionnaire number	Question	Variable name	Variable type	Notes
	Have you felt, been treated unfairly or discriminated against: the shade or colour of your skin?	NDIS0_5_Y2M	Raw	
	Have you felt, been treated unfairly or discriminated against: your ethnicity?	NDIS0_6_Y2M	Raw	
	Have you felt, been treated unfairly or discriminated against: your sexual orientation?	NDIS0_7_Y2M	Raw	
	Have you felt, been treated unfairly or discriminated against: your socio-economic status (e.g., educational level, income level or type of job/occupation)?	NDIS0_8_Y2M	Raw	
	Have you felt, been treated unfairly or discriminated against: a physical disability?	NDIS0_9_Y2M	Raw	
	Have you felt, been treated unfairly or discriminated against: you have children?	NDIS0_10_Y2M	Raw	
	Have you felt, been treated unfairly or discriminated against: your marital status?	NDIS0_11_Y2M	Raw	
	Have you felt, been treated unfairly or discriminated against: other?	NDIS0_13_Y2M	Raw	
	Have you felt, been treated unfairly or discriminated against: none of these?	NDIS0_97_Y2M	Raw	
M277	Who treated you unfairly because of: your gender - health services?	NDIS1_6_Y2M	Raw	
M278	Who treated you unfairly because of: your age - health services?	NDIS2_6_Y2M	Raw	
M279	Who treated you unfairly because of: your religious or spiritual beliefs - health services?	NDIS3_6_Y2M	Raw	
M280	Who treated you unfairly because of: your weight - health services?	NDIS4_6_Y2M	Raw	
M281	Who treated you unfairly with respect to: the shade or colour of your skin - health services?	NDIS5_6_Y2M	Raw	
M282	Who treated you unfairly because of: your ethnicity - health services?	NDIS6_6_Y2M	Raw	
M283	Who treated you unfairly because of: your sexual orientation - health services?			
M284	Who treated you unfairly because of: your socio-economic status - health services?	NDIS8_6_Y2M	Raw	

Questionnaire number	Question	Variable name	Variable type	Notes
M285	Who treated you unfairly because of: a physical disability - health services?			
M286	Who treated you unfairly because of: you have children - health services?	NDIS10_6_Y2M	Raw	
M287	Who treated you unfairly because of: your marital status - health services?	NDIS11_6_Y2M	Raw	
M288	Who treated you unfairly because of other reason - health services?	NDIS12_6_Y2M	Raw	
M292	On this list are various groups of people. Could you please mention any that you would not like to have as neighbours: drug addicts?	NA01_1_Y2M	Raw	
	NZDep2006 Index of Deprivation	NZDEP2006_Y2M	Raw	
	Rurality	RURALITYGP_Y2M	Categorised	
	District health board	DHB_Y2M	Categorised	
	Participants' residential country at 24 month interview	RESIDENTIALCOUNTRY_Y2M	Categorised	Countries other than New Zealand grouped as "Other"

1.8 Mother: 54-month data

Questionnaire number	Question	Variable name	Variable type	Notes
	Mother ID at 54 month interview (Linkable to other datasets)	IDN_M54M	Identification key	Randomly generated mother ID at 54 month interview. Allows linking to other datasets
	Mother's age at 54 month data collection	AGE_M54M	Derived	Mother's age in years at 54 month interview. Categorised the low cell counts at 20 or less and 50 or more
	Mother's country of residence	COUNTRY_M54M	Categorised	Countries other than New Zealand grouped as 'Other countries';
	Mother's gender	GENDER_M54M	Raw	
15.1	Do you know which school your {child/children} will attend?	SS3_M54M	Raw	
15.2.1	What type of school will your {child/children} will attend - State/Public primary school?	SS4_1_M54M	Raw	
15.2.2	What type of school will your {child/children} will attend - Private/independent primary school?	SS4_2_M54M	Raw	
15.2.3	What type of school will your {child/children} will attend - Charter/partnership school?	SS4_3_M54M	Raw	
15.2.4	What type of school will your {child/children} will attend - Home schooling?	SS4_4_M54M	Raw	
15.2.5	What type of school will your {child/children} will attend - Correspondence school?			Information contained in a variable SS4_97_m54M due to the low cell count
15.2.6	What type of school will your {child/children} will attend - Te kura kaupapa Māori?	SS4_6_M54M	Raw	
15.2.7	What type of school will your {child/children} will attend - Bilingual school/unit?	SS4_7_M54M	Raw	
15.2.8	What type of school will your {child/children} will attend - Religious school?	SS4_8_M54M	Raw	
15.2.9	What type of school will your {child/children} will attend - Special education school?	SS4_9_M54M	Raw	

