Infant feeding in New Zealand

Adherence to Food and Nutrition Guidelines among the Growing Up in New Zealand cohort

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Authors

Teresa Gontijo de Castro, Sarah Gerritsen, Clare Wall, Cameron Grant, Juliana Araujo Teixeira, Dirce Maria Marchioni, Avinesh Pillai and Susan Morton

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Disclaimer

The views and interpretations in this report are those of the researcher and are not the official position of the Ministry of Social Development.

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Policy summary

At present, there are no national data collected on dietary practices and nutrient intakes among New Zealand (NZ) infants. This report represents the first study in New Zealand to provide evidence of population adherence to the national food and nutrition recommendations in the first year of life. The data presented comes from an ethnically diverse and contemporary sample of New Zealand children, whose mothers were recruited and interviewed during pregnancy and then re-interviewed at several time points through early childhood: the Growing up in New Zealand cohort study (*GUiNZ*).

It was evaluated the degree to which families within the *GUiNZ* study adhered to the New Zealand Ministry of Health Food and Nutrition guidelines for Healthy Infants and Toddlers (hereafter referred as the Infant Feeding Guidelines) (Ministry of Health 2008). The findings show that, overall, the population median adherence to the guidelines was 70.0 points (from a top score of 100, which means full compliance to the guidelines). Low rates of adherence to individual infant feeding indicators point to the continued importance of promoting duration of breastfeeding to a year or beyond and the introduction of solids at around six months of age, as these guidelines did not have widespread adherence among the *GUiNZ* cohort. Serving vegetables and fruit to infants twice or more each per day also requires reinforcement. Additionally, the early introduction of inappropriate foods and drinks to many infants is of concern, as this adds excess energy and may influence taste preferences for foods and drinks high in sugar, salt and/or fat.

This report was written for the Ministry of Social Development, funded by the Children and Families Research Fund. The project was developed in collaboration with the Ministry of Health as the findings provide timely information for the Ministry of Health's review of Food and Nutrition Guidelines for Healthy Pregnant and Breastfeeding Women; and for Healthy Infants and Toddlers (0-2yrs). The review of the Infant Feeding Guidelines is being initiated and will be informed by relevant international systematic literature reviews. This report is a valuable additional piece of evidence for the review as it provides information on contemporary NZ infant feeding practices.

Executive summary

Early life nutrition has a profound and enduring effect on health. Adequate nutrition in infancy affects short- and long-term health status and is also known to influence the formation of dietary habits and food preferences. This report presents a description of population-level adherence to an infant feeding index, created based on the New Zealand Ministry of Health Food and Nutrition guidelines for Healthy Infants and Toddlers (0-2 years), from here referred to as Infant Feeding Guidelines. The index consolidates 13 indicators of practices of infant feeding, distributed across 4 domains: *breastfeeding duration* (any and exclusive); *introduction of solid foods* (age and progression); *variety of foods provided at 9 months of age* (including vegetables, fruits and iron-rich foods); and intake of *inappropriate foods and drinks*. The report considers adherence to each of the 13 indicators separately, and then overall adherence using the composite index. Associations with key sociodemographic characteristics or other variables of interest are presented for each indicator and for the final Infant Feeding Index (IFI).

Data were from 6,435 infants in the longitudinal study Growing up in New Zealand (GUINZ*)*, collected during telephone and face-to-face interviews with mothers at the Antenatal, 6 Week, 9 Month and 31 Month stages over the period 2009-2012. Data from twins, infants with low birth weight (<2500g) and/or born before 37 weeks gestation were removed from the analyses investigating associations between the Infant Feeding Index scores and sociodemographic characteristics (n=556).

Key findings

Overall adherence to the Infant Feeding Guidelines (IFI scores)

The average score for infants on the IFI was 70.0 points (interquartile ranges of 56.9 and 82.5), where 100 means that all of the guidelines were followed. The scores ranged from 13.5 to 100 points. A small number of infants (90/6184, 1.5%) received a top score of 100 on the IFI.

Differences in the IFI scores by sociodemographic characteristics

Many sociodemographic characteristics were independently associated with overall adherence to the infant feeding guidelines. Infants of mothers with a higher/post-graduate qualification scored on average 7.9 points higher on the IFI than diploma/trade certificates or NCEA Levels 5-6, and 13.4 points higher than no secondary school qualifications. Maternal ethnicity and age were also independently associated with the IFI score: infants of European mothers scored on average 7.8 points higher than Māori, 6.6 points higher than Asian, and 5.0

points higher than Pacific. Mothers aged 35 years or over scored on average 2.7 points higher than mothers aged 25-34 years, and 7.6 points higher than mothers aged under 25 years. Infants living in the least deprived neighbourhoods–decile 1 and 2 on the New Zealand Index of Deprivation (NZDep2006) scored on average 3.8 points higher than infants in the most deprived neighbourhoods (decile 9 and 10). Infants whose mothers attended antenatal classes, and/or had a partner at the antenatal interview also scored higher on the IFI after adjustment.

Some individual indicators, part of the overall IFI, had particularly low adherence (less than 50%) among population groups of interest, with associations remaining once the data were statistically adjusted for differences between groups (i.e. independently adding to the risk), as detailed in **Table 1**.

Adherence to specific Infant Feeding Guidelines

Infants in the Growing Up in New Zealand study had high adherence (80% adherence or more) to five of the 13 indicators.

Infant Feeding Guidelines with high adherence (80% or more)

- Eating 3 or more solid meals a day at 9 months of age = 94% adherence
- Only breastmilk and/or suitable formula milk given by the age of 9 months = 94% adherence
- No sugar added to baby's meals or milk at 9 months of age = 86% adherence
- No salt added to baby's meals or milk at 9 months of age = 84% adherence
- Eating iron-rich food at least once at 9 months of age = 80% adherence.

Infant Feeding Guidelines with moderate adherence

- Inappropriate drinks never tried at age of 9 months (coffee, cordials, juice, tea or soft drinks) = 61% adherence
- Solid foods introduced around 6 months of age = 57% adherence
- Eating across the four food groups daily at 9 months = 53% adherence.

Infant Feeding Guidelines with low adherence (less than 50%)

- Inappropriate foods never tried at age of 9 months (sweets, chocolate, hot chips or potato crisps) = 47% adherence
- Eating fruit twice or more daily at 9 months = 37% adherence
- Breastfeeding duration to 12 months or beyond = 37% adherence
- Exclusive breastfeeding duration to around 6 months = 35% adherence
- Eating vegetables twice or more daily at 9 months = 33% adherence.

Table 1: Infant Feeding Guidelines with less than 50% adherence and significant inequalities among population groups *

Māori and Pacific mothers	**Mothers with no partner**
Exclusively breastfeed to around 6 months of age	Breastfeed for 12 months or longer
Eating vegetables and fruit twice or more daily at 9 months of age	Exclusively breastfeed to around 6 months of age
Inappropriate foods never tried at age of 9 months (sweets, chocolate, hot chips or potato crisps)	Inappropriate foods never tried at age of 9 months (sweets, chocolate, hot chips or potato crisps)
Inappropriate drinks never tried at age of 9 months (coffee, cordials, juice, tea or soft drinks)	Inappropriate drinks never tried at age of 9 months (coffee, cordials, juice, tea or soft drinks)
Mothers with low education and young mothers (under 25 years old)	**Most deprived neighbourhoods**
Breastfeed for 12 months or longer	Eating vegetables and fruit twice or more daily at 9 months of age
Exclusively breastfeed to around 6 months of age	**Asian mothers**
Eating vegetables and fruit twice or more daily at 9 months of age	Exclusively breastfeed to around 6 months of age
Inappropriate foods never tried at age of 9 months (sweets, chocolate, hot chips or potato crisps)	Eating vegetables and fruit twice or more daily at 9 months of age

Note:* Indicators with group-level adherence of less than 50%, and with an independent and statistically significant increased risk of non-adherence compared to the reference group for that category (i.e. mothers aged 35 years or older, European, post-graduate degree, had a partner, or NZDep06 decile 1 and 2, respectively). Adjusted associations between individual infant feeding indicators and maternal sociodemographic characteristics were examined using Poisson regression with robust variance.

Introduction

The importance of nutrition in the first year of life

Infancy is a time of dramatic dietary changes, which covers the transition from an entirely milk-based diet to a diet based on solid foods with a variety of family foods (Okubo et al, 2015; Menella et al, 2012; Schwartz et al, 2011; Silva et al, 2010; Robinson et al, 2012; Przyrembel, 2012). Adequate nutrition in infancy not only affects short and long-term health status (Brazionis et al, 2013; Shonkoff 2010; Davies et al, 2016) but is also known to influence the formation of child dietary habits and food preferences (Schwartz et al, 2011; Silva et al, 2010; Robinson et al, 2012). The quality of diet in early life is important for immediate and future cognitive development and health (Okubo et al, 2015; Menella et al, 2012). There is also strong evidence that nutrition-related behaviours can track from infancy to preschool (Lioret et al 2015), early childhood through childhood (Wall et al 2013), from childhood to adolescence (Emmett et al 2015), and into adulthood (Lipsky et al 2015). The process of an infant's introduction of foods also involves complex factors such as biological, cultural, social and economic circumstances (Silva et al, 2010; Hoffman & Klein, 2012).

Knowledge of the magnitude and the socioeconomic predictors of appropriate complementary feeding are important when designing and evaluating interventions to improve infant feeding practices (Saaka et al, 2016). It is also essential in order to develop and implement culturally- and socially-appropriate public health messages. Improving infant nutrition in New Zealand (NZ) is a smart policy investment in the long-term health and wellbeing for children, young people, families and whānau (Hawkes, 2015; Hawkes et al, 2017).

The *Growing Up in New Zealand* study

Growing Up in New Zealand (*GUiNZ*) is a contemporary longitudinal study tracking the development of approximately 7,000 NZ children from before birth until they are young adults. The *GUiNZ* cohort has been demonstrated to align well with national births in the 2007-2010 period (Morton et al, 2015). The diversity of the *GUiNZ* cohort allows for robust analyses by ethnic group and socioeconomic position.

The population described in this report consists of infants that took part of the 9 month face-to-face interview for the *GUiNZ* study, where complementary feeding practices were collected (e.g. timing of food and drink introduction and usual frequency of intake).

The Ministry of Health Food and Nutrition Guidelines for Healthy Infants and Toddlers

The New Zealand Ministry of Health's Food and Nutrition Guidelines for Healthy Infants and Toddlers (Aged 0–2 years) were published in 2008 and are based on evidence which reflects the types of food and nutrition that supports health and development for this age group. These guidelines (referred from here as Infant Feeding Guidelines) were current during the time period that the 9 month interviews of the *GUiNZ* cohort were conducted (Ministry of Health, 2008). The Infant Feeding Guidelines contain 11 statements for healthy infants and toddlers (**Table 2**).

Table 2: Infant Feeding Guidelines for healthy infants and toddlers

Statements
Statement 1. Maintain healthy growth and development of your baby and toddler by providing them with appropriate food and physical activity opportunities every day.
Statement 2. Exclusively breastfeed your baby until your baby is ready for and needs extra food – this will be at around six months of age.
Statement 3. When your baby is ready, introduce him or her to appropriate complementary foods and continue to breastfeed until they are at least one year of age or beyond.
Statement 4. Increase the texture, variety, flavour and amount of food offered so that your baby receives a complementary intake of nutrients, especially iron and vitamin C, and is eating more family foods by one year of age.
Statement 5. For your baby, prepare or choose pre-prepared complementary foods with no added fat, salt, sugar, honey or other sweeteners.
Statement 6. If your baby is not fed breast milk, then use an infant formula as the milk source until your baby is one year of age.
Statement 7. Each day offer your toddler a variety of nutritious foods from each of the four major food groups, which are: vegetables and fruit; Breads and cereals, including some wholemeal, milk and milk products or suitable alternatives; and lean meat, poultry, seafood, eggs, legumes, nuts and seeds.
Statement 8. For your toddler, prepare foods or choose pre-prepared foods, drinks and snacks that: are low in salt, but if using salt, use iodised salt and have little added sugar (and limit your toddler's intake of high-sugar foods).
Statement 9. Provide your toddler with plenty of liquids each day such as water, breast milk, or cows' milk (but limit cows' milk to about 500 mL per day).
Statement 10. Do not give your infant or toddler alcohol, coffee, cordials, juice, soft drinks, tea (including herbal teas), and other drinks containing caffeine.
Statement 11. Purchase, prepare, cook and store food in ways to ensure food safety.

Previous research on NZ infant feeding practices

There is little national data available in NZ to inform the development of health policy and health promotion messaging about infant feeding. There is evidence that some discrete feeding practices (such as breastfeeding duration, timing of food introduction, diet variety, or other indicators) of NZ infants fall short of the recommendations, and that these practices may vary by ethnic group. For example, the most recent NZ Health Survey reported that 7.4% of children aged 4 months to 4 years of age had been introduced to solids before 4 months of age. Māori and Pacific infants have approximately two times higher risk of being introduced to solids early (Māori: 11.2% with an adjusted rate ratio of 1.9; Pacific 13.4% with an adjusted rate ratio of 2.1) (Ministry of Health 2016a). Quality indicators from Well Child Tamariki Ora services in NZ for March 2016 reported that 55% of the infants were exclusively or fully breastfed at the age of 3 months and that 66% of the infants were receiving breastmilk at the age of 6 months (Ministry of Health 2016b).

The *GUiNZ* study has previously reported preliminary findings regarding infant dietary intake and food behaviours (at 9 months), where practices were inconsistent with the guidelines. For example, at 9 months of age, across the cohort, more than half of the cohort had eaten inappropriate foods (including sweets, chocolate, hot chips and potato chips) and one third had received inappropriate drinks such as fruit juices, soft drinks, herbal drinks, coffee and tea (Morton et al, 2012). The *GUiNZ* study has also reported that although NZ's breastfeeding initiation rate compares favorably to other high-income countries, a large proportion of children do not achieve the international or national recommendations for duration of breastfeeding or exclusive breastfeeding (Castro et al, 2017). Social disparities in the rates of breastfeeding duration were also identified. Maternal age, education, parity and pregnancy planning were associated with an increased risk of shorter duration of breastfeeding (any and exclusive), and maternal ethnicity was associated with a risk of shorter exclusive breastfeeding duration (Castro et al, 2017).

The utility of an index to evaluate total infant dietary practices

Internationally, research describing infant feeding practices has tended to focus on the effect of discrete practices. However, infant feeding involves a series of interrelated behaviors that should be simultaneously considered as some feeding behaviours may cluster or reinforce each other. It is difficult to summarize this critical period into one or a few variables in order to reflect the practices accurately (Grag & Chandra, 2009). The utilization of an index which considers all recommended aspects of infant feeding is useful to examine the effect of infant feeding on later child health and nutrition outcomes (Ruel & Menon, 2002) and allows for evaluation of infant feeding practices as a whole. The first index to assess adherence to complementary feeding guidelines in an OECD (Organization for Economic Cooperation and Development) country was developed by Golley et al (2012), utilizing data from the cohort study Avon Longitudinal Study of Parents and Children (*n*=6065). Golley et al (2012) found higher scores on their index were associated with food and nutrient intake largely in the expected direction as well as with known maternal predictors of child diet and dietary patterns in childhood, confirming the validity of their index.

Aim and overview of this report

This project aimed to describe adherence to the national Infant Feeding Guidelines. The specific research objectives were to:

i) Create an Infant Feeding Index (IFI) based on the Infant Feeding Guidelines.

ii) Describe the degree of adherence to the Infant Feeding Guidelines in the GUiNZ Cohort and;

iii) Explore associations between level of adherence to the national Infant Feeding Guidelines and socio-demographic characteristics.

The research questions were:

- What proportion of infants are fed according to the Infant Feeding Guidelines?
- Does adherence to the Infant Feeding Guidelines correlate with different socio-demographic characteristics?

Method

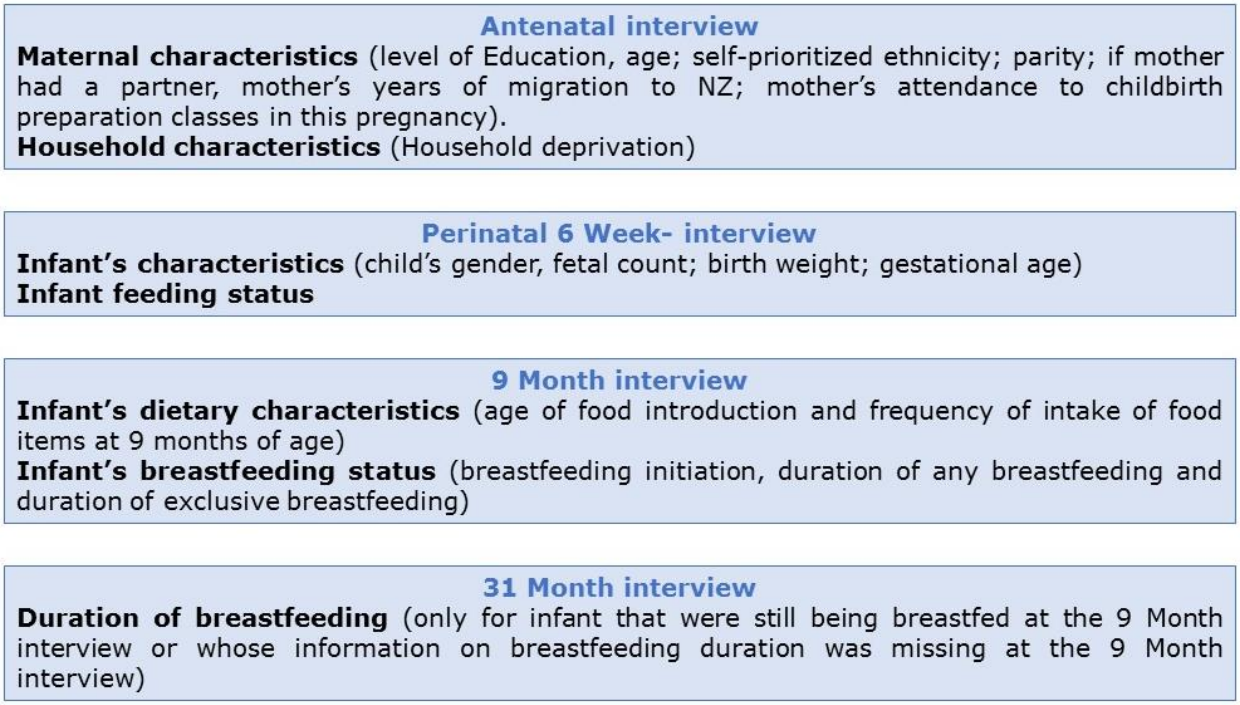
Development of work with Ministry of Health collaboration

This project was developed in collaboration with the Ministry of Health (Nutrition Policy). Decisions regarding the individual infant feeding indicators and the overall infant feeding index were informed by the Infant Feeding Guidelines, which are based on evidence which reflects the types of food and nutrition that supports health and development for this age group (Ministry of Health, 2008).

GUiNZ datasets and representativeness

This report used information from four data collection waves in the *GUiNZ* study (**Figure 1**). Information about maternal sociodemographic characteristics were collected during the antenatal period through face-to-face computer assisted personal interviews (CAPI). Infant feeding status and perinatal information was collected during telephone interviews conducted when the infant was 6 weeks old. Information on any and exclusive breastfeeding duration and dietary intake was obtained when the infant was 9 months old, during face-to-face CAPI interviews. For the infants that were still being breastfed at the 9 Month interview or had missing information at that time point, information on total duration of breastfeeding was collected at the 31 Month telephone interviews (**Figure 1**). The infants enrolled in the *GUiNZ* cohort study represented 11% of all NZ births during the study period and this cohort generally closely aligns to all NZ births from 2007-2010 (Morton et al, 2014).

Figure 1: Information gathered at different time-points in the GUiNZ cohort study



Feeding status at 6 weeks of age and dietary measures at 9 months of age

At the 6 Week interview, mothers were asked how they were feeding their infants (only breast milk; mainly breast milk but has also received some water based drinks, only formula; formula and breast milk, other). The semi-quantitative Food Frequency Questionnaire administered at the 9 Month interview was adapted from the tool used by the Southampton Women's Survey study (SWS) (Marriot et al, 2009). Mothers were asked to report the age of introduction and baby's current frequency of intake of 25 food items, including infant milk formula or milk other than breast milk (Castro et al 2017). This food list was designed by an experienced dietitian on the *GUiNZ* research team, who selected the items based on the Infant Feeding Guidelines (Ministry of Health, 2008) and foods and beverages commonly fed to NZ infants (Wall et al, 2009). The foods listed in the Food Frequency Questionnaire were: infant milk formula or milk; baby rice; baby breakfast cereal; other cereal; bread or toast; rusks; biscuits; vegetables; fruit; meat; fish; eggs; puddings; nuts or peanut butter; shellfish; soy foods; sweets; chocolate; hot chips; potato chips-crisps; fruit juices; herbal drinks; tea; coffee; and soft drinks (terminology used to refer to sweetened flavored carbonated beverages).

Estimation of any and exclusive breastfeeding duration at 9 and 31 months of age

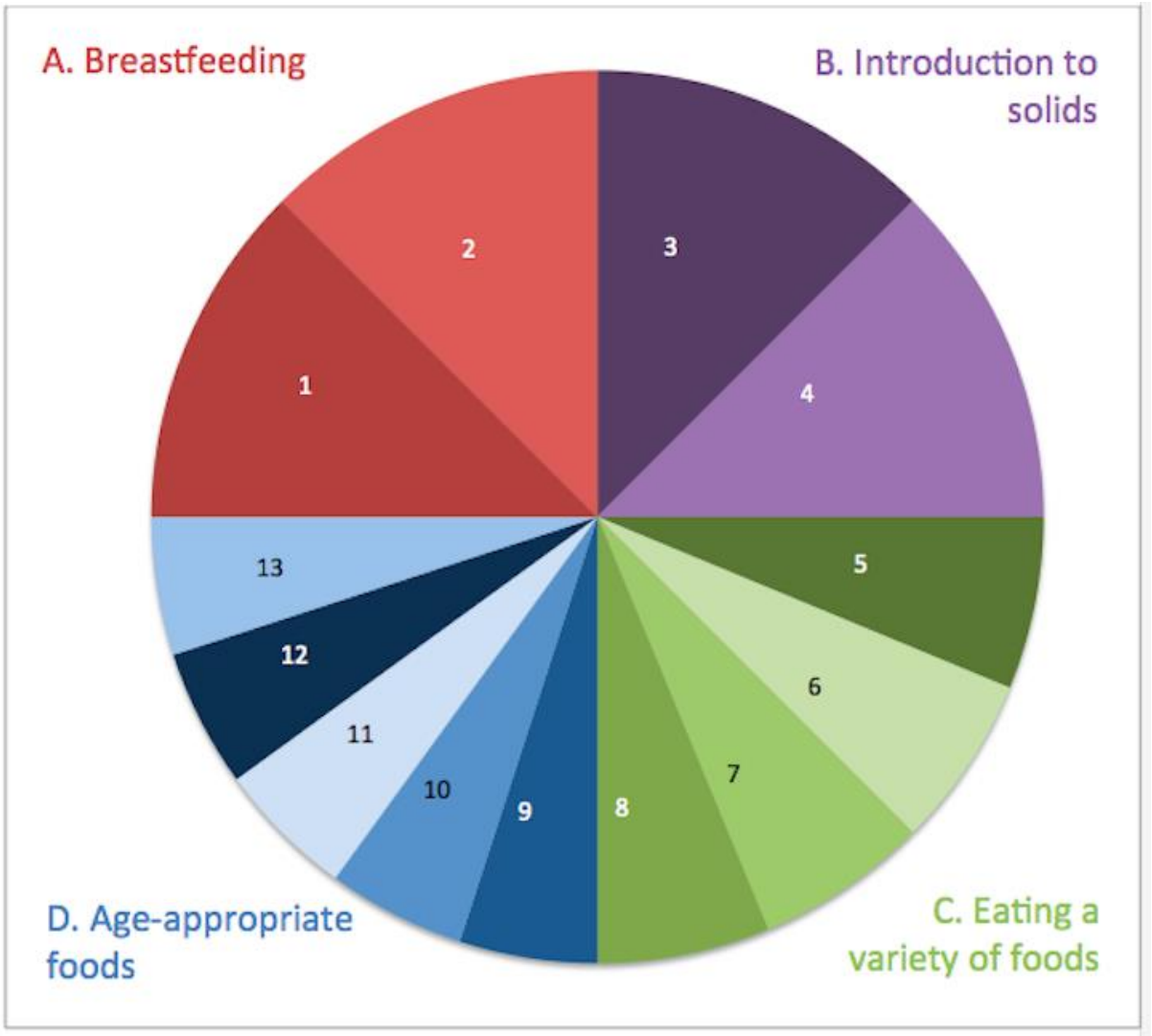
Any breastfeeding was defined as child receiving some breast milk but also receiving other milk and/or solids. Exclusive breastfeeding was defined as child receiving only breast milk and no other milk, solids, fluids or water. The description of breastfeeding duration used maternal recalled information collected when the children were 9 and 31 months old and was determined by the question *"How old was your baby when you stopped breastfeeding?* For the children that were still being breastfed at the 9-Month interview, or for whom information on breastfeeding duration was missing at that time point, information about breastfeeding duration was obtained from the 31-Month interview. The description of exclusive breastfeeding duration used the maternal recalled information collected when the children were 9 months old and it was determined by the question "*How long did you exclusively breastfeed? By exclusively I mean feeding baby only breast milk (including expressed breast milk) and not any water, milk formula, other liquids, or solid foods*". The duration of exclusive breastfeeding (in months) reported by the mothers was corrected by the information about the child`s feeding status reported when they were 6 weeks old and by the retrospective maternal recall of age of introduction of foods or drinks collected at the 9 Month interview (more details in Castro et al, 2017).

Indicators of practices of infant feeding

The indicators presented in this report were based on evidence-based statements of the Infant Feeding Guidelines (pages 19-20) (Ministry of Health, 2008) that were applicable to infants and able to be measured using the *GUiNZ* data. Consequently, the indicators were derived from the Infant Feeding Guidelines statements numbered 2 to 6, and 10 (total of thirteen indicators). **Table 3** lists the indicators chosen for the IFI, how they were derived using *GUiNZ* data, and the specific rationale linking each indicator with the Infant Feeding Guidelines statements considered.

These indicators were grouped under 4 domains with equal weighting: breastfeeding, introduction to solids, eating a variety of foods, and appropriate foods and drinks (as seen in **Figure 2**). The decision to apply equal weighting to the domains rather than equal weighting to indicators in the index was reached by reviewing the literature on infant feeding determinants of child nutrition and health outcomes, and was informed by the OECD Handbook on Constructing Composite Indicators (2008) which recommends that indicators should be aggregated and weighted based on an underlying theoretical framework, in this case, the Infant Feeding Guidelines (Ministry of Health, 2008).

Figure 2: Overview of domains and indicators in the NZ Infant Feeding Index



Key:

DOMAIN A: Breastfeeding

1. Breastfeeding duration (12.5 points)
2. Exclusive breastfeeding duration (12.5 points)

DOMAIN B: Introduction of solids

3. Progression of solid meals (12.5 points)
4. Age of introduction to solids (12.5 points)

DOMAIN C: Eating a variety of foods

5. Eating across the four food groups daily (6.25 points)
6. Vegetable intake (6.25 points)
7. Fruit intake (6.25 points)
8. Iron-rich foods (6.25)

DOMAIN D: Appropriate foods and drinks

9. Milk drinks (5 points)
10. Other drinks (5 points)
11. Other foods (5 points)
12. Addition of salt (5 points)
13. Addition of sugar (5 points)

Table 3: Indicators of infant feeding practices from the GUiNZ cohort study linked to the NZ Infant Feeding Guidelines

Domain	Indicator of infant feeding practices	RATIONALE Link to the NZ Infant Feeding Guidelines	*GUiNZ* question and/or derived variable
A. Breastfeeding	***Breastfeeding duration***	Statement 3: When your baby is ready, introduce him or her to appropriate complementary foods and continue to breastfeed until they are at least one year of age, or beyond.	Dose-response score. Breastfeeding duration was provided by maternal recall at 9 and 31 Month interviews. **Indicator: breastfeeding duration of 12 months or more**
	Exclusive breastfeeding duration	Statement 2: Exclusively breastfeed your baby until your baby is ready for and needs extra food – this will be at around six months of age.	Dose-response score with U-shape (gradually increasing to 6 months and decreasing from 7 months of duration). Exclusive breastfeeding duration was provided by maternal recall of duration adjusted by information on infant's feeding status at 6 Week interview and by maternal recall of age of food introduction at the 9 Month interview. **Indicator: 5 to less than 7 months duration of exclusive breastfeeding**
B. Introduction of solids	***Progression of solid meals***	Statement 4: Increase the texture, variety, flavour and amount of food offered so that your baby receives a complementary intake of nutrients, especially iron and vitamin C, and is eating more family foods by one year of age.	Determined by the following question, asked at the 9 Month interview: How many solid meals did the infant have in the last 24 hours? **Indicator: 3 or more solid meals a day at 9 months of age**

Domain	Indicator of infant feeding practices	RATIONALE Link to the NZ Infant Feeding Guidelines	*GUiNZ* question and/or derived variable
	Age of introduction to solids	Statement 3: When your baby is ready, introduce him or her to appropriate complementary foods and continue to breastfeed until they are at least one year of age, or beyond.	Derived from recalled maternal information on age of solids introduction, collected at the 9 Month interview. It considered the age of introduction to all of the 19 solids that are part of the FFQ. **Indicator: introduction to solids when infant is 5 to less than 7 months of age.**
C. Eating a variety of foods	***Eating across the four food groups daily***	Statement 4: Increase the texture, variety, flavour and amount of food offered so that your baby receives a complementary intake of nutrients, especially iron and vitamin C, and is eating more family foods by one year of age.	Frequency of daily intake of the four core food groups were derived from the FFQ administered at the 9 Month interview. **Indicator: daily intake of at least one serving from the 4 food groups: milk (breast milk or formula); vegetables or fruits; breads or cereals; meat, fish, eggs, shellfish, soy products and nuts, at 9 months of age**
	Vegetable intake	Statement 4: Increase the texture, variety, flavour and amount of food offered so that your baby receives a complementary intake of nutrients, especially iron and vitamin C, and is eating more family foods by one year of age.	Frequency of daily intake of vegetables were derived from the FFQ administered at the 9 Month interview. Indicator: vegetables served twice or more/daily at 9 months of age
	Fruit intake	Statement 4: Increase the texture, variety, flavour and amount of food offered so that your baby receives a complementary intake of nutrients,	Frequency of daily intake of fruit were derived from the FFQ administered at the 9 Month interview. Indicator: fruit served twice or more/daily at nine months of

Domain	Indicator of infant feeding practices	RATIONALE Link to the NZ Infant Feeding Guidelines	*GUiNZ* question and/or derived variable
		especially iron and vitamin C, and is eating more family foods by one year of age.	age
	Iron-rich foods	Statement 4: Increase the texture, variety, flavour and amount of food offered so that your baby receives a complementary intake of nutrients, especially iron and vitamin C, and is eating more family foods by one year of age.	Frequency of daily intake of iron-rich foods were derived from the FFQ administered at the 9 Month interview. Indicator: iron-rich foods served at least once a day
D. Appropriate foods and drinks	Milk drinks	Statement 3: When your baby is ready, introduce him or her to appropriate complementary foods and continue to breastfeed until they are at least one year of age, or beyond. Statement 6: If your baby is not fed breast milk, then use an infant formula as the milk source until your baby is one year of age.	Has child received up until the 9 Month interview, only breast milk or suitable formula? Indicator: only breast milk and/or appropriate formula milk ever given at 9 month interview.
	Other drinks	Statement 10: Do not give your infant or toddler alcohol, coffee, cordials, juice, soft drink, tea (including herbal drinks) and drinks	Has child received, up until the 9 Month interview, coffee, fruit juices, soft drinks, tea or herbal drinks? Indicator: No coffee, cordials, juice, soft drink, tea (including herbal drinks) of soft drinks ever tried at 9

Domain	Indicator of infant feeding practices	RATIONALE Link to the NZ Infant Feeding Guidelines	*GUiNZ* question and/or derived variable
		containing caffeine.	months of age
	Other foods	Statement 5: For your baby, prepare or choose pre-prepared complementary foods with no added fat, salt, sugar, honey or other sweeteners.	Has child received up until the 9 Month interview sweets, chocolate, hot chips or potato crisps? Indicator: food items rich in sugar, salt or fat.
	Addition of salt	Statement 5: For your baby, prepare or choose pre-prepared complementary foods with no added fat, salt, sugar, honey or other sweeteners.	Question asked at the 9 Month interview: Is salt added to baby's meal? Indicator: salt is not added to infant's meals.
	Addition of sugar	Statement 5: For your baby, prepare or choose pre-prepared complementary foods with no added fat, salt, sugar, honey or other sweeteners.	Question asked at the 9 Month interview: Is sugar added to baby's meal? Indicator: sugar is not added to infant's meals.

