July **2020**

Food Hardship and Early Childhood Nutrition

Findings from *Growing Up in New Zealand* with a focus on food hardship among tamariki Māori and Pacific children

THE UNIVERSITY OF AUCKLAND
NEW ZEALAND

MEDICAL AND HEALTH SCIENCES
SCHOOL OF POPULATION HEALTH

UNIVERSITY of OTAGO
Te Whare Wānanga o Otāgo
NEW ZEALAND

MINISTRY OF SOCIAL DEVELOPMENT
TE MANATŪ WHAKAHIATO ORA

Authors

This report was written by Dr Sarah Gerritsen[1], Dr Amanda D'Souza[2], Tyla Goodsell-Matthews[3], Avinesh Pillai[4], Professor Boyd Swinburn[3] and Professor Clare Wall.[6]

1. Social and Community Health, School of Population Health, University of Auckland
2. Department of Public Health, University of Otago Wellington
3. Epidemiology and Biostatistics, School of Population Health, University of Auckland
4. Department of Statistics, University of Auckland
5. Discipline of Nutrition and Dietetics, University of Auckland

Suggested citation: Gerritsen S, D'Souza A, Goodsell-Matthews T, Pillai A, Swinburn B, Wall C. 2020. *Food hardship and early childhood nutrition: Findings from Growing Up in New Zealand with a focus on food hardships among tamariki Māori and Pacific children.* Wellington: Ministry of Social Development.

Acknowledgements

The project was funded by the Ministry of Social Development through the Children and Families Research Fund, using *Growing Up in New Zealand* data collected by the University of Auckland. The data has been accessed and used in accordance with the *Growing Up in New Zealand* Data Access Protocol.

Thank you to the *Growing Up in New Zealand* families who have shared their information so that this research could be undertaken. We acknowledge the work of the *Growing Up in New Zealand* interviewers and research team at the University of Auckland, led by Professor Susan Morton, who created the study, constructed the questionnaires, and collected and processed the data, making it available for us to use.

This study was developed in collaboration with staff of the Department of Prime Minister and Cabinet Child Wellbeing Unit (Dr Kristie Carter and Barbara Annesley) and Ministry of Health (Dr Mary-Ann Carter, Louise McIntryre, Li-Chia Yeh). Decisions regarding variables to include in the analysis, outputs and report framing were made in consultation and agreement with the policy collaborators at two key points in the project: while developing the analysis plan and following preliminary data analysis. The authors would also like to thank Megan Tunks and Renei Ngawati from Toi Tangata for also discussing the findings and policy implications with us.

The report was reviewed by Dr Kristie Carter, Barbara Annesley and Dr Mary-Ann Carter, and peer-reviewed by Associate Professor Dr Polly Atatoa Carr (Waikato University).

Disclaimer

The final decisions for data analyses and presentation rest with the authors, who fully take responsibility for any errors or omissions. The views and interpretations in this report are those of the researchers and not the official position of the Ministry of Social Development, Department of Prime Minister and Cabinet or Ministry of Health.

Abbreviations and key terms

CAPI Computer Assisted Personal Interviews

CATI Computer Assisted Telephone Interviews

CYWS Child and Youth Wellbeing Strategy (Department of Prime Minister and Cabinet)

DCW Data Collection Wave

NZ New Zealand

OECD Organization for Economic Co-operation and Development

SoFIE Survey of Family, Income, and Employment

USDA United States Department of Agriculture

Mother is used throughout the report to refer to the primary caregiver of the cohort child in *Growing Up in New Zealand* who completed the 'mother' and 'child proxy' questionnaires. This person may not be the biological mother.

Infant refers to a child aged under 1 year.

Child refers to a child of any age.

Food hardship in this study refers to any one of the following three indicators (indicated throughout the report by icons):

- been forced to buy cheaper food so that you could pay for other things you needed
- made use of special food grants or food banks because you did not have enough money for food
- gone without fresh fruit and vegetables, so that you could pay for other things you needed.

Food insecurity is the inability to access nutritionally adequate and safe foods in a socially acceptable way that is able to meet cultural needs (such as providing for guests, or for special occasions etc)(Parnell & Gray, 2014). In this report, the three food hardships are considered to be a subset of food insecurity.

Fruit served to infants includes fresh and canned.

Vegetables served to infants includes raw and cooked.

Unhealthy food refers to an infant having tried the following foods before 9-months of age: Sweets, Chocolate, Hot chips, Potato chips (crisps).

Unhealthy drinks refers to an infant having tried the following drinks before 9-months of age: Fruit juices (including watered down), Soft/fizzy drinks, Coffee, Tea, or Herbal drinks.

Variety of fruit is defined as eating different types of fruits over the past 4 weeks at 54-months of age: 0-3 (low variety), 4-5 (moderate variety) and 6 or more (high variety). Refer to the methods section for the list of different types of fruit.

Variety of vegetables is defined as eating different types of vegetables over the past 4 weeks at 54-months of age: 0-3 (low variety), 4-5 (moderate variety) and 6 or more (high variety). Refer to the methods section for the list of different types of vegetables.

Executive Summary

Food insecurity in Aotearoa New Zealand is of growing concern among policy makers, organisations and the wider public. The food hardships that families and whānau with young children–particularly children in their first year of life when nutrition is so important for optimal development and growth–have not been comprehensively investigated before in Aotearoa New Zealand.

This study sought to understand the relationship between household food hardship and early childhood nutrition, specifically whether a mother's report of being forced to buy cheaper food or having to go without fresh fruit and vegetables to pay for other things they need, plus the use of special food grants and food banks to obtain sufficient food, had an impact on their child's breastfeeding, fruit and vegetable intake, and unhealthy food and drink intake in the preschool period. Data from the contemporary *Growing Up in New Zealand* longitudinal cohort study of more than 6,000 children, followed from before their birth in 2009/10, was used to paint a detailed picture of food hardships experienced by young children.

Food hardships were prevalent among families of infants and preschoolers, and characterised by large ethnic inequities from infancy

At 9-months of age, almost half of mothers/primary givers reported being forced to buy cheaper food, and around one in eight (12%) used food grants or food banks or went without fresh fruit and vegetables to pay for other things over the previous 12 months.

All three food hardships were much more common in the first year of life compared to later in the preschool years.

One in four Māori 9-month olds and almost one in every three Pacific 9-month olds lived in households that reported use of a special food grant or food bank in the previous year compared to one in fifteen European infants.

Households moved in and out of food hardship during early childhood: more children experienced food hardship than measurement at one time-point might suggest

Almost two in every three mothers reported that they were forced to buy cheaper food to pay for other things they needed at either or both of the early childhood interviews.

About 40% of Pacific children and 35% of tamariki Māori lived in households that made use of special food grants or food banks at either 9- and/or 54-months of age.

Although the overall proportion of children experiencing food hardship reduced between 9- and 54-months of age, food hardships became more common among households with markers of low socio-economic position at 54-months of age.

Indicators of nutrition in early childhood were suboptimal across the whole cohort, particularly in the first year of life

68% of all infants were breastfed for less than 12 months.

Two out of every three infants did not meet the guidelines for fruit and vegetable intake (37% had fruit twice a day or more and 33% had vegetables twice a day or more)

By 9-months, 51% of infants had tried unhealthy food (sweets, chocolate, hot chips or potato chips); and 37% had tried unhealthy drinks (fruit juice, soft drinks, coffee, tea or herbal drinks).

12% of 4-year olds were drinking soft drinks or energy drinks 3 or more times per week.

All measures of food hardship were separately associated with poorer nutrition

All three indicators of food hardship were significantly associated with poorer nutrition separately, and a similar pattern was found for all ethnic groups. Compared to other children, those experiencing food hardship were more likely to have:

- Stopped breastfeeding before their first birthday
- Had fewer servings per day of fruit or vegetables at 9-months of age
- Had tried unhealthy food and drinks before 9-months of age
- Eat a low or moderate variety of fruit or vegetables at age 4.5 years
- Drink three or more fizzy drinks a week at age 4.5 years.

Children in food hardship were more likely to consume unhealthy food and drinks and had a lower variety of fruit and vegetables than those from similar socioeconomic backgrounds who were not in food hardship.

After adjusting for differences in household income and size, child education, mother's age and education and neighbourhood deprivation, all three indicators of food hardship remained statistically associated with poor indicators of child nutrition. Children in families who reported using a food bank or food grant were around 45% more likely to have tried unhealthy food or drink at 9-months compared to children with similar socioeconomic characteristics whose families did not use a food bank or food grant. They were also more likely to have high soft drink intake at age four years, but results were only statistically significant for tamariki Māori after adjustment. Food grant or food bank use was also associated with low to moderate variety of fruit and vegetable intake at four years even after adjusting for all of the above socioeconomic characteristics.

Policy implications

This research supports the policy directions of the Child Poverty Reduction Act and the Child and Youth Wellbeing Strategy, including the focus on food security. It is also consistent with the Welfare Expert Advisory Group's finding that family incomes are seriously inadequate to provide a basic standard of living for children and families. While complex, there is considerable expertise, evidence and experience in Aotearoa New Zealand to support work to address food hardship and poor nutrition.

Key implications for policy-makers

1. **Policy to reduce food hardship in childhood requires specific attention to early childhood** as well as school-aged children, particularly for infants and families in the first year of life. Food programmes should aim to include a variety of early childhood settings (including marae) as well as schools and kura kaupapa.

2. **Monitoring of food hardship and nutrition should include adequate numbers of children less than five years of age**, including infants less than one year, so the data can be disaggregated by age and ethnicity and monitored over time. Regular monitoring of children's nutrition will be especially important post-COVID-19.

3. **Policy to address food hardship should be made in meaningful partnerships with, and advance the aspirations of Māori and Pacific** whānau and communities, given the marked ethnic inequities, and the cultural significance of food.

4. **Policy to reduce the prevalence and nutritional consequences of food hardship should be part of a comprehensive food policy** developed to improve nutrition and reduce obesity more widely. Priority actions should encompass:

    a. **Addressing the determinants of low family income** as recommended by the Welfare Expert Advisory Group, including, but not limited to, ensuring adequate social assistance for families with young children.

    b. **Local and national initiatives to increase the affordability, availability and promotion of healthy food**, including strengthening Māori food systems.

    c. **Local and national initiatives to protect children** and their parents and caregivers from unhealthy food environments, such as excessive availability, promotion and marketing of unhealthy food and drink products.

    d. **Fiscal measures** to make unhealthy foods less affordable and healthy foods more affordable.

    e. **Addressing barriers to breastfeeding**, including structural determinants of early breastfeeding cessation (e.g. improving employment conditions and expanding parental leave provisions).

5. **Evaluation of new policy initiatives** to ensure they are effective, appropriate, and reduce inequities.

Contents

Introduction 10

The issue of food poverty in Aotearoa New Zealand 10

Definitions of food poverty, food insecurity and food hardship 10

The policy context in Aotearoa New Zealand 14

Objectives and aims of this study 15

Method 16

The *Growing Up in New Zealand* study 16

Variables used in analyses presented in this report 17

Statistical analysis 19

Results 20

Cohort characteristics 20

Nutrition indicators at 9-months and 54-months 20

Food hardship indicators: prevalence and coexistence 22

Persistence of food hardship 26

Overall exposure to food hardship during early childhood period 27

Associations between maternal and household characteristics and food hardship indicators 28

Associations between food hardship and early childhood nutrition 29

Discussion 36

Limitations of this study 37

Future directions for research 37

Policy implications 38

Conclusion 40

References 41

Appendix 1: Missing Data Analysis 44

Appendix 2: Maternal and household characteristics for children experiencing food hardships 46

Appendix 3: Nutrition indicators related to food hardships: multivariate analyses 52

List of Tables

Table 1: Summary of previous research on food poverty among children in Aotearoa New Zealand 12

Table 2: Overview of relevant key government policy developments since 2009/10 14

Table 3: Cohort demographic and socioeconomic variables, by child ethnicity 21

Table 4: Nutrition indicators, by child ethnicity 22

Table 5: Missing observations for each variable (N=6032) 44

Table 6: Food hardship variables by response and non-response of household income variables 45

Table 7: Food hardship variables by response and non-response of breastfeeding to 12 months variable 45

Table 8: Maternal and household characteristics of 9-month old children living in households where the mother was forced to buy cheaper food to pay for other things she needed in the past 12 months, for total cohort, Māori and Pacific. 46

Table 9: Maternal and household characteristics of 54-month old children whose mother was forced to buy cheaper food to pay for other things she needed in the past 12 months, for total cohort, Māori and Pacific. 47

Table 10: Maternal and household characteristics of 9-month old children living in households where the mother made use of special food grants or food banks in the past 12 months, for total cohort, Māori and Pacific. 48

Table 11: Maternal and household characteristics of 54-month old children whose mother made use of special needs grants or food banks in the past 12 months, for total cohort, Māori and Pacific. 49

Table 12: Maternal and household characteristics of 9-month old children living in households where the mother went without fresh fruit and vegetables to pay for other things in the past 12 months, for total cohort, Māori and Pacific. 50

Table 13: Maternal and household characteristics of 54-month old children whose mother went without fresh fruit and vegetables to pay for other things in the past 12 months, for total cohort, Māori and Pacific. 51

Table 14: Adjusted multivariate nutrition indicators for those children in households who reported being forced to buy cheaper food to pay for other things 52

Table 15: Adjusted multivariate nutrition indicators for those children in households who reported having made use of special food grants or food banks 53

Table 16: Adjusted multivariate nutrition indicators for those children in households who reported having gone without fresh fruit and vegetables so that they could pay for other things 53

List of Figures

Figure 1: Timeline for selected data collection waves in the *Growing Up in New Zealand* study used in this research 16

Figure 2: Food hardships reported by mothers/primary caregivers when child aged 9-months, by child ethnicity..... 22

Figure 3: Coexistence of food hardships in households with 9-month old children, by child ethnicity..... 23

Figure 4: Food hardships reported by mothers/primary caregivers when child aged 54-months, by child ethnicity..... 24

Figure 5: Coexistence of food hardships in households with 54-month old children, by child ethnicity 25

Figure 6: Movement in and out of the food hardship "forced to buy cheaper food to pay for other things" in the past 12 months, when child aged 9-months and 54-months, by child ethnicity..... 26

Figure 7: Movement in and out of the food hardship "making use of special food grants or food banks" in the past 12 months, when child aged 9-months and 54-months, by child ethnicity..... 26

Figure 8: Movement in and out of the food hardship "going without fresh fruit and vegetables to pay for other things" in the past 12 months, when child aged 9-months and 54-months, by child ethnicity..... 27

Figure 9: Food hardships reported by mothers/primary caregivers at either or both early childhood ages (9- and/or 54-months), i.e. exposure at some point during early childhood 27

Figure 10: Indicators of poor infant nutrition when the mother/primary caregiver was forced to buy cheaper food in the past 12 months, compared to other infants 29

Figure 11: Indicators of poor nutrition at 54-months of age when the mother/primary caregiver was forced to buy cheaper food in the past 12 months, compared to other children 29

Figure 12: Indicators of poor infant nutrition for tamariki Māori when their mother/primary caregiver was forced to buy cheaper food, compared to other tamariki Māori..... 30

Figure 13: Indicators of poor nutrition for tamariki Māori at 54-months of age when the mother/primary caregiver was forced to buy cheaper food in the past 12 months, compared to other tamariki Māori 30

Figure 14: Indicators of poor infant nutrition when the mother/primary caregiver had made use of special food grants or food banks compared to other infants 31

Figure 15: Indicators of poor nutrition at 54-months of age when the mother/primary caregiver was forced to buy cheaper food in the past 12 months, compared to other children 31

Figure 16: Indicators of poor infant nutrition for tamariki Māori when their mother/primary caregiver had made use of special food grants or food banks, compared to other tamariki Māori..... 32

Figure 17: Indicators of poor nutrition at 54-months of age for tamariki Māori when their mother/primary caregiver had made use of special food grants or food banks, compared to other tamariki Māori..... 32

Figure 18: Indicators of poor infant nutrition for Pacific children when their mother/primary caregiver had made use of special food grants or food banks, compared to other Pacific children..... 33

Figure 19: Indicators of poor infant nutrition when the mother/primary caregiver had gone without fresh fruit and vegetables to pay for other things, compared to other infants..... 33

Figure 20: Indicators of poor nutrition at 54-months of age when the mother/primary caregiver had gone without fresh fruit and vegetables to pay for other things, compared to other children..... 34

Figure 21: Indicators of poor infant nutrition for tamariki Māori when their mother/primary caregiver had gone without fresh fruit and vegetables to pay for other things, compared to other tamariki Māori..... 34

Figure 22: Indicators of poor nutrition at 54-months of age for tamariki Māori when their mother/primary caregiver had gone without fresh fruit and vegetables to pay for other things, compared to other tamariki Māori 35

Figure 23: Indicators of poor infant nutrition for Pacific children when their mother/primary caregiver had gone without fresh fruit and vegetables to pay for other things, compared to other Pacific children..... 35

Introduction

The issue of food poverty in Aotearoa New Zealand

Aotearoa New Zealand has over 45% of land mass devoted to production of some of the best food in the world, with exports of more than four times the amount of energy needed to feed our population of five million people (primarily through exports of dairy, beef, lamb, kiwifruit and apples) (Rush & Obolonkin, 2020). However, within this land of plenty, there are large disparities in access to and consumption of food. Recent research has found one in five children aged 2-14 years live in households classified as moderately-to-severely food insecure, and that this is associated with indicators of poor nutrition, health and development (Ministry of Health, 2019). The prevalence of food insecurity in Aotearoa New Zealand is markedly different by ethnic group, with Māori and Pacific children more likely to live in households experiencing moderate to severe food insecurity; and this has been largely attributed to low household income and household structure (Ministry of Health, 2019).

Assured access to sufficient food that is nutritionally adequate and culturally acceptable and obtained in socially acceptable ways, is a privilege not enjoyed by everyone in Aotearoa New Zealand. A growing number of families and whānau in the last 10 years have required assistance to obtain adequate food and there have been rising calls from the charity sector to address food insecurity (Child Poverty Action Group, 2020; Kore Hiakai Zero Hunger Collective, 2020). The Ministry of Social Development is giving out a rising number of hardship grants (Ministry of Social Development, 2020) and many low-decile schools now provide breakfast and lunch to children, through corporate, charitable or government-funded food programmes.

The New Zealand Government has made a commitment, by signing the United Nation's Sustainable Development Goals, to end hunger and ensure all people, particularly the vulnerable including infants, have access to safe, nutritious and sufficient food all year round (United Nations, 2016). Child poverty (including an indicator of food insecurity) is now monitored regularly, as defined in the Child Poverty Reduction Act, and the Child and Youth Wellbeing Strategy (Department of Prime Minister and Cabinet, 2019) has identified childhood food security as an area of focus. Early childhood is a period of unrivalled development and growth, where nutrition plays an essential role, and access to appropriate foods must be assured.

Definitions of food poverty, food insecurity and food hardship

Studies in Aotearoa New Zealand and worldwide have been conducted to investigate the ability of individuals and families to obtain enough quantity and quality of food for hunger alleviation and good health. This broad research area can collectively be grouped by an interest in 'food poverty.' Within these studies there is wide variation in the terms used to refer to food poverty and the way in which key concepts of food insecurity, food-related deprivation, and food hardship have been measured.

In Aotearoa New Zealand, researchers have usually measured food security, or lack of it (Carter, Lanumata, Kruse, & Gorton, 2010; Ministry of Health, 2019; Ministry of Health, 2002; Parnell & Gray, 2014; Smith, Parnell, Brown, & Gray, 2013a; University of Otago & Ministry of Health, 2011). The definition of food security most regularly used in Aotearoa New Zealand is: the access and availability of nutritionally adequate and safe foods; the ability to acquire such foods in a socially acceptable way; and that the food available is able to meet cultural needs (such as providing for guests, on special occasions etc). This definition recognises that food insecurity is more than an individual issue, as it requires a food system that accounts for the social and cultural dimensions of food production, collection, and consumption (Gorton et al., 2010).