Questionnaire number	Question	Variable name	Variable type	Notes
15.2.97	What type of school will your {child/children} will attend - Other (specify)?	SS4_97_M54M	Raw	
15.2.99	What type of school will your {child/children} will attend - DK	SS4_99_M54M	Raw	
15.2.98	What type of school will your {child/children} will attend - Ref	SS4_98_M54M	Raw	
20.1	Do you have a current partner?	PQ5_M54M	Raw	
20.2	Does this partner live with you and your {child/children}?	PQ6_M54M	Raw	
20.3	Were you in a relationship with this same partner when your {child was/children were} two years old?	PQ5A_M54M	Raw	
23.1	In the last 12 months have you personally been forced to buy cheaper food so that you could pay for other things you needed?	DP1_M54M	Raw	
23.11	In the last 12 months have you personally put up with feeling cold to save heating costs?	DP2_M54M	Raw	
23.12	In the last 12 months have you personally made use of special food grants or food banks because you did not have enough money for food?	DP3_M54M	Raw	
23.13	In the last 12 months have you personally continued wearing shoes with holes because you could not afford replacements?	DP4_M54M	Raw	
23.14	In the last 12 months have you personally gone without fresh fruit and vegetables often, so that you could pay for other things you needed?	DP5_M54M	Raw	
23.15	In the last 12 months have you personally received help in the form of food, clothes or money from a community organisation (like the Salvation Army)?	DP6_M54M	Raw	
	NZDep2013 Index of Deprivation	NZDEP2013_M54M	Raw	New Zealand deprivation index 2013 classification
	Rurality in 2013	RURALITYGP13_M54M	Categorised	
	District health board 2013	DHB_2013_M54M	Categorised	

1.9 Mother: 72-month data

Questionnaire number	Question	Variable name	Variable type	Notes
	Mother ID at 72 month interview (Linkable to other datasets)	IDN_M72M	Identification key	Randomly generated mother ID at 72 month interview. Allows linking to other datasets
	Child ID	IDN_CHILD	Identification key	Randomly generated child ID. Allows linking to other datasets
	Mother's age at 72 month data collection	AGE_M72M	Derived	Mother's age in years at 72 month interview. Categorised the low cell counts at 22 or less and 52 or more
0.1	What is your usual country of residence? Please specify	COUNTRYM_M72M	Categorised	Countries other than New Zealand grouped as 'Other countries'
0.2	What is your Growing Up in New Zealand study child/children's usual country of residence? Please specify	COUNTRYC_M72M	Categorised	Countries other than New Zealand grouped as 'Other countries'
1	How many times have you moved house since your Growing Up in New Zealand study child/children were 4 and a half years old? (Choose one only)	NE31_M72M	Categorised	Categorised upper extreme at 7+
4	How many people live in your house? (Choose one only)	HH46_M72M	Raw	Participants either responded with number of people or preferred not to say.
4.1	How many people live in your house? Number of People	HH46S_M72M	Categorised	Categorised upper extreme at 14+
4.1.1.1	Age of Child 1	HHA1_1_M72M	Raw	
4.1.1.2	Age of Child 2	HHA1_2_M72M	Categorised	Categorised upper and lower extreme at 6
4.1.2.1	Growing Up Childs Gender 1	HHG1_1_M72M	Raw	
4.1.2.2	Growing Up Childs Gender 2	HHG1_2_M72M	Raw	
8	Is your Growing Up in New Zealand study child/children attending primary school? Note this question refers to formal primary school attendance that typically starts around five years of age, and includes those children who are schooled at home (Choose one only)	SS31_M72M	Raw	