Scoring the Infant Feeding Index

The total score for the NZ IFI is a maximum of 100 points, which indicates 100% adherence to the infant nutrition and food guidelines. Each domain was equally scored. Within each domain, the maximum domain score was divided by the total number of indicators of the domain (**Table 4**).

Table 4: Scoring of the NZ IFI domains and indicators

Indicators by domain	Response	Score	Max Indicator score	Max Domain Score
A. Breastfeeding				25
Breastfeeding (any) duration	None	0	12.5	
	< or equal 1 month	1		
	2 months	2		
	3 months	3		
	…	…		
	12 months	12		
	13 months or more	12.5		
Exclusive breastfeeding duration	None	0	12.5	
	< or equal 1 month	2.5		
	2 months	5		
	3 months	7.5		
	4 months	10		
	5-6 months	12.5		
	7-10 months	10		
B. Introduction of solids				**25**
Progression of solid meals (3 or more solid meals daily at 9 months of age)	No	0	12.5	
	Yes	12.5		
Age of introduction to solids	4 months or less	0	12.5	
	5-6 months	12.5		
	7 months or more	0		

Indicators by domain	Response	Score	Max Indicator score	Max Domain Score
C. Eating a variety of foods				**25**
Eating across the four food groups (daily at 9 months)	No	0	6.25	
	Yes	6.25		
Vegetable intake (daily at 9 months)	None or less than daily	0	6.25	
	Once a day	3.125		
	Two or more times a day	6.25		
Vegetable intake (daily at 9 months)	None or less than daily	0	6.25	
	Once a day	3.125		
	Two or more times a day	6.25		
Intake of iron-rich foods (daily at 9 months)	None or less than daily	0	6.25	
	At least once a day	6.25		
D. Inappropriate foods				**25**
Inappropriate milk drinks introduced up until 9 months	No	5	5	
	Yes	0		
Inappropriate other drinks introduced up until 9 months	No	5	5	
	Yes	0		
Inappropriate foods introduced up until 9 months	No	5	5	
	Yes	0		
Addition of salt to meals	Yes or Sometimes	0	5	
	No	5		
Addition of sugar to meals	Yes or Sometimes	0	5	
	No	5		
Total IFI Score				**100**

Other variables used in analyses

In this report, we examined potential associations between the infant feeding practices and the following covariates:

Child's characteristics (6 Week perinatal interview):

- Child's gender (female/male)
- Fetal count (singleton/twin)
- Birth weight (<2500 g/>2500 g)
- Gestational age (<37 weeks/ >37 weeks)
- **Maternal characteristics (Antenatal interview):**
- Parity (first born/subsequent)
- Level of Education (No secondary school/ Secondary School:NCEA1-4/Diploma trade cert, NCEA 5-6/ Bachelor's degree/Higher Degree)
- Age ($\geq$35 years/ $\geq$25 years & $\leq$34 years/<25 years)
- Statistics NZ Level 1 Ethnic group (European/ Māori/ Pacific/ Asian/Others)
- Mother had a partner (yes/no)
- Neighbourhood deprivation (NZDEP 1-2; NZDEP 3-4; NZDEP 5-6; NZDEP 7-8; NZDEP 9-10)
- Mother's years of migration to NZ (born in NZ/$\geq$ 10 years in NZ; $\geq$5 & $\leq$9 years in NZ; <5 years in NZ)
- Did mothers attend childbirth preparation classes in this pregnancy (Yes/no, but intend to/no, but don't intend to).

Maternal self-prioritised ethnicities were gathered from participants at the most detailed level possible and then coded into six Level 1 categories following the Statistics NZ coding criteria: (1) European, (2) Māori, (3) Pacific People, (4) Asian, (5) Middle Eastern, Latin American and African (MELAA), and (6) Other. MELAA and Other were combined for analysis purposes. Neighbourhood deprivation was measured using (NZDep06), which 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 (Salmond, 2007).

Statistical analysis

Variables were summarized as percentages, means (standard deviation) and medians (interquartile ranges). Chi-square tests were used for comparisons of proportions and analysis of variance (ANOVA) and t-test for independent samples were used for the between groups comparison of continuous data (significance was determined at $p<0.05$, and dark bars in the graph represent a

group which had >10 percentage points lower compared to the highest group in category). When calculating rates of 'any and exclusive breastfeeding' the counts of children that were never breastfed were included in the denominator.

Relationships of each indicator of the IFI with key child and maternal/household characteristics were examined using multivariate Poisson regression with robust variance (Zou, 2004). In separate multivariate models, each of the 13 indicators of the IFI were transformed into dichotomous variables, indicating whether or not the recommendation was met (Table 5). Maternal sociodemographic variables with $p<0.05$ in the adjusted models were considered significantly associated with the infant feeding indicators.

Table 5: Dichotomizing the indicators of infant feeding

Indicators	Categories
1. Breastfeeding (any) duration for 12 months or beyond	Yes - No
2. Exclusive breastfeeding duration 5 to less than 7 months	Yes - No
3. Progression of solid meals (was infant having 3 or more solid meals at 9 months of age?)	Yes - No
4. Age of introduction to solids around 6 months of age	Yes- No
5. Eating across the four food groups (daily at 9 months)	Yes - No
6. Vegetable intake twice or more/daily at 9 months	Yes - No
7. Fruit intake twice or more/daily at 9 months	Yes - No
8. Daily intake of iron-rich foods at 9 months	Yes - No
9. Inappropriate milk drinks introduced up until 9 months	Yes - No
10. Inappropriate drinks introduced by the age of 9 months	Yes - No
11. Inappropriate foods introduced by the age of 9 months	Yes - No
12. Addition of salt to meals	Yes or Sometimes - No
13. Addition of sugar to meals	Yes or Sometimes - No

Univariate and multiple linear regression models were constructed to examine associations between the IFI score (dependent variable) and child's and mother's characteristics (independent variables), presenting unadjusted and adjusted beta coefficients-β (95% confidence intervals). Variables for which the p-value for association with the IFI score had a $p<0.20$ in the univariate regressions were selected to be tested in the multivariate model. Those variables with $p<0.05$ in the multivariate model were considered significantly associated with the IFI score and were retained in the final model.

Poisson regression (with robust variance) was also used to examine the associations between IFI scores and the child's and mother's characteristics. We categorized the IFI as a dichotomous variable (<80 points versus $\geq$80 points) and performed univariate and multivariate analyses presenting the unadjusted and adjusted relative risks (95% confidence intervals). Those variables with $p<0.05$ in the multivariate model were considered significantly associated with the categories of IFI score and were retained in the final model.

For examining the relationship of IFI final score and child's and mother's characteristics, twins, babies born less than 2500 grams, and/or less than 37 weeks of gestational age were excluded. The rationale for excluding twins from the analysis is that the multivariate analysis (linear and Poisson regressions) require independent observations. The rationale for excluding babies born less than 2500 grams, and/or less than 37 weeks of gestational age is that the Infant Feeding Guidelines may not be appropriate for these infants, many of whom would be following individually-tailored clinical nutrition guidelines.

Readers interested in the absolute adherence to an individual infant guideline or the overall IFI score for a particular population group should refer to the unadjusted figures. Readers interested in differences between population groups should refer to the adjusted models.

All analyses were performed using Stata Statistical Software (version 15, StataCorp LP, College Station, TX).

Results

Study population

In total, 6,470 infants participated in the Growing Up in New Zealand 9-month interview. Of those, 35 children had missing information on dietary intake and were excluded from the analyses presented in this report. Data on 6,435 children (99.4% of the children that took part of the 9-month interview) are presented.

The majority of infants were singleton (97.5%) with two out of five infants being the first born (42.1%). At the antenatal interview, just over half of mothers were aged between 25 and 34 years (55.7%), 30.8% had a Diploma/trade cert/NCEA 5-6, 23.2% had a bachelor's degree and 16.1% had a higher post-graduate qualification. Half of mothers self-prioritized European ethnicity (55.1%), and there were substantial numbers of Māori (13.4%), Pacific (13.7%) and Asian (14.4%) mothers for reliable estimates for these ethnic groups. Two out of five mothers lived in the most deprived neighbourhood quintile (26.4%) and of the 89% of mothers who reported their relationship status at the antenatal interview, most reported having a partner (94.9%) **(Table S1-Appendix**).

Readers should note that most indicators and covariates had a number of missing data (eg. when the respondent answered "don't know" or refused), which may have introduced bias in the data reporting. The number of missing data for each item is contained in the notes below each graph and table. The indicator with the largest proportion of missing data was breastfeeding status at 12 months of age (n=338, 5.3% of the cohort) and the covariate with the largest proportion of missing data was maternal relationship status in pregnancy (n=705, 11% of the cohort). Mothers with missing maternal relationship status in pregnancy have lower qualification levels on average than other cohort members, are more likely to be Māori, Pacific or Asian, and were more likely to live in deprived neighbourhoods in pregnancy. The exclusion of this large group should be borne in mind when interpreting the results.

Description of the indicators of the IFI

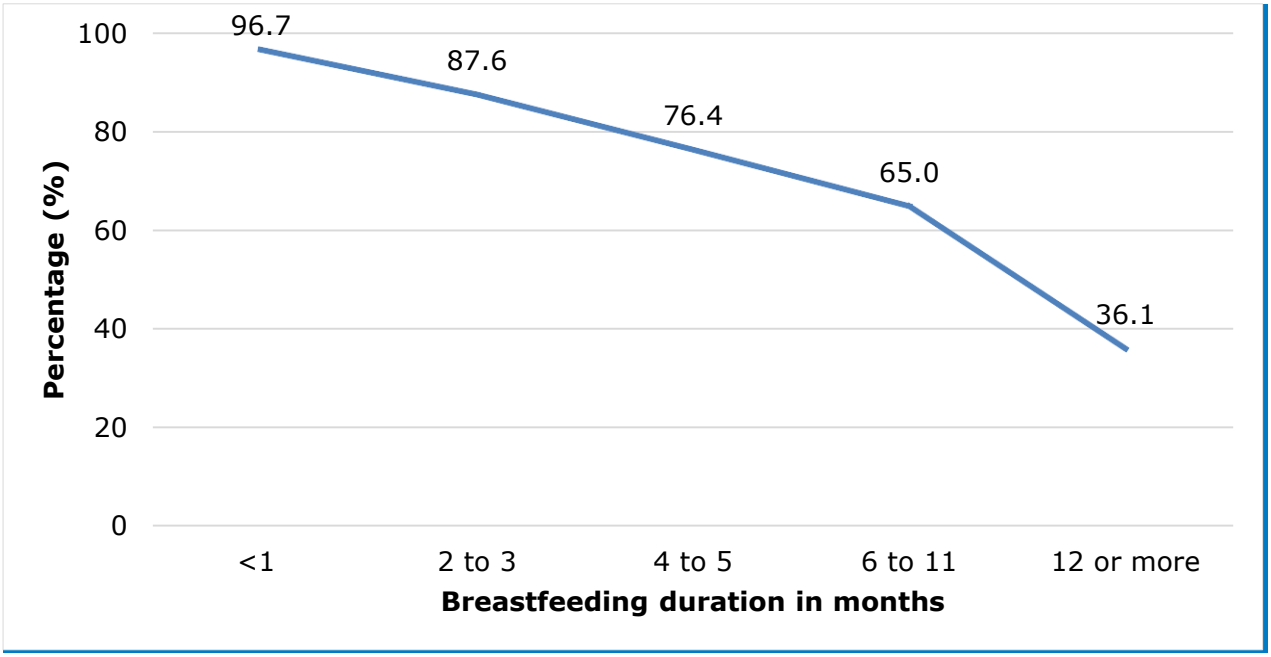
Domain A: Breastfeeding

This domain contains results for two indicators (each worth a maximum of 12.5 points in the IFI): breastfeeding duration to 12 months and exclusive breastfeeding to around 6 months of age.

Breastfeeding duration

The median (IQR) breastfeeding duration was 8 months (4;14). Just over one in three children (36.1%) were breastfed for 12 months or beyond (**Figure 3**).

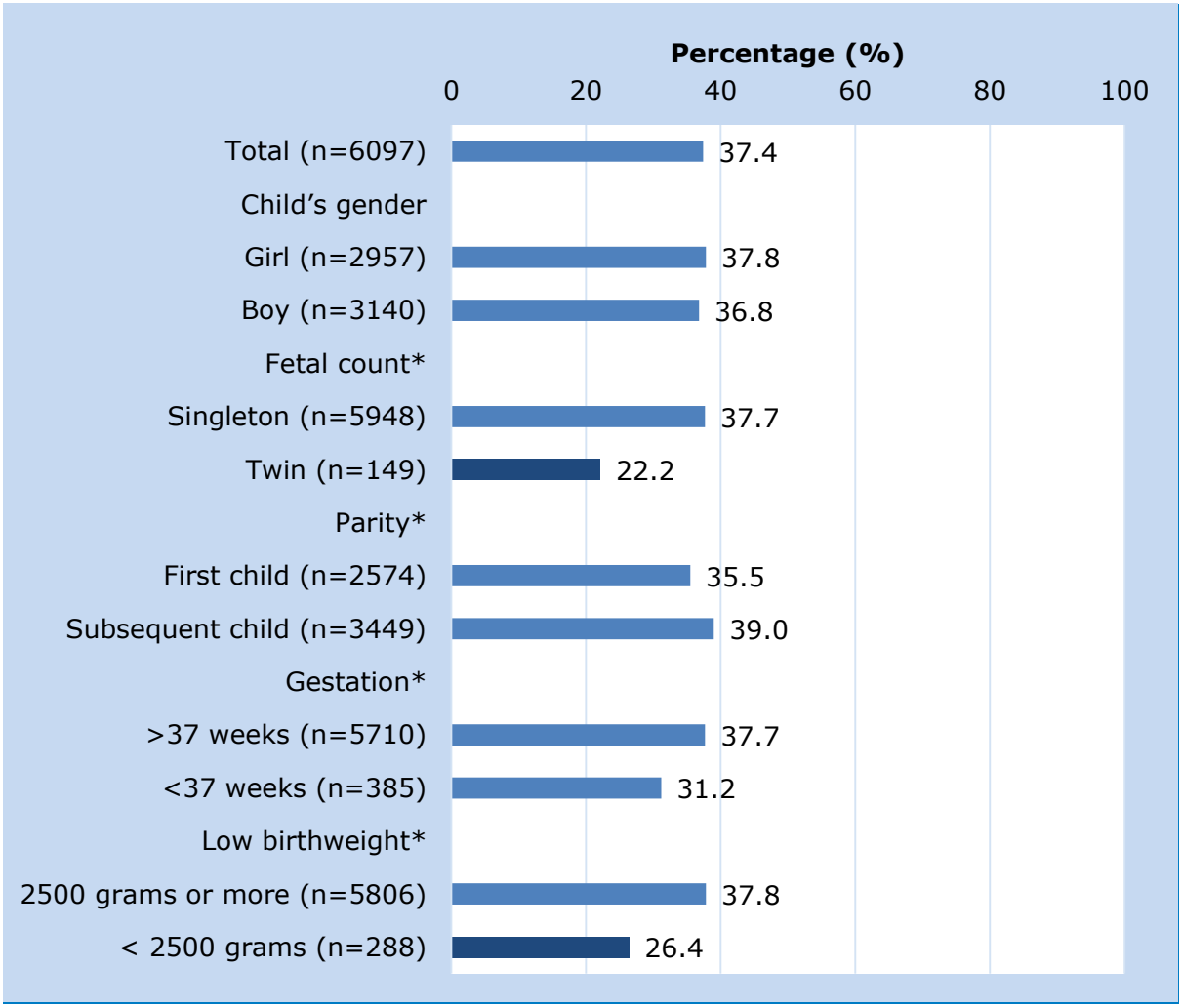
Figure 3: Rates of breastfeeding duration according to the children`s age



Notes: N=6303 (included the children that were never breastfed in the denominator; excluded children with missing information for total duration of breastfeeding).

A smaller proportion of twins and infants with a low birth weight were breastfed to 12 months, compared to singletons and normal birth weight respectively. First-born infants and those born prematurely, rather than normal gestation, were also statistically less likely to be breastfed to 12 months, but the difference between groups was small (**Figure 4)**.

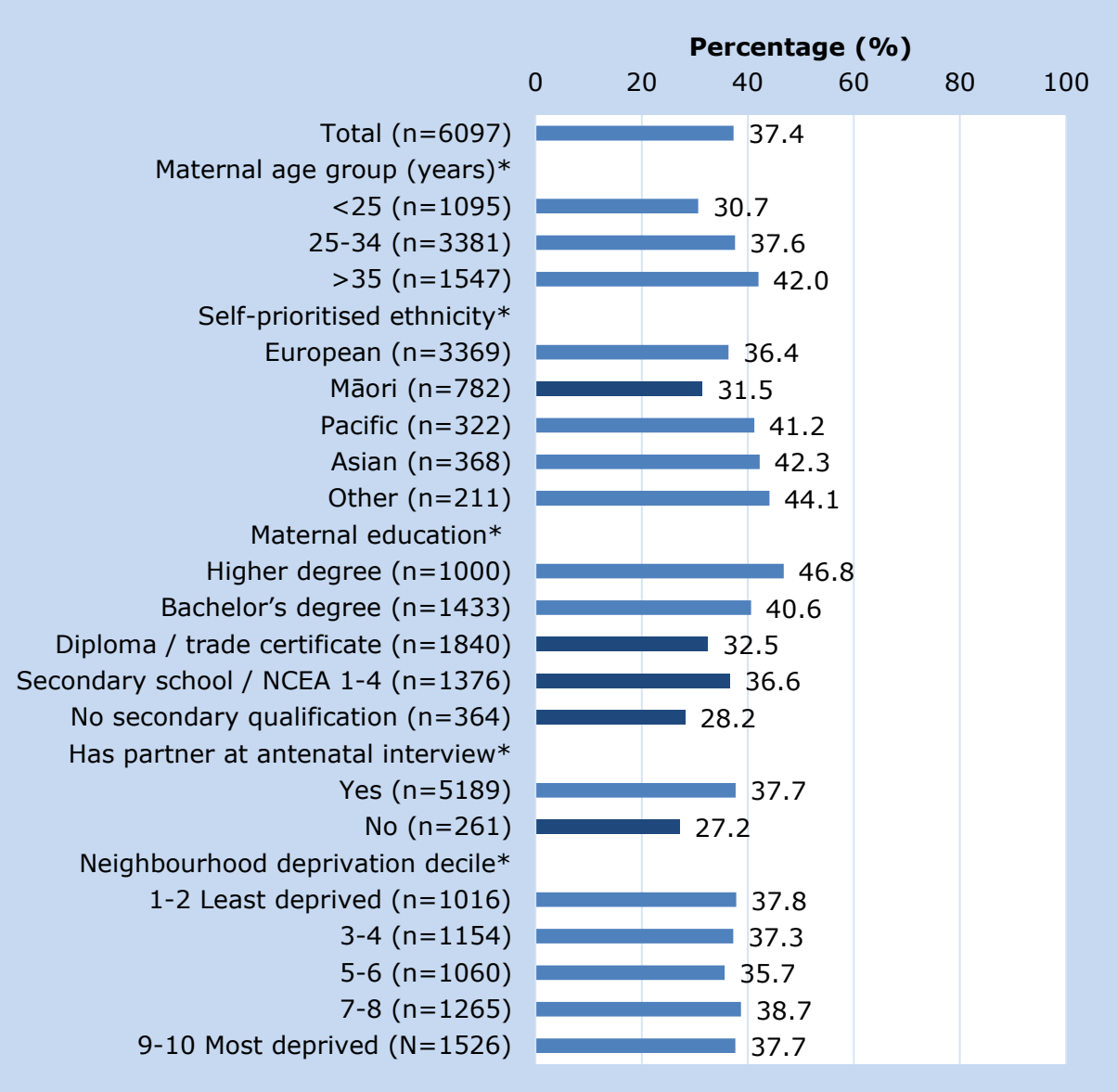
Figure 4: Breastfed for 12 months or more, by child characteristics (unadjusted)



Notes: * Statistical significance measured by chi-square test ($p<0.05$); dark blue bars indicate >10 percentage points lower than the highest group in category. Children never breastfed not included in the denominator ($n=206$). Data missing for $n=338$ regarding breastfeeding status to 12 months, $n=89$ regarding parity, $n=10$ regarding gestation and $n=4$ regarding birth weight.

Significant differences in adherence to the breastfeeding duration guideline were found by age, ethnic group, education and partner status of the mother antenatally (**Figure 5)**.

Figure 5: Breastfed for 12 months or more, by maternal and neighbourhood characteristics (unadjusted)

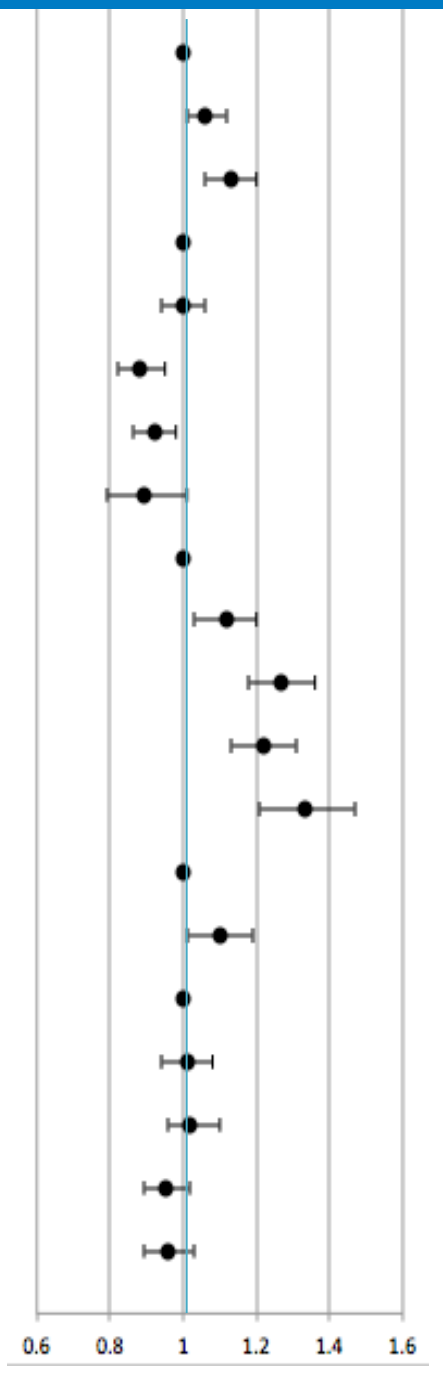


Notes: * Statistical significance measured by chi-square test ($p<0.05$); dark blue bars indicate >10 percentage points lower than the highest group in category. Children never breastfed not included in the denominator ($n=206$). Data missing for $n=338$ regarding breastfeeding status to 12 months, $n=82$ regarding mother's age, $n=99$ regarding mother's ethnicity, $n=100$ regarding mother's education, $n=705$ regarding mother's relationship status, and $n=84$ regarding neighbourhood deprivation.

After adjustment for differences between groups, women of Pacific and Asian ethnicity were significantly more likely to breastfeed their baby for 12 months or longer than Europeans. Women with a Bachelor's qualification or lower, aged under 35 years, and/or without a partner, were less likely to meet the 12 month breastfeeding duration guideline (**Table 6**).

Table 6: Risk of not meeting the guideline to breastfeed 12 months or more, by sociodemographic characteristics (adjusted)

Sociodemographic characteristic		Relative risk	95% confidence interval	Forest plot
Maternal age	≥35 years	Reference		
	25-34 years	1.06	1.01-1.12	
	≤25 years	1.13	1.06-1.20	
Self-prioritised ethnic group	European	Reference		
	Māori	1.00	0.94-1.06	
	Pacific	0.88	0.82-0.95	
	Asian	0.92	0.86-0.98	
	Other	0.89	0.79-1.01	
Maternal education	Higher/postgraduate	Reference		
	Bachelor's degree	1.12	1.03-1.20	
	Diploma/trade cert	1.27	1.18-1.36	
	Sec school / NCEA 1-4	1.22	1.13-1.31	
	No qualification	1.33	1.21-1.47	
Mother had a partner	Yes	Reference		
	No	1.10	1.01-1.19	
Neighbourhood deprivation (NZDep decile)	1-2 Least deprived	Reference		
	Decile 3-4	1.01	0.94-1.08	
	Decile 5-6	1.02	0.96-1.10	
	Decile 7-8	0.95	0.89-1.02	
	9-10 Most deprived	0.96	0.89-1.03	

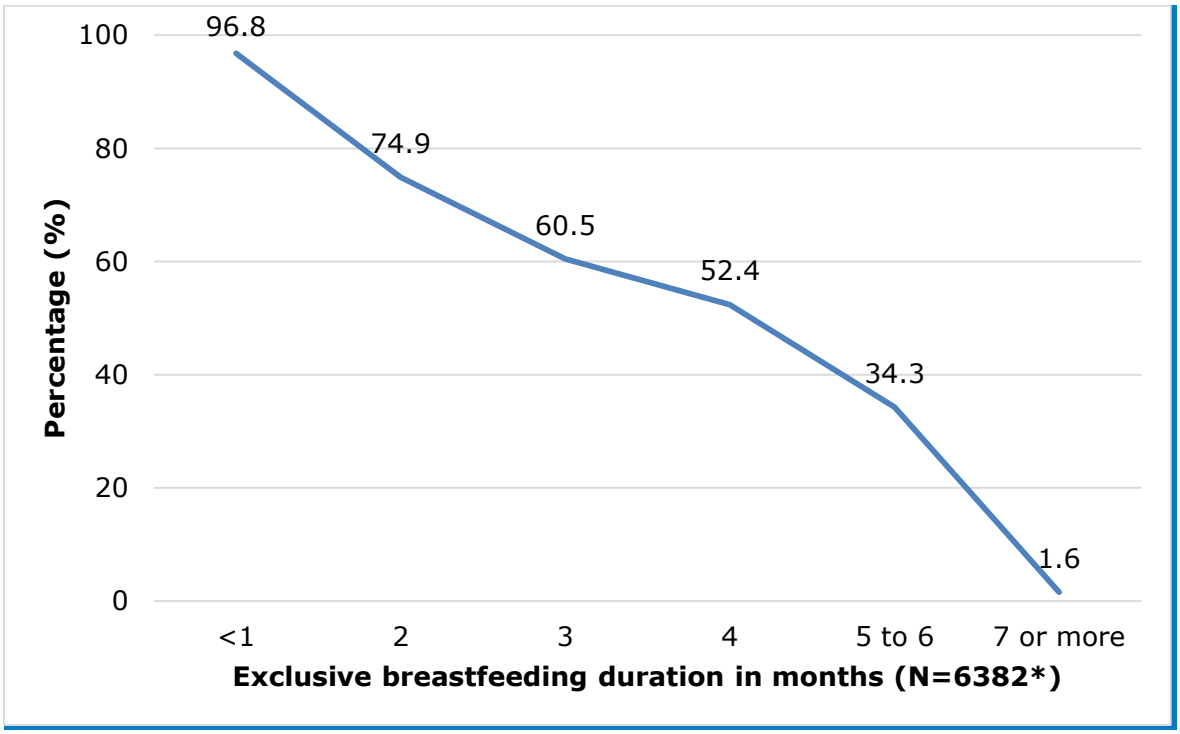


Notes: Poisson regression model with robust estimation adjusted for maternal age, ethnic group, education, partner status and Neighbourhood deprivation at the antenatal interview. A statistically significant difference from the reference group is shown in bold (Wald chi square test p-value<0.05). Twins and infants born prematurely or with low birth weight were removed from the dataset (*n*=556). The model did not include participants with one or more missing data for maternal or household characteristics. Total N=5045. CI=confidence interval.