The questions used to measure the food insecurity within samples have varied (Table 1). The most commonly-used measure of food insecurity in Aotearoa New Zealand was developed and validated by Parnell and Gray (2014) and consists of eight questions that cover all the areas of food security described above, with different questions receiving different weightings to identify households that have full, moderate or low food security. A previous study used the *Growing Up in New Zealand* data to create an index of infant food insecurity (Schlichting et al., 2019). The study used several variables from the 9-month interview which were not aligned with Parnell and Gray's definition of food insecurity. The resulting index conflated food-related deprivation, financial hardship, and nutrition indicators for infants, making it difficult to disentangle the issue of food hardship from poor nutrition due to other factors (such as unhealthy food environments, parenting decisions, or cultural norms).

Table 1 outlines previous research on the prevalence of food insecurity in Aotearoa New Zealand children. All studies have reported around 20% of Aotearoa New Zealand children experience food insecurity. This is higher than the rate in Aotearoa New Zealand adults–the 2008 Adult Nutrition Survey found 7.3% of households were classified as having low food security (males 5.6%; females 8.8%) (University of Otago & Ministry of Health, 2011). Few studies have focused on food poverty experienced in the first year of life and the long-term effects that this may have on child development and growth.

The Child Nutrition Survey only included 5-14 year olds and although the Health Survey collected food insecurity data about all children aged 0-14 years, the nutrition (e.g. fruit and vegetable and fizzy drink consumption) and health outcome (e.g. BMI) data were for 2-14 year olds (Ministry of Health, 2019). The Ministry of Health intends to continue to monitor child food insecurity in the Health Survey with the indicator of how many children live in households "where food runs out sometimes or often."

Other studies in the United States have used the term 'food hardship' as an umbrella measure of any type of deprivation related to food (Slack & Yoo, 2005) or when the measure of food insecurity is unavailable (DePolt et al., 2009). The term 'food insufficiency' is also used in the United States, as defined by an inadequate amount of food available in the household and/or inadequate intake of food (Alaimo et al., 1998; Slack & Yoo, 2005; Vozoris & Tarasuk, 2003). The US Department of Agriculture has developed standardised measures for food insecurity and food insufficiency. Food insecurity is measured by an 18-item questionnaire that can measure presence or absence of food insecurity as well as with or without hunger (Slack & Yoo, 2005). The measure for food insufficiency is a single question, "which of the following describes the amount of food your household has to eat: enough to eat, sometimes not enough to eat, or often not enough to eat?" (Slack & Yoo, 2005).

In Aotearoa New Zealand, the Ministry of Social Development uses the term 'hardship' to refer to a situation where people have insufficient income and assets to cover their immediate needs with their own resources. Hardship assistance provided by the State includes non-recoverable Special Needs Grants (largely to cover food, but also can be applied for accommodation costs, emergency housing or medical expenses) and advance payment of benefits, and a small number of recoverable assistance payments (Ministry of Social Development, 2020). Families experiencing food insecurity may also choose to obtain assistance from charitable food banks, in place of, or in addition to, hardship assistance.

In this report, we have used "food hardship" as an umbrella term for answering yes to one of three questions collected during the early childhood data collection waves (DCW) of *Growing Up in New Zealand*:

In the last 12 months have you personally...

- been forced to buy cheaper food so that you could pay for other things needed;
- made use of special food grants or food banks because you did not have enough money for food;
- gone without fresh fruit and vegetables often, so that you could pay for other things you needed?

The three measures have collectively been referred to previously as 'food insecurity' (Carter et al., 2010), but they do not include a measure whether food available is able to meet cultural needs, such as providing for guests, on special occasions etc–one of the key components of the Parnell and Gray (2014) definition of food insecurity–so we consider the three measures to be a subset of food insecurity.

In this report, the three measures of food hardship are investigated separately, and any overlap/coexistence is also described. The relationships between each food hardship indicator and each child nutrition indicator are investigated separately to see how each contributes to early childhood nutrition. Being "forced to buy cheaper food to pay for other things needed" may be problematic as a measure of food hardship as it could be interpreted as buying food on special, or buying home-brand products instead of branded food products. However, the questions were asked in the context of other 'household deprivation' questions, after questions on household income and debt, and were preceded with: "The following few questions are designed to identify people who have had special financial needs in the last 12 months. Although these questions may not apply directly to you, for completeness we need to ask them of everyone." By analysing each indicator separately we can determine the veracity of each one. Nevertheless, readers should be aware that these indicators (separately and collectively) provide only a partial picture about wider food poverty and food insecurity among families with infants and young children in Aotearoa New Zealand.

Table 1: *Summary of previous research on food poverty among children in Aotearoa New Zealand*

Study	Question wording	Prevalence of food insecurity
NZ Health Survey 2012/13, 2014/15, 2015/16 Asked food security scale questions to households with a child (under 15 yrs old) - completed by their primary caregiver. Reference: Household Food Insecurity Among Children: New Zealand Health Survey (Ministry of Health, 2019)	NZ Food Security Scale; 8-item questionnaire with response categories: often, sometimes, never 1. I/we can afford to eat properly. How often [have the following statements] been true for your household over the past year? 2. Food runs out in my/our household due to lack of money. 3. I/we eat less because of lack of money. 4. The variety of food I am/we are able to eat is limited by a lack of money. 5. I/we rely on others to provide food and/or money for food for my/our household when I/we don't have enough money. 6. I/we make use of special food grants or food banks when I/we do not have enough money for food. 7. I feel stressed because of not having enough money for food. 8. I feel stressed because I can't provide the food I want for social occasions.	In the 2015/16 survey, 19% of all children lived in household with severe to moderate food insecurity, with 1.6% living in households with severe food insecurity. Of those children in severe-to-moderate food insecure households, 10.5% made use of food grants or food banks in 2015/16. 17.4% of children aged 0-4 years old lived in households with food insecurity compared with 19.5% of children aged 5-9 years old, however this was not a statistically significant difference.
NZ Children Nutrition Survey 2002, 5-15 years old. Reference: NZ Food NZ Children: Key results of the 2002 National Children's Nutrition Survey (Ministry of Health New Zealand, 2002)		22% household with children reported food runs out 'often' due to lack of money. Less than 1% households 'often' and 8.6% households 'sometimes' used food grants or food banks when they did not have enough money for food.
Growing Up in New Zealand **(9-month data collection, 2010/11) Cohort of 6385 mothers and 6467 infants.** Reference: Infant food security in New Zealand: A multidimensional index developed from cohort data (Schlichting et al., 2019)	Infant Food Security index based on conformity factor analysis using 15 variables from the *Growing Up in New Zealand* DCW1. The index included measures of coping (forced to buy cheaper food, going without fruit and vegetables, help from charity, use of a foodbank), exclusive breastfeeding to 3 months, daily consumption of sentinel foods (vegetables, fruit, grains, meat, fish, legumes) and daily consumption of energy dense, nutrient poor foods (biscuits, sweets, chocolate, hot chips, crisps, fruit juice, soft drinks).	Half (54%) mothers reported using one coping method and 18% used two or more. Forced to buy cheaper food was the most common coping method (50%). From the food security index, 15% of the cohort were highly food secure, 43% tenuously food insecure and 16% highly food insecure.
Youth'07 and Youth'12 Survey conducted with high school students aged 13-18 years old. Reference: Rising food security concerns among New Zealand adolescents and association with health and wellbeing (Utter et al., 2018)	Do your parents, or the people who act as your parents, ever worry about not having enough money to buy food? (Never, Occasionally, Sometimes, Often, All the time)	In 2012, 33% of young people reported having food security concerns occasionally/ sometimes, and 11% reported having food security concerns often/ always. In 2007, 28% young people reported having food security concerns occasionally/sometimes and 8% reported food security concerns often/all the time.

Study	Question wording	Prevalence of food insecurity
Survey of Families, Income and Employment (SoFIE) Reference: What are the determinants of food insecurity in New Zealand and does this differ for males and females? (Carter, Lanumata, Kruse & Gorton, 2010)	In the past 12 months, have you personally • Made use of special food grants or food banks because you did not have enough money for food? • Been forced to buy cheaper food so that you could pay for other things you needed? • Gone without fresh fruit and vegetables so that you could pay for other things?	This survey looked at food insecurity within adults (> 15 years old) and found that 15.8% were food insecure. TO be defined as food insecurity, participant had to answer 'Yes' to all three questions. 21.5% answered yes to 'made use of special food grants or food banks because you did not have enough money for food' 95.2% answered yes to 'been forced to buy cheaper food so that you could pay for other things you needed' 14.8% answered yes to 'gone without fresh fruit and vegetables so that you could pay for other things'
New Zealand General Social Survey (NZGSS) 2016 Reference: Well-being statistics: 2018 (Statistics New Zealand (2019b).	Adequacy of income to meet everyday needs is based on the respondent's self-assessment of their income (and their partner's if applicable). The respondent rates whether they had more than enough money, enough money, just enough money, or not enough money to meet their everyday need for such things as accommodation, food, clothing, and other necessities	For the survey population (> 15 years old) in 2018, 10% reported not having enough money to meet everyday needs and 27.1% only just had enough money to meet their everyday needs. In 2016, 11.2% reported not having enough money to meet everyday needs and 24.4% only just had enough money to meet their everyday needs.
Household Economic Survey 2018-2019 Reference: Household Economic Survey 2018-19 Economic (Data New Zealand, 2020)	Adequacy of income to meet everyday needs Whether an individual's or couple's income is enough to meet the necessities of life.	Across all income 10.9% of households reported not having enough money for everyday needs and 26.0% reporting only just having enough income to meet everyday needs. These everyday needs include food.

Determinants of food insecurity in Aotearoa New Zealand

Food insecurity exists as a result of many different circumstances, which interact as part of a complex system and impact on a household's ability to provide adequate food (Signal et al., 2013). Low household income has been identified as the major determinant of food insecurity. The Ministry of Health's latest research shows that among children in households with an annual income lower than $30,000, over half were classified as food insecure and almost 70% of all children that were food insecure had a household income of less than $50,000 a year (Ministry of Health, 2019). Income remains strongly associated with food security even after adjusting for other sociodemographic factors related to food security, with those in the lowest income quartile five times more likely to be food insecure than those in the highest quartile after adjustment for sex, age, ethnicity, education, family composition, labour market activity, neighbourhood deprivation, wealth and housing tenure (Carter et al., 2010).

Receipt of an income-tested benefit is also closely related to food insecurity. Most research has found around half of household receiving a benefit were food insecure compared to only around one tenth of those who are not on a benefit (Carter et al., 2010; Ministry of Health, 2019; Smith et al., 2013b). Differences in rates of food insecurity between households with and without receipt of a benefit were lower but remained statistically significant after adjusting for income (Ministry of Health, 2019).

Higher rates of food insecurity have been found in those living in neighbourhoods categorised as experiencing high deprivation (Ministry of Health, 2019; Ministry of Health, 2002; University of Otago & Ministry of Health, 2011), with the relationship still present when adjusted for differences in sex, age, ethnicity, family composition, education, labour market activity, income and wealth (Carter et al., 2010). Housing tenure was also shown to be related to food insecurity, with food insecure households more likely to live in rented dwellings compared their own home, with the relationship still present after adjusting as described above (Carter et al., 2010; Ministry of Health, 2019).

Signal and colleagues also identified several structural determinants that impact on a family's ability to afford nutritious food. They identified factors such as minimum wage levels, benefit entitlements, loan shark regulations, sales tax, the role of the food industry, lack of access to in-kind provisions of food (school food programmes) or community-based initiatives (Signal et al., 2013).

Food insecurity inequities by ethnicity also feature prominently. People who identify as European were much less likely to have concerns around food security compared with Māori and Pacific people (Carter et al., 2010; Ministry of Health, 2002; Parnell, Reid, Wilson, McKenzie, & Russell, 2001; Utter et al., 2018). Pacific children have been shown to experience the highest rates of food insecurity, followed by Māori (Ministry of Health, 2019). Tamariki Māori were 1.8 times more likely than non-Māori to live in households that experienced food insecurity after adjusting for age and sex, however there were no statistically significant differences by ethnicity found for gross household income and number of children in the household (Ministry of Health, 2019). This suggests that the higher rate of household food insecurity for Māori is due to over-representation in low income and large households. Pacific children were 2.3 times more likely than non-Pacific to live in households that experienced food insecurity when adjusting for child's age and sex, and this ethnic difference remained significant (at 1.5 times more likely for Pacific compared to non-Pacific when adjusting for gross household income and number of children in the household) (Ministry of Health, 2019). However, another study showed that the relationship between Māori ethnicity and food insecurity remained significantly higher than non-Māori after fully adjusting for socioeconomic variables (household income, labour market activity, neighbourhood deprivation, housing tenure and wealth) but was no longer significant for Pacific compared to non-Pacific (Carter et al., 2010). These findings suggest that an inequitable distribution of economic resources is the major driver of differences in rates of food insecurity between ethnic groups in New Zealand, with other drivers such as housing affordability, education, employment and neighbourhood food environments also playing a role.

Children's nutrition in households experiencing food insecurity

Food insecurity has been associated with a range of nutritional, health and development outcomes. Insufficient food or a lack of nutritious food in early childhood can result in a poor dietary pattern and micronutrient deficiencies that affect child development, health and wellbeing (Shonkoff, 2010; Davies, 2016). Researchers in the United States found children aged 2-5 years who were food insecure had lower consumption of fruits and vegetables (Asfour et al., 2015) and less healthier diet quality overall, with lower overall Healthy Eating Indicator scores (Bhattacharya et al., 2004). However, US research suggests that children may be protected from poor nutrition when their family experiences food insecurity, possibly due to parents prioritising food for the children over themselves (Bhattacharya et al, 2004). Children living in food insecure households in Aotearoa New Zealand have been found to have lower intake of fruit and vegetables compared to those who were food secure, with fruit and vegetable intake lowest in children 5-14 years old (Ministry of Health, 2019; Utter et al., 2012). Findings have been mixed regarding fast food and fizzy drink consumption. The New Zealand Health Survey found higher rates of both amongst children who were food insecure compared to children living in food secure household, increasing with increased children's age (Ministry of Health, 2019). However, Utter et al (2012) found no relationship between food insecurity and fast food or fizzy drink intake among adolescents. There has been no research in Aotearoa New Zealand on the effect of household food insecurity on infant or early childhood nutrition, which is important to establish given that parents may prioritise their child's food intake over their own. Additionally, there has been no research to investigate the effect of food insecurity on variety of fruit and vegetables eaten, with a focus on quantity of food intake rather than variety in previous research. The Food and Nutrition Guidelines for Healthy Infants and Toddlers (Ministry of Health, 2012) and the Food and Nutrition Guidelines for Healthy Children and Young People (Ministry of Health, 2015) recommend offering a variety of nutritious foods from each of the four major food groups to encourage acceptance of a variety of tastes and to ensure adequate nutrient intakes. Particular guidance is included on offering different colours to ensure a range of vegetables and fruits are provided to children (Ministry of Health, 2015).

Children living in food insecure households in Aotearoa New Zealand have been found to have lower intake of fruit and vegetables compared to those who were food secure, with fruit and vegetable intake lowest in children 5-14 years old.

The policy context in Aotearoa New Zealand

Aotearoa New Zealand's policy settings of most relevance to food insecurity and nutrition in early childhood are complex and constantly changing. They encompass key determinants of food-related hardship, such as household income and housing costs, as well as policies or settings that may mitigate its impact, such as early childhood education (ECE), school-based programmes, and provisions for parent/whānau support or child health. Recent decades have seen considerable advocacy and policy activity in relation to children. Advocacy from the Children's Commissioner, community organisations, professionals and others have highlighted a range of concerns such as the country's poor international ranking in child health and wellbeing and high rates of preventable diseases, psychosocial stressors and health inequities. Poverty has been a particular priority because children are the most likely of all age groups to experience it and rates have remained high after more than doubling in the early 1990s (Boston, 2014). Māori and Pacific children and those from households relying on a benefit are disproportionately affected.

Major initiatives have been introduced over recent years that, as well as potentially affecting the *Growing Up in New Zealand* cohort, have considerably changed the policy context (see Table 2 for recent key welfare and family support initiatives). Other key policy developments in the decade prior to the birth of the *Growing Up in New Zealand* cohort include the Working for Families tax credit for families who meet a paid work criteria, the introduction of free ECE hours and paid parental leave, and the Before School Check. In addition, over decades, free primary healthcare has slowly expanded to include more under-6 year olds, and in recent years, all children aged under-14 years.

While these developments reflect a growing prioritisation of children's wellbeing in policy, including for childhood food security, implementation is still relatively early. Official reporting of child poverty indicators has started and show little substantive improvement yet, although the Families Package was introduced partway through the last reporting period (figures released February 2020 (Statistics New Zealand, 2020). The first Child and Youth Wellbeing Strategy, published in August 2019, includes a range of actions in the "Have what they need" domain and specifically identify as a priority "regular access to nutritious food" (Department of Prime Minister and Cabinet, 2019). As well as wider measures to address income poverty, a free school lunch programme is currently being piloted in selected schools in disadvantaged areas which has recently been expanded to up to 200,000 school children (New Zealand Government, 2020a).

Table 2: *Overview of relevant key government policy developments since 2009/10*

Policy development	Brief description
Children's Action Plan 2012 (National-led coalition Government)	Priority aim to improve outcomes for vulnerable children at most risk of maltreatment. A broad package of institutional changes and accountability for children in the care and protection system and those at risk of harm.
Whānau Ora programme 2010–present (led by Māori Party in National-led coalition)	Priority aim to realise whānau aspirations. Māori-led programme to empower whānau and better coordinated engagement with services.
Welfare reform package 2012/13 (National-led coalition Government)	Priority aim to reduce dependence on benefits. Included: Three new benefits to replace existing main benefits, work obligations (including for parents of young children) and extended sanctions for non-compliance. Emphasis on social investment and using data for assessing risk.
Families package 2018 (Labour-led coalition Government)	A range of new initiatives such as the best start payment (universal until age 1, age 3 for low income families), winter energy payment (for those on benefits), extended paid parental leave, increased accommodation supplements and tax credits.
Child Poverty Reduction Act 2018 and Child Wellbeing Strategy (Labour-led coalition Government)	The Child Poverty Reduction Act requires government to identify and set 3-year and 10-year poverty reduction targets, including for material hardship (measured by the 17-item Material Deprivation Index, which includes food-related questions). Child Poverty Related Indicators (CPRI) must be reported annually; food security is included. The Act also requires governments to produce a Child and Youth Wellbeing Strategy to improve outcomes across a comprehensive range of domains.

Sources: (Kia Piki Ake Welfare Advisory Group, 2019; Welfare Expert Advisory Group, 2018a, 2018b)

Objectives and aims of this study

Understanding the extent of food hardship and the subsequent consequences on dietary intake is important for the development and implementation of well-formulated food and nutrition policies and programmes that address children's right to adequate, nutritious food. This research therefore seeks to provide evidence for current policy development around the Government's commitment to reduce child poverty, improve child wellbeing, and address health inequities, by filling the gap in knowledge about food insecurity experienced in early childhood and its effect on nutrition.

Aims of the research

This research aims to describe households with early childhood-aged children that experience different types of food hardship, and investigate (for all children, and Māori and Pacific children separately):

- the prevalence, type, co-existence and persistence of food hardship within households,
- associations between household food hardship and a range of early childhood nutrition indicators.

Objectives of the research

The research objectives utilise the *Growing Up in New Zealand* data to examine:

1a. At 9-months and 54-months of age, what proportion of children lived in households where their mother reported any food hardship?