Questionnaire number	Question	Variable name	Variable type	Notes
9.1	Which of the following reasons relate to why your Growing Up in New Zealand study child/children is/are not attending school? Because of their health needs			Information contained in a variable NSS32_M72M
9.2	Which of the following reasons relate to why your Growing Up in New Zealand study child/children is/are not attending school? Because of their developmental needs			Information contained in a variable NSS32_M72M
9.3	Which of the following reasons relate to why your Growing Up in New Zealand study child/children is/are not attending school? Because of their social needs			Information contained in a variable NSS32_M72M
9.97	Which of the following reasons relate to why your Growing Up in New Zealand study child/children is/are not attending school? Other			Information contained in a variable NSS32_M72M
9.98	Which of the following reasons relate to why your Growing Up in New Zealand study child/children is/are not attending school? Prefer not to say			Information contained in a variable NSS32_M72M
	Which of the following reasons relate to why your Growing Up in New Zealand study child/children is/are not attending school?	NSS32_M72M	Categorised	Code frames different to questionnaire. Different responses were combined together to protect participants' identity
11	Where does your Growing Up in New Zealand study child/children go to school? (Choose one only)	SS34_M72M	Raw	Free text information was not included.
12.1	What type of school is this? State/Public primary school	SS35_1_M72M	Raw	
12.2	What type of school is this? Private/independent primary school	SS35_2_M72M	Raw	
12.3	What type of school is this? Charter/partnership school	SS35_3_M72M	Raw	
12.4	What type of school is this? Home schooling	SS35_4_M72M	Raw	
12.5	What type of school is this? Correspondence school	SS35_5_M72M	Raw	
12.6	What type of school is this? Te Kura Kaupapa Māori	SS35_6_M72M	Raw	
12.7	What type of school is this? Bilingual school	SS35_7_M72M	Raw	
12.8	What type of school is this? Religious school	SS35_8_M72M	Raw	
12.9	What type of school is this? State Integrated primary school	SS35_9_M72M	Raw	
12.1	What type of school is this? International school	SS35_10_M72M	Raw	

Questionnaire number	Question	Variable name	Variable type	Notes
12.11	What type of school is this? Special needs school	SS35_11_M72M	Raw	
12.97	What type of school is this? Other	SS35_97_M72M	Raw	
12.99	What type of school is this? Don't Know	SS35_99_M72M	Raw	
12.98	What type of school is this? Prefer not to say	SS35_98_M72M	Raw	
16.6	How important were these factors when deciding which school your Growing Up in New Zealand study child/children attends? The school values align with our preferred religious practices or activities	SS44_M72M	Raw	
56	Have you completed a new educational qualification since your Growing Up in New Zealand study child was/children were born? (Choose one only)	ED10_M72M	Raw	
57.1	What is the qualification that you completed? National certificate levels 1-4	ED11_1_M72M	Raw	
57.2	What is the qualification that you completed? Trade certificate	ED11_2_M72M	Raw	
57.3	What is the qualification that you completed? Diploma below Bachelors level or National Certificate levels 5 or 6	ED11_3_M72M	Raw	
57.4	What is the qualification that you completed? Bachelor's degree	ED11_4_M72M	Raw	
57.5	What is the qualification that you completed? Bachelor's degree with honours, or postgraduate diploma	ED11_5_M72M	Raw	
57.6	What is the qualification that you completed? Master's degree	ED11_6_M72M	Raw	
57.7	What is the qualification that you completed? PhD	ED11_7_M72M	Raw	
57.97	What is the qualification that you completed? Other	ED11_97_M72M	Raw	
57.99	What is the qualification that you completed? Don't Know	ED11_99_M72M	Raw	
57.98	What is the qualification that you completed? Prefer not to say	ED11_98_M72M	Raw	
	NZDep2013 Index of Deprivation	NZDEP2013_M72M	Raw	New Zealand Deprivation Index 2013 classification