Exclusive breastfeeding duration

The median (IQR) duration of exclusive breastfeeding was 4.0 months (1.0; 5.0). One in three children (34.3%) were exclusively breastfed to around 6 months (5 to 6 months of age), and a small proportion of infants were exclusively breastfed beyond 6 months of age (**Figure 6**).

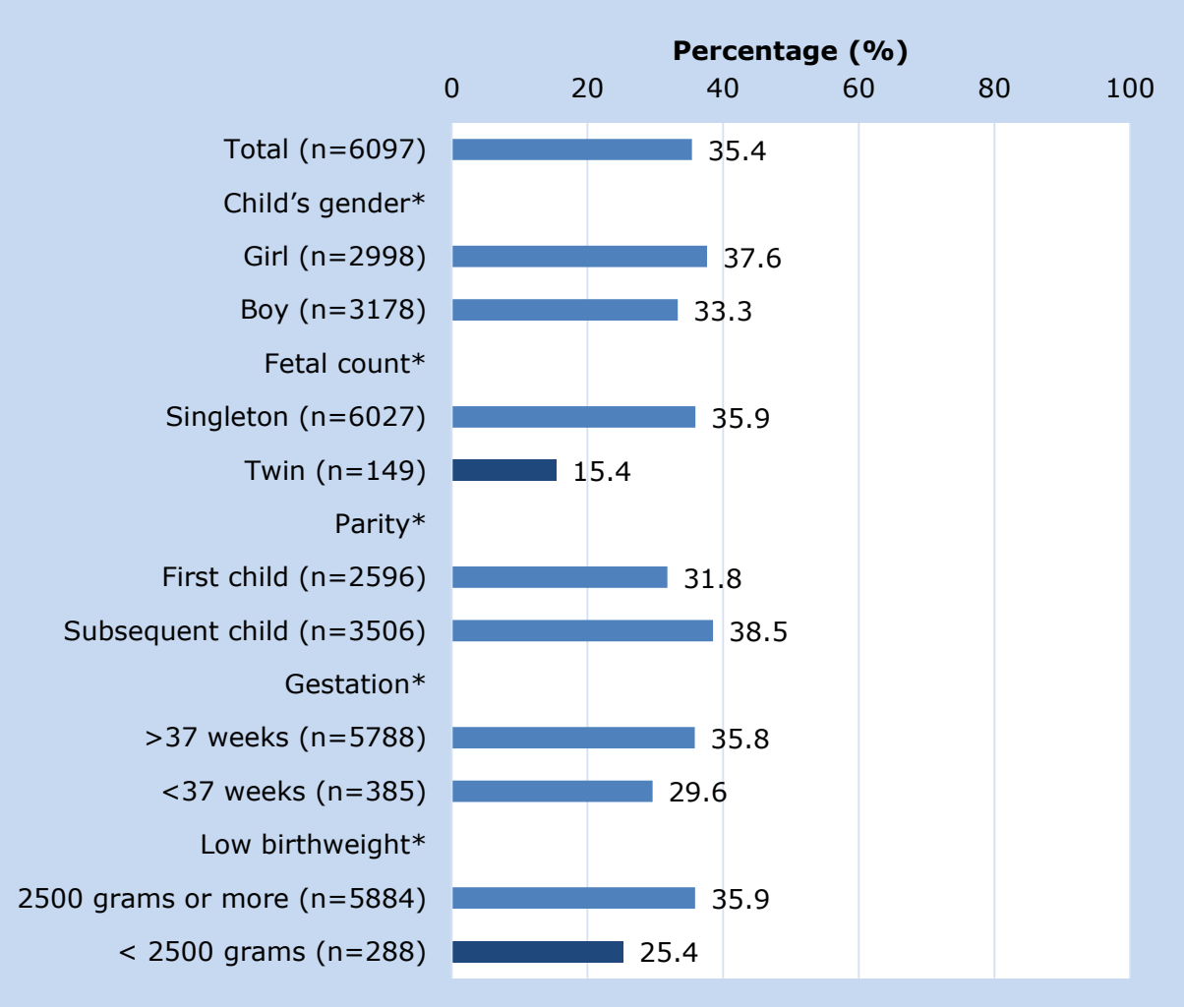
Figure 6: Rates of exclusive breastfeeding duration according to the children's age



Notes: N=6382*(included the children that were never breastfed in the denominator; excluded children with missing information for total duration of breastfeeding).

Twins, infants with a low birth weight and born prematurely were the least likely to be exclusively breastfed to 5 months. A lower proportion of first born compared to subsequent children, were exclusively breastfed to 5 months of age. Boys were significantly less likely to be exclusively breastfed to 5 months of age, however, the difference between the genders was small (**Figure 7**).

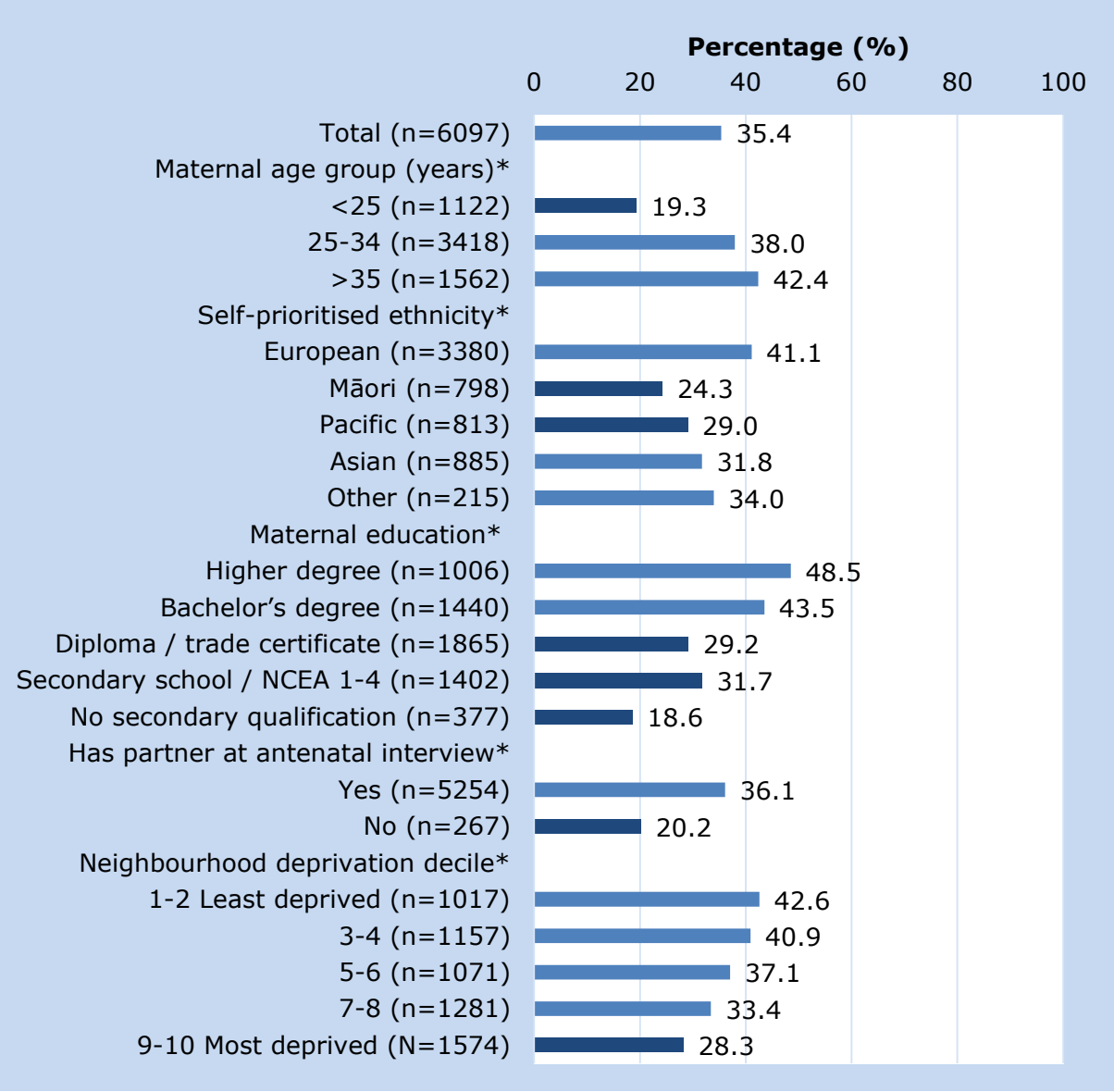
Figure 7: Exclusively breastfed until 5-6 months of age, by child characteristics (unadjusted)



Notes: * Statistical significance measured by chi-square test ($p<0.05$); dark blue bars indicate >10 percentage points lower than the highest group in category. Data missing for n=259 regarding breastfeeding status to 6 months, n=89 regarding parity, n=10 regarding gestation and n=4 regarding birth weight.

Significant differences in adherence to the exclusive breastfeeding duration guideline were found by all maternal and neighbourhood characteristics (**Figure 8**).

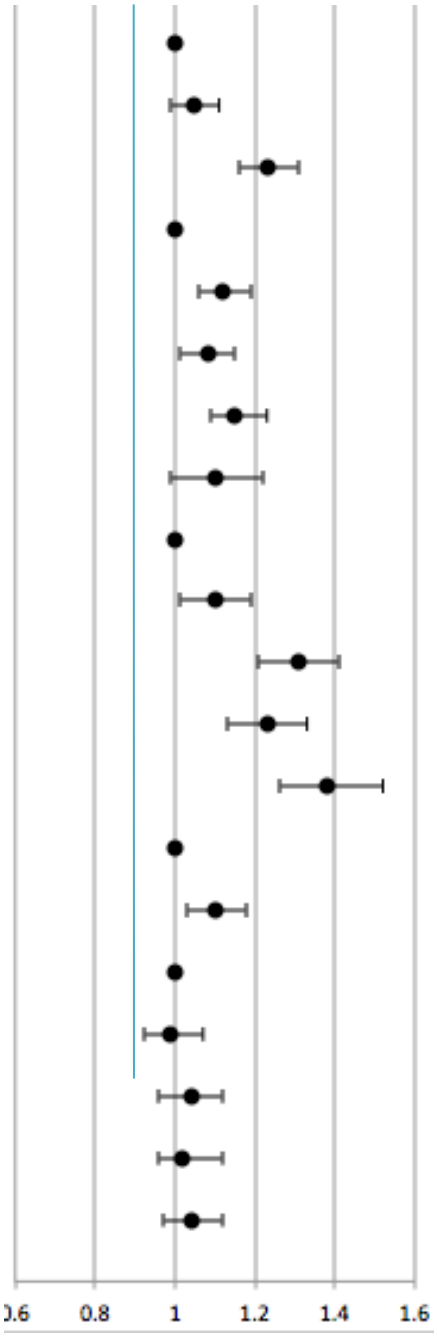
Figure 8: Exclusively breastfed until 5-6 months of age, by maternal and neighbourhood characteristics (unadjusted)



Notes: * Statistical significance measured by chi-square test ($p<0.05$); dark blue bars indicate >10 percentage points lower than the highest group in category. Data missing for $n=259$ regarding breastfeeding status to 6 months, $n=82$ regarding mother's age, $n=99$ regarding mother's ethnicity, $n=100$ regarding mother's education, $n=705$ regarding mother's relationship status, and $n=84$ regarding neighbourhood deprivation.

Maternal age and education were the largest drivers of disparities in exclusive breastfeeding duration. After adjustment for differences between groups, women with a Bachelor's qualification or lower were less likely to meet the guideline compared to a higher degree. Mothers aged under 25 years were less likely to meet the guideline compared to mothers aged 35 years or older. Asian, Māori, and Pacific mothers were also less likely to meet the guideline (**Table 7**).

Table 7: Risk of not meeting the guideline to exclusively breastfeed to around 6 months, by sociodemographic characteristics (adjusted)

Sociodemographic characteristic		Relative risk	95% confidence interval	Forest plot
Maternal age	≥35 years	Reference		
	25-34 years	1.05	0.99-1.11	
	≤25 years	1.23	1.16-1.31	
Self-prioritised ethnic group	European	Reference		
	Māori	1.12	1.06-1.19	
	Pacific	1.08	1.01-1.15	
	Asian	1.15	1.09-1.23	
	Other	1.10	0.99-1.22	
Maternal education	Higher/postgraduate	Reference		
	Bachelor's degree	1.10	1.01-1.19	
	Diploma/trade cert	1.31	1.21-1.41	
	Sec school / NCEA 1-4	1.23	1.13-1.33	
	No qualification	1.38	1.26-1.52	
Mother had a partner	Yes	Reference		
	No	1.10	1.03-1.18	
Neighbourhood deprivation (NZDep decile)	1-2 Least deprived	Reference		
	Decile 3-4	0.99	0.92-1.07	
	Decile 5-6	1.04	0.96-1.12	
	Decile 7-8	1.02	0.96-1.12	
	9-10 Most deprived	1.04	0.97-1.12	

Notes: Poisson regression model with robust estimation adjusted for maternal age, ethnic group, education, partner status and neighbourhood deprivation at the antenatal interview. A statistically significant difference from the reference group is shown in bold (Wald chi square test p-value<0.05). Twins and infants born prematurely or with low birth weight were removed from the dataset (n=556). The model did not include participants with one or more missing data for maternal or household characteristics. Total N=5045. CI=confidence interval.

Domain B: Introduction to solids

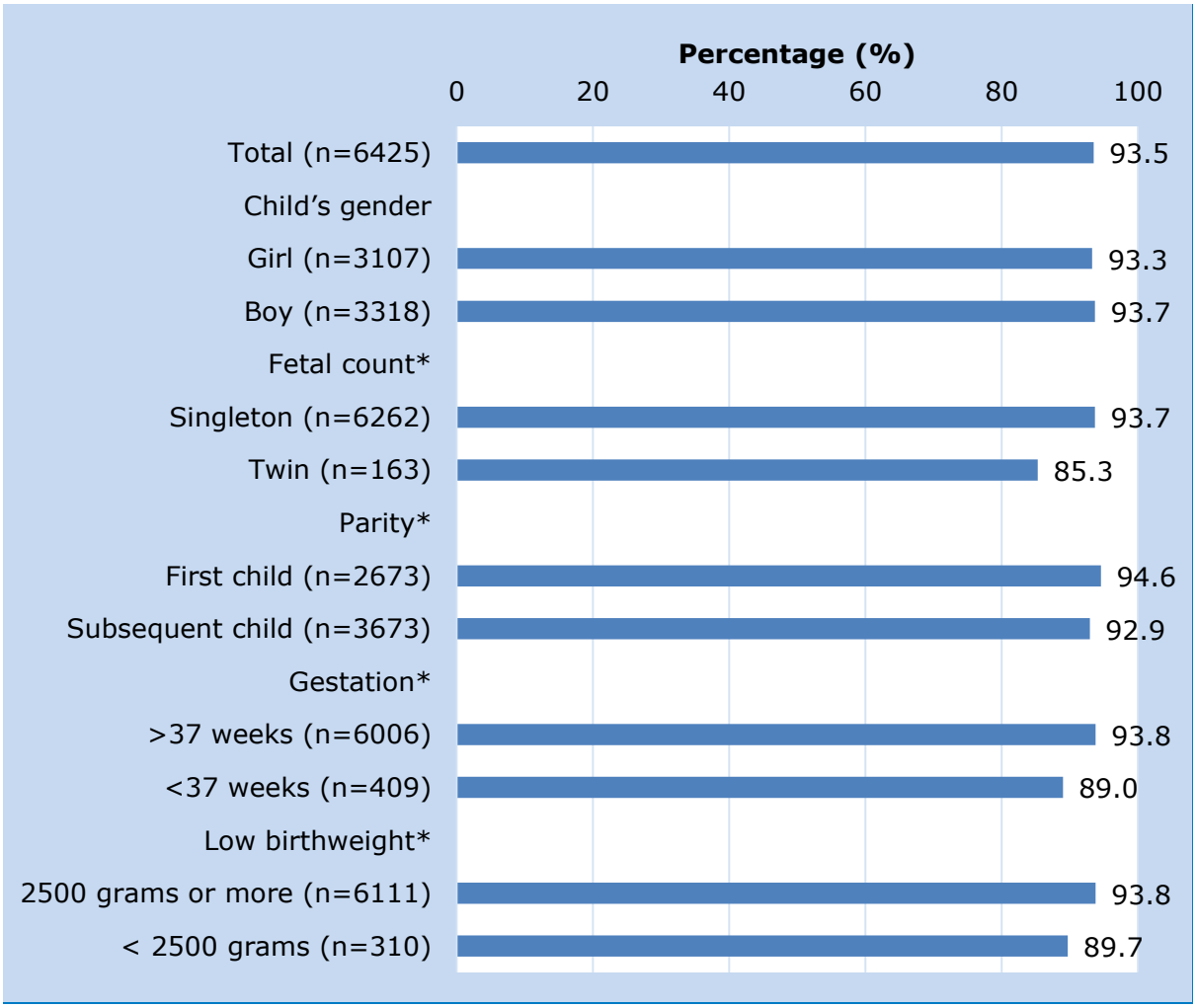
This domain contains results for two indicators (each worth a maximum of 12.5 points in the IFI): progression of solid meals at 9 months of age and introduction to solids around 6 months of age.

Progression of solid meals

Nine out of ten infants (6009, 93.5%) were eating 3 or more solid meals a day at nine months of age; 5.3% (n=339) were eating 2 solid meals a day, 0.8% (n=54) were eating 1 solid meals a day, and 0.4% (n=23) were not receiving any solid meals at nine months of age.

A lower proportion of twins, infants born early (<37 weeks gestation) and of low birth weight (<2500 grams) had three or more solid meals a day at 9 months of age, but these differences were all less than 10% points (**Figure 9**).

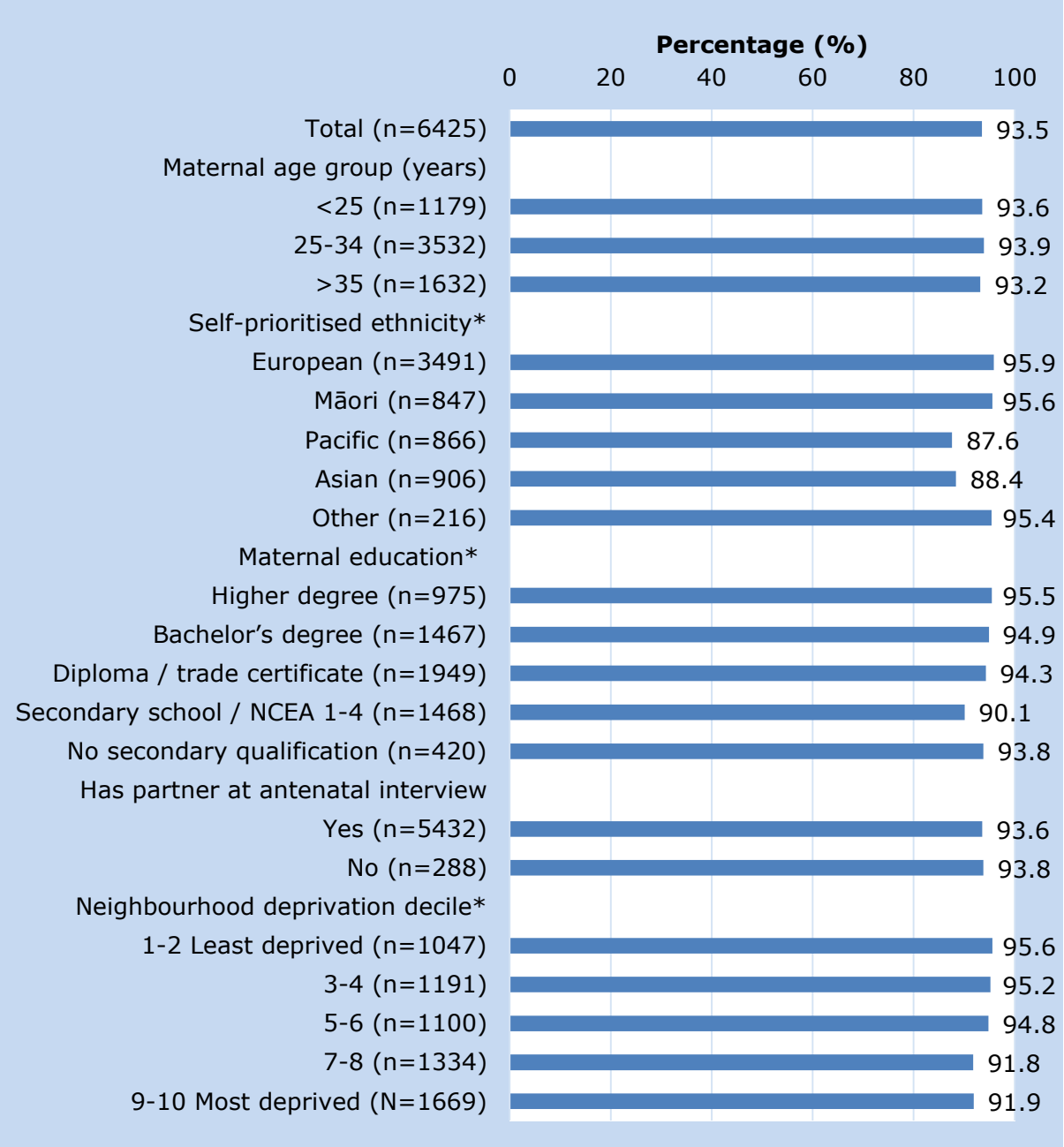
Figure 9: Three or more solid meals a day at 9 months of age, by child characteristics (unadjusted)



Notes: * Statistical significance measured by chi-square test ($p<0.05$); dark blue bars indicate >10 percentage points lower than the highest group in category (none in this graph). Data missing for n=10 infants regarding number of solid meals per day, n=89 regarding parity, n=10 regarding gestation and n=4 regarding birth weight.

Significant differences in the proportion of infants adhering to the guideline about progression of solid meals were found by maternal ethnic group, maternal education and neighbourhood deprivation, but these were all small (**Figure 10**).

Figure 10: Three or more solid meals a day at 9 months of age, by maternal and neighbourhood characteristics (unadjusted)

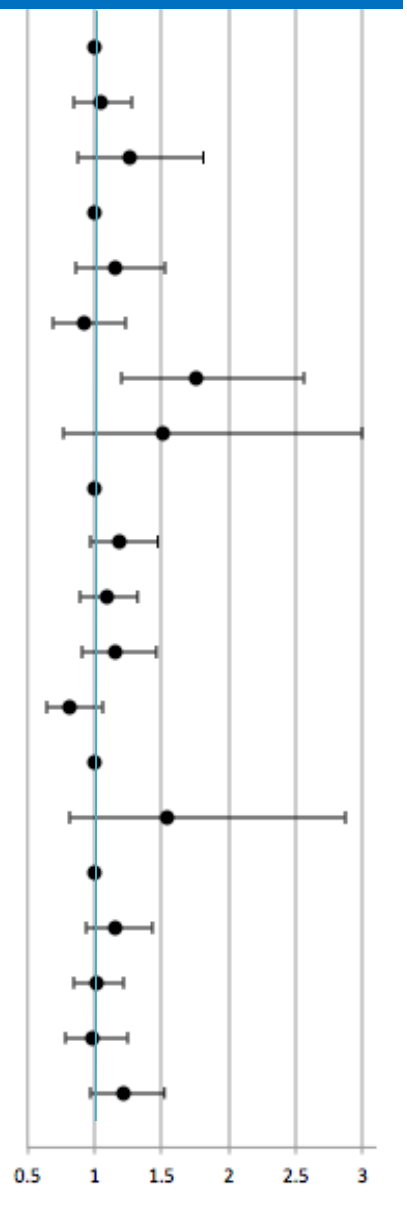


Notes: * Statistical significance measured by chi-square test ($p<0.05$); dark blue bars indicate >10 percentage points lower than the highest group in category (none in this graph). Data missing for n=82 regarding mother's age, n=99 regarding mother's ethnicity, n=100 regarding mother's education, n=705 regarding mother's relationship status, and n=84 regarding neighbourhood deprivation.

After adjustment for differences between groups, infants of Asian mothers were 1.8 times less likely to meet the guideline to progress to three or more solid meals a day by nine months of age, when compared to European infants (**Table 8**).

Table 8: Risk of not meeting the guideline to progress to three solid meals a day by 9 months of age, by sociodemographic characteristics (adjusted)

Sociodemographic characteristic		Relative risk	95% confidence interval	Forest plot
Maternal age	≥35 years	Reference		
	25-34 years	1.04	0.85-1.28	
	≤25 years	1.26	0.87-1.81	
Self-prioritised ethnic group	European	Reference		
	Māori	1.15	0.86-1.53	
	Pacific	0.92	0.69-1.23	
	Asian	1.75	1.20-2.56	
	Other	1.51	0.76-3.00	
Maternal education	Higher/postgraduate	Reference		
	Bachelor's degree	1.19	0.96-1.47	
	Diploma/trade cert	1.09	0.89-1.32	
	Sec school / NCEA 1-4	1.15	0.91-1.46	
	No qualification	0.82	0.64-1.06	
Mother had a partner	Yes	Reference		
	No	1.54	0.82-2.87	
Neighbourhood deprivation (NZDep decile)	1-2 Least deprived	Reference		
	Decile 3-4	1.15	0.93-1.43	
	Decile 5-6	1.02	0.85-1.22	
	Decile 7-8	0.99	0.78-1.25	
	9-10 Most deprived	1.21	0.96-1.52	

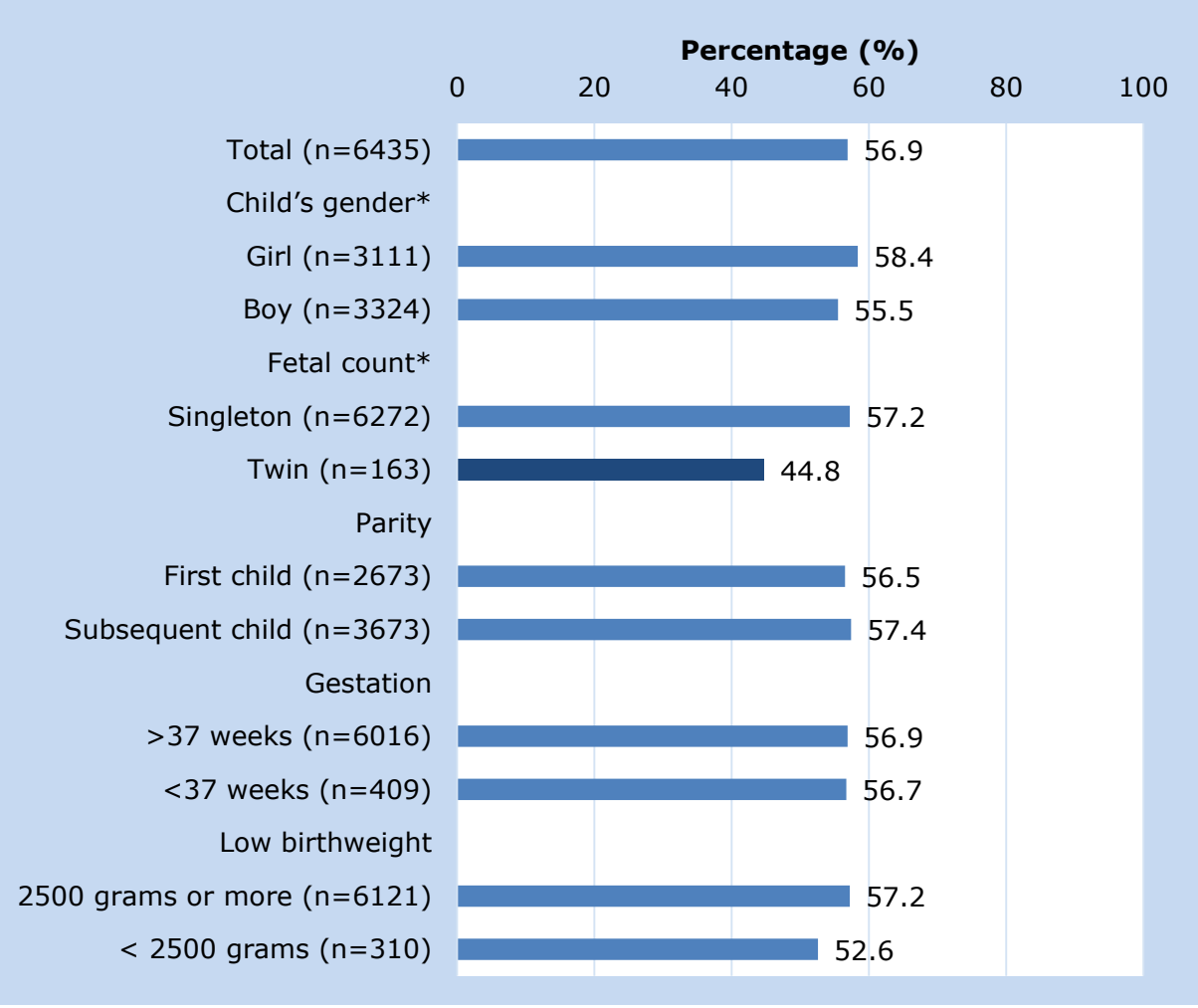


Notes: Poisson regression model with robust estimation adjusted for maternal age, ethnic group, education, partner status and neighbourhood deprivation at the antenatal interview. A statistically significant difference from the reference group is shown in bold (Wald chi square test p-value<0.05). Twins and infants born prematurely or with low birth weight were removed from the dataset (n=556). The model did not include participants with one or more missing data for maternal or household characteristics. Total N=5045. CI=confidence interval.