1b. Which food hardships co-existed at each time point?

1c. What proportion of children lived in households that experienced persistent food hardship in early childhood (indicators at both 9-months and 54-months of age)?

2. What maternal and household characteristics were associated with household food hardships (variables in 1a, 1b and 1c)?

3. How was household food hardship related to early childhood nutrition indicators of breastfeeding, fruit and vegetable intake, and unhealthy food and drink intake?

Aotearoa New Zealand's policy settings of most relevance to food insecurity and nutrition in early childhood are complex and constantly changing. They encompass key determinants of food-related hardship, such as household income and housing costs, as well as policies or settings that may mitigate its impact, such as early childhood education (ECE), school-based programmes, and provisions for parent/whānau support or child health.

Method

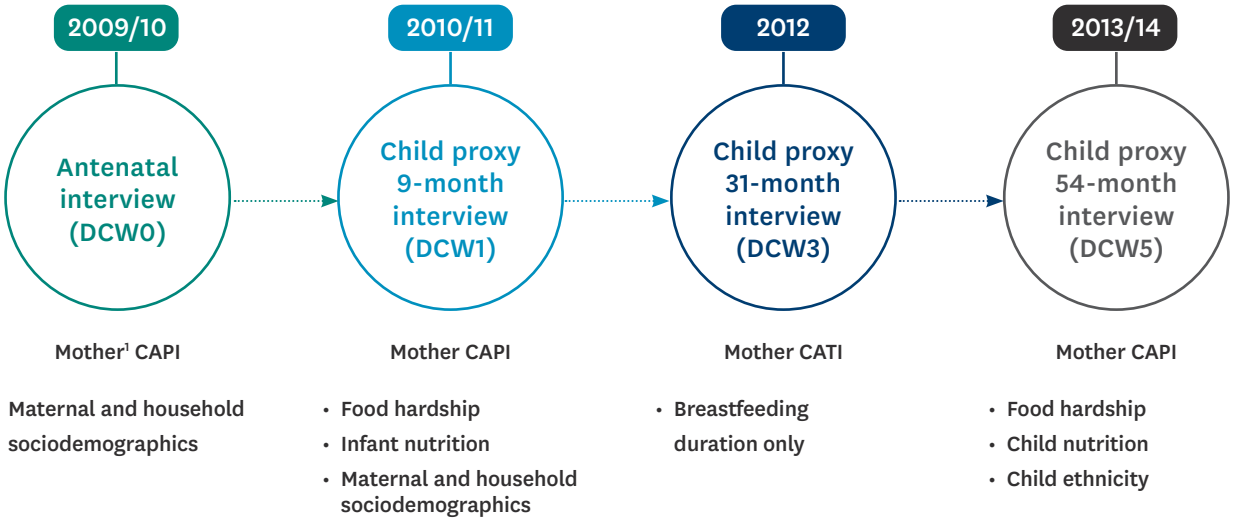
The *Growing Up in New Zealand* study

Growing Up in New Zealand is a contemporary longitudinal study, tracking the development of approximately 6,800 children from before birth until they are young adults (Morton et. al., 2010). *Growing Up in New Zealand* recruited pregnant women whose babies were due between 25th April 2009 and 25th March 2010 and the cohort has been demonstrated to be generalisable to all national births in the 2007-2010 period (Morton et al., 2015). The scale and diversity of the cohort allows for robust analyses by ethnic group and socioeconomic position.

Growing Up in New Zealand collected information at face-to-face interviews with mothers or primary caregivers when the cohort children were 9-months and 54-months old; data collection wave one (DCW1) and data collection wave one (DCW5). Information was gathered about three aspects of food hardship: buying cheaper food in order to pay for other things needed, accessing food assistance (special food grants or food banks), and going without fresh fruit and vegetables to pay for other things needed.

Figure 1 shows the timeline for selected data collection waves of the *Growing Up in New Zealand* data used in this study. The first interview was during the antenatal period (completed June 2010, DCW0), the second when the child was nine months old (completed January 2011, DCW1) and the third when the child was around 54-months old (collected over 2013/2014, DCW5). Other data collection waves during the early childhood period (at age 24, 31 and 45 months) did not contain questions on food hardships (Growing Up in New Zealand, 2020).

Figure 1: *Timeline for selected Growing Up in New Zealand data collection waves and variables used in this study*



CAPI: Computer Assisted Personal Interview; CATI: Computer Assisted Telephone Interview

[1] "Mother" in this report refers to the primary caregiver that completed the antenatal and 'child proxy' questionnaires in *Growing Up in New Zealand* data collection waves.

Variables used in analyses

Food hardships

Three questions from the *Growing Up in New Zealand* study were used as indicators of food hardship; asked at the 9-month interview (DCW1) and repeated at the 54-month interview (DCW5):

In the last 12 months have you personally:

- been forced to buy cheaper food so that you could pay for other things you needed?
- made use of special food grants or food banks because you did not have enough money for food?
- gone without fresh fruit and vegetables, so that you could pay for other things you needed?

These questions are part of a validated 8-item tool used to measure individual-level socioeconomic deprivation, NZiDep (Salmond, Crampton, King & Waldegrave, 2006). They were developed by Wellington School of Medicine and Health Sciences (University of Otago) academics in collaboration with researchers from The Family Centre, Lower Hutt and tested for acceptability and validity in a survey and qualitative interviews with 975 New Zealanders, including near equal numbers of Māori, Pacific and non-Māori/non-Pacific (mostly Pakeha/Europeans). The first and third questions are related to material deprivation (limitations on consumption) and the second question on use special needs grants or food banks measures indirect material deprivation, i.e. the use of a service to mitigate material deprivation (Salmond, Crampton, King & Waldegrave, 2006).

The three questions are not a comprehensive measure of food insecurity as they do not measure whether the household had food available to meet cultural needs (such as providing for guests at special occasions). However, Parnell and Gray argue that the use of food banks is a socially unacceptable way to obtain food in Aotearoa New Zealand, and on its own provides a good indicator of food insecurity (Parnell & Gray, 2014). Previous Aotearoa New Zealand studies have found that 'use of special food grants or food banks in the past 12 months' is the least reported and most severe indicator of food insecurity (Ministry of Health, 2019; Parnell & Gray, 2014).

> In the last 12 months have you personally been forced to buy cheaper food so that you could pay for other things you needed?

Child ethnicity

Child main ethnicity was reported by mother at DCW5 in response to the question: *What is the MAIN ethnic group that [your child] identifies with?* and was treated as time invariant in analyses, even though ethnic identification is in reality not fixed, but a multi-dimensional and dynamic construct that is self-determined and subjective (Ministry of Health, 2017). A derived variable was created from the detailed ethnic identification to categorise child ethnicity within one of the following four categories: Māori, Pacific, Asian and European/Other (collapsing the European, MELAA, Other and New Zealander categories of the Statistics New Zealand 2005 Level 1 classification) which is a method used in previous analyses with this dataset (explained in detail in Hobbs et al., 2019). All descriptive analyses were run separately for Māori, Pacific, Asian, European/Other and Total. Separate multivariate models were run for Māori, Pacific and Total.

Maternal and household characteristics

Several covariates from the *Growing Up in New Zealand* data were used in the analyses: maternal age and education, number of children and adults in the household, neighbourhood (area-level) deprivation, income benefit receipt, and household income (total and equivalised). **Maternal age and education** were collected at antenatal interview and further categorised. **Number of children and adults in household** was asked at the maternal DCW1 interview (when the cohort child was 9-months old). Unfortunately, the number of children/adults in the household was not available on the external DCW5 dataset and so the DCW1 response was treated as time-invariant in analyses.

> In the last 12 months have you personally made use of special food grants or food banks because you did not have enough money for food?

Household income was collected at DCW1 and DCW5 by maternal-report to the question '*what was your household's total income?*' and further categorised as <$30K, $30-50K, $50-70K, >$100K. For household income at DCW5 there were 298 (5.5%) mothers who declared a loss of income in the last year, and these answers were included in the <$30K category. Total (gross) household income, as collected in *Growing Up in New Zealand*, is not ideal for use in poverty analyses as it does not adequately represent the financial resources available to a household for spending on items such as food. A better indicator, which is used in the Government's official definition of child poverty (Statistics New Zealand, 2019), is *disposable* household income which includes taxable and non-taxable income, Working for Families tax credits and rebates, less ACC earner's levy and tax payable. Unfortunately, creating a disposable household income variable was not possible with the anonymised external dataset. Total household income is also problematic as an indicator of poverty because it does not account for the number of people supported on that income. Larger households require a larger income, and so in order to account for this, a process of 'equivalisation' is required so that incomes from different sized households can be compared in analyses. In this study, **equivalised household income** was calculated for both 9-month and 54-month time points using the OECD square root equivalisation method (OECD, 2020), which is the square root of the total number of people in the house. The square root method is not the method Statistics New Zealand recommends, but the external dataset for *Growing Up in New Zealand* does not contain household grid information with the age of household members. In order to use the modified OECD equivalisation statistic which Statistics New Zealand recommends, the number of children aged under 14 years is required and the external dataset only includes total number of people in the household. Number of people in the household was also only available at the 9-month DCW and so was used for both 9-month and 54-month equivalisation with the respective time-point's total household income. **Income tested benefit** information was collected from the mother at DCW1 and DCW5 when asked about sources of household income and categorised as 'yes' if someone in the household received any of the following: *unemployment benefit*, *sickness*, *domestic purposes*, *invalid's benefit*, *student allowance*, *other government benefits*. **Neighbourhood deprivation** was measured using the NZDep2006 (for DCW1 collected in 2010/11) and NZDep2013 (for DCW5 collected in 2013/14) indicators of area-level deprivation, calculated from household address and Census data (Atkinson et al., 2014; Salmond, Crampton & Atkinson, 2006).

Child nutrition indicators

Five mother-reported indicators of infant nutrition and three indicators of early childhood nutrition (at 54-months of age) were created for use in this study from the *Growing Up in New Zealand* data. **Breastfeeding to 12 months** was defined in earlier research (Castro et al., 2017) using DCW1 to DCW3 (telephone interview when the child was 31 months old) from the question *how old was your baby when you stopped breastfeeding?* **Fruit twice per day** and **vegetables twice per day** were from the DCW1 (9-month) interview in response to the questions: *how often does baby have fruit (includes fresh and canned) currently?* and how often does baby have vegetables (raw or cooked) currently? Responses were recoded as yes or no to the child being served fruit/vegetables two or more times a day, as in previous research (Gontijo De Castro et al., 2018). The **ever tried unhealthy drinks and unhealthy foods** variables were from the DCW1 interview in response to the questions: *Has baby ever tried: Coffee? Fruit juices (including watered down)? Soft drinks? Tea? Herbal drinks? and Has baby ever tried: Sweets? Chocolate? Hot chips? Potato chips (crisps)?* Responses were recoded as yes if positive for any of these responses, as in previous research on infant feeding (Gontijo De Castro et al., 2018). The **variety of fruit** and **variety of vegetables** variables were created with responses to questions from the

> In the last 12 months have you personally gone without fresh fruit and vegetables, so that you could pay for other things you needed?

Food Frequency Questionnaire answered by the mother at the DCW5 (54-month) interview with photographic showcards as prompts: *Can you tell me how often {he/she} has eaten {name} over the last four weeks?* regarding the following types of fruits: *Citrus fruits, such as oranges, lemons, grapefruit? Apples, pears? Bananas? Peaches, nectarines, melon, lychees, pawpaw? Strawberries, raspberries, blueberries, mango, kiwifruit? Plums, cherries, grapes? Dried fruit?* And the following types of vegetables: *Green leafy vegetables such as lettuce, cabbage, bok choy, spinach, brussel sprouts, taro leaves, pele leaves, puha, or any other green leafy vegetables? Peas, green beans, mushrooms? Potatoes, kumara, pumpkin, yams, taro, sweet potatoes? Carrots? Broccoli, cauliflower? Sweetcorn? Peppers, tomatoes? Avocado?* Fresh, frozen or canned fruit and vegetables were included for both fruit and vegetable questions. Any positive response was coded as 1, and then summed across the fruit and vegetables separately (giving a score range 0-7 for fruit and 0-8 for vegetables) to give the number of different types of fruit and vegetables eaten by the child per month. The score was recoded as 0-3 (low variety), 4-5 (moderate variety) and 6 or more (high variety). The **soft drink** variable used a single question from the Food Frequency Questionnaire (FFQ) answered by the mother at the DCW5 interview: *How often has {he/she} had soft drinks and energy drinks over that last four weeks?* The response was recoded to <3 per week or 3 or more per week as in previous research on food insecurity (Ministry of Health, 2019).

Prior to analyses, children who lived overseas at the time of the interview were removed from the dataset, and twins removed to allow for independent observations in the analyses.

Statistical analysis

The objectives of the research were addressed in sequence. To answer research questions 1a, b and c, descriptive statistics such as counts and percentages (proportions) were reported for the total cohort, and by ethnic group, with chi square tests for difference used to determine statistical significance. Derived variables were created to explore the coexistence (overlap) of food hardships at the same time point, and also the proportion of families moving in and out of different food hardship (transitions) between the two time points. To enable a health equity focus and in response to the higher proportions of Māori and Pacific children living in households experiencing food hardship, the remaining analyses considered these two ethnic groups separately for all analyses, in addition to the total cohort.

For research question 2a, associations were explored between the food hardship indicators and maternal and household characteristics available. Univariate logistic regression was used to determine odds ratios to show the burden of food hardship among particular population groups. To answer research question 3, associations were explored between food hardship and child nutrition-related variables at each time point respectively (for total cohort and then stratified by ethnic group). Logistic regression was used to determine odds ratios to show the burden of poor nutrition for particular population groups. Univariate logistic regressions were carried out for each nutrition indicators and list of predictors separately. Final multivariate regression models were produced for each of the nutrition indicators associated with the three food hardships at the two time points, adjusted for potential confounders of maternal age and education, child ethnic group (in the total cohort models), equivalised household income and neighbourhood deprivation (recognising that neighbourhood food environments that adversely affect child nutrition may be socially patterned).

All missing data for indicators, predictor and sociodemographic variables were examined (see Appendix 1). No imputations were carried out for missing data. Three variables in the dataset had more than 10% missing data for food hardship indicators (Appendix 1 Table 5): household income at nine months and 54-months, and breastfeeding to 12 months. Those who declined to answer, or did not know their household income, were more likely to experience any of the three food hardship variables (Appendix 1 Table 6). Those who were missing breastfeeding data were only slightly more likely to experience any of the three food hardship variables (Appendix 1 Table 7).

A significance level of 0.1 was used for inclusion in the final models based on the univariate regressions, and $p<0.05$ was considered statistically significant for the final models. Statistical analyses were performed in Stata/SE 15.0 on the external *Growing Up in New Zealand* data access platform (Guacamole v.0.8.4).

Results

Cohort characteristics

Table 3 presents the demographic and socioeconomic characteristics of the *Growing Up in New Zealand* children, using mother-reported child main ethnic group. In total, data from 6,032 cohort children was included in descriptive analyses: 13% of children were Māori, 13% Pacific, 12% Asian and 62% European/Other. Just over half of all mothers had an antenatal age between 24-34 years (56.3%), and around a third of mothers of Māori and Pacific children were aged under 25 years (35.2% and 32.5%, respectively). Differences could be seen in the distribution of maternal education, neighbourhood deprivation, household income, and receipt of an income-tested benefit according to child ethnicity. Around half of mothers of European/Other and Asian children had a Bachelor's degree or higher, with lower proportions of mothers of Māori and Pacific children attaining a university degree. At both 9-months and 54-months of age, around four out of five Pacific children, three out of five tamariki Māori, and one out of five European/Other children lived in areas of high deprivation. One in four infants lived in a household receiving an income tested benefit, and this reduced to one in six at 54-months of age, which is most likely due to the mothers returning to the workforce (a cohort effect). At both time points, Māori and Pacific children were over twice as likely as Asian or European/Other children to live in households that received an income-tested benefit. There were differences in income distributions between the four ethnic groups, which were even more pronounced once household income was equivalised to take into account the number of people in the household (Table 3).

> At both 9-months and 54-months of age, around four out of five Pacific children, three out of five tamariki Māori, and one out of five European/Other children lived in areas of high deprivation.

Nutrition indicators at 9-months and 54-months

Table 4 contains a description of nutrition indicators for the cohort at 9- and 54-months of age. Overall, the duration of breastfeeding was low with the majority of children not breastfed to 12 months and most infants not meeting the national guidelines for fruit and vegetable intake. 37% of infants had tried unhealthy drinks (fruit juices, soft drinks, tea or coffee) by 9-months of age, and this proportion was even higher among Asian (48%), Māori (55%), and Pacific (61%) infants. Over half of infants had tried unhealthy foods (confectionary, hot chips or potato chips/crisps). At 54-months, most of the cohort were eating a variety of fruits and vegetables. At the same age more than 12% were having three or more soft drinks a week. Higher proportions of tamariki Māori and Pacific children at 54-months of age ate a low variety of fruit and vegetables and drank soft drinks (Table 4).