1.10 Mother: 8-year data

Questionnaire number	Question	Variable name	Variable type	Notes
	Mother ID at 8 years interview (linkable to other datasets)	IDN_Y8M	Identification key	Randomly generated mother ID at 8 years interview. Allows linking to other datasets
0.2	Mother's usual country of residence	COUNTRYMGP_Y8M	Categorised	
	Rurality in 2013	RURALITYGP_2013_Y8M	Categorised	
	District health board 2013	DHBGP_2013_Y8M	Categorised	
	NZDep 2013	NZDEP2013_Y8M	Raw	
	Mother's age at 8 year collection wave	AGE_Y8M	Derived	

1.11 Partner: Antenatal data

Questionnaire number	Question	Variable name	Variable type	Notes
	Partners ID	IDN_AP	Identification key	Randomly generated partner ID at antenatal interview. Allows linking to other datasets
BG1	Age (years) of partner at antenatal interview	AGE_AP	Derived	Upper extremes categorised
PRG34	Have you decided yet if you will have your child fully immunised?	PRG34_AP	Raw	
PRG35	During this pregnancy have you received or been told any information that is encouraging you to immunise this child once s/he is born?	PRG35_AP	Raw	
PRG36	Where did you get this information from: family/whanau?	NPRG36_1_AP	Raw	
	Where did you get this information from: friends?	NPRG36_2_AP	Raw	
	Where did you get this information from: GP (family doctor)?	NPRG36_3_AP	Raw	
	Where did you get this information from: midwife?	NPRG36_4_AP	Raw	
	Where did you get this information from: obstetrician?	NPRG36_5_AP	Raw	
	Where did you get this information from: dietician/nutritionist?			Combined low cell count responses of 'Dietician/Nutritionist' (NPRG36_6_AP) with 'Other'
	Where did you get this information from: alternative health practitioner?	NPRG36_7_AP	Raw	
	Where did you get this information from: antenatal class?	NPRG36_8_AP	Raw	
	Where did you get this information from: the internet?	NPRG36_9_AP	Raw	
	Where did you get this information from: radio?	NPRG36_10_AP	Raw	
	Where did you get this information from: TV?	NPRG36_11_AP	Raw	
	Where did you get this information from: books, magazines, newspapers?	NPRG36_12_AP	Raw	
	Where did you get this information from: other?	NPRG36_13_AP	Re-classified	Combined low cell count responses of 'Dietician/Nutritionist' (NPRG36_6_AP) with 'Other' NPRG36_13_AP)

Questionnaire number	Question	Variable name	Variable type	Notes
PRG37	During this pregnancy have you received or been told any information that is discouraging you to immunise this child once s/he is born?	PRG37_AP	Raw	
PRG38	Where did you get this information from: family/whanau?	NPRG38_1_AP	Raw	
	Where did you get this information from: friends?	NPRG38_2_AP	Raw	
	Where did you get this information from: GP (family doctor)?	NPRG38_3_AP	Raw	
	Where did you get this information from: midwife?	NPRG38_4_AP	Raw	
	Where did you get this information from: obstetrician?	NPRG38_5_AP	Raw	
	Where did you get this information from: dietician/nutritionist?	NPRG38_6_AP	Raw	
	Where did you get this information from: alternative health practitioner	NPRG38_7_AP	Raw	
	Where did you get this information from: antenatal class?	NPRG38_8_AP	Raw	
	Where did you get this information from: the internet?	NPRG38_9_AP	Raw	
	Where did you get this information from: radio?	NPRG38_10_AP	Raw	
	Where did you get this information from: TV?	NPRG38_11_AP	Raw	
	Where did you get this information from: books, magazines, newspapers?	NPRG38_12_AP	Raw	
	Where did you get this information from: other?	NPRG38_13_AP	Raw	
HH2	How many people are in the household, not counting yourself?	HH2_AP	Categorised	Upper extremes re-categorised
REL2	What best describes the nature of your relationship with the baby's mother?	REL2_AP	Raw	
ETH1	Which country were you born in?	OL1_AP	Re-classified	Birth countries re-classified into regions
ETH2	When did you first arrive to live in New Zealand?	AGETONZ_AP	Derived and categorised	Information contained in derived variable AGETONZ_AP
	Number of years in NZ	TIMEINNZ_AP	Derived and categorised	Values converted to years and categorised
ETH4	Eth4-level 1. Main ethnicity - European	ETH4_E_AP	Re-classified	Re-classified to Statistics New Zealand Level 1 classification of ethnicity