Age of introduction to solids

Over half of infants (3,663, 56.9%) were introduced to solid foods at around 6 months of age (5 to less than 7 months old). Two out of five (2,531, 39.3%) were introduced to solids early, i.e. before 5 months of age, and a small proportion were introduced late at 7 to 9 months of age (233, 3.6%) or later (8, 0.1%). Fewer twins compared to singletons, and a slightly lower proportion of boys compared to girls, met the guideline of introducing solids at around 6 months of age (**Figure 11**).

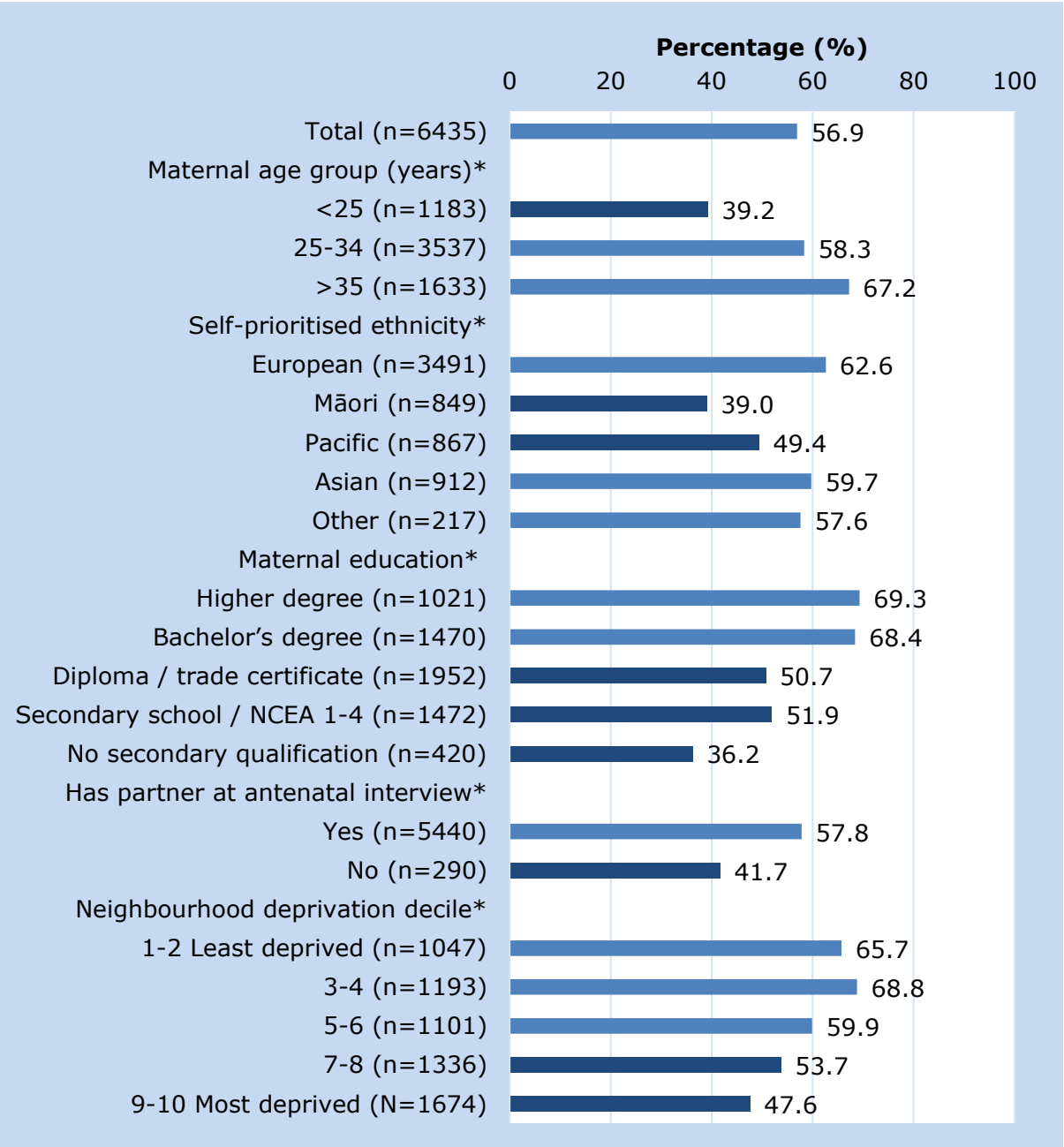
Figure 11: Introduced solids around 6 months of age, by child characteristics (unadjusted)



Notes: * statistical significance measured by chi-square test ($p<0.05$); dark blue bars indicate >10 percentage points lower than the highest group in category. Data missing for n=89 regarding parity, n=10 regarding gestation and n=4 regarding birth weight.

Significant differences in adherence to the guideline were found between all groups by maternal and neighbourhood characteristics (**Figure 12**).

Figure 12: Introduced to solids around 6 months of age, by maternal and neighbourhood characteristics (unadjusted)

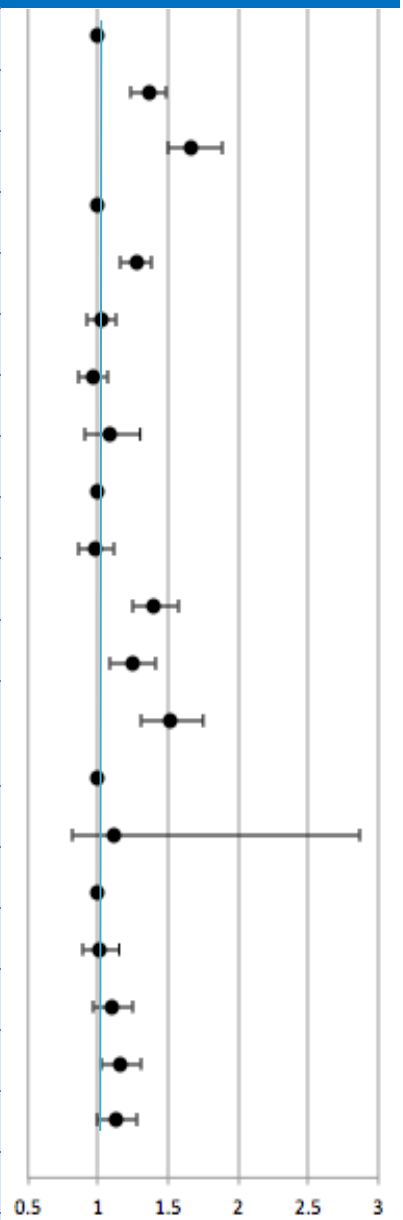


Notes: * statistical significance measured by chi-square test ($p<0.05$); dark blue bars indicate >10 percentage points lower than the highest group in category. Data missing for n=82 regarding mother's age, n=99 regarding mother's ethnicity, n=100 regarding mother's education, n=705 regarding mother's relationship status, and n=84 regarding neighbourhood deprivation.

After adjustment for differences between groups, Māori mothers were 1.3 times less likely to introduce solids around 6 months of age than European mothers; mothers without a bachelor's or higher degree were 1.2-1.5 times less likely to introduce solids around 6 months of age compared to mothers with a higher degree; and mothers living in the 40% most deprived neighbourhoods (NZDep2013 decile 7-10) were also less likely to introduce solids around 6 months of age compared to those living in the least deprived neighbourhoods (**Table 8**).

Table 9: Risk of not meeting the guideline to introduce solids around 6 months of age, by sociodemographic characteristics (adjusted)

Sociodemographic characteristic		Relative risk	95% confidence interval	Forest plot
Maternal age	≥35 years	Reference		
	25-34 years	1.36	1.23-1.49	
	≤25 years	1.67	1.50-1.89	
Self-prioritised ethnic group	European	Reference		
	Māori	1.27	1.16-1.38	
	Pacific	1.02	0.92-1.13	
	Asian	0.96	0.86-1.07	
	Other	1.09	0.91-1.30	
Maternal education	Higher/postgraduate	Reference		
	Bachelor's degree	0.98	0.86-1.12	
	Diploma/trade cert	1.40	1.24-1.58	
	Sec school / NCEA 1-4	1.24	1.09-1.41	
	No qualification	1.51	1.30-1.75	
Mother had a partner	Yes	Reference		
	No	1.12	0.82-2.87	
Neighbourhood deprivation (NZDep decile)	1-2 Least deprived	Reference		
	Decile 3-4	1.01	0.89-1.15	
	Decile 5-6	1.10	0.97-1.25	
	Decile 7-8	1.16	1.03-1.31	
	9-10 Most deprived	1.13	1.00-1.28	



Notes: Poisson regression model with robust estimation adjusted for maternal age, ethnic group, education, partner status and neighbourhood deprivation at the antenatal interview. A statistically significant difference from the reference group is shown in bold (Wald chi square test p-value<0.05). Twins and infants born prematurely or with low birth weight were removed from the dataset (n=556). The model did not include participants with one or more missing data for maternal or household characteristics. Total N=5045. CI=confidence interval.

Domain C: Eating a variety of foods

This domain contains results for four indicators (each worth a maximum of 6.25 points in the final IFI): At 9 months of age: eating across the four food groups daily, eating fruit twice or more daily, eating vegetables twice or more daily and eating iron-rich foods daily.

Eating across the four food groups at 9 months of age

Just over half of infants (3369, 53.0%) were eating at least once a day each of the four food groups at 9 months of age. The food group with the least adherence to the guideline was meat and meat alternatives, with two in five infants not usually having this food group daily (**Table 10**).

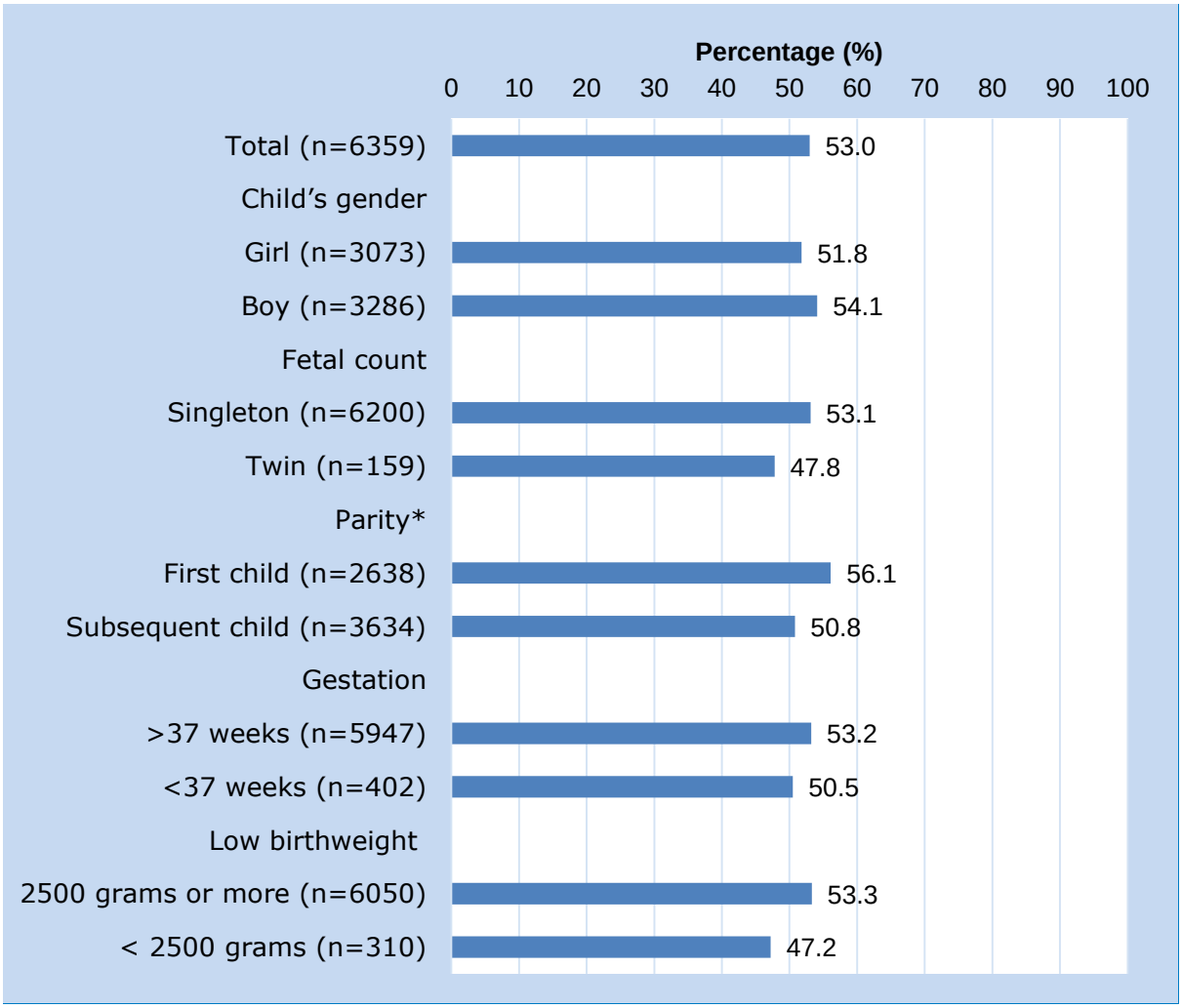
Table 10: Proportion of children eating at least once a day each of the four food groups at 9 months of age

Food group	Frequency of intake per day	
	Zero or less than daily *n* (row %)	Once or more per day *n* (row %)
Fruits and vegetables	281 (4.4)	6150 (95.6)
Breads and cereals	665 (10.3)	5768 (89.7)
Breastmilk or infant formula	238 (3.7)	6158 (96.3)
Meat and meat alternatives*	2516 (39.3)	3879 (60.7)

Notes: * Meat, fish, eggs, shellfish, soy products and nuts. Data missing for n= 4 (fruits and vegetables); n= 2 (Breads and cereals); n=39 (breast milk or infant formula); n=40 (meat and meat alternatives).

A greater proportion of first-born children compared to subsequent children were eating from each of the four food groups daily at 9 months of age (**Figure 13**).

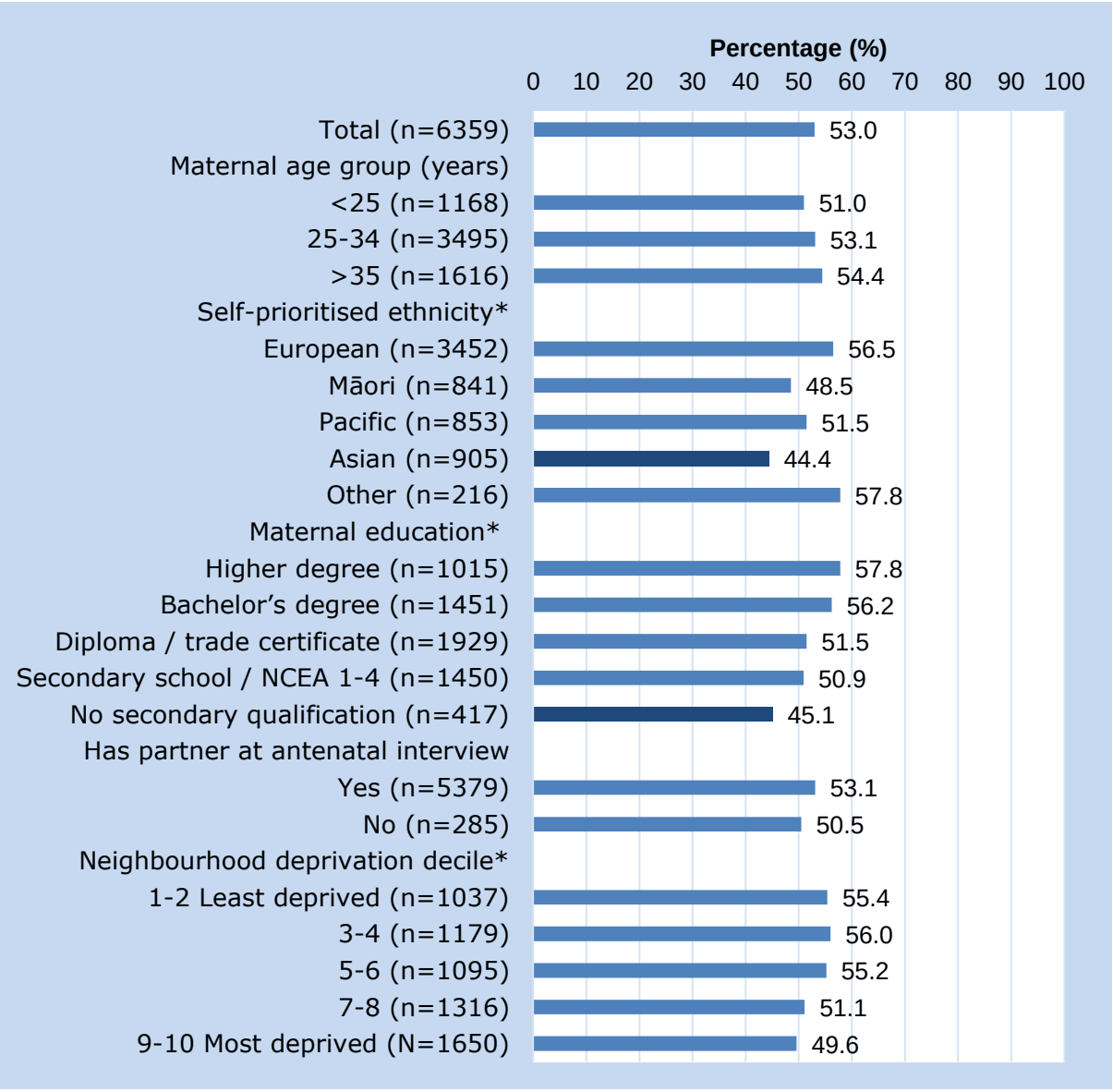
Figure 13: Eating from the four food groups at least once a day at 9 months of age, by child characteristics (unadjusted)



Notes: * statistical significance measured by chi-square test ($p<0.05$); dark blue bars indicate >10 percentage points lower than the highest group in category (none in this graph). Data missing for n=76 infants regarding food from across the four food groups per day, n=89 regarding parity, n=10 regarding gestation and n=4 regarding birth weight.

Significant differences in the proportion of infants adhering to the guideline to eat across the four food groups were found by maternal ethnic group, maternal education and neighbourhood deprivation (**Figure 14**).

Figure 14 Eating from the four food groups at least once a day at 9 months of age, by maternal and neighbourhood characteristics (unadjusted)

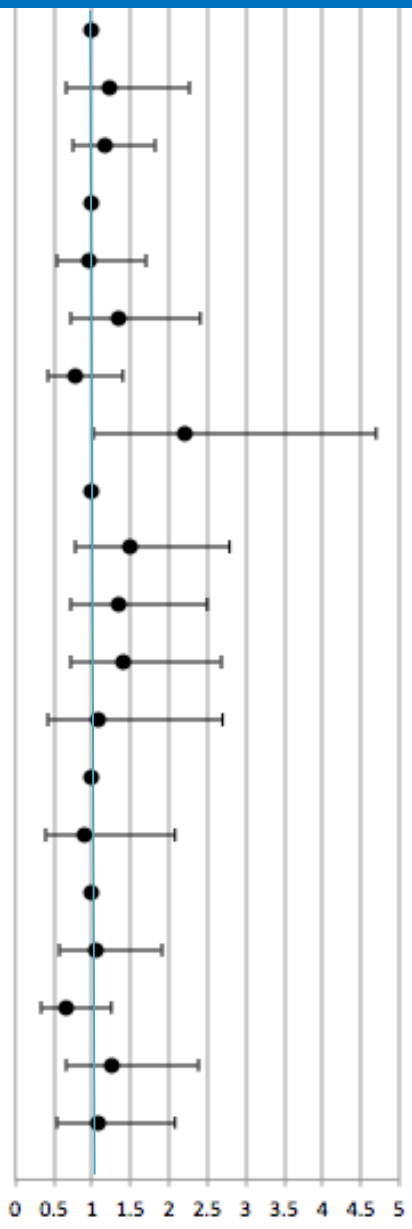


Notes: * Statistical significance measured by chi-square test ($p<0.05$); dark blue bars indicate >10 percentage points lower than the highest group in category. Data missing for n=76 infants regarding food from across the four food groups per day, n=82 regarding mother's age, n=99 regarding mother's ethnicity, n=100 regarding mother's education, n=705 regarding mother's relationship status, and n=84 regarding neighbourhood deprivation.

After adjustment for differences between groups, infants with mothers of Other ethnicity (not European, Māori, Pacific or Asian) were 2.2 times more likely to not meet this guideline compared to European infants (**Table 11**).

Table 11: Risk of not meeting the guideline to eat from the four food groups at least once a day, by sociodemographic characteristics (adjusted)

Sociodemographic characteristic		Relative risk	95% confidence interval	Forest plot
Maternal age	≥35 years	Reference		
	25-34 years	1.23	0.67-2.28	
	≤25 years	1.17	0.75-1.82	
Self-prioritised ethnic group	European	Reference		
	Māori	0.96	0.54-1.71	
	Pacific	1.33	0.73-2.41	
	Asian	0.78	0.43-1.40	
	Other	2.20	1.03-4.70	
Maternal education	Higher/postgraduate	Reference		
	Bachelor's degree	1.48	0.79-2.79	
	Diploma/trade cert	1.35	0.73-2.50	
	Sec school / NCEA 1-4	1.39	0.71-2.69	
	No qualification	1.07	0.43-2.70	
Mother had a partner	Yes	Reference		
	No	0.91	0.40-2.08	
Neighbourhood deprivation (NZDep decile)	1-2 Least deprived	Reference		
	Decile 3-4	1.04	0.56-1.91	
	Decile 5-6	0.66	0.34-1.25	
	Decile 7-8	1.26	0.67-2.39	
	9-10 Most deprived	1.07	0.55-2.08	



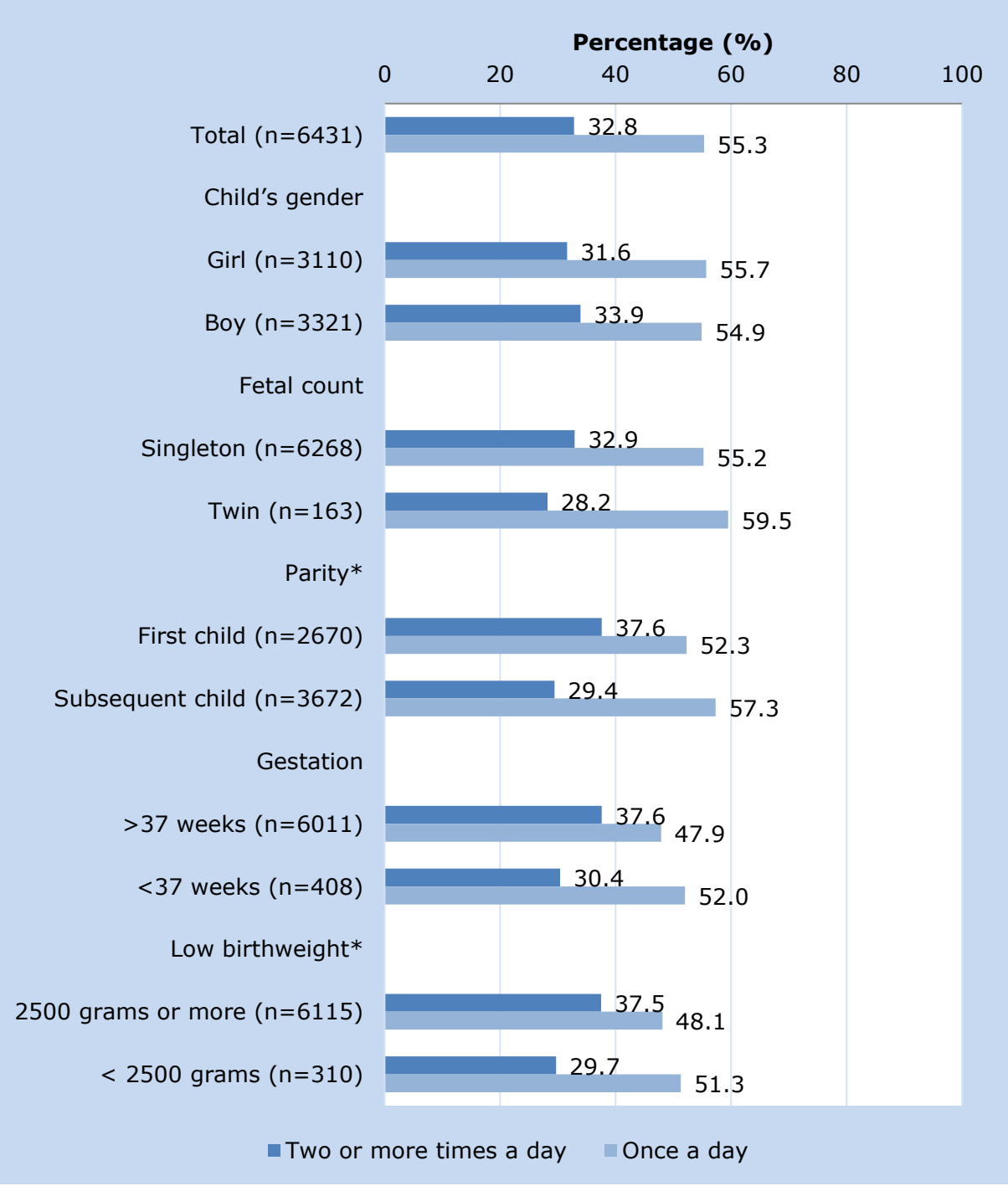
Notes: Poisson regression model with robust estimation adjusted for maternal age, ethnic group, education, partner status and neighbourhood deprivation at the antenatal interview. A statistically significant difference from the reference group is shown in bold (Wald chi square test p-value<0.05). Twins and infants born prematurely or with low birth weight were removed from the dataset (n=556). The model did not include participants with one or more missing data for maternal or household characteristics. Total N=5045. CI=confidence interval. Vegetable and fruit intake at 9 months of age

One in three infants (2,108, 32.8%) met the vegetable intake recommendation at 9 months of age, of eating vegetables twice or more daily. A further 55.3% (3,556) ate vegetables once a day and 11.9% (767) ate vegetables less than daily or never. Two out of five infants (2,384, 37.1%) met the fruit intake recommendation at 9 months of age, eating fruit twice or more daily. A further 48.2% (3,099) ate fruit once a day and 14.7% (946) ate fruit less than daily or never. One in five infants (1,462, 22.7%) were eating both fruit and vegetables at least twice a day and one in 16 infants (392, 6.1%) did not eat fruit or vegetables daily.

A lower proportion of twins compared to singletons, subsequent children compared to first-borns, and low birth weight infants compared to those born 2,500 grams or more, met the vegetable and fruit recommendations at 9 months of age, but these differences were not large (**Figure 15 and Figure 16**).

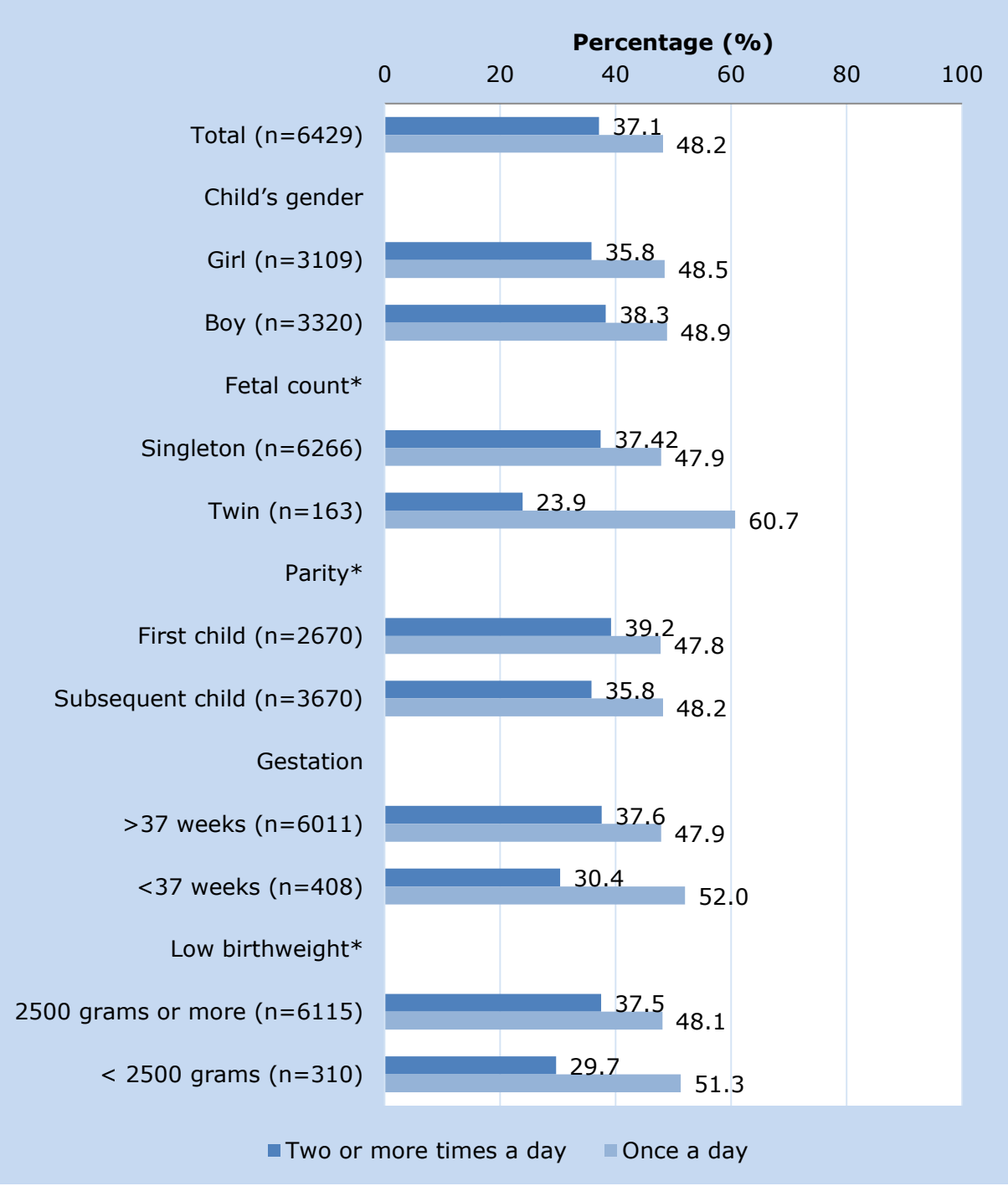
Large and significant differences in adherence to the vegetable and fruit intake guidelines were found by maternal and neighbourhood characteristics (**Figure 17 and Figure 18**).