Table 3: Cohort demographic and socioeconomic variables, by child ethnicity

Variables	Categories	Māori, n (%) 768 (13.3)	Pacific, n (%) 742 (12.5)	Asian, n (%) 693 (11.7)	European/ Other, n (%) 3721 (61.7)	Total, n (%) 6032 (100)
Maternal age (antenatal)	<25 y 25–34 y 35y +	270 (35.2) 372 (48.4) 126 (16.2)	241 (32.5) 371 (50) 130 (17.5)	73 (10.5) 491 (70.9) 129 (18.6)	424 (11.4) 2110 (56.7) 1187 (31.9)	1024 (17.0) 3393 (56.3) 1615 (26.8)
Maternal education	No qual / Sec School Diploma / Trade Cert Bachelors or Higher	333 (43.6) 268 (35.1) 162 (21.2)	379 (51.4) 272 (36.9) 87 (11.8)	139 (20.1) 185 (26.7) 368 (53.2)	816 (22.0) 1067 (28.7) 1834 (49.3)	1696 (28.2) 1830 (30.4) 2492 (41.4)
Children (under 18 years of age) in household	1 child 2 children 3 children 4 or more children	202 (26.3) 232 (30.3) 169 (22.0) 165 (21.4)	132 (17.8) 178 (24.0) 181 (24.4) 251 (33.8)	317 (45.7) 277 (40.0) 76 (11.0) 23 (3.3)	1452 (39.0) 1407 (37.8) 630 (16.9) 232 (6.2)	2133 (35.4) 2127 (35.3) 1086 (18.0) 685 (11.4)
Neighbourhood deprivation (DCW1)	Low deprivation Medium deprivation High deprivation	93 (10.7) 270 (31.0) 507 (58.3)	31 (3.7) 134 (15.9) 679 (80.5)	154 (20.8) 313 (42.2) 274 (37.0)	1398 (37.6) 1548 (41.6) 773 (20.8)	1958 (28.4) 2539 (36.8) 2401 (34.8)
Neighbourhood deprivation (DCW5)	Low deprivation Medium deprivation High deprivation	88 (10.6) 250 (30.2) 489 (59.1)	53 (6.5) 173 (21.2) 592 (72.4)	186 (27.1) 303 (44.1) 198 (28.8)	1453 (41.2) 1424 (40.4) 651 (18.5)	2002 (30.6) 2439 (37.3) 2092 (32.0)
Income-tested benefit (DCW1)	Yes	364 (47.4)	328 (44.2)	114 (16.5)	660 (17.7)	1497 (24.8)
Income-tested benefit (DCW5)	Yes	275 (35.9)	226 (30.6)	93 (13.5)	431 (11.6)	1044 (17.4)
Household income (DCW1)	<30K 30–50K 50–70K 70–100K 100K+	125 (20.4) 137 (22.3) 136 (22.2) 192 (31.3) 24 (3.9)	105 (18.8) 184 (32.9) 143 (25.6) 111 (19.9) 16 (2.9)	71 (12.5) 127 (22.3) 146 (25.7) 204 (35.9) 21 (3.7	215 (6.3) 448 (13.1) 679 (19.8) 1612 (47.1) 470 (13.7)	528 (10.1) 912 (15.4) 1115 (21.2) 2162 (41.1) 538 (10.2)
Household Income (DCW5)	<30K 30–50K 50–70K 70–100K 100K+	89 (13.3) 135 (20.1) 126 (18.8) 254 (37.9) 67 (10.0)	88 (16.1) 124 (22.6) 117 (21.4) 174 (31.8) 45 (8.2)	70 (12.0) 75 (12.8) 96 (16.4) 280 (47.9) 64 (10.9)	297 (8.4) 311 (8.8) 421 (11.9) 1660 (46.9) 850 (24.0)	559 (10.3) 654 (12.1) 771 (14.2) 2406 (44.3) 1039 (19.1)
Equivalised household income (DCW1)	<25K 25<35K 35<50K 50K+	251 (40.9) 165 (26.9) 137 (22.3) 61 (9.9)	327 (58.5) 137 (24.5) 95 (17.0) <10	174 (30.6) 153 (26.9) 177 (31.1) 65 (11.4)	525 (15.3) 622 (18.2) 1264 (36.9) 1013 (29.6)	1304 (24.8) 1087 (20.7) 1686 (32.1) 1178 (22.4)
Equivalised household income (DCW5)	<25K 25<35K 35<50K 50K+	221 (32.9) 138 (20.6) 208 (31.0) 104 (15.5)	251 (45.8) 125 (22.8) 172 (31.4) <10	132 (22.6) 101 (17.3) 232 (39.7) 120 (20.5)	527 (14.9) 395 (11.2) 1240 (35.0) 1377 (38.9)	1155 (21.3) 769 (14.2) 1839 (33.9) 1666 (30.7)

Table 4: Nutrition indicators, by child ethnicity

Variables	Categories	Māori, n (%) 768 (13.3)	Pacific, n (%) 742 (12.5)	Asian, n (%) 693 (11.7)	European/ Other, n (%) 3721 (61.7)	Total, n (%) 6032 (100)
Breastfeeding duration	Less than 12 months	389 (62.5)	412 (67.3)	485 (72.2)	2278 (68.2)	3634 (68.0)
Fruit served per day (DCW1)	None or less One time Two times or more	185 (24.1) 373 (48.6) 210 (27.3)	197 (26.6) 349 (47.0) 196 (26.4)	138 (20.0) 363 (52.5) 190 (27.5)	285 (7.7) 1800 (48.4) 1633 (43.9)	822 (13.6) 2938 (48.8) 2267 (37.6)
Vegetables served per day (DCW1)	None or less One time Two times or more	111 (14.5) 516 (67.2) 141 (18.4)	168 (22.6) 392 (52.8) 182 (24.5)	144 (20.8) 302 (43.7) 245 (35.5)	233 (6.3) 2097 (56.4) 1389 (37.4)	665 (11.1) 2274 (56.0) 1989 (33.0)
Unhealthy drinks (DCW1)	Yes No	419 (54.6) 349 (45.4)	453 (61.1) 289 (39.0)	329 (47.5) 363 (52.5)	988 (26.6) 2733 (73.5)	2235 (37.1) 3796 (62.9)
Unhealthy foods (DCW1)	Yes No	580 (75.5) 188 (24.5)	473 (63.8) 269 (36.3)	291 (42.1) 401 (58.0)	1702 (45.7) 2019 (54.4)	3104 (51.5) 2927 (48.5)
Variety of fruit (DCW5)	Low variety Medium variety High variety	76 (9.9) 273 (35.6) 419 (54.6)	92 (12.4) 292 (39.4) 358 (48.3)	48 (6.9) 204 (29.4) 441 (63.6)	314 (8.4) 1063 (28.6) 2344 (63.0)	540 (9.0) 1874 (31.0) 3618 (60.0)
Variety of vegetables (DCW5)	Low variety Medium variety High variety	75 (9.8) 176 (22.9) 517 (67.3)	86 (11.6) 191 (25.7) 465 (62.7)	32 (4.6) 115 (16.6) 546 (78.8)	189 (5.1) 568 (15.3) 2964 (79.7)	393 (6.5) 1066 (17.7) 4573 (75.8)
Soft drink intake (DCW5)	Three or more 1–2 a week Less than weekly None	172 (22.4) 226 (29.4) 164 (21.4) 206 (26.8)	206 (27.8) 242 (32.7) 132 (17.8) 160 (21.6)	71 (10.3) 147 (21.3) 132 (19.1) 341 (49.4)	264 (7.1) 424 (11.4) 936 (25.2) 2095 (56.3)	727 (12.1) 1057 (17.6) 1383 (23.0) 2854 (47.4)

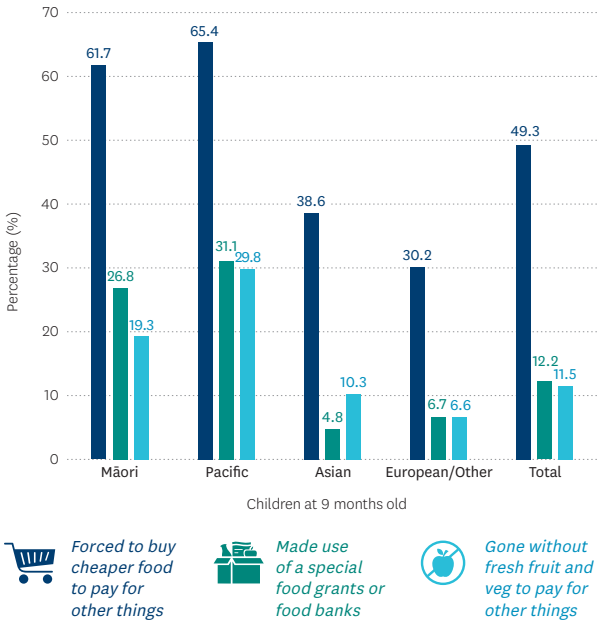
Food hardship indicators: prevalence and coexistence

Food hardships in households with 9-month old children

Half (49.3%) of mothers at the 9-month interview reported that they had been forced to buy cheaper food so that they could pay for other things they needed in the past 12 months; one in eight (12.2%) had made use of special food grants or food banks in the past 12 months, and a similar proportion (11.5%) had gone without fresh fruit and vegetables to pay for other things (Figure 2).

Higher proportions of 9-month old Pacific and Māori children lived in households experiencing household food hardship, compared to 9-month old Asian and European/Other children (Figure 2). Over 60% of mothers with Pacific or Māori children reported that they were forced to buy cheaper food in the past 12 months. One in three (31.3%) Pacific infants lived in households that made use of food bank or food grant in the past 12 months, and a similar proportion (29.8%) lived in households where their mother had gone without fresh fruit and vegetables to pay for other things (Figure 2). One in four (26.8%) Māori infants lived in households that made use of food bank or food grant in the past 12 months, and one in five (19.3%) lived in households where their mother had gone without fresh fruit and vegetables to pay for other things (Figure 2).

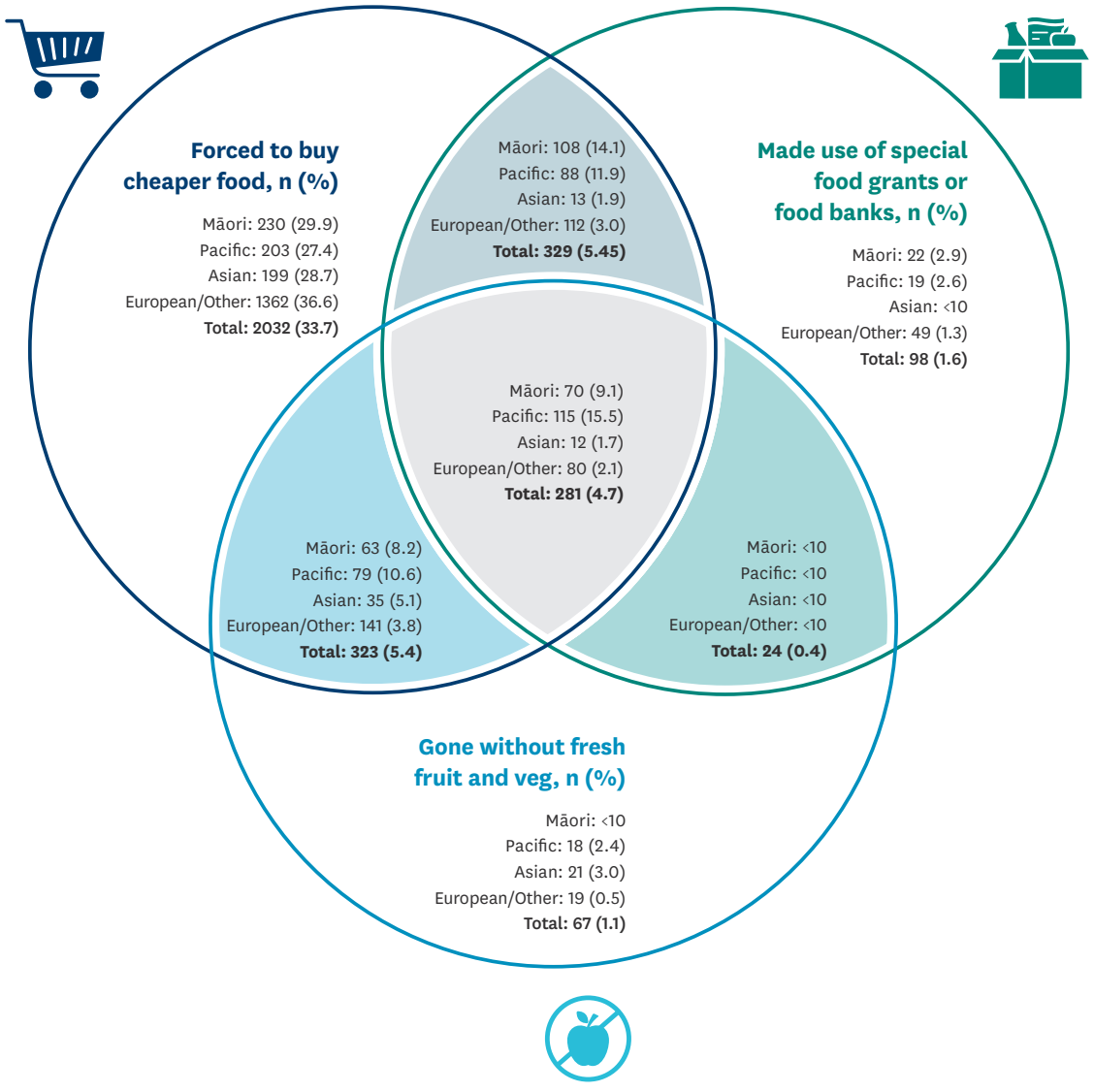
Figure 2: Food hardships reported by mothers/primary caregivers when child aged 9-months, by child ethnicity



There was overlap between the three different types of food hardship reported by mothers when their child was 9-months old. Mothers that reported using special food grants or food banks and those that reported going without fresh fruit and vegetables nearly always reported that they were forced to buy cheaper food in the last 12 months (Figure 3). However, there was little overlap between the mothers reporting making use of special food grants or food banks and those that reported going without fresh fruit and vegetables (Figure 3).

A significantly greater proportion of 9-month old Pacific (15.5%) and Māori (9.1%) children lived in households experiencing all three food hardships, compared to Asian (1.7%) and European/Other (2.1%) infants ($p<0.001$).

Figure 3: *Coexistence of food hardships in households with 9-month old children, by child ethnicity*



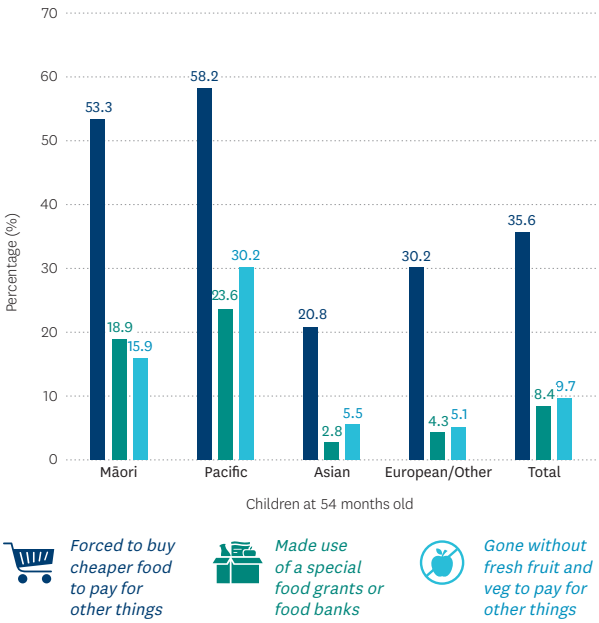
Note: N for all percentages is the total number of individuals within the cohort for each ethnic group (Māori = 768, Pacific = 742, Asian = 693, European/Other = 3721, Total = 6032)

Food hardships in households with 54-month old children

The proportion of mothers reporting food hardships when their child was 54-months old were lower overall than at 9-months. One in three (35.6%) mothers reported that they were forced to buy cheaper food so they could pay for other things they needed in the past 12 months; one in twelve (8.4%) had made use of special food grants or food banks in the past 12 months, and one in ten (9.7%) had gone without fresh fruit and vegetables to pay for other things when their child was 54-months old (Figure 4).

While the overall extent of food hardship had reduced by 54-months, it was still highly prevalent and had the same marked pattern of ethnic inequities seen at 9-months (Figure 4). Lower proportions of Māori children at 54-months experienced the three food hardships at the 9-month interview. The percentage of Pacific children living in households where their mother went without fresh fruit and vegetables was unchanged between the two time points (29.8% and 30.2% respectively).

Figure 4: *Food hardships reported by mothers/primary caregivers when child aged 54-months, by child ethnicity*

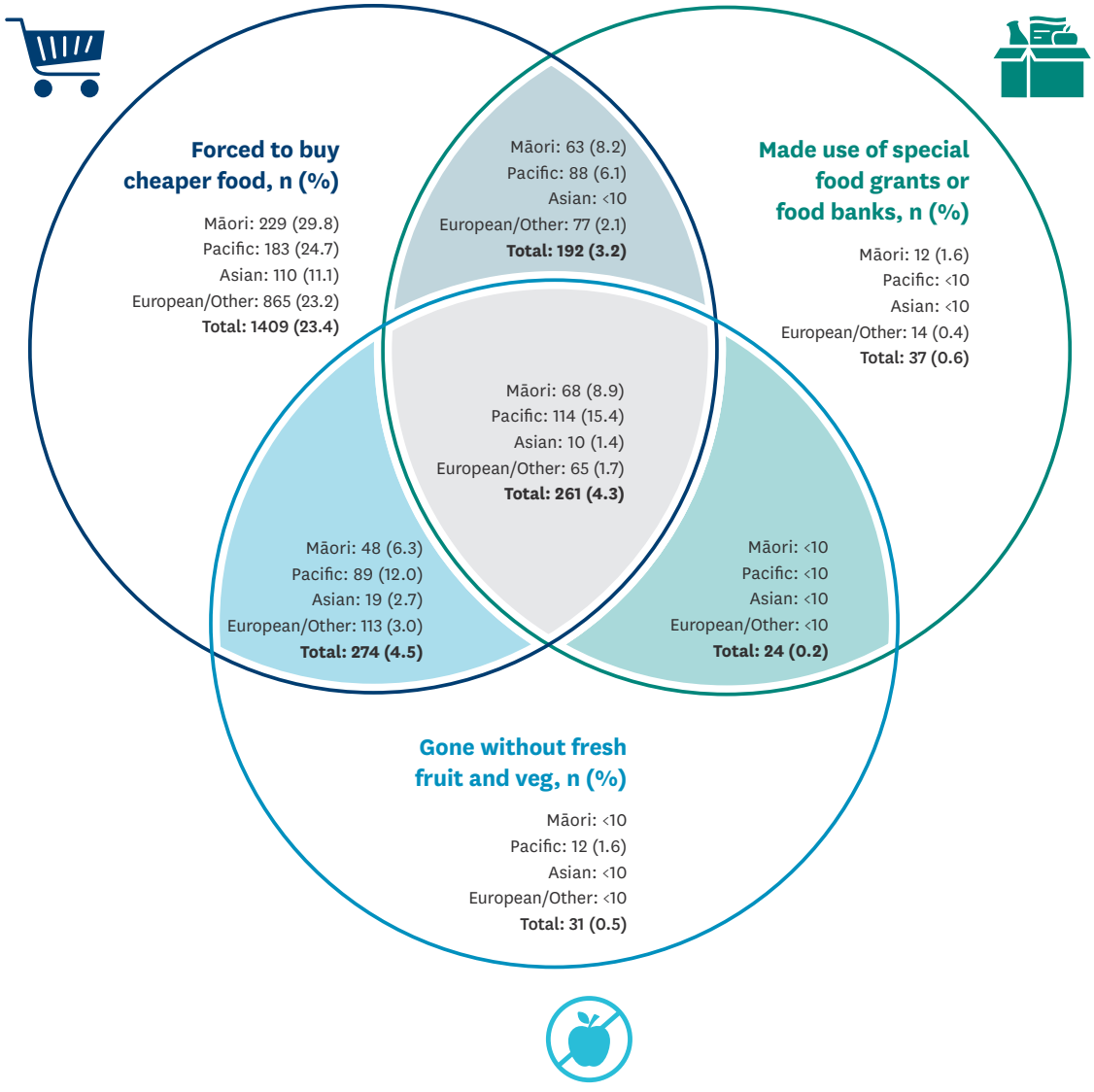


One in ten (9.7%) had gone without fresh fruit and vegetables to pay for other things when their child was 54-months old (Figure 4)

The overlap between the three different types of food hardship reported by mothers when their child was 9-months old (Figure 3) was similar at 54-months (Figure 5), with those reporting using a food bank or special food grant or going without fresh fruit and vegetables more likely than those that did not to also report being forced to buy cheaper food. The proportions of mothers (in total, and for each of the ethnic groups separately) who reported all three food-related hardships was only slightly lower at 54-months (Figure 5) than 9-months (Figure 3).

While the overall extent of food hardship had reduced by 54-months, it was still highly prevalent and had the same marked pattern of ethnic inequities seen at 9-months (Figure 4).