Questionnaire number	Question	Variable name	Variable type	Notes
	Eth4-level 1. Main ethnicity - Māori	ETH4_M_AP	Re-classified	Re-classified to Statistics New Zealand Level 1 classification of ethnicity
	Eth4-level 1. Main ethnicity - Pacific	ETH4_P_AP	Re-classified	Re-classified to Statistics New Zealand Level 1 classification of ethnicity
	Eth4-level 1. Main ethnicity - Asian	ETH4_A_AP	Re-classified	Re-classified to Statistics New Zealand Level 1 classification of ethnicity
	Eth4-level 1. Main ethnicity - MELAA	ETH4_MELA_AP	Re-classified	Re-classified to Statistics New Zealand Level 1 classification of ethnicity
	Eth4-level 1. Main ethnicity - Other	ETH4_O_AP	Re-classified	Re-classified to Statistics New Zealand Level 1 classification of ethnicity
	Eth4-level 1. ALL ethnicities - New Zealander	ETH4_NZDER_AP	Re-classified	Re-classified to Statistics New Zealand Level 1 classification of ethnicity
	Self prioritised ethnicity	SELF_PROETH_AP	Re-classified	Level 1 - single response ethnicity
ETH8	Have you ever felt you have been treated unfairly, e g , treated differently, kept waiting, by a health professional, e g , doctor, nurse, dentist etc., because of your ethnicity in New Zealand: yes, more than 12 months ago?	ETH8_1_AP	Raw	
	Have you ever felt you have been treated unfairly, e g , treated differently, kept waiting, by a health professional, e g , doctor, nurse, dentist etc., because of your ethnicity in New Zealand: no?	ETH8_2_AP	Raw	
	Have you ever felt you have been treated unfairly, e g , treated differently, kept waiting, by a health professional, e g , doctor, nurse, dentist etc., because of your ethnicity in New Zealand: not applicable?	ETH8_3_AP	Raw	
	What is your highest completed secondary school qualification?	EDALL_AP	Re-classified	

Questionnaire number	Question	Variable name	Variable type	Notes
	Apart from secondary school qualifications, do you have any other completed qualifications, the equivalent of 3 months or more full-time study to complete?			Information contained in derived variable EDALL_AP
	What is your highest completed qualification?			Information contained in derived variable EDALL_AP
NE18	What is the community or communities of people to which you belong based around: religion?	NNE18_2_AP	Raw	
	NZDep2006	NZDEP2006_AP	Raw	New Zealand deprivation index 2006 classification
	District health board of maternal domicile	DHBGP_AP	Raw	
	Rurality code	RURALITYGP_AP	Categorised	
	Partner interview date	INTERVIEW_AP	Raw	

1.12 Partner: 9-month data

Questionnaire number	Question	Variable name	Variable type	Notes
	Partner ID	IDN_M9P	Identification key	Randomly generated partner ID at nine month interview. Allows linking to other datasets
	Age (years) of partner at 9 month interview	AGE_M9P	Derived	Values converted to years. Lower and upper extremes categorised
PQ5	Do you have a current partner?	PQ5_M9P	Raw	
P176	Do you belong to any of the following social networks and groups or organisations: A church or spiritual group?	NBL7_2_M9P	Raw	
	NZDep2006 Index of Deprivation	NZDEP2006_M9P	Raw	
	Rurality	RURALITYGP_M9P	Raw	
	District health board group	DHB_M9P	Re-classified	Re-classified into seven main regions