Figure 15: Daily intake of vegetables at 9 months of age, by child characteristics (unadjusted)



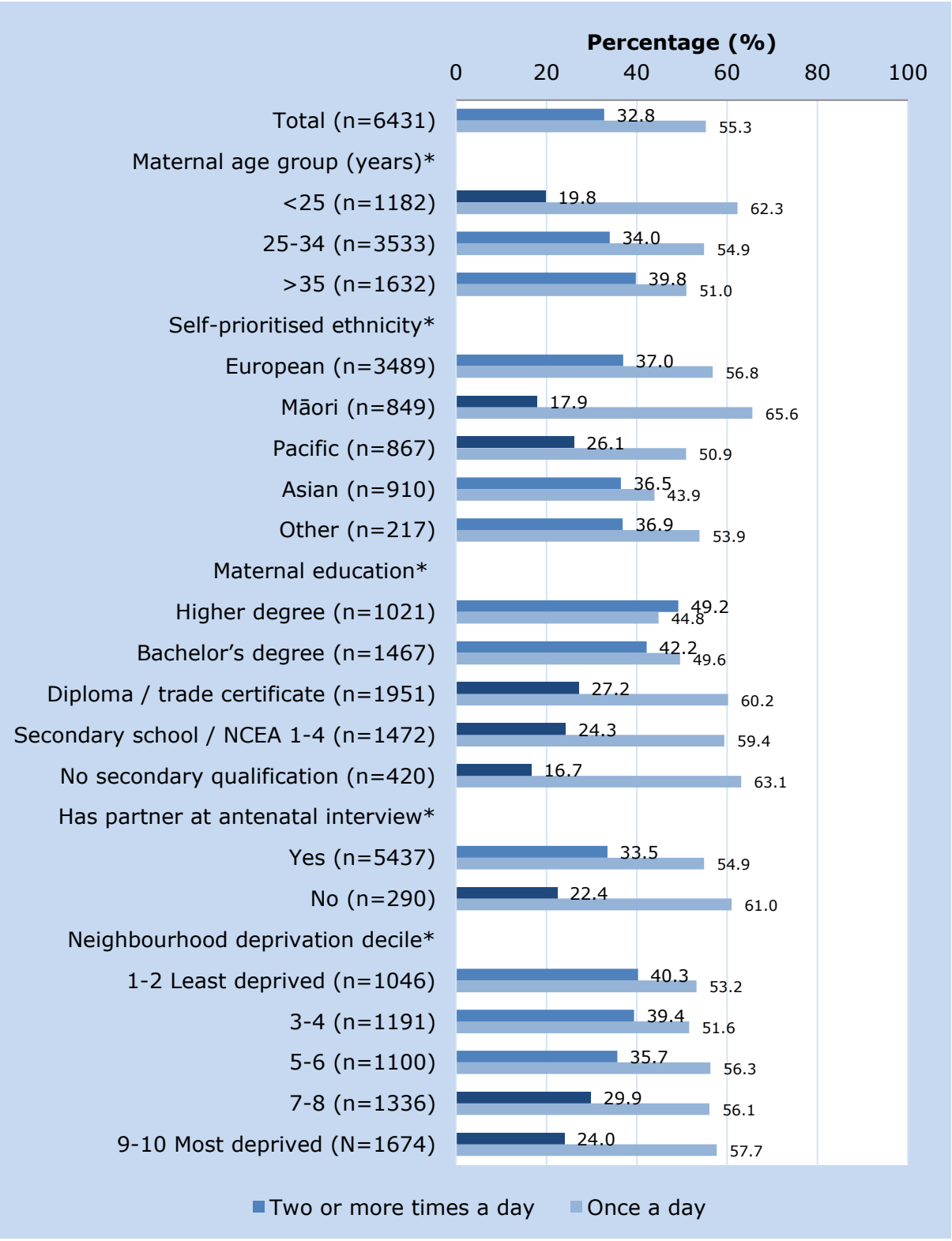
Notes: * Statistical significance measured by chi-square test ($p<0.05$); dark blue bars indicate >10 percentage points lower than the highest group in category (none in this graph). Data missing for n=4 infants regarding vegetable intake, n=89 regarding parity, n=10 regarding gestation and n=4 regarding birth weight.

Figure 16: Daily intake of fruit at 9 months of age, by child characteristics (unadjusted)



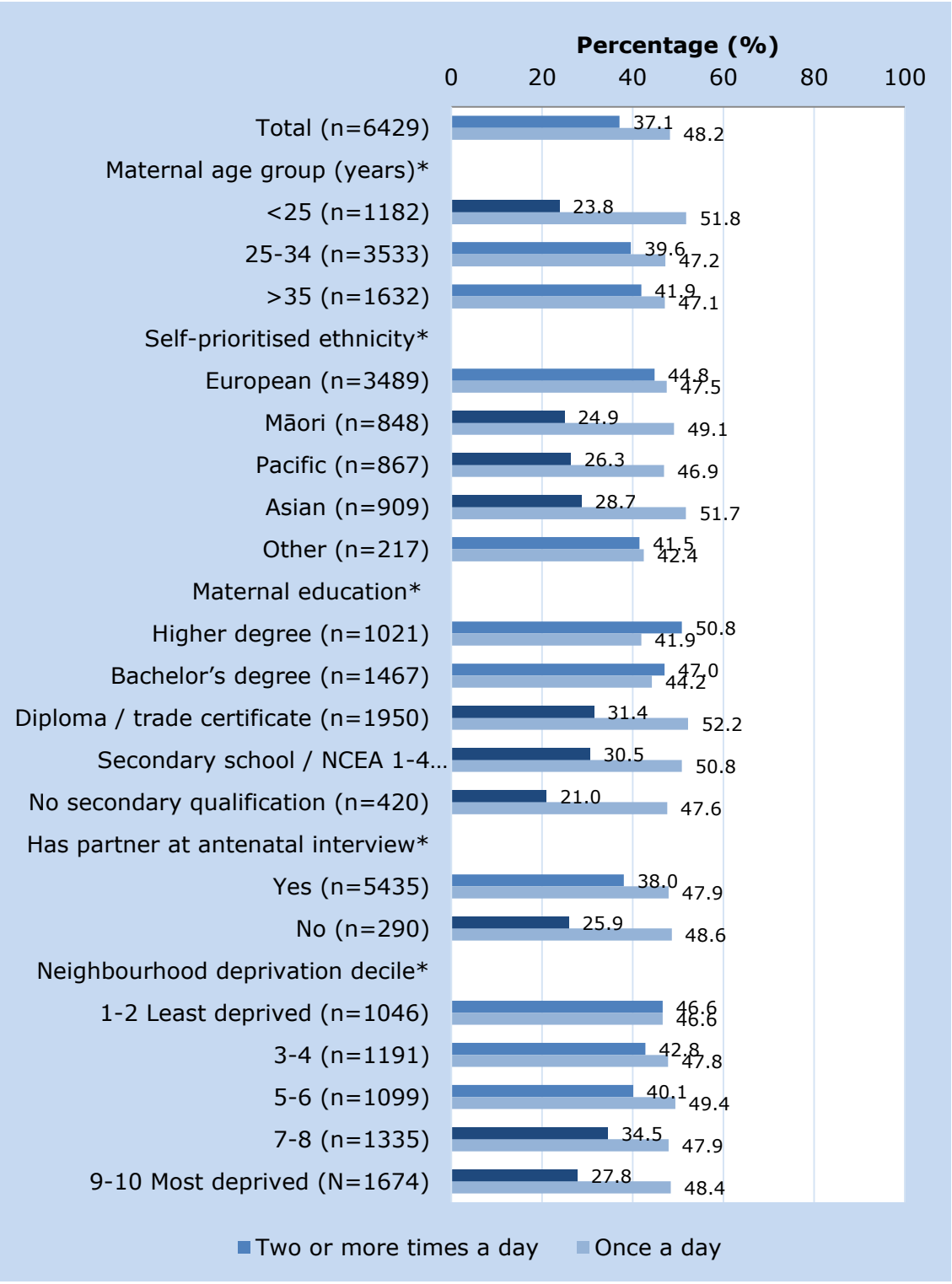
Notes: * Statistical significance measured by chi-square test ($p<0.05$); dark blue bars indicate >10 percentage points lower than the highest group in category (none in this graph). Data missing for n=6 infants regarding fruit intake, n=89 regarding parity, n=10 regarding gestation and n=4 regarding birth weight.

Figure 17: Daily intake of vegetables at 9 months of age, by maternal and neighbourhood characteristics (unadjusted)



Notes: * Statistical significance measured by chi-square test (P<0.05); dark blue bars indicate >10 percentage points lower than the highest group in category. Data missing for n=4 infants regarding vegetable intake, n=82 regarding mother's age, n=99 regarding mother's ethnicity, n=100 regarding mother's education, n=705 regarding mother's relationship status, and n=84 regarding neighbourhood deprivation.

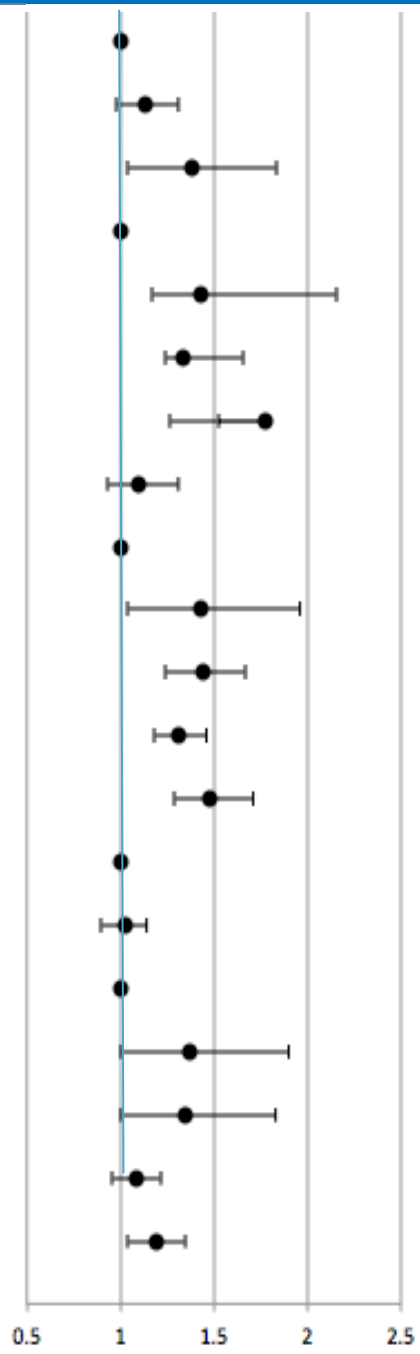
Figure 18: Daily intake of fruit at 9 months of age, by maternal and neighbourhood characteristics (unadjusted)



Notes: * statistical significance measured by chi-square test (P<0.05); dark blue bars indicate >10 percentage points lower than the highest group in category. Data missing for n=6 infants regarding fruit intake, n=82 regarding mother's age, n=99 regarding mother's ethnicity, n=100 regarding mother's education, n=705 regarding mother's relationship status, and n=84 regarding neighbourhood deprivation.

After adjustment for differences, younger mothers compared to older mothers, and Asian, Māori, and Pacific mothers compared to European mothers, were less likely to meet the vegetable and fruit intake guidelines (**Tables 12 and 13**). Mothers with less than a post-graduate qualification were less likely to meet these guidelines, compared to mothers with a postgraduate qualification. Infants living in neighbourhoods with an NZDep decile of 5-6 and decile 9-10 were less likely to meet the vegetable guideline, whereas only infants living in neighbourhoods decile 9-10 were less likely to meet the fruit guideline (**Tables 12 and 13)**.

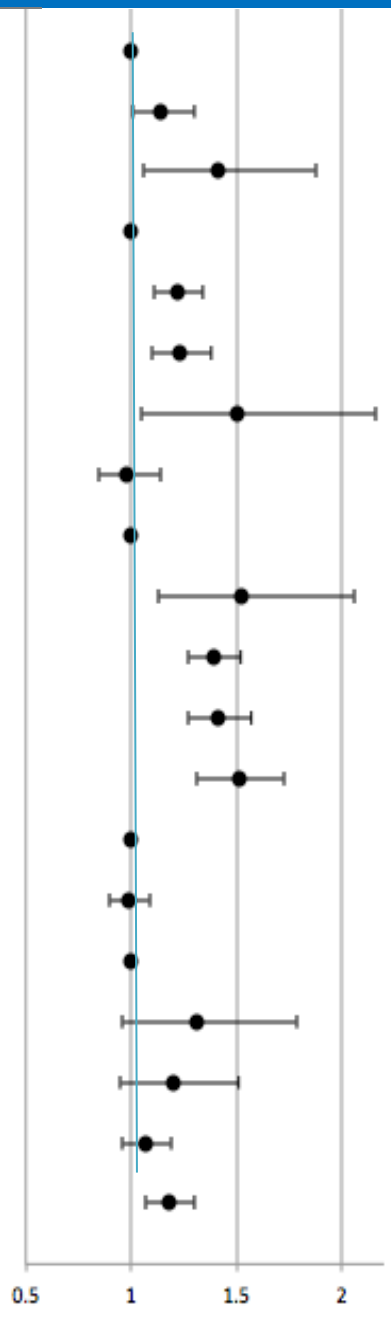
Table 12: Risk of not meeting the guideline to eat vegetables twice or more a day, by sociodemographic characteristics (adjusted)

Sociodemographic characteristic		Relative risk	95% confidence interval	Forest plot
Maternal age	≥35 years	Reference		
	25-34 years	1.13	0.98-1.31	
	≤25 years	1.38	1.04-1.84	
Self-prioritised ethnic group	European	Reference		
	Māori	1.43	1.17-2.16	
	Pacific	1.33	1.24-1.66	
	Asian	1.78	1.26-1.52	
	Other	1.10	0.93-1.31	
Maternal education	Higher/postgraduate	Reference		
	Bachelor's degree	1.43	1.04-1.96	
	Diploma/trade cert	1.44	1.24-1.67	
	Sec school / NCEA 1-4	1.31	1.18-1.46	
	No qualification	1.48	1.29-1.71	
Mother had a partner	Yes	Reference		
	No	1.02	0.90-1.14	
Neighbourhood deprivation (NZDep decile)	1-2 Least deprived	Reference		
	Decile 3-4	1.37	1.00-1.90	
	Decile 5-6	1.35	1.00-1.83	
	Decile 7-8	1.08	0.95-1.22	
	9-10 Most deprived	1.19	1.04-1.35	

Notes: Poisson regression model with robust estimation adjusted for maternal age, ethnic group, education, partner status and neighbourhood deprivation at the antenatal interview. A statistically significant difference from the reference group is shown in bold (Wald chi square test p-value<0.05). Twins and infants born prematurely or with low birth weight were removed from the dataset (*n*=556). The model did not include participants with one or more missing data for maternal or household characteristics. Total N=5045. CI=confidence interval.

Table 13: Risk of not meeting the guideline to eat fruit twice or more a day, by sociodemographic characteristics (adjusted)

Sociodemographic characteristic		Relative risk	95% confidence interval	Forest plot
Maternal age	≥35 years	Reference		
	25-34 years	1.14	1.01-1.30	
	≤25 years	1.41	1.06-1.88	
Self-prioritised ethnic group	European	Reference		
	Māori	1.22	1.11-1.34	
	Pacific	1.23	1.10-1.38	
	Asian	1.50	1.05-2.16	
	Other	0.98	0.85-1.14	
Maternal education	Higher/postgraduate	Reference		
	Bachelor's degree	1.52	1.13-2.06	
	Diploma/trade cert	1.39	1.27-1.52	
	Sec school / NCEA 1-4	1.41	1.27-1.57	
	No qualification	1.51	1.31-1.73	
Mother had a partner	Yes	Reference		
	No	0.99	0.90-1.09	
Neighbourhood deprivation (NZDep decile)	1-2 Least deprived	Reference		
	Decile 3-4	1.31	0.96-1.79	
	Decile 5-6	1.20	0.95-1.51	
	Decile 7-8	1.07	0.96-1.19	
	9-10 Most deprived	1.18	1.07-1.30	

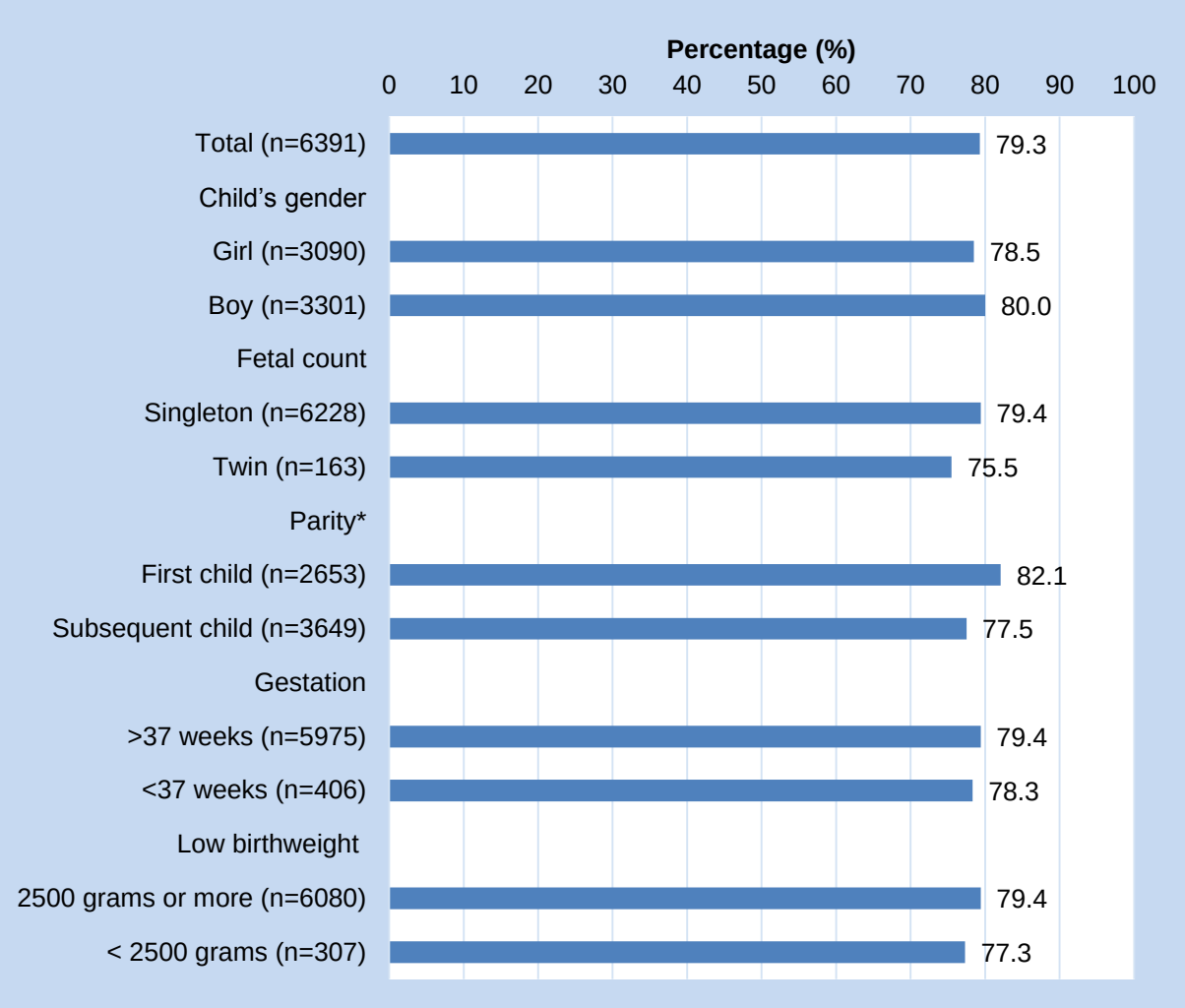


Notes: Poisson regression model with robust estimation adjusted for maternal age, ethnic group, education, partner status and neighbourhood deprivation at the antenatal interview. A statistically significant difference from the reference group is shown in bold (Wald chi square test p-value<0.05). Twins and infants born prematurely or with low birth weight were removed from the dataset (n=556). The model did not include participants with one or more missing data for maternal or household characteristics. Total N=5045. CI=confidence interval.

Intake of iron-rich foods at 9 months of age

Four out of five infants (79.3%) ate iron-rich foods at least once a day at 9 months of age: meat, fish, shellfish, baby rice or baby breakfast cereal. A higher proportion of first-born children met this guideline compared to subsequent children (**Figure 19**).

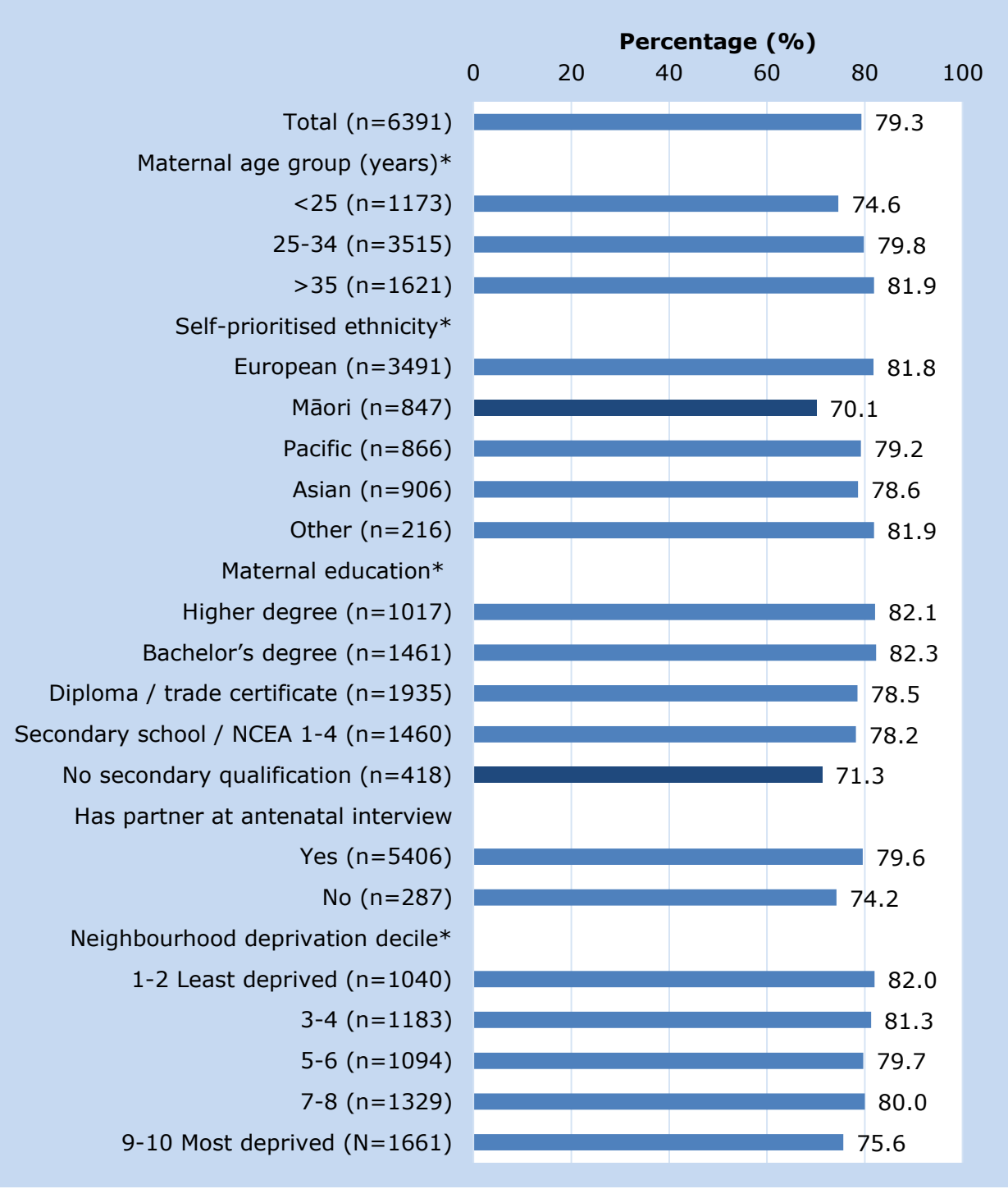
Figure 19: Daily intake of iron-rich foods at 9 months of age, by child characteristics (unadjusted)



Notes: * Statistical significance measured by chi-square test ($p<0.05$); dark blue bars indicate >10 percentage points lower than the highest group in category (none in this graph). Data missing for n=6 infants regarding intake of iron-rich foods (meat, fish, shellfish, baby rice or baby cereal), n=89 regarding parity, n=10 regarding gestation and n=4 regarding birth weight.

Significant differences in the proportion of infants eating iron-rich food daily were found by maternal age, ethnic group, education and neighbourhood deprivation (**Figure 20**).

Figure 20: Daily intake of iron-rich foods at 9 months of age, by maternal and neighbourhood characteristics (unadjusted)

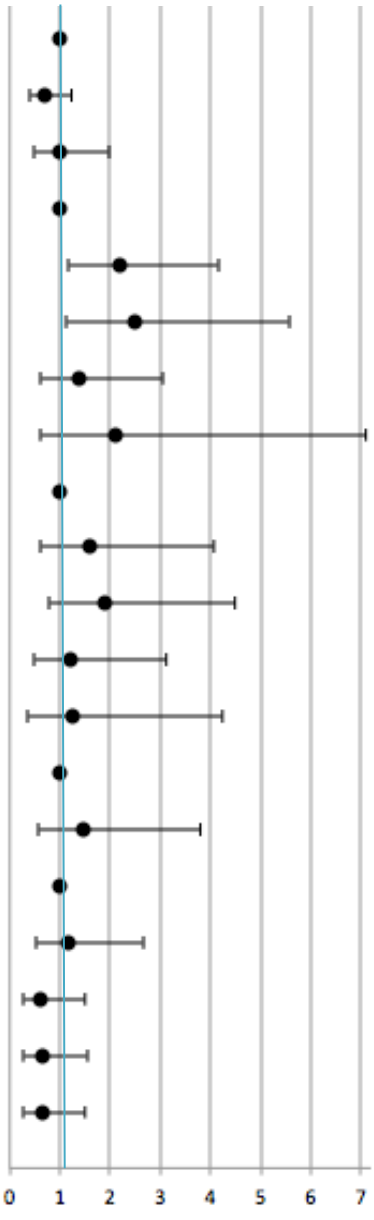


Notes: * Statistical significance measured by chi-square test ($p<0.05$); dark blue bars indicate >10 percentage points lower than the highest group in category. Data missing for n=6 infants regarding intake of iron-rich foods (meat, fish, shellfish, baby rice or baby cereal, n=82 regarding mother's age, n=99 regarding mother's ethnicity, n=100 regarding mother's education, n=705 regarding mother's relationship status, and n=84 regarding neighbourhood deprivation.

After adjustment for differences between groups, infants with mothers of Pacific and Māori ethnicity were less likely to have iron-rich foods daily compared to infants of mothers of European ethnicity (**Table 14**).

Table 14: Risk of not meeting the guideline (iron-rich foods at least once a day at 9 months), by sociodemographic characteristics (adjusted)

Sociodemographic characteristic		Relative risk	95% confidence interval	Forest plot
Maternal age	≥35 years	Reference		
	25-34 years	0.69	0.38-1.23	
	≤25 years	0.98	0.48-1.98	
Self-prioritised ethnic group	European	Reference		
	Māori	2.19	1.15-4.17	
	Pacific	2.50	1.12-5.58	
	Asian	1.36	0.60-3.06	
	Other	2.09	0.62-7.10	
Maternal education	Higher/postgraduate	Reference		
	Bachelor's degree	1.58	0.62-4.07	
	Diploma/trade cert	1.90	0.80-4.49	
	Sec school / NCEA 1-4	1.22	0.48-3.12	
	No qualification	1.25	0.37-4.24	
Mother had a partner	Yes	Reference		
	No	1.47	0.57-3.80	
Neighbourhood deprivation (NZDep decile)	1-2 Least deprived	Reference		
	Decile 3-4	1.18	0.52-2.68	
	Decile 5-6	0.62	0.26-1.50	
	Decile 7-8	0.64	0.26-1.55	
	9-10 Most deprived	0.64	0.27-1.50	



Notes: Poisson regression model with robust estimation adjusted for maternal age, ethnic group, education, partner status and Neighbourhood deprivation at the antenatal interview. A statistically significant difference from the reference group is shown in bold (Wald chi square test p-value<0.05). Twins and infants born prematurely or with low birth weight were removed from the dataset (*n*=556). The model did not include participants with one or more missing data for maternal or household characteristics. Total N=5045. CI=confidence interval.

Domain D: Appropriate foods and drinks

This domain contains results for five indicators (each worth a maximum of 5 points in the final Infant Feeding Index): Inappropriate milk given by the age of 9 months, inappropriate drinks (e.g. juice, soft drinks, tea, coffee) given by the age of 9 months, inappropriate foods (e.g. hot chips, chocolate) given by the age of 9 months, and the addition of sugar or salt to baby's food at 9 months of age.

Types of milk

More than nine out of ten infants 6038 (94.3%) had only received breastmilk or a suitable infant formula by the age of 9 months (not given inappropriate milks). The remaining infants had been given an inappropriate milk drink of pasteurized/bottled cow's milk (272, 4.2%) or other milks (100, 1.6%) (**Table 15**).