Figure 5: *Coexistence of food hardships in households with 54-month old children, by child ethnicity*



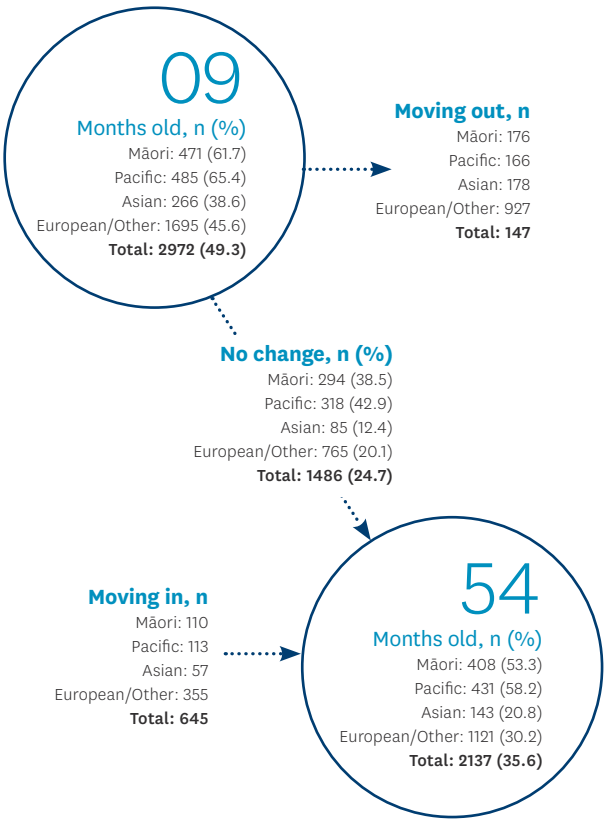
Note: N for all percentages is the total number of individuals within the cohort for each ethnic group (Māori = 768, Pacific = 742, Asian = 693, European/Other = 3721, Total = 6032)

Persistence of food hardship

There was considerable movement in and out of the three different types of food-related hardships across the early childhood period. Only half of mothers that were forced to buy cheaper food so they could pay of other things they needed when their child was 9-months of age, also reported this when their child was 54-months of age (24.7% of the total cohort, Figure 6). A third (30.2%) of mothers forced to buy cheaper food when their child was 54-months of age had not reported this hardship when their child was 9-months old (Figure 6). In total, 59.5% of mothers reported that they were forced to buy cheaper food in the past 12 months when their child was either 9-months, 54-months or at both ages (n=3608).

Much higher proportions 54-month Māori (38.5%) and Pacific (42.9%) children were living in households 'persistently' forced to buy cheaper food so they could pay of other things (that is, they reported this food hardship at both time points in the early childhood period), compared to European/Other (20.3%) and Asian (12.4%) children (Figure 6).

Figure 6: *Movement in and out of the food hardship "forced to buy cheaper food to pay for other things" in the past 12 months, when child aged 9-months and 54-months, by child ethnicity*

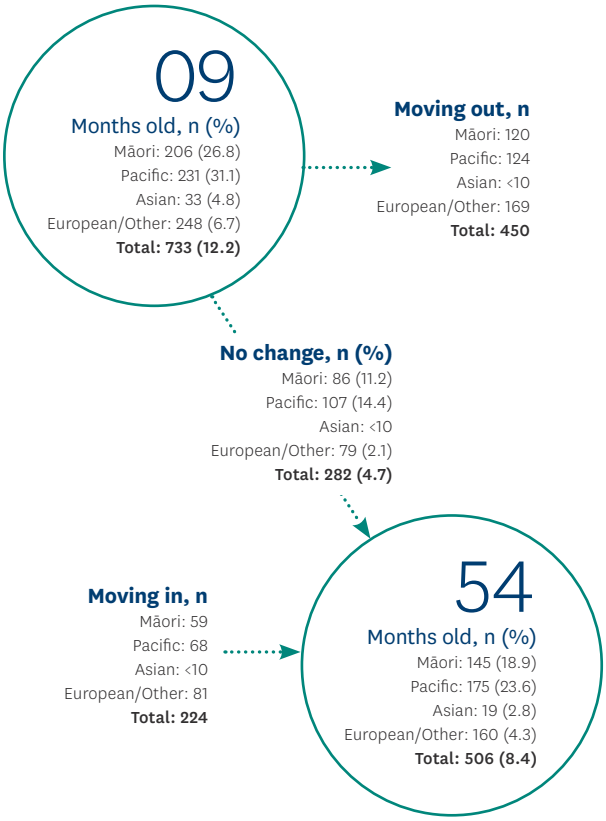


For Māori N_{DCW1}=768 and N_{DCW5}=767, Pacific N_{DCW1}=742 and N_{DCW5}=742, Asian N_{DCW1}=683 and N_{DCW5}=689

The same patterns of persistence and movement in and out of food hardship over time, were also seen in the use of special food grants or food banks (Figure 7) and for those going without fresh fruit and vegetables to pay for other things (Figure 8).

In total, one in six (15.9%) mothers reported that they used special food grants or food banks when their child was either 9-months, 54-months or both ages in the early childhood period (n=733+506-282=957). Higher proportions of mothers of tamariki Māori (34.5%, n=206+145-86=265) and Pacific children (40.3%, n=231+175-107=299) reported that they used special food grants or food banks when their child was either 9-months, 54-months or both ages (Figure 7).

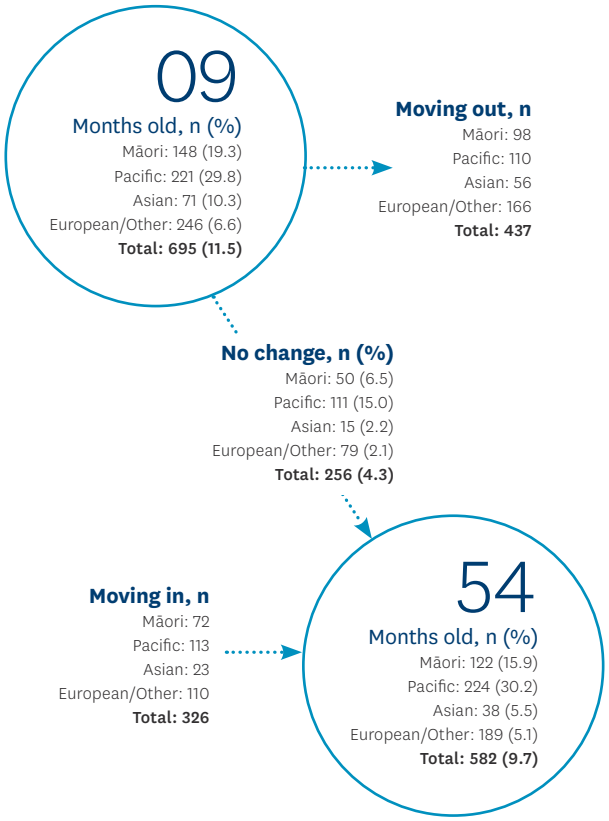
Figure 7: *Movement in and out of the food hardship "making use of special food grants or food banks" in the past 12 months, when child aged 9-months and 54-months, by child ethnicity*



For Māori N_{DCW1}=768 and N_{DCW5}=767, Pacific N_{DCW1}=742 and N_{DCW5}=742, Asian N_{DCW1}=683 and N_{DCW5}=689

In total, one in six (15.9%) mothers also reported that they had gone without fresh fruits and vegetables when their child was either 9-months, 54-months or both ages in the early childhood period (n = 695+582-256=1021). Higher proportions of mothers of tamariki Māori (28.6%, n=148+122-50=220) and Pacific children (45.0%, n=221+224-111=334) reported that they had gone without fresh fruits and vegetables in the past 12 months when their child was either 9-months, 54-months or both ages (Figure 8).

Figure 8: *Movement in and out of the food hardship "going without fresh fruit and vegetables to pay for other things" in the past 12 months, when child aged 9-months and 54-months, by child ethnicity*



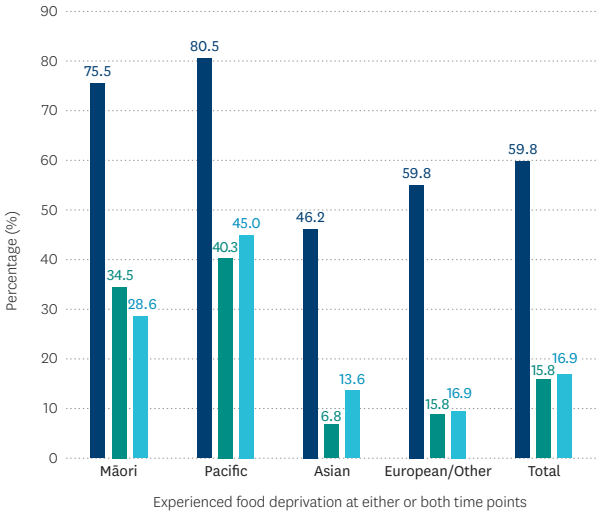
For Māori N_{DCW1}=768 and N_{DCW5}=767, Pacific N_{DCW1}=742 and N_{DCW5}=742, Asian N_{DCW1}=683 and N_{DCW5}=689

Overall exposure to food hardship during early childhood period

As shown in Figures 5 and 6, there was a lot of movement in and out of the different types of food hardship measures between the 9-month and 54-month interviews, i.e. different children and households were affected at each time point. As a consequence, the proportion of children exposed to a food hardship at some point during early childhood was larger than prevalence at one point in time may suggest.

Figure 9 presents the overall proportion of children exposed to one or all of the food hardships at either or both time points during their early childhood. This shows nearly two in every three mothers reported that they were forced to buy cheaper food to pay for other things they needed at either or both of the early childhood interviews (Figure 9). About 40% of Pacific children and 35% of tamariki Māori lived in households that made use of special food grants or food banks at either 9- and/or 54-months of age (Figure 9).

Figure 9: *Food hardships reported by mothers/primary caregivers at either or both early childhood ages (9- and/or 54-months), i.e. exposure at some point during early childhood*



Note: N Māori = 768, N Pacific = 742, N Asian = 693, N European/Other = 3721, N Total = 6032.

Associations between maternal and household characteristics and food hardship indicators

Appendix 2 contains tables which describe the unadjusted associations between the cohort children's maternal and household characteristics and each of the three food hardships separately: "Forced to buy cheaper food" when children were 9-months (Table 8) and 54-months (Table 9); "Use of special food grants or food banks" when children were 9-months (Table 10) and 54-months (Table 11); and "Going without fresh fruit and vegetables" when children were 9-months (Table 12) and 54-months (Table 13).

Overall, low equivalised household income had the largest magnitude of effect on the increased likelihood of food hardships in households with infants and young children, compared to other socioeconomic indicators. Seven out of every ten households with a total income of less than $30,000 reported that they were forced to buy cheaper food, and 41% had made use of special food grants or food banks in the past 12 months, when they had a 9-month old (Appendix 2: Tables 8 and Table 10). However, mothers in households at all income levels reported food hardships, e.g. 38% of mothers of 9-month olds in households with a total annual income of $70,000 or more reported that they had been forced to buy cheaper food to pay for other things that they needed (Appendix 2: Table 8). The number of people in the household was important to consider; sometimes households in the $30,000 to less than $50,000 income bracket were at increased risk of food hardship than the under $30,000 bracket due to a higher number of people in the household. Once equivalised, household income showed the expected relationship with food hardship, whereby the lower the equivalised income, the higher the risk of all food hardships.

For all three food hardships, the magnitude of effect of socioeconomic position increased from the 9-month to the 54-month time point, with increased risk over time for households with lower equivalised income, receiving income tested benefits, in neighbourhoods of high deprivation and for mothers with low educational attainment. These findings signal an increase in socioeconomic inequities for food hardship over the early childhood period, despite the overall reduction in the numbers of households experiencing food hardship during the early childhood period.

Compared to the total cohort, a higher proportion of tamariki Māori with markers of low socioeconomic position (low equivalised household income, receiving an income tested benefit, living in areas of high deprivation and low maternal education) experienced food hardship at 9-months and 54-months of age (Appendix 2: Table 8 to Table 13). Similar to the total cohort, low equivalised household income had the largest effect on risk of food hardship for tamariki Māori. The odds of experiencing nearly all food hardships increased between 9-months and 54-months of age for tamariki Maori with markers of low socioeconomic position; evidence of widening socioeconomic inequities through the early childhood period.

Pacific children had similar patterns to the total cohort and tamariki Māori of socioeconomic disadvantage resulting in higher risk of food hardships. However, like tamariki Māori, when compared to the total cohort, a higher proportion of Pacific children with markers of low socioeconomic position (low equivalised household income, receiving an income tested benefit, living in areas of high deprivation and low maternal education) experienced food hardship at 9-months and 54-months of age (Appendix 2: Table 8 to Table 13). Low household equivalised income, living in areas of high deprivation and low maternal education were the characteristics with the largest effect sizes across the three different types of hardships for Pacific children at the two time-points.

Associations between food hardship and early childhood nutrition

Forced to buy cheaper food to pay for other things in the past 12 months (total cohort)

Higher proportions of children in the total cohort had the following indicators of poor nutrition when their mother reported being forced to buy cheaper food, compared to children whose mothers had not reported being forced to buy cheaper food (Figure 10 and Figure 11):

- Breastfed to less than 12 months (p=0.04)
- Served fruit less than twice daily at 9-months of age (p<0.01)
- Served vegetables less than twice daily at 9-months of age (p<0.01)
- Ever tried unhealthy drinks before 9-months of age (p<0.01)
- Ever tried unhealthy foods before 9-months of age (p<0.01)
- A low or moderate variety of fruit at 54-months of age (p<0.01)
- A low or moderate variety of vegetables at 54-months of age (p<0.01)
- Three or more fizzy drinks a week at 54-months of age (p<0.01).

> Low household equivalised income, living in areas of high deprivation and low maternal education were the characteristics with the largest effect sizes across the three different types of hardships for Pacific children at the two time-points.

Figure 10: *Indicators of poor infant nutrition when the mother/primary caregiver was forced to buy cheaper food in the past 12 months, compared to other infants*

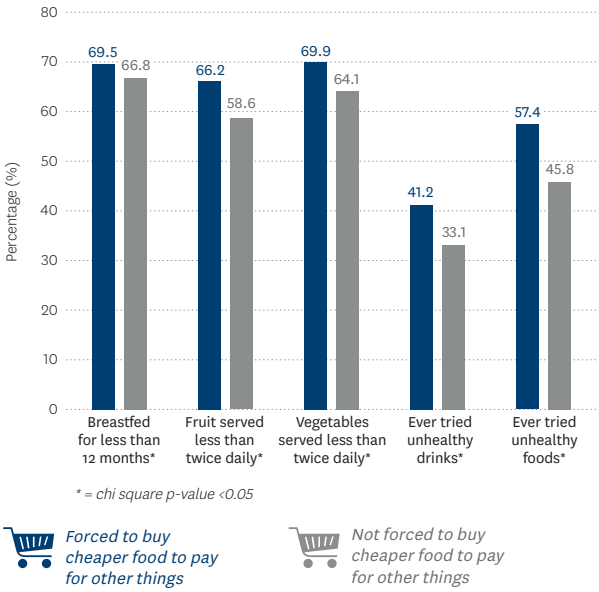
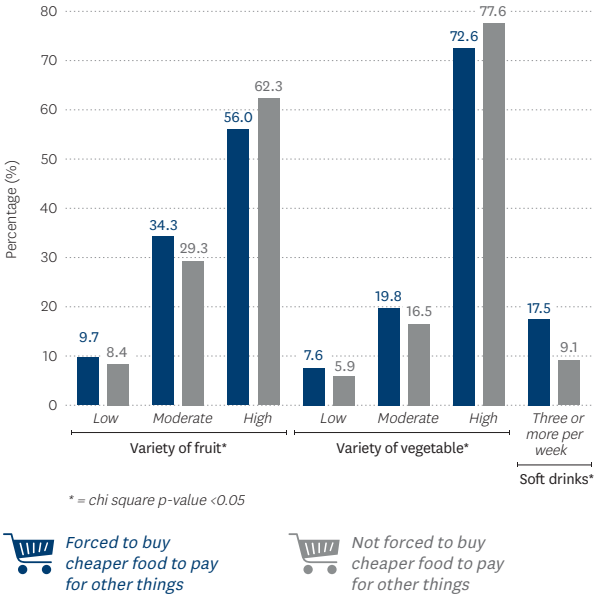


Figure 11: *Indicators of poor nutrition at 54-months of age when the mother/primary caregiver was forced to buy cheaper food in the past 12 months, compared to other children*



After adjustment for differences in household income and size, child ethnicity, mother's age and education, and neighbourhood deprivation, 9-month old infants whose mothers reported that they were forced to buy cheaper food to pay for other things were 24% more likely to be served fruit less than twice a day (AOR:1.24, p<0.01) and 20% more likely to have tried unhealthy foods at 9-months (AOR:1.20, p<0.01) compared to other infants. The other differences were no longer statistically significant once adjusted for maternal and household socioeconomic differences between groups (data not shown).

Tamariki Māori whose mothers had been forced to buy cheaper food

Tamariki Māori whose mothers reported that they were forced to buy cheaper foods had higher prevalence of consuming unhealthy drinks (p=0.01) and unhealthy foods (p=0.02) before 9-months of age compared to 9-month old tamariki Māori whose mothers were not forced to buy cheaper foods (Figure 12), and were more likely to drink three or more fizzy drinks a week compared to other tamariki Māori at 54-months (p<0.01) (Figure 13).

There were no statistically significant differences in breastfeeding (p=0.92) or fruit (p=0.46) and vegetable (p=0.35) serves for tamariki Māori under 12-months old living in families forced to buy cheaper food in the past 12 months, compared to other tamariki Māori (Figure 12). There were also no statistically significant differences in the variety of fruit (p=0.35) and vegetables (p=0.96) eaten for 54-month old tamariki Māori whose mothers were forced to buy cheaper food compared with other tamariki Māori.

Figure 12: *Indicators of poor infant nutrition for tamariki Māori when their mother/primary caregiver was forced to buy cheaper food, compared to other tamariki Māori*

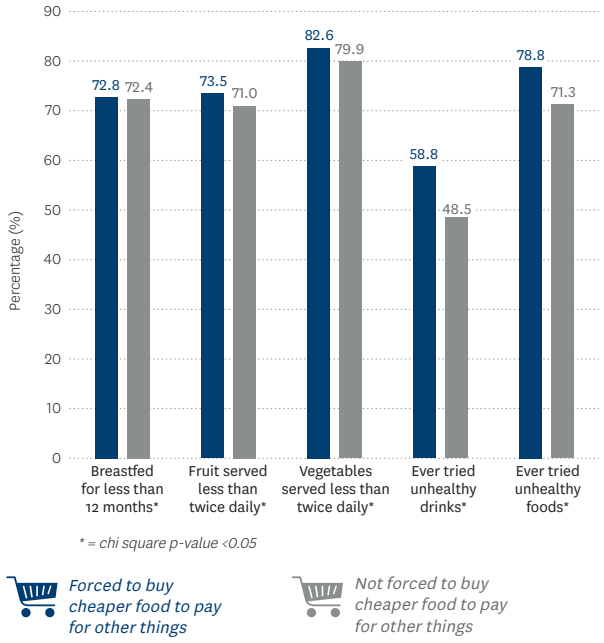
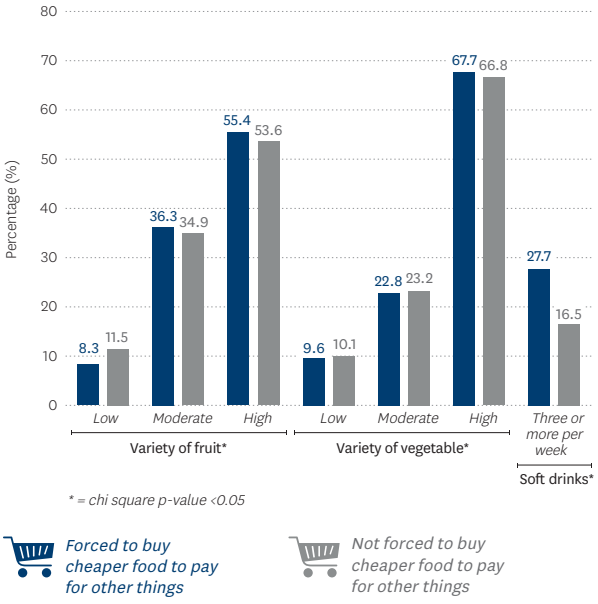


Figure 13: *Indicators of poor nutrition for tamariki Māori at 54-months of age when the mother/primary caregiver was forced to buy cheaper food in the past 12 months, compared to other tamariki Māori*



After adjustment for differences in household income and size, mother's age and education, and neighbourhood deprivation, tamariki Māori whose mothers reported that they were forced to buy cheaper food to pay for other things were 63% more likely to have three or more soft drinks or energy drinks a week compared to other tamariki Māori (AOR:1.63, p=0.02). The other differences were no longer statistically significant once adjusted for maternal and household socioeconomic differences between groups (data not shown).