1.13 Partner: 2-year data

Questionnaire number	Question	Variable name	Variable type	Notes
	Partner ID	IDN_Y2P	Identification key	Pseudo ID are provided for data integration
	Age (years) of partner at 24 month interview	AGE_Y2P	Derived	Values derived from interview date (Interview_Date_Y2P) and date of birth(BG1A_AP) and converted to years. Lower and upper extremes categorised
	Country of residence	RESIDENTIALCOUNTRY_Y2P	Categorised	Countries other than New Zealand grouped as "Other"
M244	Do you consider yourself as currently belonging to any particular religion or denomination?	RA1_Y2P	Raw	
M245	Belonging to any particular religion or denomination	NRA2_Y2P	Re-classified	Re-classified to Statistics New Zealand Level 1 classification of religious affiliation
M246	How long have you had this particular faith?	RA3_Y2P	Raw	
M247	Apart from special occasions such as weddings and funerals, about how often do you attend religious services nowadays?	RA4_Y2P	Raw	
M248	Regardless of whether you belong to a particular religion, how spiritual would you say you are?	RA5_Y2P	Raw	
M276	Have you felt, been treated unfairly or discriminated against: your gender?	NDIS0_1_Y2P	Raw	
	Have you felt, been treated unfairly or discriminated against: your age?	NDIS0_2_Y2P	Raw	
	Have you felt, been treated unfairly or discriminated against: your religious or spiritual beliefs?	NDIS0_3_Y2P	Raw	
	Have you felt, been treated unfairly or discriminated against: your weight?	NDIS0_4_Y2P	Raw	
	Have you felt, been treated unfairly or discriminated against: the shade or colour of your skin?	NDIS0_5_Y2P	Raw	

Questionnaire number	Question	Variable name	Variable type	Notes
	Have you felt, been treated unfairly or discriminated against: your ethnicity?	NDIS0_6_Y2P	Raw	
	Have you felt, been treated unfairly or discriminated against: your sexual orientation?	NDIS0_7_Y2P	Raw	
	Have you felt, been treated unfairly or discriminated against: your socio-economic status (e.g., educational level, income level or type of job/occupation)?	NDIS0_8_Y2P	Raw	
	Have you felt, been treated unfairly or discriminated against: a physical disability?	NDIS0_9_Y2P	Raw	
	Have you felt, been treated unfairly or discriminated against: you have children?	NDIS0_10_Y2P	Raw	
	Have you felt, been treated unfairly or discriminated against: your marital status?	NDIS0_11_Y2P	Raw	
	Have you felt, been treated unfairly or discriminated against: other?	NDIS0_13_Y2P	Raw	
	Have you felt, been treated unfairly or discriminated against: none of these?	NDIS0_97_Y2P	Raw	
M277	Who treated you unfairly because of: your gender - health services?	NDIS1_6_Y2P	Raw	
M278	Who treated you unfairly because of: your age - health services?	NDIS2_6_Y2P	Raw	
M279	Who treated you unfairly because of: your religious or spiritual beliefs - health services?	NDIS3_6_Y2P	Raw	
M280	Who treated you unfairly because of: your weight - health services?	NDIS4_6_Y2P	Raw	
M281	Who treated you unfairly with respect to: the shade or colour of your skin - health services?	NDIS5_6_Y2P	Raw	
M282	Who treated you unfairly because of: your ethnicity - health services?	NDIS6_6_Y2P	Raw	
M283	Who treated you unfairly because of: your sexual orientation - health services?			
M284	Who treated you unfairly because of: your socio-economic status - health services?	NDIS8_6_Y2P	Raw	

Questionnaire number	Question	Variable name	Variable type	Notes
M285	Who treated you unfairly because of: a physical disability - health services?			
M286	Who treated you unfairly because of: you have children - health services?	NDIS10_6_Y2P	Raw	
M287	Who treated you unfairly because of: your marital status - health services?	NDIS11_6_Y2P	Raw	
M288	Who treated you unfairly because of other reason (DIS0-other) - health services?	NDIS12_6_Y2P	Raw	
	NZDep2006 Index of Deprivation	NZDEP2006_Y2P	Raw	
	Rurality	RURALITYGP_Y2P	Categorised	
	District health board group	DHBGP_Y2P	Categorised	