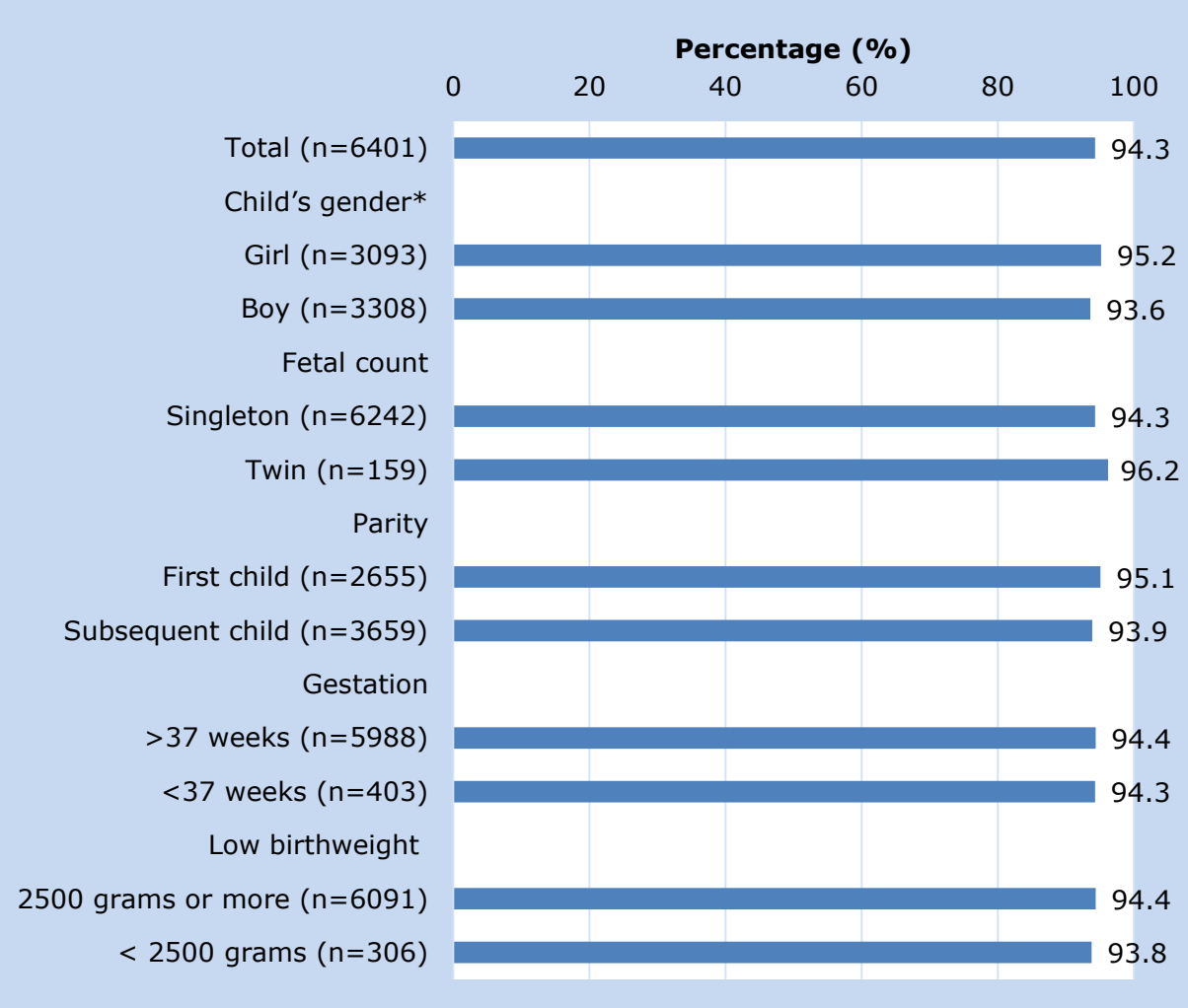
Table 15: Types of milks "ever given" to baby by the age of 9 months

Appropriate milks	***n* (row %)**
Breastmilk	6199 (96.8)
Cow's milk infant formula	2978 (46.4)
Follow-on formula	3676 (57.3)
Soy formula	218 (3.4)
Goat's milk formula	341 (5.3)
Hypoallergenic formula	195 (3.0)
Lactose free formula	52 (0.8)
Anti-reflux formula	78 (1.2)
Inappropriate milks	***n* (row %)**
Pasteurized /bottled cow's milk	272 (4.2)
Other milks, e.g. almond, raw	100 (1.6)

Notes: Multiple response categories so columns do not add to 100%. Data missing for *n*=30 regarding breastfeeding, *n*=16 regarding type of milks baby ever consumed and *n*=5 regarding type of milks consumed at 9 months of age.

A slightly lower proportion of boys compared to girls had only consumed appropriate milks by the age of 9 months (**Figure 21**).

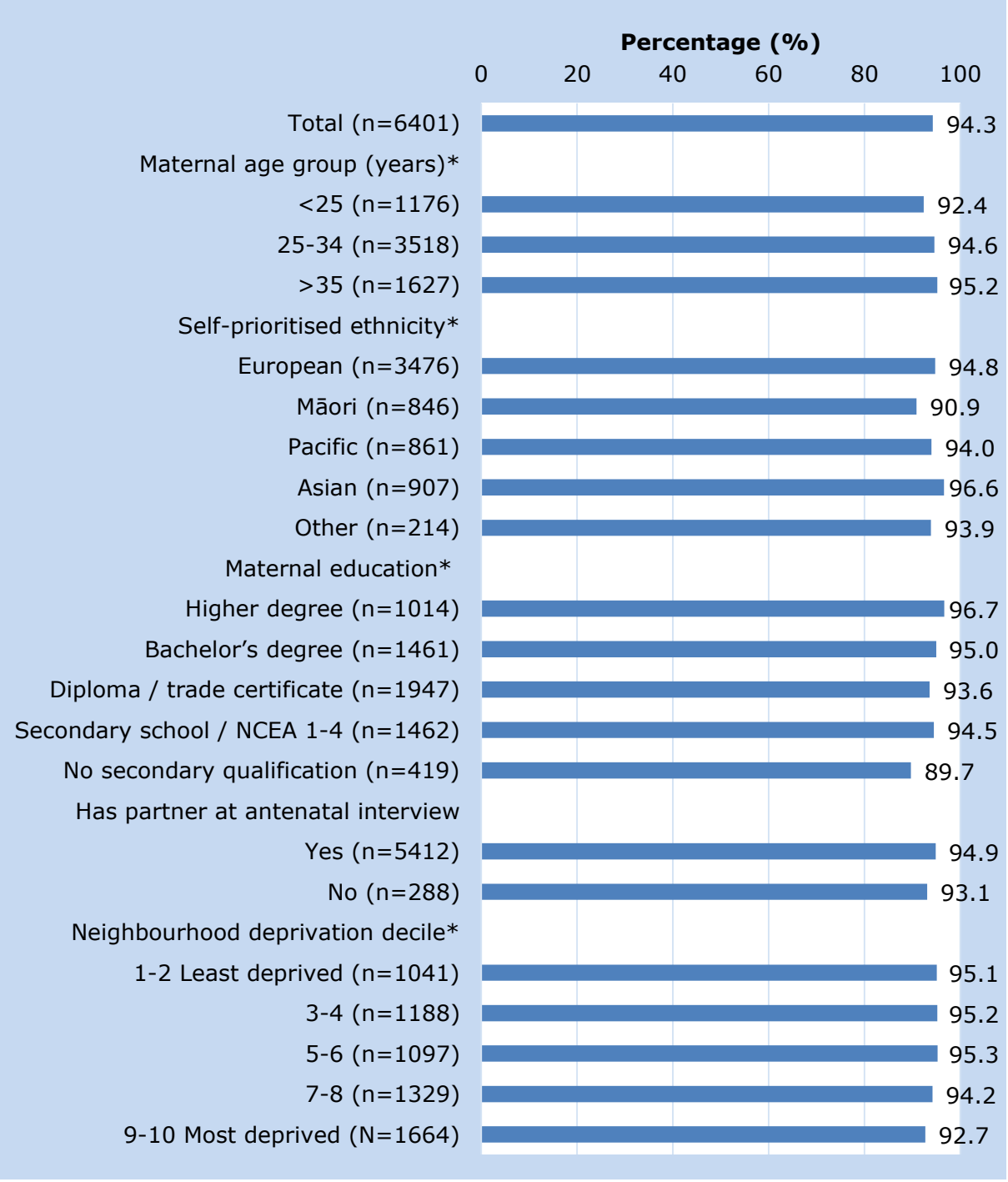
Figure 21: Appropriate milks consumed at 9 months of age, by child characteristics (unadjusted)



Notes: * Statistical significance measured by chi-square test ($p<0.05$); dark blue bars indicate >10 percentage points lower than the highest group in category (none in this graph). Data missing for n=34 infants regarding type of milk consumed, n=89 regarding parity, n=10 regarding gestation and n=4 regarding birth weight.

Small but significant differences in the consumption of inappropriate milks were found by maternal age, ethnic group, education and neighbourhood deprivation (**Figure 22**).

Figure 22: Appropriate milks consumed at 9 months of age, by maternal and neighbourhood characteristics (unadjusted)



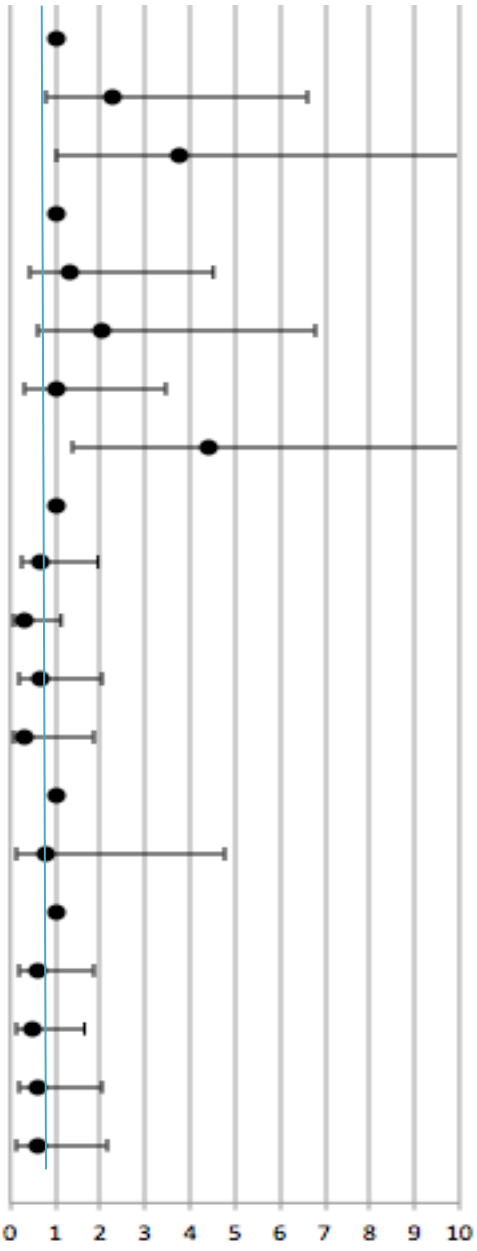
Notes: * Statistical significance measured by chi-square test ($p<0.05$); dark blue bars indicate >10 percentage points lower than the highest group in category (none in this graph). Data missing for n=34 infants regarding type of milk consumed, n=82 regarding mother's age, n=99 regarding mother's ethnicity, n=100 regarding mother's education, n=705 regarding mother's relationship status, and n=84 regarding neighbourhood deprivation.

After adjustment for differences between groups, infants of younger mothers were 3.8 times less likely to consume appropriate milk drinks only, compared to

mothers aged 35 years or older. Infants of mothers from the Other ethnic group were also less likely to only consume appropriate milks (**Table 16**).

Table 16: Risk of not meeting the guideline to only give breastmilk or an appropriate infant formula by sociodemographic characteristics(adjusted)

Sociodemographic characteristic		Relative risk	95% confidence interval	Forest plot
Maternal age	>35 years	Reference		
	25-34 years	2.27	0.78-6.64	
	≤25 years	3.77	1.02-14.02	
Self-prioritised ethnic group	European	Reference		
	Māori	1.34	0.40-4.52	
	Pacific	2.03	0.60-6.79	
	Asian	1.03	0.30-3.46	
	Other	4.41	1.38-14.07	
Maternal education	Higher/postgraduate	Reference		
	Bachelor's degree	0.69	0.24-1.95	
	Diploma/trade cert	0.32	0.09-1.13	
	Sec school/NCEA 1-4	0.65	0.21-2.05	
	No qualification	0.33	0.06-1.86	
Mother had a partner	Yes	Reference		
	No	0.78	0.13-4.79	
Neighbourhood deprivation (NZDep decile)	1-2 Least deprived	Reference		
	Decile 3-4	0.58	0.18-1.87	
	Decile 5-6	0.47	0.13-1.65	
	Decile 7-8	0.60	0.18-2.04	
	9-10 Most deprived	0.58	0.15-2.18	



Notes: Poisson regression model with robust estimation adjusted for maternal age, ethnic group, education, partner status and neighbourhood deprivation at the antenatal interview. A statistically significant difference from the reference group is shown in bold (Wald chi square test p-value<0.05). Twins and infants born prematurely or with low birth weight were removed from the dataset (n=556). The model did not include participants with one or more missing data for maternal or household characteristics. Total N=5045. CI=confidence interval.

Inappropriate other drinks

Two out of five infants (38.8%) had "ever tried" fruit juices, soft drinks, coffee, tea or herbal drinks by nine months of age. The majority of the inappropriate drinks consumed by nine months of age were fruit juice (which included watered-down juice), with one in five infants (22.6%) having a fruit juice at least weekly at 9 months. One in 18 infants (5.5%) had tried a soft drink by 9 months of age (**Table 17**).

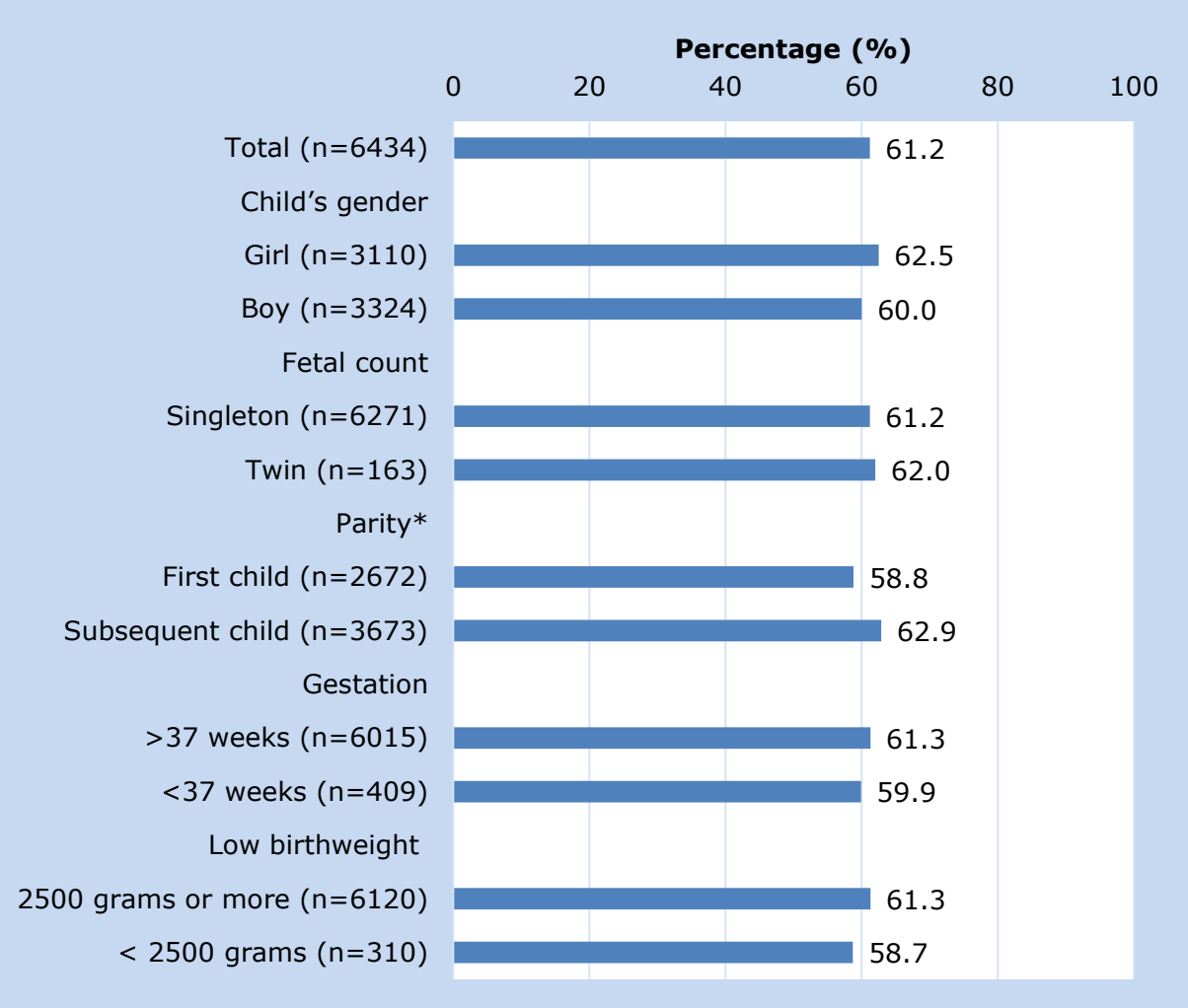
Table 17: Inappropriate drinks ever tried and current frequency at 9 months of age, by type of drink

Type of drink	Never tried *n* (row %)	Ever tried *n* (row %)	At least once a week *n* (row %)	At least once a day *n* (row %)
Fruit juices*	4094 (63.6)	2340 (36.4)	1452 (22.6)	592 (9.2)
Soft drink	6082 (94.5)	352 (5.5)	123 (1.9)	23 (0.4)
Tea	6231 (96.8)	203 (3.2)	101 (1.6)	26 (0.4)
Herbal drink	6292 (97.8)	142 (2.2)	59 (0.9)	10 (0.2)
Coffee	6396 (99.4)	38 (0.6)	10 (0.2)	-

Notes: * Includes watered-down juices. Data missing for *n*=1 regarding type of drinks ever tried at 9 months, *n*=12 regarding how often fruit juice consumed at 9 months, *n*=3 regarding how often soft drinks consumed at 9 months, and n=1 regarding how often tea, herbal drinks consumed at 9 months.

A lower proportion of first-born children met the guideline for inappropriate drinks, compared to subsequent children (**Figure 23**).

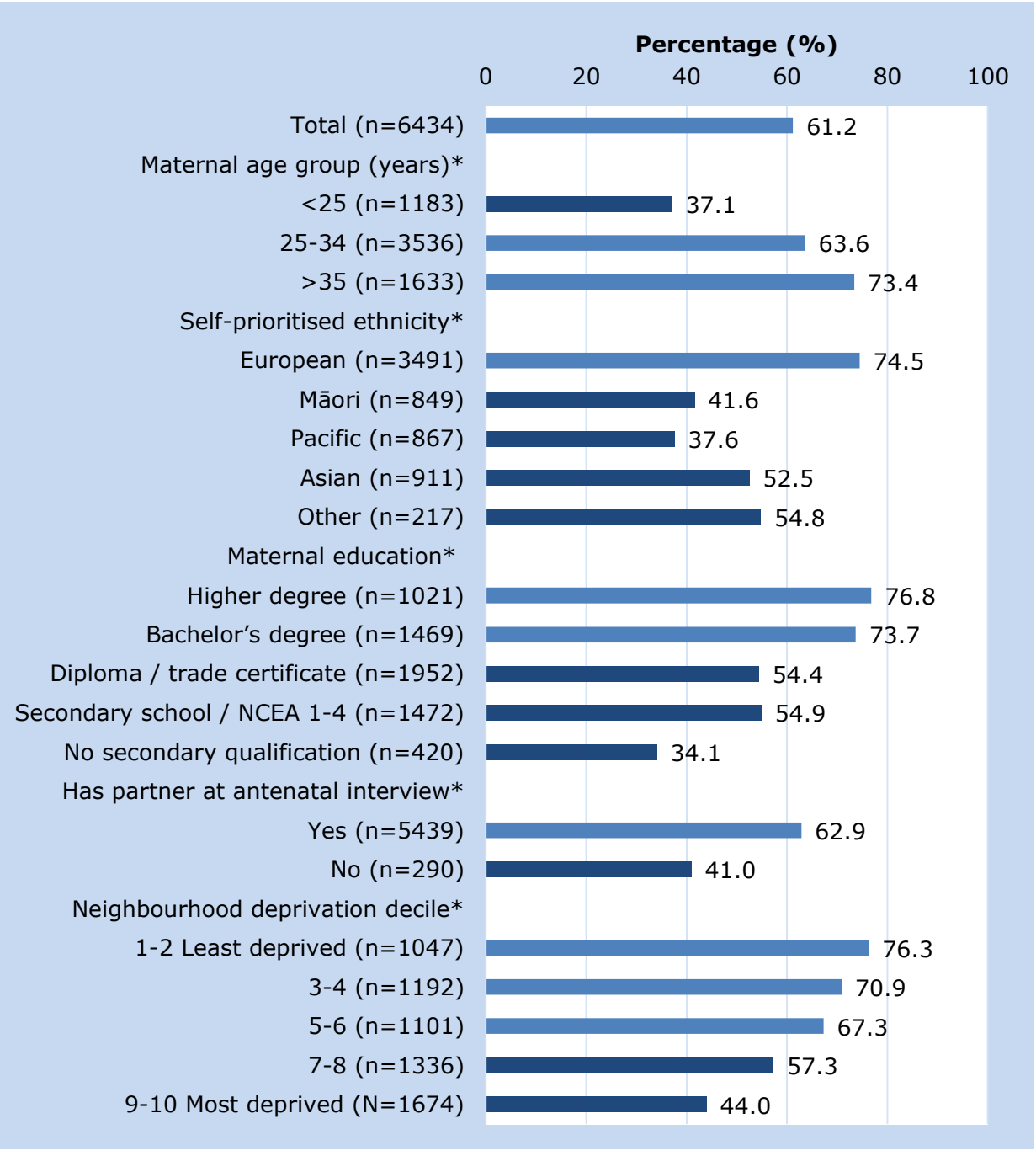
Figure 23: No inappropriate drinks 'ever tried' at 9 months of age, by child characteristics (unadjusted)



Notes: * Statistical significance measured by chi-square test (P<0.05); no differences >10 percentage points lower than the highest group in category. Data missing for n=1 infant regarding drinks consumed, n=89 regarding parity, n=10 regarding gestation and n=4 regarding birth weight.

Large differences in adherence to the inappropriate drinks guideline were found by maternal age, ethnic group, education, partner status and neighbourhood deprivation (**Figure 24**).

Figure 24: No inappropriate drinks 'ever tried' at 9 months of age, by maternal and neighbourhood characteristics (unadjusted)

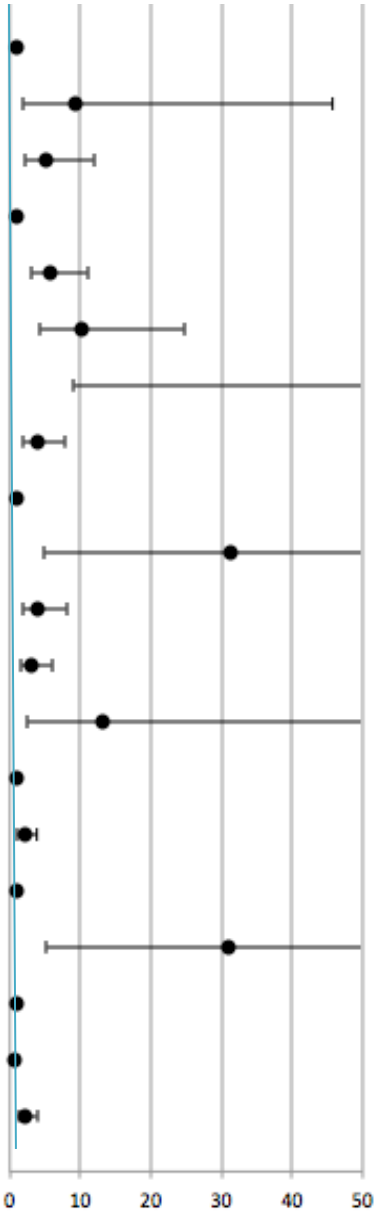


Notes: * Statistical significance measured by chi-square test (P<0.05); dark blue bars indicate >10 percentage points lower than the highest group in category. Data missing for n=1 infant regarding drinks consumed, n=82 regarding mother's age, n=99 regarding mother's ethnicity, n=100 regarding mother's education, n=705 regarding mother's relationship status, and n=84 regarding neighbourhood deprivation.

After adjustment for differences between groups, maternal age, ethnicity, education, partner status and neighbourhood deprivation all remained independently associated with the likelihood that an infant had "ever tried" an inappropriate drink (Table 18).

Table 18: Risk of not meeting the guideline for no inappropriate drinks, by sociodemographic characteristics (adjusted)

Sociodemographic characteristic		Relative risk	95% confidence interval	Forest plot
Maternal age	≥35 years	Reference		
	25-34 years	9.43	1.94-45.74	
	≤25 years	4.98	2.05-12.06	
Self-prioritised ethnic group	European	Reference		
	Māori	5.75	2.96-11.16	
	Pacific	10.17	4.16-24.84	
	Asian	56.14	9.09-346.86	
	Other	3.89	1.93-7.84	
Maternal education	Higher/postgraduate	Reference		
	Bachelor's degree	31.20	4.83-201.62	
	Diploma/trade cert	3.96	1.93-8.11	
	Sec school / NCEA 1-4	3.16	1.65-6.07	
	No qualification	13.17	2.31-75.16	
Mother had a partner	Yes	Reference		
	No	2.02	1.06-3.83	
Neighbourhood deprivation (NZDep decile)	1-2 Least deprived	Reference		
	Decile 3-4	30.90	5.06-188.93	
	Decile 5-6	0.95	0.64-1.40	
	Decile 7-8	0.79	0.55-1.13	
	9-10 Most deprived	2.15	1.15-4.05	



Notes: Poisson regression model with robust estimation adjusted for maternal age, ethnic group, education, partner status and neighbourhood deprivation at the antenatal interview. A statistically significant difference from the reference group is shown in bold (Wald chi square test p-value<0.05). Twins and infants born prematurely or with low birth weight were removed from the dataset (n=556). The model did not include participants with one or more missing data for maternal or household characteristics. Total N=5045. CI=confidence interval.

Inappropriate foods

Half of infants (3393, 52.7%) had "ever tried" sweets, chocolate, hot chips or potato crisps by 9 months of age. The most frequently consumed inappropriate food was hot chips, with two out of five (40.6%) infants having tried hot chips by 9 months of age and one in seven (14.0%) were eating hot chips at least once a week (**Table 19**).

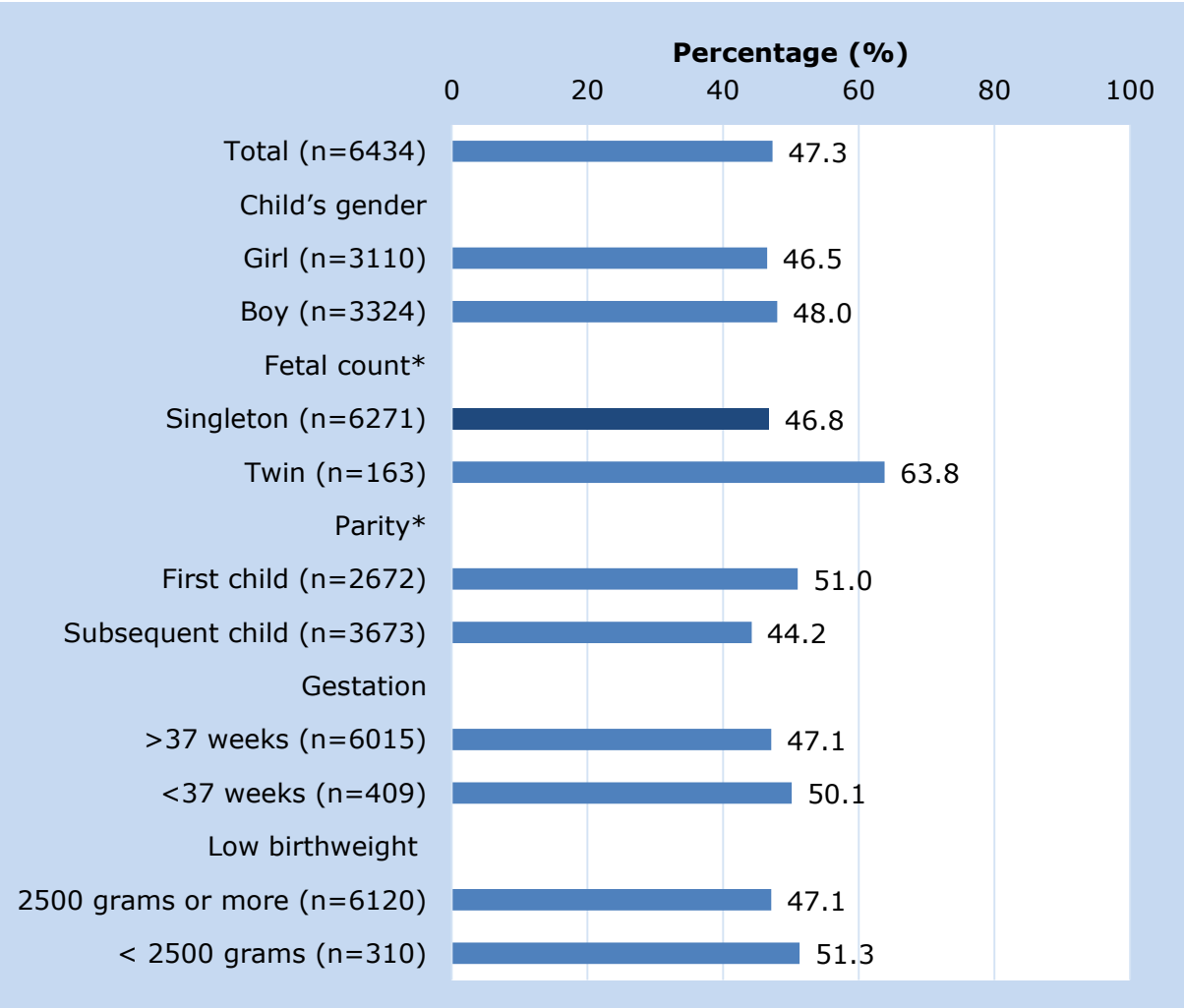
Table 19: Inappropriate foods ever tried and current frequency at 9 months of age, by type of food

Type of food	Never tried *n* (row %)	Ever tried *n* (row %)	At least once a week *n* (row %)	At least once a day *n* (row %)
Hot chips	3821 (59.4)	2613 (40.6)	898 (14.0)	31 (0.5)
Chocolate	4507 (70.1)	1927 (30.0)	444 (6.9)	33 (0.5)
Confectionery (sweets, lollies)	5054 (78.6)	1380 (21.5)	500 (7.8)	69 (1.1)
Potato chips (crisps)	5168 (80.3)	638 (19.9)	458 (7.1)	42 (0.7)

Notes: Data missing for *n*=4 regarding type of foods ever tried at 9 months, *n*=23 regarding how often sweets were consumed at 9 months, *n*=7 how often chocolate and potato chips were consumed at 9 months, and n=5 regarding how often hot chips were consumed at 9 months.