Pacific children whose mothers had been forced to buy cheaper food

Pacific children whose mothers reported being forced to buy cheaper foods in the past 12 months had no statistically significant differences in any of the nutrition indicators at 9-months or 54-months of age, compared to other Pacific children, before and after adjustment for socioeconomic differences between groups (all p-values>0.05, data not shown).

Made use of special food grants or food banks in the past 12 months (total cohort)

Higher proportions of children in the total cohort had the following indicators of poor nutrition when their mother reported using special food grants or food banks in the past 12 months, compared to those that had not made use of special food grants or food banks (Figure 14 and Figure 15):

- Breastfed to less than 12-months (p<0.01)
- Served fruit less than twice daily (p<0.01)
- Served vegetables less than twice daily (p<0.01)
- Ever tried unhealthy drinks at 9-months of age (p<0.01)
- Ever tried unhealthy foods at 9-months of age (p<0.01)
- A low or moderate variety of fruit at 54-months of age (p<0.01)
- A low or moderate variety of vegetables at 54-months of age (p<0.01)
- Three or more fizzy drinks a week at 54-months of age (p<0.01).

Figure 14: *Indicators of poor infant nutrition when the mother/primary caregiver had made use of special food grants or food banks compared to other infants compared to those who had not at the 9-month interview (total cohort)*

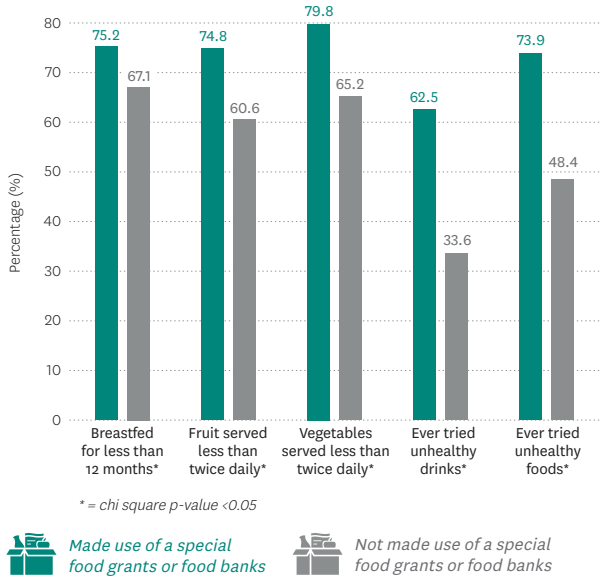
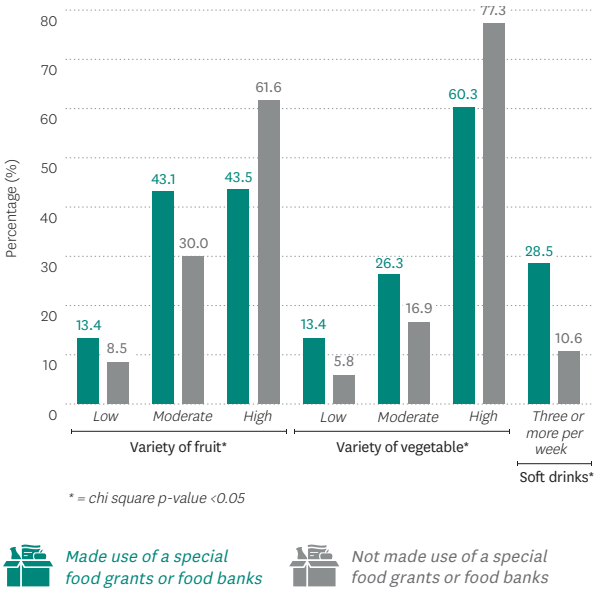


Figure 15: *Indicators of poor nutrition at 54-months of age when the mother/primary caregiver was forced to buy cheaper food in the past 12 months, compared to other children*



After adjustment for differences in household income and size, child ethnicity, mother's age and education, and neighbourhood deprivation, infants whose mothers had made use of special food grants or food banks in the past 12 months were one and a half times more likely to have tried unhealthy drinks (AOR:1.45, p<0.01) and foods (AOR: 1.44, p<0.01), compared to other 9-month old infants. At 54-months of age, children whose mothers had made use of special food grants or food banks in the past 12 months were nearly twice as likely likely to be served a low variety of vegetables (AOR: 1.91, p<0.01) compared to other children. The other differences were no longer statistically significant once adjusted for maternal and household socioeconomic differences between groups (data not shown).

> At 54-months of age, children whose mothers had made use of special food grants or food banks in the past 12 months were nearly twice as likely to be served a low variety of vegetables compared to other children (AOR: 1.91, p<0.01).

Tamariki Māori whose mother had made use of special food grants or food banks

Tamariki Māori whose mothers reported that they made use of special food grants or food banks in the past 12 months had higher prevalence of being served fruit less than twice a day (p=0.04), and being served unhealthy drinks (p<0.01) and unhealthy foods (p<0.01) by 9-months of age, compared to other 9-month old tamariki Māori (Figure 16). Tamariki Māori whose families made use of special food grants or food banks were also less likely to have a high variety of fruit (p<0.01) and vegetables (p<0.01) served to them at 54-months of age, compared to other tamariki Māori (Figure 17).

There were no statistically significant differences in breastfeeding (p=0.05) or vegetable serves (p=0.22) for tamariki Māori up to 12-months old living in families that made use of special food grants or food banks, compared to other tamariki Māori (Figure 16).

Figure 16: *Indicators of poor infant nutrition for tamariki Māori when their mother/primary caregiver had made use of special food grants or food banks, compared to other tamariki Māori*

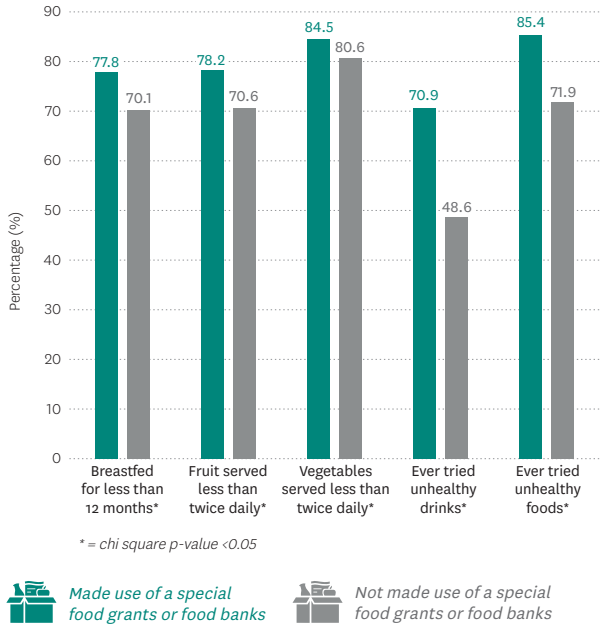
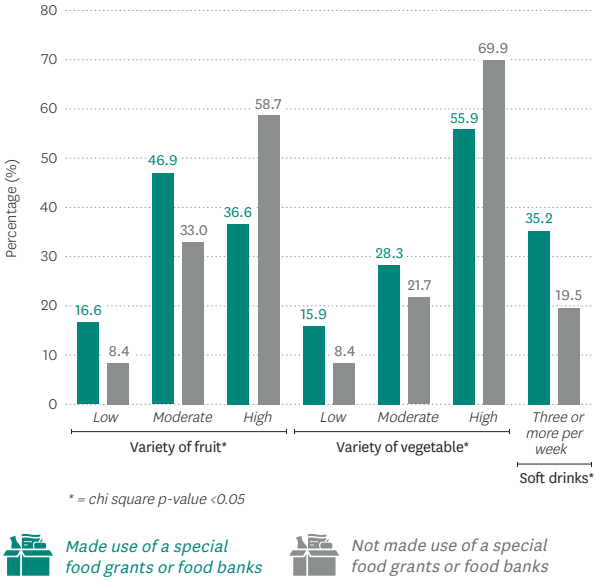


Figure 17: *Indicators of poor nutrition at 54-months of age for tamariki Māori when their mother/primary caregiver had made use of special food grants or food banks, compared to other tamariki Māori*



After adjustment for differences in household income and size, mother's age and education, and neighbourhood deprivation, tamariki Māori whose mothers had made use of special food grants or food banks in the past 12 months were 80% more likely to have tried unhealthy drinks (AOR:1.80, p<0.01) at 9-months of age, compared to other 9-month old tamariki Māori. At 54-months of age, tamariki Māori whose mothers had made use of special food grants or food banks were 124% more likely to eat a low variety of fruit (AOR: 2.24, p=0.03) and 88% more likely to have three or more soft drinks a week (AOR: 1.88, p=0.01), compared to other tamariki Māori. The other differences were no longer statistically significant once adjusted for maternal and household socioeconomic differences between groups (data not shown).

Pacific children whose mother had made use of special food grants or food banks

Pacific children living in families that had used a food grant or food bank in the past 12 months were less likely to have a high variety of fruit served to them at 54-months of age, compared to other Pacific children (Figure 18). There were no other statistically significant differences in the nutrition indicators at 9-months and 54-months of age for Pacific children families that had used a food grant or food bank, compared to other Pacific children (p-values>0.05, data not shown). However, the direction of association was as expected (food hardship associated with lower fruit and vegetable intake, more likely to have tried unhealthy drinks and unhealthy foods at 9-months of age, and less variety of vegetables at 54-months of age).

Figure 18: *Indicators of poor infant nutrition for Pacific children when their mother/primary caregiver had made use of special food grants or food banks, compared to other Pacific children*

After adjustment for differences in household income and size, mother's age and education, and neighbourhood deprivation, Pacific children whose mothers reported they had made use of special food grants or food banks in the past 12 months, were two and a half times more likely to have a low variety of vegetables at 54-months of age, compared to other Pacific children (AOR: 2.54, p<0.01). The other differences were no longer statistically significant once adjusted for maternal and household socioeconomic differences between groups (data not shown).

Gone without fresh fruit and vegetables in the past 12 months (total cohort)

Higher proportions of children in the total cohort had the following indicators of poor nutrition when their mothers reported going without fresh fruit and vegetables to pay for other things in the past 12 months, when compared to those whose mothers had not gone without fresh fruit and vegetables (Figure 19 and Figure 20):

- Served fruit less than twice daily (p<0.01)
- Served vegetables less than twice daily (p<0.01)
- Ever tried unhealthy drinks before 9-months of age (p<0.01)
- Ever tried unhealthy foods before 9-months of age (p<0.01)
- A low or moderate variety of fruit at 54-months of age (p<0.01)
- A low or moderate variety of vegetables at 54-months of age (p<0.01)
- Three or more fizzy drinks a week at 54-months of age (p<0.01).

There were no differences in prevalence of breastfeeding to 12 months of age for children whose mothers reported going without fresh fruit and vegetables, compared to other children (p=0.19).

Figure 19: *Indicators of poor infant nutrition when the mother/primary caregiver had gone without fresh fruit and vegetables to pay for other things, compared to other infants*

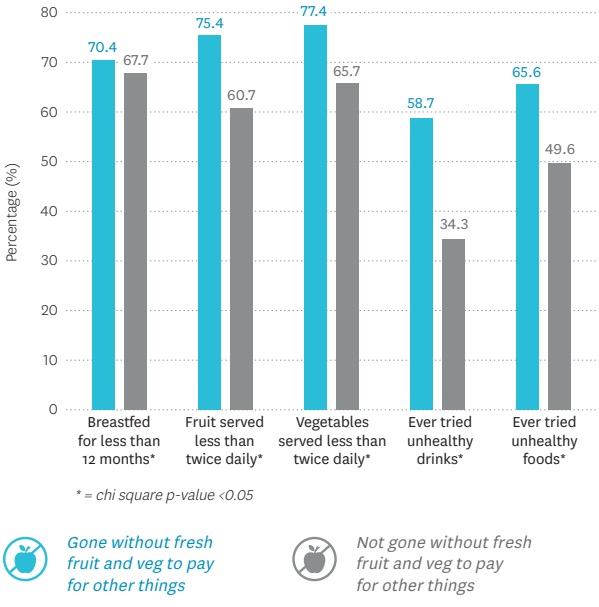
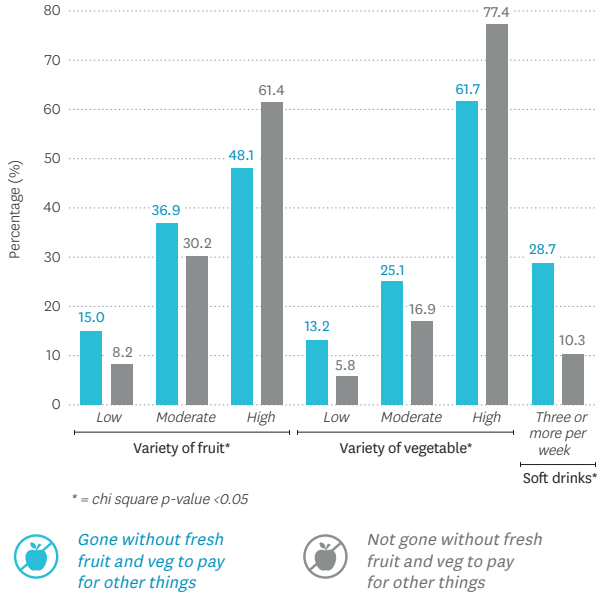


Figure 20: *Indicators of poor nutrition at 54-months of age when the mother/primary caregiver had gone without fresh fruit and vegetables to pay for other things, compared to other children*



After adjustment for differences in household income and size, child ethnicity, mother's age and education, and neighbourhood deprivation, infants whose mothers reported that they had gone without fresh fruit and vegetables to pay for other things in the past 12 months were 41% more likely to have less than two serves of fruit per day (AOR: 1.41, p<0.01) and 67% more likely to have tried unhealthy drinks (AOR:1.67, p<0.01), compared to other 9-month old infants. At 54-months of age, children whose mothers reported that they had gone without fresh fruit and vegetables to pay for other things in the past 12 months were 44% more likely to eat a low variety of fruit (AOR: 1.44, p=0.04) and nearly twice as likely to eat a low variety of vegetables (AOR:1.96, p<0.01) compared to other children.

Tamariki Māori whose mothers had gone without fresh fruit and vegetables

Tamariki Māori whose mothers reported that they had gone without fresh fruit and vegetables to pay for other things in the past 12 months, were more likely to be breastfeeding for less than 12 months (p=0.01), and been given unhealthy drinks (p<0.01) and unhealthy foods (p<0.01) by 9-months of age (Figure 21), compared to other tamariki Māori. There were no statistically significant differences in the number of fruit (p=0.13) and vegetable (p=0.67) serves at 9-months of age when comparing tamariki Māori whose mothers reported that they had gone without fresh fruit and vegetables to pay for other things and other tamariki Māori (Figure 21).

At 54-months, tamariki Māori whose mothers reported that they had gone without fresh fruit and vegetables to pay for other things in the past 12 months, had a lower variety of vegetables served (p<0.02) and were more likely to have three or more soft drinks a week (p<0.01) compared to other tamariki Māori. There was not a statistically significant difference in the variety of fruit served to tamariki Māori whose mothers reported that they had gone without fresh fruit and vegetables to pay for other things in the past 12 months, compared to other tamariki Māori (p=0.05) at 54-months of age, but the association was in the expected direction (Figure 22).

Figure 21: *Indicators of poor infant nutrition for tamariki Māori when their mother/primary caregiver had gone without fresh fruit and vegetables to pay for other things, compared to other tamariki Māori*

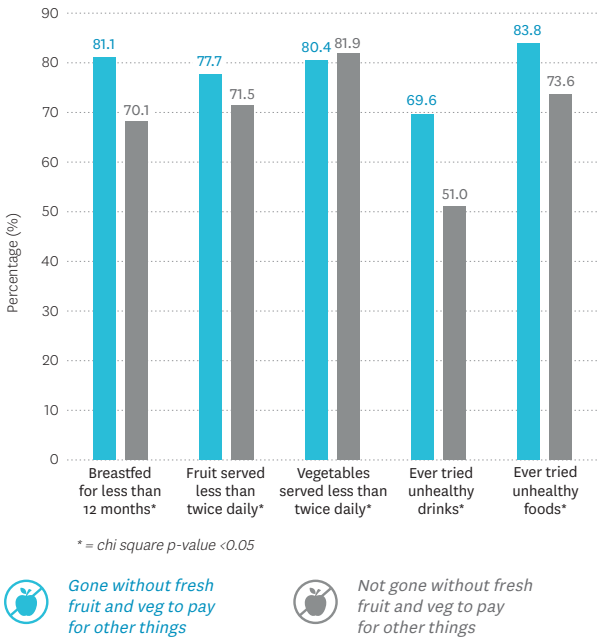
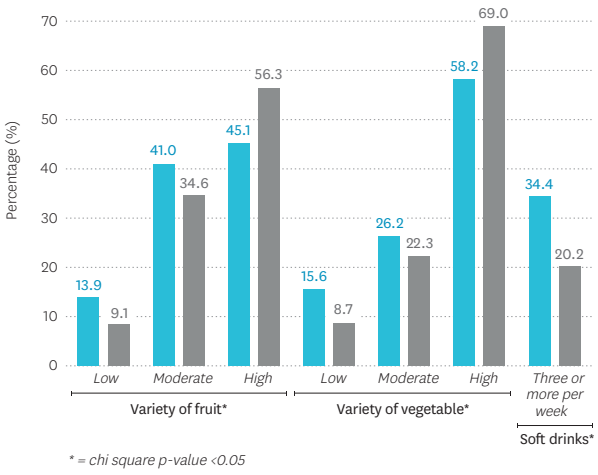


Figure 22: *Indicators of poor nutrition at 54-months of age for tamariki Māori when their mother/primary caregiver had gone without fresh fruit and vegetables to pay for other things, compared to other tamariki Māori*

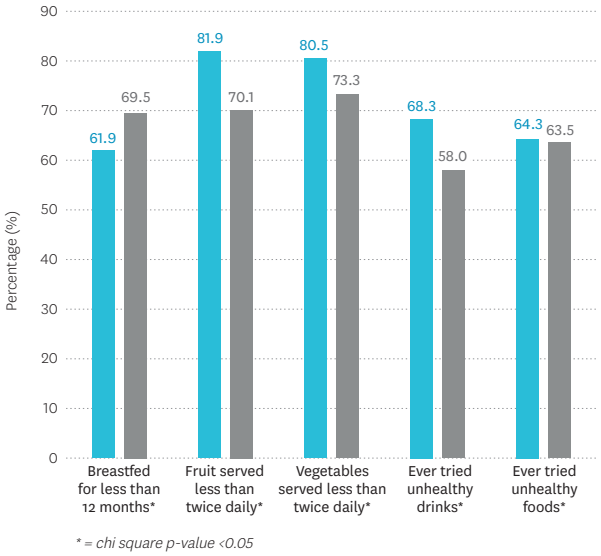


After adjustment for differences in household income and size, mother's age and education, and neighbourhood deprivation, tamariki Māori whose mothers reported that they had gone without fresh fruit and vegetables to pay for other things in the past 12 months were 73% more likely to not have been breastfed to 12 months of age (AOR:1.73, p=0.05), and 89% more likely to have tried unhealthy drinks at 9-months of age (AOR: 1.89, p<0.01), compared to other tamariki Māori. At 54-months of age, tamariki Māori whose mothers had gone without fresh fruit and vegetables were over twice as likely to have three or more soft drinks a week (AOR: 2.29, p<0.01), compared to other tamariki Māori. The other differences were no longer statistically significant once adjusted for maternal and household socioeconomic differences between groups (data not shown).

Pacific children whose mothers had gone without fresh fruit and vegetables

Pacific children whose mothers reported that they had gone without fresh fruit and vegetables to pay for other things in the past 12 months had were less likely to be served fruit (p<0.01) and vegetables (p=0.04) twice a day, and more likely to have tried unhealthy drinks (p<0.01) at 9-months of age, compared to other 9-month old Pacific children (Figure 23). At 54-months there was no difference seen in child nutrition indicators between those Pacific children whose mothers had gone without fresh fruit and vegetables and those who had not (data not shown).

Figure 23: *Indicators of poor infant nutrition for Pacific children when their mother/primary caregiver had gone without fresh fruit and vegetables to pay for other things, compared to other Pacific children*



After adjustment for differences in household income and size, mother's age and education, and neighbourhood deprivation, Pacific children whose mothers reported they had gone without fresh fruit and vegetables to pay for other things were 2.2 times more likely to have been served fruit less than twice daily (AOR: 2.19, p<0.01), and to have tried unhealthy drinks (AOR: 2.17, p<0.01) at 9-months of age, compared to other 9-month Pacific children. The other differences were no longer statistically significant once adjusted for maternal and household socioeconomic differences between groups (data not shown).

Discussion

This study examined the extent and nutritional impact of food hardship in a broadly generalisable cohort of children born in Aotearoa New Zealand in 2009/10. The *Growing Up in New Zealand* data had sufficient power for Māori and Pacific sub-group analyses and the examination of some relatively rare phenomenon (e.g. longitudinal use of special food grants and food banks). Data on food hardship were collected at two time points in early childhood, allowing for the examination of movements in and out of food hardship.

Food hardship was prevalent among families of infants and preschoolers, and by age 9-months ethnic inequities in food hardships were already marked. At 9-months of age, almost half of mothers reported being forced to buy cheaper food in the last 12 months to pay for other things they needed, and around one in eight (12%) had used food grants or food banks or had gone without fresh fruit and vegetables to pay for other things over the previous year. One in four Māori infants and almost one in every three Pacific infants lived in households that reported use of a special food grant or food bank compared to one in fifteen European infants. Inequities by ethnicity were the largest for infants experiencing all three food hardships at age 9-months: two percent of European infants compared to 15.5% of Pacific infants and 9.1% of Māori infants. Food hardship was strongly patterned by socioeconomic position, particularly by household income. By age 54-months, the prevalence of all three measures of food hardship had decreased, however the same pattern of inequities by ethnicity and socioeconomic position persisted. All three indicators of food hardship were significantly associated with poorer nutrition as assessed in this study, and a similar relationship between food hardship and poor nutrition was found for all ethnic groups.

This was the first study in Aotearoa New Zealand to examine the effect of food hardship on child nutrition in families with children aged under five years old. Having young children is a financially stressful time for many families, often resulting in one or more adults taking extended time out of the workforce and a reduced household income. This study has shown that low household income (below $50,000 per annum), and particularly an equivalised household income below $25,000, dramatically increased the risk of food hardship. It is likely the decreased proportion of families affected by food hardship between infancy and 4 years of age in the *Growing Up in New Zealand* cohort was due to an overall increase in household income over that time period (e.g. 32.2% of the cohort had an equivalised household income of over $35,000 per year when their children were 9-months of age, whereas 46.5% were in the same bracket when their children were 54-months of age). However, this may also be in part due to a 'period effect' related to the years in which data collection took place, with the 9-month old *Growing Up in New Zealand* interviews held in 2010/11 and the 54-month old interviews held in 2013/14.

The New Zealand Health Survey found rates of food insecurity among households with children reduced from 2012/13 to 2015/16 and so possibly food hardships were more prevalent in the population in 2010/11 than 2013/14 (Ministry of Health, 2019). However, average housing costs for families, particularly low income families, increased over the data collection period, which would have put increased pressure on household food budgets, particularly those with low income (Perry, 2019) which may explain the increasing levels of food hardships among families with low socioeconomic position when their children were 4 years old. Also, it should be noted that eligibility for special food grants and the accessibility of food banks has improved since the 54-month data collection waves, which may have increased the numbers of families accessing food support. Since 2010 the overall rates of material deprivation have remained high among families with children and there have been reports of increasing food bank use by charitable organisations throughout this time (Kore Hiakai Zero Hunger Collective, 2020). The existing food crisis faced by many families with young children as in this study is likely to worsen with the COVID-19 pandemic; the extent and impact of which will unfold in the coming months and years.

A key finding of this study was the high amount of movement in and out of food hardship over the early childhood period, which provides important information for policy makers above the cross-sectional prevalence of food hardships at the different time-points. For example, more than 60% of families that had made use of food grants or food banks when their child was 9-months old no longer reported needing that support by 54-months. In comparison, 44% of those accessing food grants/banks at 54-months had not previously needed that help. This resulted in a higher proportion of children overall in the cohort (16%) whose family had accessed a food grant or food banks at some point during early childhood, compared to at either time point (12% at 9-months and 8% at 54-months). The longitudinal nature of this study has allowed for greater understanding of the extent of exposure to–and movement in and out of–food hardship in early childhood and provided context for more responsive support to families of young children.

This study was unique in the examination of coexistence of different food hardships, finding that most mothers who reported using special food grants or food banks also reported being forced to buy cheaper food to pay for other things, but tended not to report going without fresh fruit and vegetables. Being forced to buy cheaper food to pay for other things was an extremely common experience and, while that might not necessarily mean food of lower nutrient value is purchased (for example, more expensive items are substituted by cheaper home brands or discounted food), this study found there was a clear association with poorer

nutritional indicators for children. Further, the social gradient and large disparities evident in responses to this question, detailed throughout the report, suggest the "forced to buy cheaper food" indicator is helpful to distinguish families with food hardship at the moderate end of the scale.

Our study adds to previous evidence that food insecurity in Aotearoa New Zealand is primarily a financial issue (Carter et al., 2010; Gorton et al., 2010; Smith et al., 2013a), with low household income the greatest determinant of food hardship for the children in the *Growing Up in New Zealand* cohort, and Māori and Pacific children at greater risk of living in a low income household.

The associations found between food hardship and poor nutritional indicators in early childhood confirm findings from the New Zealand Health Survey that children living in households with food hardship are less likely to have a nutritious diet (Ministry of Health, 2019). Statistically significant associations between food hardship and poor nutrition in early childhood persisted even after adjustment for differences in household income. Infants experiencing food hardship were more likely to have tried unhealthy food and drinks, and four-year olds experiencing food hardship had less variety of fruit or vegetables. Increased child consumption of soft drinks or energy drinks was also found when families experienced any of the three types of food hardship, which remained for tamariki Māori after adjustment for socioeconomic differences. There is little New Zealand research to aide in understanding why families facing food hardship would be more likely to introduce unhealthy foods and drinks early to infants and give fizzy drinks to young children, compared with families in the same socioeconomic position that do not experience food hardship. This finding suggests that there is a different experience for families in food hardship that adversely impacts on child nutrition, for example, while the wider 'obesogenic' food environment may be similar for other families with a similar socioeconomic background, perhaps there is a particular susceptibility for those in food hardship (for example, they may be more time-poor, socially isolated or under additional stressors that impact on nutrition). This will be an important issue for future research. For example, those families may be particularly vulnerable to a lack of availability of, or access to, local healthy food options or the extensive promotion of, or easy accessibility to, unhealthy food and drinks. Previous research with Māori found that cost, stress and a lack of time were important factors in parental food decisions (Glover et al, 2019). Some intended to limit food waste by offering only food and drinks they know the child will eat/drink, and often there was a desire to give their child a 'treat' and make sure they 'don't miss out' in the context of food hardship (Glover et al, 2019).

This study found a strong relationship between a mother going without fresh fruit and vegetables and a low fruit and vegetable intake for her infant and low variety of fruits and vegetables for her pre-schooler. Such a relationship would be expected given that those variables are closely related. There is some evidence from US research to suggest that mothers forgo their own nutrition for the benefit of their children (Bhattacharya, Currie & Haider, 2004). However, our research suggests a primary problem is the lack of fruit and vegetables in the household in the first place, which is necessary for children to be offered them or access them. The availability of fruit and vegetables for the wider household is also important to allow for positive adult role modelling behaviours of eating fruit and vegetables.

Limitations of this study

The main limitations of this research relate to measurement. First, the three measures of food hardship do not provide a complete definition of food insecurity and therefore may be underestimating the extent of food insecurity among Aotearoa New Zealand infants and young children. Second, the nutrition indicators used in the report are not direct measures of dietary intake, relying instead on mother's recall of the child's usual intake over the past four weeks in a food frequency questionnaire with photographic showcards as prompts. Food frequency questionnaires are useful for estimating population-level nutritional intake (Cade, Burley, Warm, Thompson & Margetts, 2004) but typically overestimate dietary intake for each child (Kaskoun, Johnson & Goran, 1994). Additionally, the bias in missing data detailed in Appendix 1, whereby mothers that did not report their household income were more likely to report food hardships, indicate that the levels of food hardship are likely to be even higher than stated in the report. Readers should note that the analyses do not control for nutrition-related knowledge and skills of caregivers, maternal mental health, or maternal employment, which may also be plausibly related to accessing good child nutrition. A final consideration is the use of prioritised main child ethnicity as reported by mothers, which would have slightly undercounted the Pacific cohort (as a small number of these children were reported by their mother to identify as Māori ethnicity and would therefore have been included in the Māori subgroup analyses).

Future directions for research

This study has generated many areas requiring further investigation, both using data collected in the *Growing Up in New Zealand* study, and for other qualitative and community-based research.

Future research on the health and wellbeing implications of exposure to food hardship (including child mental health, oral health, childhood obesity, family functioning, and maternal mental health) are all possible using the *Growing Up in New Zealand* study. The mechanisms behind food hardship could be further investigated by exploring the employment and housing situation for families who changed food hardship status between the time points (e.g. used special food grants or food banks at 9-months but not at 54-months, and vice versa). Additionally, an exploration of potential mechanisms between food insecurity and obesity, particularly given the independent associations found between food hardship and unhealthy food and drink consumption, would be a logical next step. Qualitative and community-based research could explore the reasons for why the food hardships were related to increased intake of unhealthy food and drink.

This study only examined two time-points in early childhood (9-months and 54-months) which were the only time-points for which food hardship questions were asked to the cohort. *Growing Up in New Zealand* included the full set of food insecurity questions in the 8-year data collection wave (2018/19) and plan to collect this again when the cohort are 11-years of age (2021) so future research on the associations between food insecurity and the full range of child wellbeing, health and development measures will be possible.

While the data presented in this report were collected some years ago and recent statistics on early childhood food insecurity are not available, food bank use data from community agencies (The Salvation Army, 2020) and the 2015/16 New Zealand Health Survey findings (Ministry of Health, 2019) suggest that food insecurity among families with children continues to be a major problem. Indeed, food hardship has rapidly increased in 2020, due to the COVID-19 epidemic which has resulted in a severe financial downturn and sharp rise in unemployment (Galicki, 2020). Data collected on food hardship and dietary intake around the time of the COVID-19 epidemic will provide insight into how vulnerable families in particular cope in times of crisis.

Policy implications

First, the prevalence of food hardship was high at both early childhood data collection points, but was especially high during infancy. Access to adequate food is a universal human right for all age groups (and 'zero hunger' is also a Sustainable Development Goal) (United Nations, 2016), but food hardship during the early years is especially concerning. Infancy is a foundational period for life-long health and infants are entitled to special protection given their vulnerability. Under the UN Convention on the Rights of the Child, New Zealand has a duty to ensure that young children have access to adequate, nutritious food; have healthy lives; are free from discrimination; and that their parents and caregivers have an adequate standard of living and are supported in the caregiving role (United Nations General Assembly, 1989).

Second, the marked ethnic inequities observed in this study were associated with underlying economic inequities evident in the *Growing Up in New Zealand* cohort, all of which are concerning in a te Tiriti o Waitangi context. While wider action to address food insecurity is needed, the situation for Māori and Pacific communities is an urgent matter and requires addressing the underlying structural drivers of inequities, including the marginalistion of Māori society due to colonisation and the ongoing impacts of racism and discrimination. Further, efforts to address food insecurity will require working in partnership with Māori and Pacific communities, practitioners and experts to understand the issue in context and develop meaningful, sustainable, te Tiriti-based and culturally-appropriate initiatives.

Third, all three indicators of food hardship were associated with poorer nutritional indicators, however those indicators were also prevalent in the population as a whole. Infant indicators were particularly concerning, with high rates of suboptimal breastfeeding duration, low quantity and variety of fruit and vegetable intake, and exposure to unhealthy food and drink from a young age. This research found a relationship between food hardship and the consumption of unhealthy food products that remained after taking into account socioeconomic characteristics such as household income and size, mother's age and education, and neighbourhood deprivation. Hence, improving food security in the early childhood population will be challenging without also addressing other underlying drivers of poor nutrition. These may include the structural determinants of early breastfeeding cessation such as employment conditions and parental leave provisions, and the 'obesogenic' food environment—the prolific promotion and availability of junk food and sugary drinks plausibly contributes to the early introduction of these foods and the displacement of fruit and vegetables in children's diets in Aotearoa New Zealand.

Fourth, the patterns of food hardships and poor nutrition found in this research are consistent with a complex system. Consequently, policies to reduce the prevalence of food hardships and associated poor nutritional indicators require a systems approach to prevention as identified by Signal et al (2013). Evidence-based, multi-pronged, te Tiriti-based and culturally-appropriate actions have been identified in previous research and policy recommendations (Mackay et al., 2020; Signal et al., 2013; Bowers et al., 2009; McKerchar, Bowers, Heta, Signal & Mato, 2015). While this is a complex problem, there is considerable expertise, evidence and experience in Aotearoa New Zealand to support this work.

With regards to current government policy settings, the implications from this research broadly support the current policy direction of the Child Poverty Reduction Act and the Child and Youth Wellbeing Strategy, including the focus on childhood food security. This research also supports the Welfare Expert Advisory Group's findings that family incomes are seriously inadequate to provide a basic standard of living for children and families and that cross-system, integrated actions are needed to improve social security (Kia Piki Ake Welfare Advisory Group, 2019). A review by Loopstra et al. (2018) provides evidence to suggest that for high-income nations social protection policies are the most effective approach for addressing food insecurity; community-based

interventions such as food banks or volunteer initiatives are limited in the extent of assistance they are able to provide for the extent of need and also the potential for stigmatisation may be a barrier for some people. Hence, families with young children require a basic level of income to mitigate food hardships; addressing food hardship will need substantive action to lift the incomes of the poorest families in Aotearoa New Zealand. A randomised controlled trial conducted in New Zealand with low-income households found that providing additional money, in this case $17 a week, resulted in more money spent on food (an average of $15.20 extra/week) (Smith, Parnell, Brown & Gray, 2013a). Recent provisions to improve household incomes such as the Families Package and winter energy payment are likely to be beneficial. Further, when the *Growing Up in New Zealand* cohort were born, Aotearoa New Zealand had one of the shortest and lowest paid parental leave allowances in the OECD at 18 weeks, which was raised to 22 weeks in July 2018 and will be 26 weeks from July 2020 with enhanced eligibility criteria. Further expanding the duration or availability of paid parental leave may also be beneficial.

Policy settings are also changing rapidly in response to the evolving COVID-19 pandemic. The Government has introduced a range of support packages for families in different circumstances, including for those in crisis, as well as specific food-related support of scaling up existing food parcel programmes for 10 weeks and additional support for foodbanks, food rescue and community food services (New Zealand Government, 2020b); plus the expansion of the Free and Healthy School Lunch Programme for up to 200,000 Year 1-13 students in schools with the highest disadvantage (New Zealand Government, 2020a).

Finally, it will be important to continue monitoring the prevalence and nutritional indicators of children over time, particularly given the COVID-19 economic crisis facing the country, and to understand the experience of food hardship for this cohort through school. New Zealand Health Survey data suggested that exposure to food insecurity may be more prevalent in school-aged children compared to early childhood (Ministry of Health, 2019). However, there were small numbers of preschoolers included in the Health Survey (less than 2000 under five-year olds each data collection year) and so the data is not disaggregated by age to see findings for under one-year-olds.

> Addressing food hardship will need substantive action to lift the incomes of the poorest families in Aotearoa New Zealand.

Key implications for policy-makers

1. **Policy to reduce food hardship in childhood requires specific attention to early childhood** as well as school-aged children, particularly for infants and families in the first year of life. Food programmes should aim to include a variety of early childhood settings (including marae) as well as schools and kura kaupapa.

2. **Monitoring of food hardship and nutrition should include adequate numbers of children less than five years of age**, including infants less than one year, so the data can be disaggregated by age and ethnicity and monitored over time. Regular monitoring of children's nutrition will be especially important post-COVID-19.

3. **Policy to address food hardship should be made in meaningful partnerships with, and advance the aspirations of Māori and Pacific** whānau and communities, given the marked ethnic inequities, and the cultural significance of food.

4. **Policy to reduce the prevalence and nutritional consequences of food hardship should be part of a comprehensive food policy** developed to improve nutrition and reduce obesity more widely. Priority actions should encompass:

    a. **Addressing the determinants of low family income** as recommended by the Welfare Expert Advisory Group, including, but not limited to, ensuring adequate social assistance for families with young children.

    b. **Local and national initiatives to increase the affordability, availability and promotion of healthy food**, including strengthening Māori food systems.

    c. **Local and national initiatives to protect children** and their parents and caregivers from unhealthy food environments, such as excessive availability, promotion and marketing of unhealthy food and drink products.

    d. **Fiscal measures** to make unhealthy foods less affordable and healthy foods more affordable.

    e. **Addressing barriers to breastfeeding**, including structural determinants of early breastfeeding cessation (e.g. improving employment conditions and expanding parental leave provisions).

5. **Evaluation of new policy initiatives** to ensure they are effective, appropriate, and reduce inequities.

Conclusion

Food hardship, and the inequitable distribution of food hardship, is a pressing public health and human rights issue in Aotearoa New Zealand. The inability of the country's social and food systems to provide equitable access to healthy food for the most vulnerable families is unambiguous and has been exacerbated by the COVID-19 pandemic unfolding as this report was finalised. Early childhood exposure to the food hardships detailed in this report was associated with poor nutrition, particularly less variety of fruit and vegetables and higher intake of unhealthy food and drinks. This issue requires an urgent response at the systemic level–ensuring sufficient income so families can have healthy diets, ensuring healthy food is more available, affordable and promoted, as well as ensuring communities are not swamped with fast food outlets, that marketing of unhealthy foods is restricted, and that fiscal measures are used to make unhealthy foods less affordable and healthy foods more affordable.

Halfway through the 'Decade of Nutrition 2016-2025'–where United Nation member states have committed to undertake sustained and coherent implementation of policies and programmes to eliminate malnutrition in all its forms (hunger, micronutrient deficiencies, and overweight and obesity)–it is time for action to reduce the nutritional implications of widespread food insecurity among children in Aotearoa New Zealand.