A higher proportion of twins compared to singletons, and first-born children compared to subsequent children, had never tried inappropriate foods by the age of 9 months (**Figure 25**).

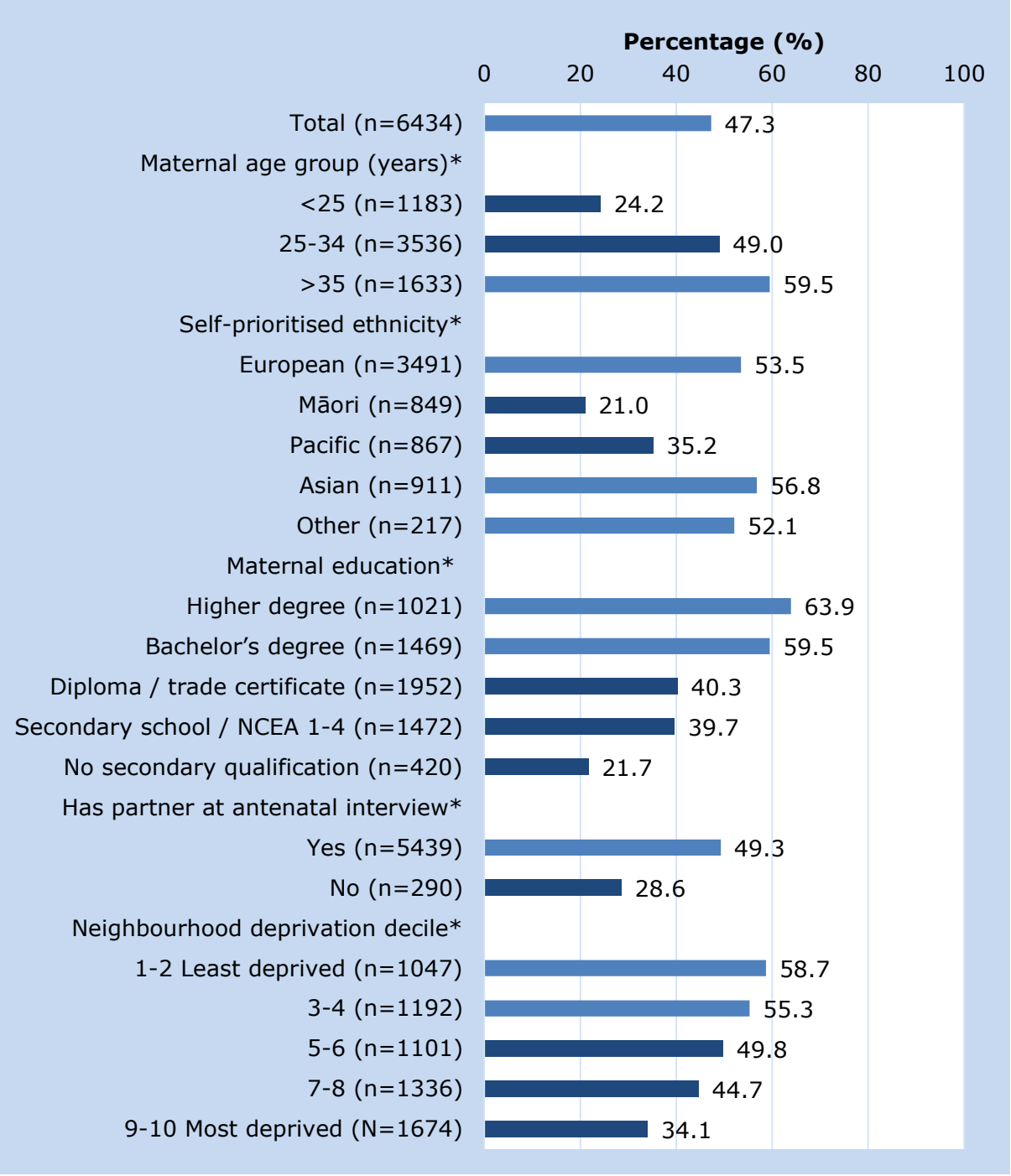
Figure 25: No inappropriate foods 'ever tried' at 9 months of age, by child characteristics (unadjusted)



Notes: * Statistical significance measured by chi-square test (P<0.05); dark blue bars indicate >10 percentage points lower than the highest group in category. Data missing for n=1 infant regarding foods ever tried, n=89 regarding parity, n=10 regarding gestation and n=4 regarding birth weight.

Large differences in adherence to the inappropriate foods guideline were found by all maternal sociodemographic characteristics (**Figure 26**).

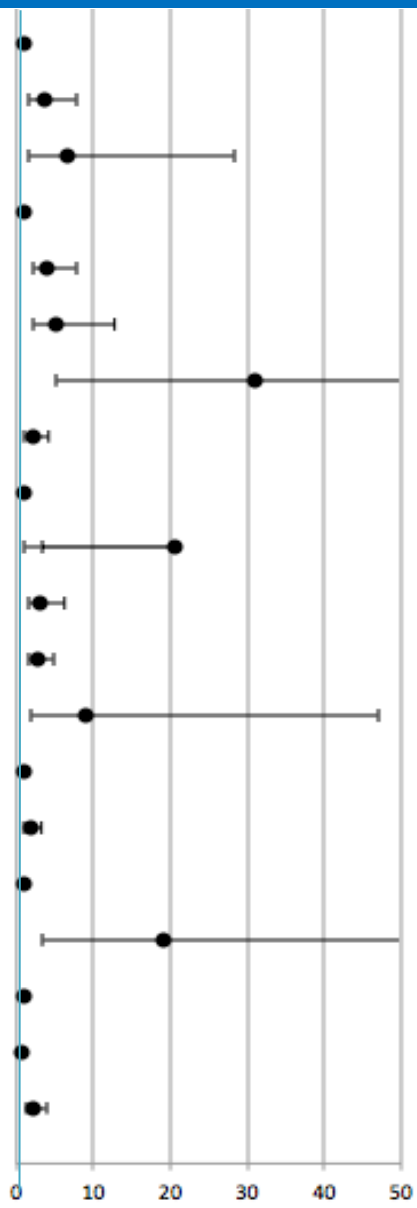
Figure 26: No inappropriate foods 'ever tried' at 9 months of age, by maternal and neighbourhood characteristics (unadjusted)



Notes: * Statistical significance measured by chi-square test (P<0.05); dark blue bars indicate >10 percentage points lower than the highest group in category. Data missing for n=1 infant regarding foods ever tried, n=82 regarding mother's age, n=99 regarding mother's ethnicity, n=100 regarding mother's education, n=705 regarding mother's relationship status, and n=84 regarding neighbourhood deprivation.

After adjustment for differences between groups, maternal age, ethnicity, education, partner status and neighbourhood deprivation all remained independently associated with the likelihood that an infant had "ever tried" an inappropriate food (**Table 20**).

Table 20: Risk of not meeting the guideline for no inappropriate foods, by socio-demographic characteristics (adjusted)

Sociodemographic characteristic		Relative risk	95% confidence interval	Forest plot
Maternal age	≥35 years	Reference		
	25-34 years	3.57	1.62-7.90	
	≤25 years	6.52	1.50-28.36	
Self-prioritised ethnic group	European	Reference		
	Māori	4.05	2.10-7.80	
	Pacific	5.19	2.12-12.74	
	Asian	31.11	5.04-192.20	
	Other	2.14	1.10-4.16	
Maternal education	Higher/postgrad.	Reference		
	Bachelor's degree	20.59	1.03-3.23	
	Diploma/trade cert	3.11	1.55-6.23	
	Sec school/NCEA 1-4	2.64	1.44-4.86	
	No qualification	9.12	1.76-47.09	
Mother had a partner	Yes	Reference		
	No	1.82	1.03-3.23	
Neighbourhood deprivation (NZDep decile)	1-2 Least deprived	Reference		
	Decile 3-4	19.00	3.32-108.77	
	Decile 5-6	0.87	0.61-1.23	
	Decile 7-8	0.64	0.45-0.91	
	9-10 Most deprived	2.15	1.15-4.05	

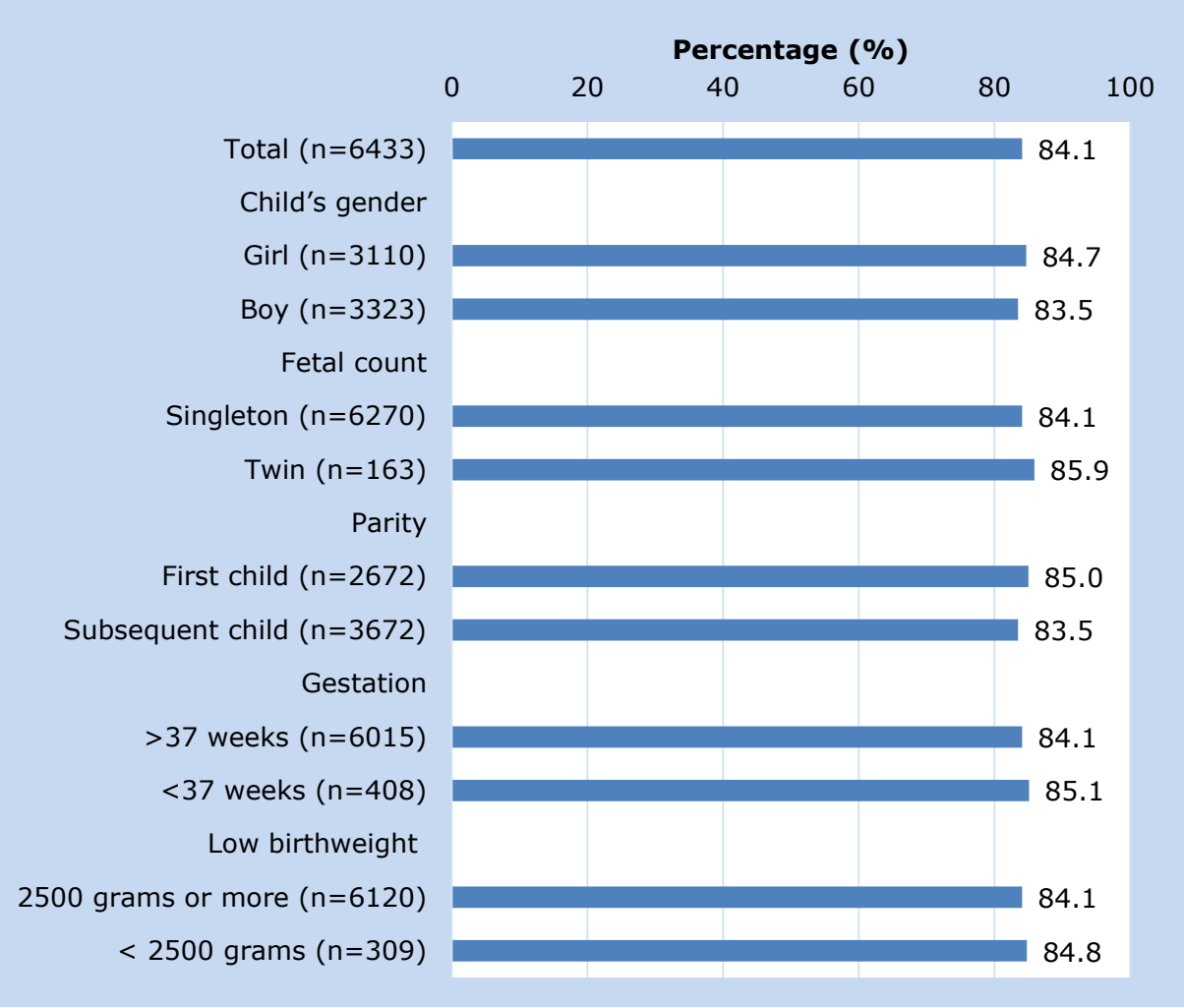
Notes: Poisson regression model with robust estimation adjusted for maternal age, ethnic group, education, partner status and neighbourhood deprivation at the antenatal interview. A statistically significant difference from the reference group is shown in bold (Wald chi square test p-value<0.05). Twins and infants born prematurely or with low birth weight were removed from the dataset (n=556). The model did not include participants with one or more missing data for maternal or household characteristics. Total N=5045. CI=confidence interval.

Addition of sugar or salt to food or milk

One in six infants (1022, 15.9%) had salt added to their food or milk, and one in seven infants (921, 14.3%) had sugar added to their food or milk at 9 months of age. One in 13 infants (494, 7.6%) had both sugar and salt added to their food and/or milk.

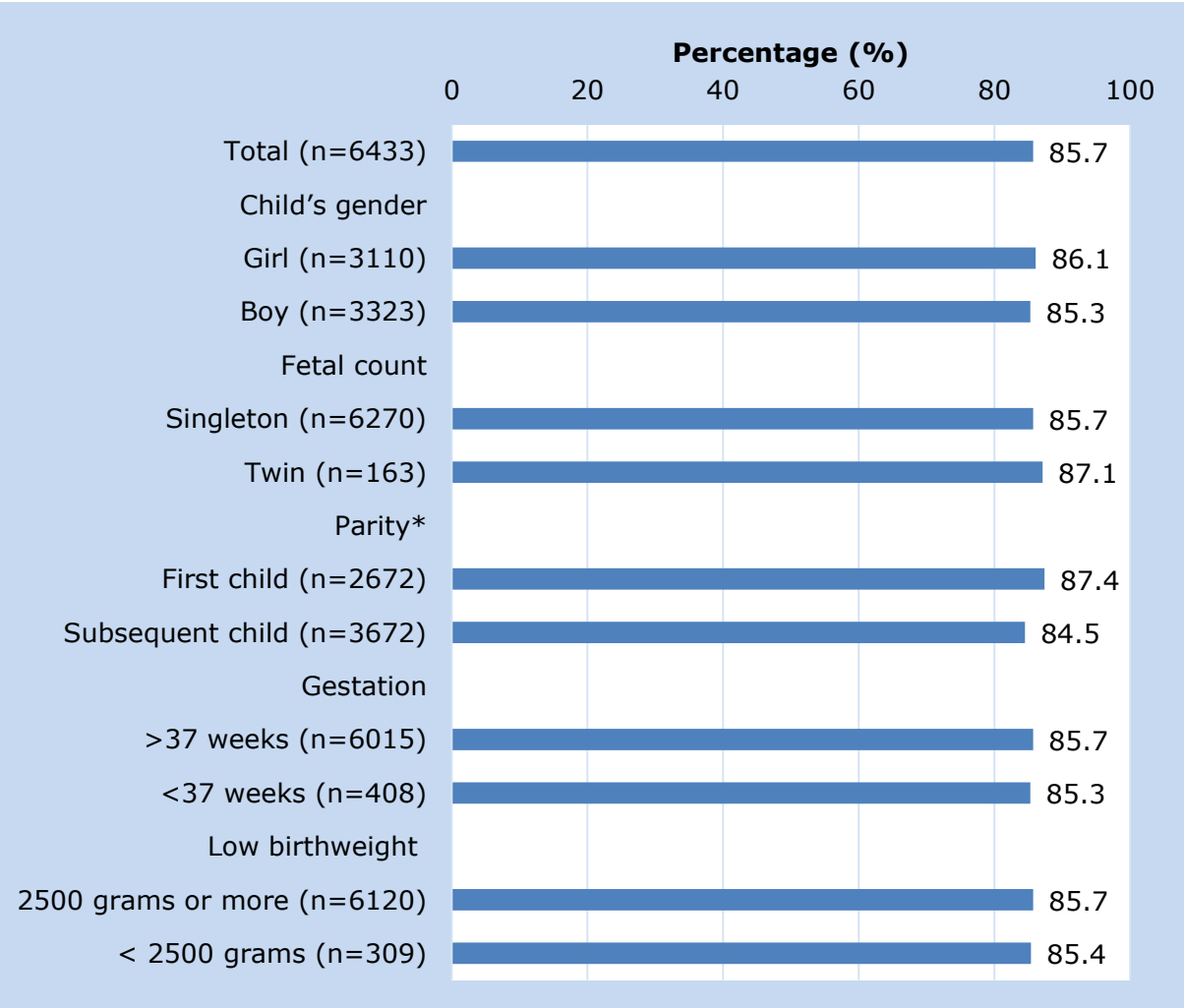
There were no differences by child characteristics in the addition of salt to baby's meals (**Figure 27**) and only a small difference for added sugar, in that a lower proportion of subsequent children compared to first-born children did not have sugar added to their meals at 9 months of age (**Figure 28**).

Figure 27: Salt is not added to baby's meals at 9 months of age, by child characteristics (unadjusted)



Notes: * Statistical significance measured by chi-square test (P<0.05); no differences >10 percentage points lower than the highest group in category. Data missing for n=2 infants regarding salt addition to meals, n=89 regarding parity, n=10 regarding gestation and n=4 regarding birth weight.

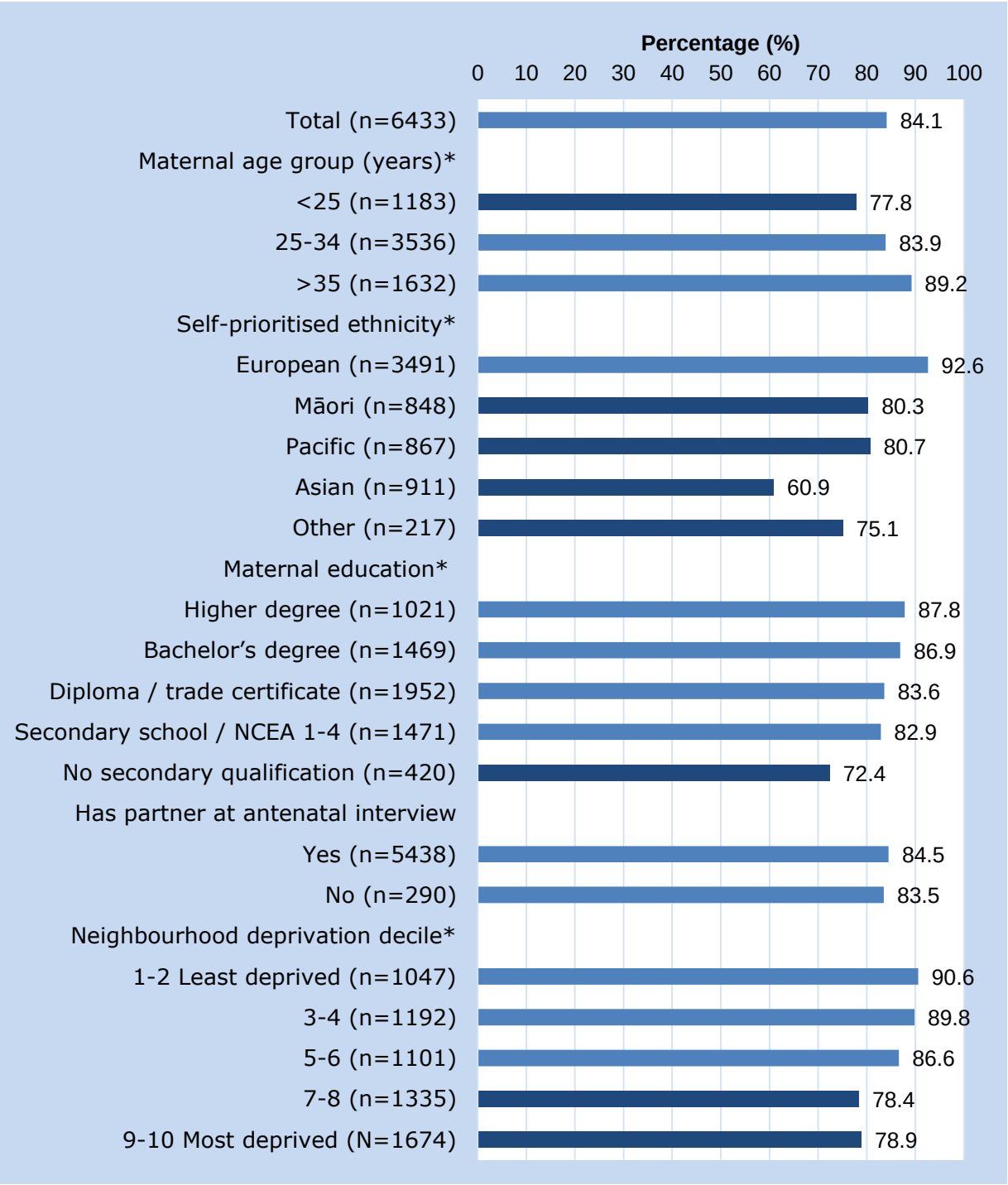
Figure 28: Sugar is not added to baby's meals at 9 months of age, by child characteristics (unadjusted)



Notes: * Statistical significance measured by chi-square test (P<0.05); no differences >10 percentage points lower than the highest group in category. Data missing for n=2 infants regarding sugar addition to meals, n=89 regarding parity, n=10 regarding gestation and n=4 regarding birth weight.

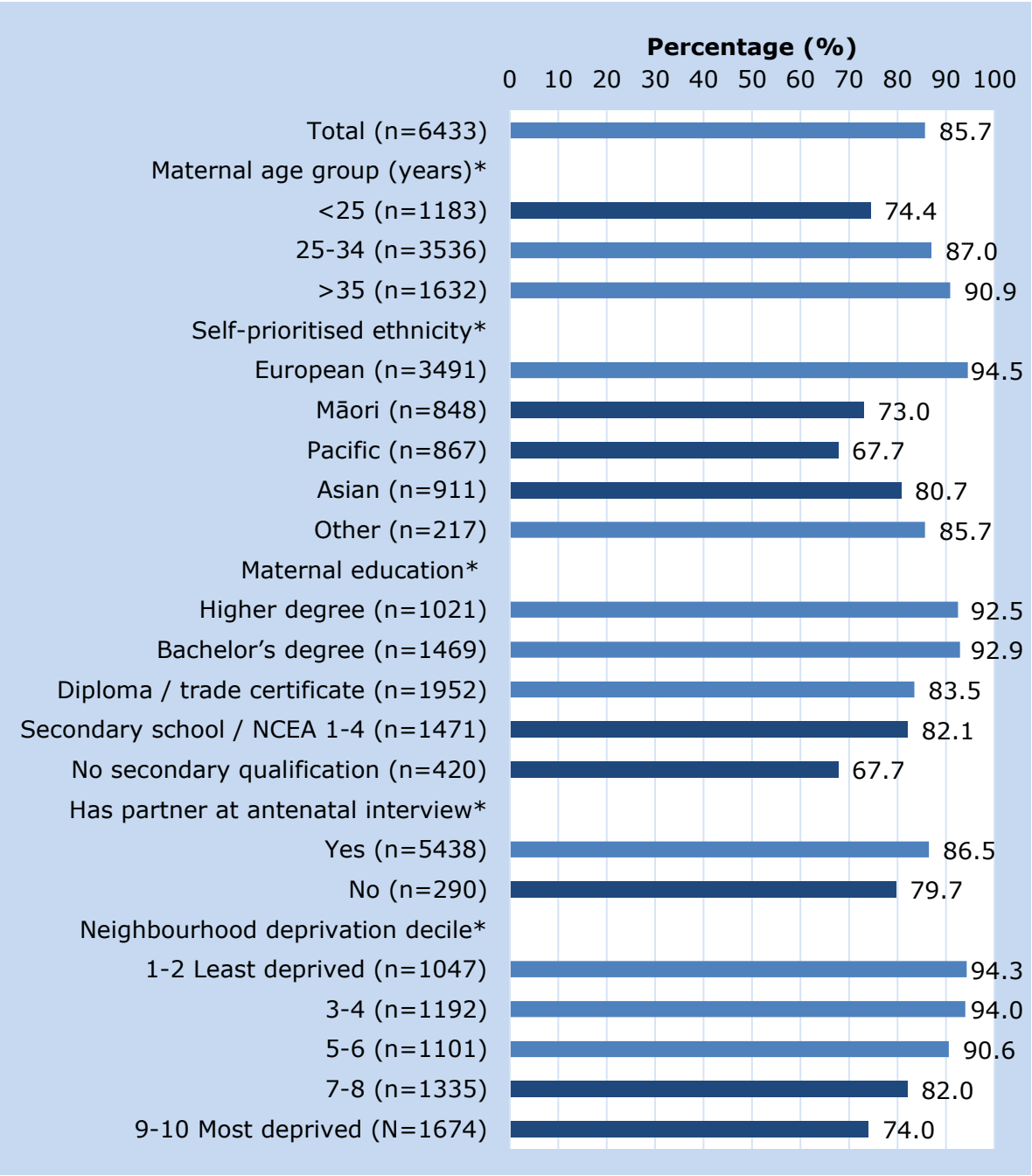
Significant differences were found by maternal age, ethnic group, education and neighbourhood deprivation in adherence to both the salt and sugar guidelines (**Figure 29** and **Figure 30**).

Figure 29: Salt is not added to baby's meals at 9 months of age, by maternal and neighbourhood characteristics (unadjusted)



Notes: * Statistical significance measured by chi-square test (P<0.05); dark blue bars indicate >10 percentage points lower than the highest group in category. Data missing for n=2 infants regarding salt addition to meals, n=82 regarding mother's age, n=99 regarding mother's ethnicity, n=100 regarding mother's education, n=705 regarding mother's relationship status, and n=84 regarding neighbourhood deprivation.

Figure 30: Sugar is not added to baby's meals at 9 months of age, by maternal and neighbourhood characteristics (unadjusted)

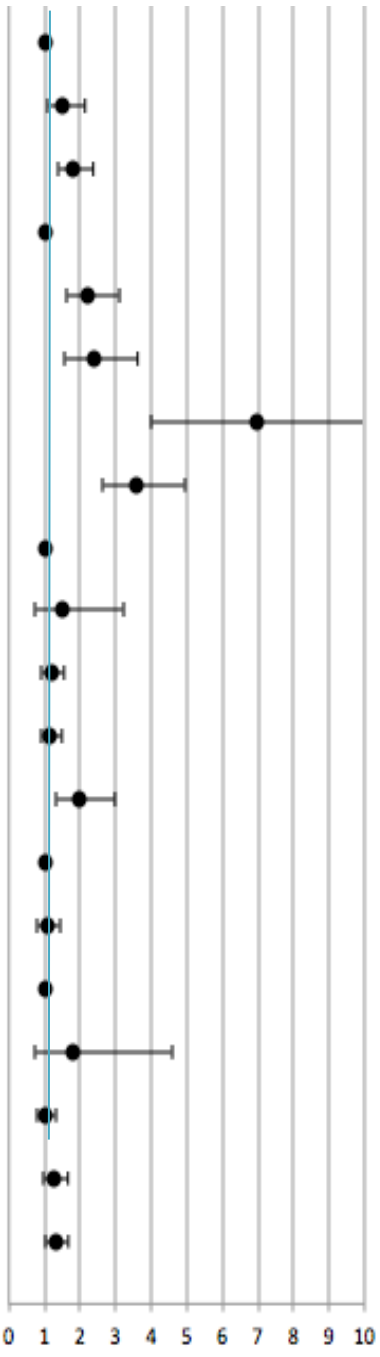


Notes: * Statistical significance measured by chi-square test (P<0.05); dark blue bars indicate >10 percentage points lower than the highest group in category. Data missing for n=2 infants regarding sugar addition to meals, n=82 regarding mother's age, n=99 regarding mother's ethnicity, n=100 regarding mother's education, n=705 regarding mother's relationship status, and n=84 regarding neighbourhood deprivation.

After adjustment for differences between groups, maternal age, ethnicity, education, partner status and neighbourhood deprivation all remained independently associated with the likelihood that an infant had salt added to their food or drinks (**Table 21**). Infants of Asian, Māori, Pacific and Other mothers were much more likely to have salt added to their meals compared with infants of European mothers (**Table 21**).

Table 21: Risk of not meeting the guideline of no salt added to baby's food or drinks, by sociodemographic characteristics (adjusted)

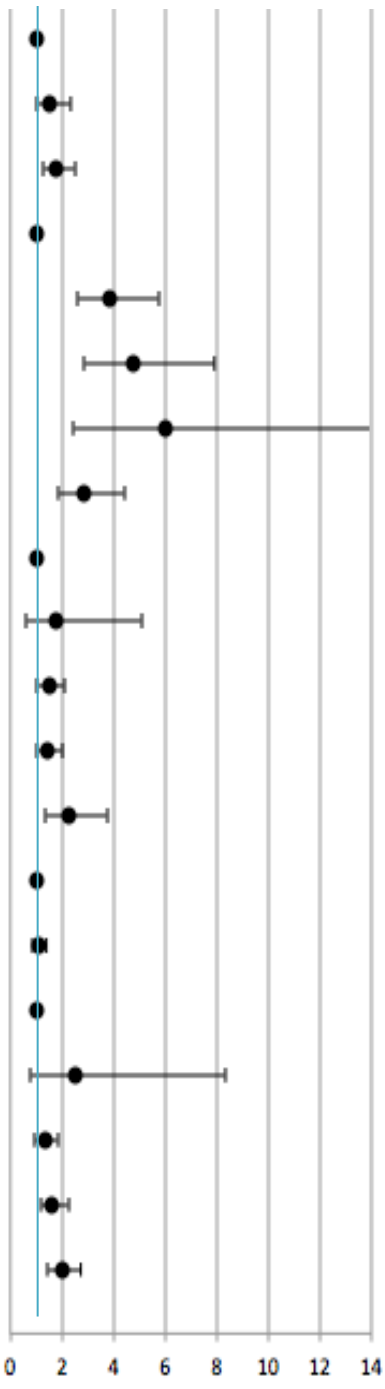
Sociodemographic characteristic		Relative risk	95% confidence interval	Forest plot
Maternal age	≥35 years	Reference		
	25-34 years	1.51	1.07-2.14	
	≤25 years	1.80	1.36-2.37	
Self-prioritised ethnic group	European	Reference		
	Māori	2.24	1.61-3.11	
	Pacific	2.39	1.58-3.62	
	Asian	6.98	3.97-12.28	
	Other	3.59	2.60-4.96	
Maternal education	Higher/postgraduate	Reference		
	Bachelor's degree	1.52	0.71-3.25	
	Diploma/trade cert	1.20	0.93-1.55	
	Sec school/NCEA 1-4	1.15	0.89-1.49	
	No qualification	1.98	1.32-2.98	
Mother had a partner	Yes	Reference		
	No	1.09	0.81-1.46	
Neighbourhood deprivation (NZDep decile)	1-2 Least deprived	Reference		
	Decile 3-4	1.82	0.72-4.61	
	Decile 5-6	1.02	0.78-1.34	
	Decile 7-8	1.27	0.98-1.66	
	9-10 Most deprived	1.30	1.02-1.67	



Notes: Poisson regression model with robust estimation adjusted for maternal age, ethnic group, education, partner status and neighbourhood deprivation at the antenatal interview. A statistically significant difference from the reference group is shown in bold (Wald chi square test p-value<0.05). Twins and infants born prematurely or with low birth weight were removed from the dataset (n=556). The model did not include participants with one or more missing data for maternal or household characteristics. Total N=5045. CI=confidence interval.

Similar to salt, maternal age, ethnicity, education, partner status and neighbourhood deprivation all remained independently associated with the likelihood that an infant had sugar added to their food or drinks (**Table 22**). Infants of Asian, Māori, Pacific and Other mothers were much more likely to have sugar added to their meals compared with infants of European mothers (**Table 22**).

Table 22: Risk of not meeting the guideline for no sugar added to baby's food or drinks, by sociodemographic characteristics (adjusted)

Sociodemographic characteristic		Relative risk	95% confidence interval	Forest plot
Maternal age	≥35 years	Reference		
	25-34 years	1.55	1.02-2.34	
	≤25 years	1.79	1.27-2.52	
Self-prioritised ethnic group	European	Reference		
	Māori	3.86	2.58-5.76	
	Pacific	4.77	2.88-7.91	
	Asian	5.98	2.47-14.44	
	Other	2.85	1.83-4.43	
Maternal education	Higher/postgraduate	Reference		
	Bachelor's degree	1.76	0.61-5.12	
	Diploma/trade cert	1.49	1.03-2.14	
	Sec school / NCEA 1-4	1.42	0.98-2.05	
	No qualification	2.27	1.36-3.80	
Mother had a partner	Yes	Reference		
	No	1.07	0.82-1.40	
Neighbourhood deprivation (NZDep decile)	1-2 Least deprived	Reference		
	Decile 3-4	2.54	0.77-8.34	
	Decile 5-6	1.31	0.92-1.87	
	Decile 7-8	1.63	1.15-2.30	
	9-10 Most deprived	1.99	1.45-2.73	

Notes: Poisson regression model with robust estimation adjusted for maternal age, ethnic group, education, partner status and neighbourhood deprivation at the antenatal interview. A statistically significant difference from the reference group is shown in bold (Wald chi square test p-value<0.05). Twins and infants born prematurely or with low birth weight were removed from the dataset (n=556). The model did not include participants with one or more missing data for maternal or household characteristics. Total N=5045. CI=confidence interval.

Overall adherence to the infant feeding guidelines

Average IFI scores

For the total infant population, including twins, babies born with low birth weight and short gestation, the median (interquartile range) of the IFI in the population was 70.00 points (56.87; 82.50) out of a top score of 100. The minimum and maximum scores obtained were 13.5 and 100 points, respectively. The median (IQR) points for each domain are presented in **Table 23.** A small number of infants (90/6184, 1.5%) were fed according to all of the guidelines, receiving a top score of 100 on the national Infant Feeding Guidelines. The domain with the highest median was Domain B (Introduction to solid foods) and the domain with the lowest median was Domain A (Breastfeeding).

Table 23 Median (interquartile ranges) points for each domain of the IFI (maximum score per domain = 25 points)

Domain	Median (IQR*)
A. Breastfeeding	17.0 (8.5; 22.5)
B. Introduction to solids	25.0 (12.5; 25.0)
C. Eating a variety of foods	18.8 (12.5; 21.9)
D. Appropriate food and drinks	20.0 (15.0; 25.0)

Notes: *IQR= Interquartile range (values of percentiles 25th and 75th)

Relationships between the IFI score and socio-demographic characteristics

In the univariate analysis, the associations for all independent variables and the final IFI had $p<0.10$ (**Table S2, Appendix 1**). In the multivariate model, independently of mother's parity, mother`s year of migration to NZ and child's gender, the following variables were associated with the IFI: mother's age, ethnicity, level of education, neighbourhood deprivation, relationship status, and attendance at childbirth preparation classes during pregnancy (**Table 24**).

As shown in **Table 24**, infants of mothers with no secondary school qualification, with a Diploma/trade cert/NCEA 5-6, or with a Sec School/ NCEA 1-4 had, on average, respectively 13.4 points, 7.9 points and 6.9 fewer points in the final IFI score when compared to infants with mothers who had a higher degree, when adjusted. The younger the mother, the lower the IFI score of the infant. Infants of mothers between 25-34 years old and mothers younger than 25 years of age had on average 2.08 points and 7.64 points less respectively for their IFI score, when compared to infants of mothers aged 35 years or older.

Additionally, as shown in **Table 23**, infants of mothers who self-identify as Māori, Asian, Pacific or Other ethnicities had, respectively and in descending order, 7.8, 6.6, 5.0, and 2.6 fewer points for their IFI score, when compared to the infants of European mothers. Infants whose mothers did not attend and did not intend to go to childbirth preparation classes, and infants whose mothers did not attend but intended to attend to these classes, scored, respectively, on average, 4.1 points and 2.4 points less on the IFI, compared to infants whose mothers had attended these classes.

Table 24 also shows a social gradient in neighbourhood deprivation, whereby the higher the neighbourhood deprivation, the lower the IFI score of the infant. Children from the most deprived neighbourhoods (NZDep 9-10) had, on average, 3.8 fewer points for their IFI score, when compared to those from the least deprived neighbourhoods (NZDep 1-2). Those belonging to the fourth (NZDep 7-8) and the third (NZDep 5-6) quintiles of neighbourhood deprivation presented, respectively, 2.2 and 1.5 fewer points for their IFI score, compared to the least deprived neighbourhoods. Infants of mothers who did not have a partner at the antenatal interview scored, on average, 3.7 fewer points for the IFI, compared to infants whose mothers had a partner.

Comparable results were found when examining the risk of a low IFI score by sociodemographic characteristics, comparing the infants who scored $\leq$80 points and the infants who scored > 80 points (**Appendix 1 Table S3**).

Table 24: Associations between IFI scores and sociodemographic variables (adjusted)

Sociodemographic characteristics	N (%)*	Score for Infant Feeding Index (IFI) β	95% CI	P
Child's gender				
Female	2,723 (48.2)	Reference	-	
Male	2,927 (51.8)	-0.84	-1.54; -1.66	0.046
Parity				
First born	2,363 (41.8)	Reference	-	
Subsequent	3,286 (58.2)	0.93	-0.30; 2.16	0.138
Maternal age group				
≥ 35 years	1,435 (25.4)	Reference	-	
≥25 & ≤ 34 years	3,180 (56.3)	-2.68	-3.67; -1.66	<0.001
<25 years	1,034 (18.3)	-7.64	-9.10; -6.20	<0.001
Maternal education				
Higher degree	931 (16.5)	Reference	-	
Bachelor's degree	1,328 (23.5)	-1.13	-2.45; 0.18	0.092
Diploma/trade cert/NCEA 5-6	1,731 (30.8)	-7.86	-9.16; -6.56	<0.001
Sec School/ NCEA 1-4	1,287 (22.8)	-6.92	-8.33; -5.51	<0.001
No secondary school	363 (6.4)	-13.41	-15.53; -11.28	<0.001
Self-prioritised ethnic group				
European	3,148 (55.8)	Reference	-	
Māori	751 (13.3)	-7.76	-9.12; -6.39	<0.001
Pacific	756 (13.4)	-4.95	-6.46; -3.45	<0.001
Asian	797 (14.1)	-6.56	-8.09; -5.02	<0.001
Others	190 (3.4)	-2.60	-4.96; -0.23	0.031
Mother had a partner				
Yes	4,874 (95.3)	Reference	-	
No	244 (4.7)	-3.73	-5.72; -1.74	<0.001
Neighbourhood deprivation decile				
1-2 Least deprived	947 (16.8)	Reference	-	
3-4	1,076 (19.1)	-0.16	-1.54; 1.21	0.814
5-6	983 (17.4)	-1.53	-2.94; -0.12	0.033
7-8	1,181 (20.9)	-2.17	-3.58; -0.78	0.002
9-10 Most deprived	1,460 (25.8)	-3.79	-5.23; -2.34	<0.001
Years since mother migrated to NZ				

Sociodemographic characteristics	N (%)*	Score for Infant Feeding Index (IFI)		
		β	95% CI	P
Born in New Zealand	3,698 (65.5)	Reference	-	
≥ 10 years (born overseas)	643 (11.4)	0.36	-1.08; 1.80	0.626
≥ 5 to ≤ 9 years (born overseas)	599 (10.6)	-0.03	-1.61; 1.55	0.974
< 5 years (born overseas)	709 (12.5)	-1.21	-2.70; 0.28	0.113
Mother attended childbirth preparation classed for this pregnancy				
Yes	1,232 (21.9)	Reference	-	
No, but intend to	1,034 (18.4)	-2.39	-3.69; -1.10	<0.001
No, and don't intend to	3,346 (59.6)	-4.13	-5.54; -2.71	<0.001

Notes: Multiple linear regression model adjusted for maternal age, ethnic group, education, partner status, household deprivation, Mother's years of migration to NZ and birth preparation class attendance at the time of the antenatal interview (Adj R^2= 0.23). A statistically significant difference from the reference group is shown in bold (p-value<0.05). Twins and infants born prematurely or with low birth weight were removed from the dataset (n=556). The model did not include participants with one or more missing data for:Child's gender (n=0); Parity (n=1) Mother's level of education (n=10); Mother's age (n=1); Mother's ethnicity (n=8); Neighbourhood deprivation (n=3); Mother had a partner (n=532); Mother's years of migration to NZ (n=1); Mother attended to childbirth classes preparation (n=38). Total N=5068. CI=confidence interval.

Discussion

Synthesis of the main findings

This report aimed to: *i*) Create an Infant Feeding Index (IFI) based on the Infant Feeding Guidelines; *ii)* Describe the degree of adherence to the Infant Feeding Guidelines in the GUiNZ Cohort and; *iii)* Explore associations between level of adherence to the national Infant Feeding Guidelines and socio-demographic characteristics.

The IFI created in this study provides a measure that assesses overall adherence to nutrition guidelines, and the results show a clear need for more emphasis on appropriate infant feeding and assistance with how to achieve this. Overall, the average score for infants on the Infant Feeding Index (IFI) was 70.0 points out of a top score of 100. Only 1.5% of the infants scored 100 points, indicating complete adherence to all guidelines. Almost one-third of infants (31.4%) scored 80 points or more in the IFI, indicating that their mothers followed the majority of the guidelines. The domain with the lowest median score was breastfeeding, where only 15.8% (n=996) of infants met both the critical guidelines of exclusively breastfeeding to around 6 months, and breastfeeding for 12 months or beyond.

When considering the 13 indicators that individually contribute to the IFI, ≥80% of the infants achieved the following guidelines: three or more solid food meals a day at 9 months; only breastmilk or infant formula given by the age of 9 months; no sugar or salt added to baby's meals or milk at 9 months; and serving an iron-rich food at least once daily at 9 months. Moderate adherence was seen for the following indicators: No introduction of inappropriate drinks by the age of 9 months; Solids introduced around 6 months; Eating across the four food groups daily at 9 months. Low adherence (less than 50% of the infants) was found for the following indicators: No introduction of inappropriate foods by the age of 9 months, Intake of fruit twice or more daily at 9 months, Intake of vegetables twice or more daily at 9 months; Any breastfeeding duration of 12 months or beyond; Exclusive breastfeeding duration to around 6 months of age.

In NZ, similar to that reported for Australian infants in 2010, despite high rates of breastfeeding initiation (97% in NZ and 96 % in Australia), a large proportion of infants do not meet the national recommendations for duration of any and exclusive breastfeeding. In Australia, 15.4% of the infants were being exclusively breastfed past 5 months of age while only 2.1% were exclusively breastfed to age of 6 months. Breastfeeding duration past 13 months of age was observed for less than 20% of Australian infants (18.2%). Despite better indicators for duration of any and exclusive breastfeeding observed in NZ when compared to Australia and other high-income countries (Castro et al, 2017),

New Zealand is not on track to achieve the global nutrition target for 2025 of at least 50% of infants exclusively breastfed at the age of 6 months (WHO, 2014).

The international literature indicates socio-demographic factors are significantly related to diet quality (Hoffman & Klein 2012) and our results corroborate this. Overall, younger mothers, mothers with self-prioritised ethnic groups other than European, mothers with a low level of education, and mothers who live in deprived neighbourhoods were less likely to adhere to the dietary guidelines (adhering to less than the full 13 guidelines/indicators). Among these socioeconomic determinants, maternal education was the strongest factor associated with adherence to the IFI. This indicates that extra information and resources that enhance maternal knowledge and interpretation of the guidelines may be necessary for disadvantaged families to ensure good nutrition for infants. Additionally, these findings provide evidence that wider policies that promote equitable access to education for women can effectively improve child health.

We also found that infants of mothers with a partner during the antenatal period and those who attended childbirth antenatal classes scored higher on the IFI. Creating or improving social mechanisms to support mothers during this period of dramatic dietary change, may have a positive impact, leading to better adherence to healthy feeding practices in the first 12 months of life. Health professionals play a central and critical role in improving access, equity and quality childcare for the population, in a way that can be customized to the individual infant and their family. The indicators of the IFI could be added to protocols used by key NZ health professionals (e.g. Wellchild providers), helping identify groups at risk of inadequate nutrition, monitoring them over time and facilitating individual dietary advice. The results generated by the IFI are easy to interpret by health professionals and by caregivers.

Limitations and future directions

Strengths and limitations of this study

To our knowledge, the IFI is the first index created with a large data set to describe adherence to the NZ national Infant Feeding Guidelines. We used the GUiNZ cohort study data, which enrolled a cohort of infants that represented 11% of all NZ births during the study period and generally closely aligns to all NZ births from 2007-2010 (Morton et al, 2014). Consequently, this is also the first study in NZ to describe the overall practices of infant feeding in a broadly generalizable to the NZ infant population. Information derived from this large study can help policy makers to design new strategies and/or evaluate interventions that are appropriate to improve infant feeding practices in NZ.

Another strength of this study is that the IFI created was able to discriminate between socio-demographic characteristics in mothers of the infants, which indicates this tool's ability to evaluate diet quality (Lazarou & Newby, 2011; Kourlaba & Panagiotakos, 2009).

Readers should be aware that the final IFI was not able to comprehensively evaluate adherence to all statements in the Infant Feeding Guidelines (Ministry of Health, 2008), as it was limited to those indicators collected in the *GUiNZ* study at 9 months of age, i.e. 6 of the 11 statements using 13 different indicators. Readers should also note the level of missing data for some analyses, particularly in multivariate models, which may have introduced bias in the data reporting. The variable with the largest proportion of missing data was maternal relationship status in pregnancy (n=705, 11% of the full cohort). Another aspect to take into consideration is that we measured infant dietary intake at 9 months of age using a Food Frequency Questionnaire developed to evaluate the adherence to the Ministry of Health guidelines for Healthy Infants and Toddlers (Ministry of Health, 2008). The referred Ministry of Health's guidelines cover recommendations for intake of the four main food groups: fruits and vegetables, breads and cereals, milk and milk products, and lean meat, meat alternatives and eggs. The questionnaire was therefore not comprehensive (as would have been the case with a food diary or 24 hour recall), and it was not designed to evaluate usual intake.

Another potential limitation of the study is that we weighted the four domains of the IFI equally, rather than equally weighting each indicator, and we were unable to comprehensively evaluate whether the IFI indicators should be weighted differently. Most dietary indices created for children in developed countries have weighted the indicators equally (Lazarou & Newby, 2011), however, in agreement with our policy collaborators, it was decided that the present approach of equally weighting the domains was more appropriate. However, this weighting approach arguably gave undue influence to indicators where there were only two indicators within a domain. An example where this appears to have been problematic in the IFI is for the *Introduction to Solid foods domain*, which obtained the highest median score on the IFI due to a particularly high score for one of the two indicators (three or more solid meals a day at 9 months of age). Although components that show ceiling effects or limited variation across the range of scores could have been eliminated, the appeal of an index that can be used to monitor adherence for as many of the current Infant Feeding Guidelines as possible would be lost (Moeller 2007).

Areas for future research

This research has produced an IFI score for the *GUiNZ* dataset, which can be used in subsequent studies of children development. In order to fully validate the IFI created, the next step is to analyze the cumulative effect of early life

nutrition on later outcomes within the *GUiNZ* cohort study (e.g. cognitive, health, social and behavioural outcomes).

Additionally, the following areas would benefit from further analyses of the data:

1. This study has been limited in the extent to which it could explore barriers and enablers of healthy infant feeding practices. Further research on the issues mothers encounter with maintaining breastfeeding and particularly exclusively breastfeeding would be of relevance. Further analysis of proximal, intermediate and distal determinants of any and exclusive breastfeeding in New Zealand is needed to understand and improve those rates nationally. This comprehensive analytical approach should address a number of variables, including the effect that health care providers, paid maternal leave, women's workplace support, childcare and antenatal classes can have on these indicators.
2. Within the *GUiNZ* cohort, there are sufficient numbers for some ethnic groups to allow further detailed analyses of infant feeding practices. It is clear from the data presented in this report that important cultural differences exist. It would be useful to have the indicators in this report replicated for largely homogenous ethnic populations, such as Chinese, Indian, Samoan ethnicities etc., as this report only included Statistics New Zealand's Level 1 Ethnic groups, which combines some quite diverse cultures together as the same ethnic group.
3. Similarly, when discussing the adequacy of infant feeding practices, the ability of families and whānau to access and afford a variety of healthy foods for their infants must be taken in consideration, in order to reduce feeding inequities during infancy.

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Appendix: Supplementary data tables

Table S1: Characteristics of the GUiNZ cohort children and mothers

Maternal characteristics[1]	Description	n (%)
Maternal age	<25 years	1183 (18.6)
	25-34	3537 (55.7)
	35+ years	1633 (25.7)
Maternal self-prioritised ethnicity	European	3491 (55.1)
	Māori	849 (13.4)
	Pacific	867 (13.7)
	Asian	912 (14.4)
	Other	217 (3.4)
Maternal highest level of education	Higher degree	1021 (16.1)
	Bachelor's degree	1470 (23.2)
	Diploma/trade cert/NCEA 5-6	1952 (30.8)
	Secondary school/NCEA 1-4	1472 (23.2)
	No secondary school	420 (6.6)
Neighbourhood deprivation (NZDep 2006)	Decile 1-2	1047 (16.5)
	Decile 3-4	1193 (18.8)
	Decile 5-6	1101 (17.3)
	Decile 7-8	1336 (21.0)
	Decile 9-10	1674 (26.4)
Mother had a partner	No	290 (5.1)
	Yes	5440 (94.9)
Child characteristics[2]		
Gender	Male	3324 (51.7)
	Female	3111 (48.3)
Parity	First child	2673 (42.1)
	Subsequent child	3673 (57.9)
Fetal count	Singletons	6272 (97.5)
	Twins	163 (2.5)
Total		**6435 (100)**

Notes: 1. Data from Growing Up in New Zealand DCW0 collected during pregnancy 2. Data from Growing Up in New Zealand DCW1 collected when baby was 6 weeks of age.

Table S2: Associations between IFI final scores and sociodemographic variables (Unadjusted)

Sociodemographic characteristics	N (%)	Score for Infant Feeding Index (IFI)		
		β *	95% CI	p
Child's gender				
Female	2,723 (48.2)	Reference	-	
Male	2,927 (51.80)	-0.76	-1.64; 0.13	0.094
Parity				
First born	2,363 (41.8)	Reference	-	
Subsequent	3,286 (58.2)	**-0.96**	**-1.86; -0.066**	**0.035**
Maternal age group				
≥ 35 years	1,435 (25.4)	Reference	-	
≥25 & ≤ 34 years	3,180 (56.3)	**-3.75**	**-4.76; -2.73**	**0.000**
<25 years	1,034 (18.3)	**-14.62**	**-15.92; -13.32**	**0.000**
Maternal education				
Higher degree	931 (16.5)	Reference	-	
Bachelor's degree	1,328 (23.5)	**-2.33**	**-3.65; -1.00**	**0.001**
Diploma/trade cert/NCEA 5-6	1,731 (30.8)	**-11.65**	**-12.91; -10.39**	**0.000**
Sec School/ NCEA 1-4	1,287 (22.8)	**-12.29**	**-13.62; -10.96**	**0.000**
No secondary school	363 (6.4)	**-22.11**	**-24.02; -20.19**	**0.000**
Self-prioritised ethnic group				
European	3,148 (55.8)	Reference	-	
Māori	751 (13.3)	**-14.14**	**-15.41; -12.86**	**0.000**
Pacific	756 (13.4)	**-11.88**	**-13.16; -10.61**	**0.000**
Asian	797 (14.1)	**-7.41**	**-8.65; -6.16**	**0.000**
Others	190 (3.4)	**-3.11**	**-5.46; -0.77**	**0.009**
Mother had a partner				
Yes	4,874 (95.3)	Reference	-	
No	244 (4.7)	**-10.11**	**-12.27; -7.95**	**0.000**
Neighbourhood deprivation decile				
1-2 Least deprived	947 (16.8)	Reference	-	
3-4	1,076 (19.1)	**-1.54**	**-2.96; -0.12**	**0.034**
5-6	983 (17.4)	**-3.83**	**-5.29; -2.38**	**0.000**
7-8	1,181 (20.9)	**-7.77**	**-9.17; -6.38**	**0.000**
9-10 Most deprived	1,460 (25.8)	**-12.54**	**-13.87; -11.21**	**0.000**

Sociodemographic characteristics	N (%)	Score for Infant Feeding Index (IFI)		
		β *	95% CI	p
Years since mother migrated to NZ				
Born in New Zealand	3,698 (65.5)	Reference	-	
≥ 10 years (born overseas)	643 (11.4)	0.69	-0.73; 2.11	0.341
≥5 & ≤9 years (born overseas)	599 (10.6)	0.12	-1.34; 1.58	0.973
≤ 4years (born overseas)	709 (12.5)	**-2.11**	**-3.48; -0.75**	**0.002**
Mother attended childbirth preparation classes for this pregnancy				
Yes	1,232 (21.9)	Reference	-	
No, but intend to	1,034 (18.4)	**-3.89**	**-5.28; -2.49**	**0.000**
No, and don't intend to	3,346 (59.6)	**-5.48**	**-6.58; -4.38**	**0.000**

Notes: Linear regression models (unadjusted) showing * the average difference in final IFI score compared to the reference group. A statistically significant difference from the reference group is shown in bold (p-value<0.05). Twins and infants born prematurely or with low birth weight were removed from the analysis (n=556). The univariate models did not include participants with missing information for the covariates under study: Child's gender (n=0); Parity (n=1) Mother's level of education (n=10); Mother's age (n=1); Mother's ethnicity (n=8); neighbourhood deprivation (n=3); Mother had a partner (n=532); Mother's years of migration to NZ (n=1); Mother attended to childbirth classes preparation (n=38). CI=confidence interval.

Table S3: Risk of a low IFI score (<80 out of 100), by sociodemographic variables (unadjusted and adjusted)

Sociodemographic characteristics	Score for Infant Feeding Index < 80 points							
	Yes N (%)	No N (%)	Unadjusted Relative Risk	95% CI	p	Adjusted Relative Risk	95% CI	p
Child's gender								
Female	1,852 (68.0)	871 (32.0)	Reference	-		---	---	---
Male	2,022 (69.1)	905 (30.9)	1.02	0.98; 1.05	0.388			
Parity								
First born	1,607 (68.0)	756 (32.0)	Reference	-		----	---	---
Subsequent	2,266 (69.0)	1,020 (31.0)	1.01	0.98; 1.05	0.448			
Maternal age group								
≥ 35 years	818 (56.7)	617 (43.3)	Reference	-		Reference	-	
≥25 & ≤ 34 years	2,136 (67.0)	1,044 (33.0)	1.18	1.12; 1.24	0.000	**1.13**	**1.08; 1.20**	**0.000**
<25 years	919 (89.0)	115 (11.0)	1.56	1.48; 1.64	0.000	**1.29**	**1.22; 1.37**	**0.000**
Maternal education								
Higher degree	472 (50.7)	459(49.3)	Reference	-		Reference	-	
Bachelor's degree	744 (56.0)	584 (44.0)	1.14	1.05; 1.22	0.002	**1.09**	**1.00; 1.18**	**0.045**
Diploma/trade cert/NCEA 5-6	1,319 (76.1)	412 (23.9)	1.55	1.44; 1.66	0.000	**1.38**	**1.28; 1.48**	**0.000**
Sec School/ NCEA 1-4	1,015 (79.0)	272 (21.0)	1.60	1.49; 1.72	0.000	**1.36**	**1.26; 1.47**	**0.000**
No secondary school	327 (89.8)	36 (10.2)	1.83	1.70; 1.97	0.000	**1.45**	**1.34; 1.58**	**0.000**
Self-prioritised ethnic group								
European	1,853 (59.0)	1,295 (41.0)	Reference	-		Reference	-	
Māori	648 (86.2)	103 (13.8)	1.46	1.41; 1.53	0.000	**1.22**	**1.17; 1.28**	**0.000**
Pacific	636 (83.9)	120 (16.1)	1.43	1.37; 1.49	0.000	**1.16**	**1.10; 1.23**	**0.000**
Asian	608 (76.3)	189 (23.7)	1.29	1.23; 1.36	0.000	**1.25**	**1.17; 1.34**	**0.000**
Other	121 (63.7)	69 (36.3)	1.08	0.97; 1.21	0.170	1.07	0.95; 1.19	0.268

Sociodemographic characteristics	Score for Infant Feeding Index < 80 points							
	Yes N (%)	No N (%)	Unadjusted Relative Risk	95% CI	p	Adjusted Relative Risk	95% CI	p
Mother had a partner								
Yes	3,290 (67.5)	1,584 (32.5)	Reference	-		Reference	-	
No	213 (87.3)	31 (12.7)	1.29	1.23; 1.36	0.000	**1.09**	**1.04; 1.15**	**0.001**
Neighbourhood deprivation decile								
1-2 Least deprived	530 (56.1)	417 (43.9)	Reference	-		Reference	-	
3-4	626 (58.2)	450 (41.8)	1.04	0.96; 1.12	0.317	0.98	0.91; 1.06	0.8647
5-6	654 (66.5)	329 (33.5)	1.19	1.11; 1.28	0.000	**1.09**	**1.01; 1.17**	**0.019**
7-8	875 (74.1)	306 (25.9)	1.33	1.24; 1.41	0.000	**1.10**	**1.03; 1.19**	**0.008**
9-10 Most deprived	1,186 (81.2)	274 (18.8)	1.45	1.36; 1.54	0.000	**1.10**	**1.02; 1.18**	**0.006**
Years since mother migrated to NZ								
Born in New Zealand	2,508 (67.8)	1,190 (32.2)	Reference	-		Reference	-	
≥ 10 years (born overseas)	430 (67.0)	213 (33.0)	0.99	0.93; 1.04	0.639	1.00	0.93; 1.06	0.785
≥5 & ≤9 years (born overseas)	405 (67.8)	194 (32.2)	1.00	0.94; 1.06	0.920	0.98	0.91; 1.06	0.620
≤ 4years (born overseas)	530 (74.8)	179(25.2)	1.10	1.05; 1.16	0.000	1.05	0.99; 1.12	0.106
Mother attended childbirth preparation classes for this pregnancy								
Yes	482 (39.1)	750 (60.9)	Reference	-		Reference	-	
No, but intend to	707 (68.4)	327 (31.6)	1.12	1.06; 1.19	0.000	1.06	0.99; 1.12	0.074
No, and don't intend to	2,382 (71.2)	962 (28.8)	1.17	1.11; 1.23	0.000	**1.10**	**1.04; 1.15**	**0.001**

Notes: Poisson regression model with robust estimation (unadjusted), then adjusted for maternal age, ethnic group, education, partner status, neighbourhood deprivation, years since migrated to NZ and birth preparation class attendance at the time of the antenatal interview. A statistically significant difference from the reference group is shown in bold (p-value<0.05). Twins and infants born prematurely or with low birth weight were removed from the analysis (n=556). The final multivariate model did not include participants with one or more missing data for the covariates under study: Child's gender (n=0); Parity (n=1) Mother's level of education (n=10); Mother's age (n=1); Mother's ethnicity (n=8); Neighbourhood deprivation (n=3); Mother had a partner (n=532); Mother's years of migration to NZ (n=1); Mother attended to childbirth classes preparation (n=38). Total N for final multivariate model =5068. CI=confidence interval.