References

Alaimo, K., Briefel, R. R., Frongillo, E. A., & Olson, C. M. (1998). Food insufficiency exists in the United States: Results from the Third National Health and Nutrition Examination Survey (NHANES III). *American Journal of Public Health, 88*(3), 419–426. https://doi.org/10.2105/AJPH.88.3.419

Asfour, L., Natale, R., Uhlhorn, S., Arheart, K. L., Haney, K., & Messiah, S. E. (2015). Ethnicity, Household Food Security, and Nutrition and Activity Patterns in Families With Preschool Children. *Journal of Nutrition Education and Behavior, 47*, 498–505. https://doi.org/10.1016/j.jneb.2015.07.003

Atkinson, J., Salmond, C., & Crampton, P. (2014). NZDep2013 *Index of Deprivation*. https://www.otago.ac.nz/wellington/otago069936.pdf

Bhattacharya, J., Currie, J., & Haider, S. (2004). Poverty, food insecurity, and nutritional outcomes in children and adults. *Journal of Health Economics*, 23, 839–862. https://doi.org/10.1016/j.jhealeco.2003.12.008

Boston, J. (2014). Child poverty in New Zealand: Why it matters and how it can be reduced. *Educational Philosophy and Theory, 46*(9), 962–988. https://doi.org/10.1080/00131857.2014.931002

Bowers, S., K. Carter, D. Gorton, C. Heta, T. Lanumata, R. Maddison, C. McKerchar, C. Ni Mhurchu, D. O'Dea and J. Pearce (2009). Enhancing food security and physical activity for Māori, Pacific and low-income peoples. Wellington, Clinical Trials Research Unit, University of Auckland; GeoHealth Laboratory, University of Canterbury;Health Promotion and Policy Research Unit, University of Otago; Te Hotu Manawa Māori. Available from https://www.otago.ac.nz/wellington/otago022607.pdf

Cade, J., Burley, V., Warm, D., Thompson, R., & Margetts, B. (2004). Food-frequency questionnaires: A review of their design, validation and utilisation. *Nutrition Research Reviews, 17*(1), 5–22. doi:10.1079/NRR200370

Carter, K. N., Lanumata, T., Kruse, K., & Gorton, D. (2010). What are the determinants of food insecurity in New Zealand and does this differ for males and females? *Australian and New Zealand Journal of Public Health*. https://doi.org/10.1111/j.1753-6405.2010.00615.x

Castro, T., Grant, C., Wall, C., Welch, M., Marks, E., Fleming, C., Teixeira, J., Bandara, D., Berry, S., & Morton, S. (2017). Breastfeeding indicators among a nationally representative multi-ethnic sample of New Zealand children. *New Zealand Medical Journal, 130*(1466), 34–44.

Child Poverty Action Group (2020). *Media release: Aotearoa Land of the long wide bare cupboard*. https://www.cpag.org.nz/campaigns/the-latest-aotearoa-land-of-the-long-wide/media-release-2/

Data New Zealand (2020). Household Economic Survey 2018-19 Economic. Retrieved from https://catalogue.data.govt.nz/dataset/household-economic-survey-2018-19-economic-wellbeing-including-maori-households/resource/8ed44f17-021b-4129-ab36-49f3dc7e602c

Davies PSW, Funder J, Palmer DJ, Sinn J, Vickers MW, Wall CR. (2016) Early life nutrition and the opportunity to influence long-term health: an Australasian perspective. *J DOHaD, 7* (5): 440–8.

Department of Prime Minister and Cabinet (2019). *Child and Youth Wellbeing Strategy*. https://childyouthwellbeing.govt.nz/

DePolt, R. A., Moffitt, R. A., & Ribar, D. C. (2009). Food stamps, temporary assistance for needy families and food hardships in three American cities. *Pacific Economic Review, 14*(4), 445–473. https://doi.org/10.1111/j.1468-0106.2009.00462.x

Galicki, C. (2020). *Impact of Covid-19 on financial wellbeing*. Commission for Financial Capability. https://cffc-assets-prod.s3.ap-southeast-2.amazonaws.com/public/Uploads/Research-2020%2B/COVID-19/CFFC-COVID-19-Research-Report-May-2020.pdf

Glover, M., Wong, S.F., Taylor, R.W., Derraik, J.G.B., Fa'alili-Fidow, J., Morton, S., Cutfield, W.S. (2019) The complexity of food provisioning decisions by Māori caregivers to ensure the happiness and health of their children. *Nutrients, 11*, 994. https://doi.org/10.3390/nu11050994

Gontijo De Castro, T., Gerritsen, S., Wall, C., Grant, C., Teixeira, J. A., Marchioni, M., Pillai, A., & Morton, S. (2018). *Infant feeding in New Zealand Adherence to Food and Nutrition Guidelines among the Growing Up in New Zealand cohort*. https://www.msd.govt.nz/documents/about-msd-and-our-work/publications-resources/research/infant-feeding/infant-feeding-in-new-zealand.pdf

Gorton, D., Bullen, C. R., & Mhurchu, C. N. (2010). Environmental influences on food security in high-income countries. *Nutrition Reviews, 68*(1), 1–29. https://doi.org/10.1111/j.1753-4887.2009.00258.x

Hobbs, M. R., Atatoa Carr, P., Fa'Alili-Fidow, J., Pillai, A., Morton, S. M. B., & Grant, C. C. (2019). How differing methods of ascribing ethnicity and socio-economic status affect risk estimates for hospitalisation with infectious disease. *Epidemiology and Infection, 147*(E40). https://doi.org/10.1017/S0950268818002935

Kaskoun, M. C., Johnson, R. K., & Goran, M. I. (1994). Comparison of energy intake by semiquantitative food-frequency questionnaire with total energy expenditure by the doubly labeled water method in young children. *The American Journal of Clinical Nutrition, 60*(1), 43–47. https://doi.org/10.1093/ajcn/60.1.43

Kia Piki Ake Welfare Advisory Group (2019). *Welfare Expert Advisory Group Report*. http://www.weag.govt.nz/weag-report/

Kore Hiakai Zero Hunger Collective (2020). *Kore Hiakai Zero Hunger Collective*. https://www.zerohunger.org.nz/problem

Loopstra, R. (2018). Interventions to address household food insecurity in high-income countries. *Proceedings of the Nutrition Society 77*(3): 270–281.

Mackay, S., Sing, F., Gerritsen, S., & Swinburn, B. (2020). *Benchmarking Food Environments 2020: Progress by the New Zealand Government on implementing recommended food environment policies & priority recommendations*. https://www.informas.org/2020/06/19/food-epi-nz-2020/

McKerchar, C., S. Bowers, C. Heta, L. Signal and L. Matoe (2015). Enhancing Māori food security using traditional kai. *Global Health Promotion 22*(3): 15–24.

Ministry of Health (2012). *Food and Nutrition Guidelines for Healthy Children and Young People (Aged 2–18 years): A background paper*. Partial revision February 2015. Wellington: Ministry of Health. https://www.health.govt.nz/publication/food-and-nutrition-guidelines-healthy-infants-and-toddlers-aged-0-2-background-paper-partially

Ministry of Health (2017). *HISO 10001 :2017 Ethnicity Data Protocols*. https://www.health.govt.nz/publication/hiso-100012017-ethnicity-data-protocols

Ministry of Health (2019). *Household Food Insecurity Among Children: New Zealand Health Survey*. https://www.health.govt.nz/system/files/documents/publications/household-food-insecurity-among-children-new-zealand-health-survey-jun19.pdf

Ministry of Health New Zealand (2002). *NZ Food NZ Children: Key results of the 2002 National Children's Nutrition Survey*. https://www.health.govt.nz/publication/nz-food-nz-children

Ministry of Social Development (2020). Benefit Factsheets Snapshot – March 2020 Quarter. https://msd.govt.nz/about-msd-and-our-work/publications-resources/statistics/benefit/index.html

Ministry of Social Development (2020). *Hardship Assistance: Latest quarterly results*. https://www.msd.govt.nz/about-msd-and-our-work/publications-resources/statistics/benefit/latest-quarterly-results/hardship-assistance.html

Morton, S. M. B., Ramke, J., Kinloch, J., Grant, C. C., Carr, P. A., Leeson, H., Lee, A. C. L., & Robinson, E. (2015). *Growing Up in New Zealand* cohort alignment with all New Zealand births. *Australian and New Zealand Journal of Public Health, 39*(1), 82–87. https://doi.org/10.1111/1753-6405.12220

OECD (2020). OECD *Project on Income Distribution and Poverty: what are equivalence scales?* http://www.oecd.org/els/soc/OECD-Note-EquivalenceScales.pdf

New Zealand Government (2020a, May 14). *Major expansion of school lunch programme*. https://www.beehive.govt.nz/release/major-expansion-school-lunch-programme

New Zealand Government (2020b, May 14). *Supporting our people as we rebuild the economy*. https://www.beehive.govt.nz/release/supporting-our-people-we-rebuild-economy

Parnell, W R, Reid, J., Wilson, N. C., McKenzie, J., & Russell, D. G. (2001). Food security: is New Zealand a land of plenty? *The New Zealand Medical Journal, 114*(1128), 141–145. http://www.ncbi.nlm.nih.gov/pubmed/11346164

Parnell, Winsome R., & Gray, A. R. (2014). Development of a food security measurement tool for New Zealand households. *British Journal of Nutrition, 112*(8), 1393–1401. https://doi.org/10.1017/S0007114514002104

Perry, B. 2019. *Household incomes in New Zealand: Trends in indicators of inequality and hardship 1982 to 2018*. Wellington: Ministry of Social Development. https://www.msd.govt.nz/about-msd-and-our-work/publications-resources/monitoring/household-incomes/household-incomes-1982-to-2018.html

Rush, E., & Obolonkin, V. (2020). Food exports and imports of New Zealand in relation to the food-based dietary guidelines. *European Journal of Clinical Nutrition, 74*(2), 307–313. https://doi.org/10.1038/s41430-019-0557-z

Salmond, C., Crampton, P., King, P., & Waldegrave, C. (2006). NZiDep: A New Zealand index of socioeconomic deprivation for individuals. *Social Science & Medicine, 62*(6), 1474–1485. https://doi.org/10.1016/j.socscimed.2005.08.008

Salmond, C., Crampton, P., & Atkinson, J. (2006). *NZDep2006 Index of Deprivation*. https://www.otago.ac.nz/wellington/otago020348.pdf

Schlichting, D., Hashemi, L., & Grant, C. (2019). Infant food security in New Zealand: A multidimensional index developed from cohort data. *International Journal of Environmental Research and Public Health, 16*(2). https://doi.org/10.3390/ijerph16020283

Shonkoff, J.P. (2010) Building a New Biodevelopmental Framework to Guide the Future of Early Childhood Policy. *Child Development, 81*(1): 357–367.

Signal, L. N., Walton, M. D., Ni Mhurchu, C., Maddison, R., Bowers, S. G., Carter, K. N., Gorton, D., Heta, C., Lanumata, T. S., McKerchar, C. W., O'Dea, D., & Pearce, J. (2013). Tackling "wicked" health promotion problems: A New Zealand case study. *Health Promotion International, 28*(1), 84–94. https://doi.org/10.1093/heapro/das006

Slack, K. S., & Yoo, J. (2005). Food Hardship and Child Behavior Problems among Low-Income Children. *Review, 79*(3), 511–536. https://doi.org/10.1086/430894

Smith, C., Parnell, W. R., Brown, R. C., & Gray, A. R. (2013a). Providing additional money to food-insecure households and its effect on food expenditure: A randomized controlled trial. *Public Health Nutrition, 16*(8), 1507–1515. https://doi.org/10.1017/S1368980012003680

Smith, C., Parnell, W. R., Brown, R. C., & Gray, A. R. (2013b). Balancing the diet and the budget: Food purchasing practices of food-insecure families in New Zealand. *Nutrition and Dietetics, 70*(4), 278–285. https://doi.org/10.1111/1747-0080.12043

Statistics New Zealand (2019a). *Measuring child poverty: concepts and definitions*. https://www.stats.govt.nz/methods/measuring-child-poverty-concepts-and-definitions

Statistics New Zealand (2019b). Wellbeing statistics: 2018. Retrieved from https://www.stats.govt.nz/information-releases/wellbeing-statistics-2018

Statistics New Zealand (2020). *Child pvoerty statistics: Year ended June 2019*. https://www.stats.govt.nz/tereo/information-releases/child-poverty-statistics-year-ended-june-2019

The Salvation Army (2020). COVID-19 Social Impact Dashboard 24 April 2020. April, 1–13. https://www.salvationarmy.org.nz/article/sppu-covid19-social-impact-dashboard-report-2

United Nations General Assembly (1989). *Convention on the Rights of the Child. Resolution 44/25. UN General Assembly*. Geneva, United Nations.

United Nations (2016). *Transforming our world: The 2030 Agenda for Sustainable Development. A/RED/70/1*. https://sustainabledevelopment.un.org/post2015/transformingourworld/publication

University of Otago & Ministry of Health (2011). *A Focus on Nutrition: Key Findigns of the 2008/09 New Zealand Adult Nutrition Survey*. Ministry of Health. https://www.health.govt.nz/publication/focus-nutrition-key-findings-2008-09-nz-adult-nutrition-survey

Utter, J., Denny, S., Robinson, E., Teevale, T., Crengle, S., Ameratunga, S., & Fleming, T. (2012). Food Security Concerns Among Young People: Impact on Eating Behaviors and Weight Status. *Journal of Hunger & Environmental Nutrition, 7*(1), 101–111. https://doi.org/10.1080/19320248.2012.649675

Utter, J., Izumi, B. T., Denny, S., Fleming, T., & Clark, T. (2018). Rising food security concerns among New Zealand adolescents and association with health and wellbeing. *New Zealand Journal of Social Sciences Online, 13*(1), 29–38. https://doi.org/10.1080/1177083X.2017.1398175

Vozoris, N. T., & Tarasuk, V. S. (2003). Household Food Insufficiency Is Associated with Poorer Health. *The Journal of Nutrition, 133*(1), 120–126. https://doi.org/10.1093/jn/133.1.120

Welfare Expert Advisory Group (2018a). *A brief history of family support payments in New Zealand*. July. http://www.weag.govt.nz/assets/documents/WEAG-report/background-documents/133db2ad05/History-of-family-support-payments-010419.pdf

Welfare Expert Advisory Group (2018b). *Families and whānau and the benefit system – A high-level initial briefing* (Issue May). http://www.weag.govt.nz/weag-report/evidence-briefs/

Appendix 1: Missing data analysis

Missing data includes refused or don't know responses to question or did not complete interview at that data collection wave. The total missing were not included in the dominator of analyses.

Table 5: *Missing observations for each variable (N=6032)*

Variable name	Description of variable	Total missing, n (%)
Household food hardship variables		
FH1_9m	Cheaper food 9-months	<10
FH1_54M	Cheaper food 54-months	11 (0.2)
FH2_9m	Food banks / grants 9-months	<10
FH2_54M	Food banks / grants 54-months	20 (0.3)
FH3_9M	Without F&V 9-months	14 (0.2)
FH3_54M	Without F&V 54-months	16 (0.3)
Maternal and household characteristics		
ETHN	Mother-reported child main ethnicity at 54-months	108 (1.8)
NZDep06	NZDep 2006 at 9-months	<10
NZDep13	NZDep 2013 at 54-months	<10
Age	Maternal Age	<10
EDU	Maternal Education	14 (0.2)
FS1	Partner Support	<10
Income_9m	Household Income at 9-months	777 (12.9)
Income_54m	Household Income at 54-months	603 (10.0)
Benefit_m9m	Income-Tested Benefit at 9-months	<10
hh12_9m	Number of children in household	<10
Hhtotalcat_m9M	Total number of people in household	<10
Child nutrition-related indicators		
BF12months	Breastfeeding to 12-months	690 (11.4)
C6_IFI	Fruit intake 9-months (2 serves/day)	<10
C7_IFI	Vegetable intake 9-months (2 serves/day)	<10
C10_IFI	Inappropriate drinks at 9-months	<10
C11_IFI	Inappropriate foods at 9-months	<10
VarietyFruit_54	Variety of fruit at 54-months	<10
VarietyVeg_54	Variety of vegetables at 54-months	<10
Softdrink	Three or more soft drinks or energy drinks a week at 54-months	11 (0.2)

Table 6: Food hardship variables by response and non-response of household income variables

Household Income *		Missing Income n (%)	Responded Income n (%)
Bought cheaper food at 9-months	No	353 (45.4)	2698 (51.4)
	Yes	422 (54.3)	2550 (48.6)
Used SNG or food bank at 9-months	No	583 (75.0)	4705 (89.7)
	Yes	191 (24.6)	542 (10.3)
Bought less F&V at 9-months	No	624 (80.3)	4710 (89.6)
	Yes	150 (19.3)	545 (10.3)
Bought cheaper food at 54-months	No	332 (55.1)	3543 (65.4)
	Yes	262 (43.5)	1875 (34.6)
Used SNG or food banks at 54-months	No	494 (81.9)	5018 (92.6)
	Yes	102 (16.9)	404 (7.5)
Bought less F&V at 54-months	No	473 (78.4)	4961 (91.5)
	Yes	122 (20.2)	460 (8.5)

** Nine month income variable used for nine month food hardship variables. 54-month income variable used for nine month food hardship variables.*

Table 7: Food hardship variables by response and non-response of breastfeeding to 12 months variable

Breastfeeding to 12-months		Missing breastfeeding data n (%)	Responded to breastfeeding n (%)
Bought cheaper food at 9-months	No	333 (48.3)	2718 (51.0)
	Yes	356 (51.6)	2616 (49.0)
Used SNG or food bank at 9-months	No	580 (84.1)	4708 (88.3)
	Yes	109 (15.8)	624 (11.7)
Bought less F&V at 9-months	No	585 (84.8)	4749 (88.9)
	Yes	104 (15.1)	591 (11.1)

Appendix 2: Maternal and household characteristics of children experiencing food hardships

Table 8: *Maternal and household characteristics of 9-month old children whose mother was forced to buy cheaper food to pay for other things she needed in the past 12 months, for total cohort, Māori and Pacific.*

	Total children Total, n (row %) 2972 (49.3)	**Unadjusted (OR, 95% CI)**	**Tamariki Māori Total, n (row %) 471 (61.7%)**	**Unadjusted (OR, 95% CI)**	**Pacific children Total, n (row %) 485 (65.4%)**	**Unadjusted (OR, 95% CI)**
Maternal age	***				***	
<25 yrs	583 (57.1)	1.62 (1.38-1.89)***	170 (63.0)	--	133 (55.2)	0.49 (0.31-0.77)**
25–34 yrs	1660 (49.0)	1.17 (1.04-1.31)**	218 (59.2)		259 (69.8)	0.92 (0.59-1.43)
35yrs +	729 (45.2)	1.00 (Ref)	83 (65.9)		93 (71.5)	1.00 (Ref)
Maternal education	***					
No qual / Sec school	964 (57.0)	1.94 (1.71-2.20)***	211 (64.1)	1.54 (1.05-2.26)*	238 (62.8)	--
Diploma / Trade cer	988 (54.1)	1.72 (1.52-1.94)***	171 (63.8)	1.52 (1.02-2.26)*	183 (67.3)	
Bachelors or higher	1012 (40.6)	1.00 (Ref)	87 (53.7)	1.00 (Ref)	61 (70.1)	
Children in household	***		**		**	
1 child	918 (43.1)	1.00 (Ref)	105 (52.0)	1.00 (Ref)	74 (56.1)	1.00 (Ref)
2 children	1049 (49.4)	1.29 (1.14-1.46)***	151 (65.1)	1.72 (1.17-2.53)**	116 (65.2)	1.47 (0.94-2.33)
3 children	582 (53.6)	1.53 (1.32-1.77)***	106 (62.7)	1.55 (1.05-2.36)*	114 (63.0)	1.33 (0.84-2.17)
4 or more children	422 (62.0)	2.15 (1.81-2.57)***	108 (67.5)	1.92 (1.25-2.95)**	181 (72.1)	2.03 (1.30-3.15)**
Income-tested benefit	***		***			
Yes	963 (64.6)	2.30 (2.03-2.59)***	251 (69.7)	1.93 (1.43-2.59)***	217 (66.2)	--
No	2009 (44.3)	1.00 (Ref)	220 (54.5)	1.00 (Ref)	268 (64.7)	
Household income	***		***		*	
<$30,000	375 (71.2)	4.11 (3.35-5.04)***	102 (81.6)	4.52 (2.67-7.65)***	74 (70.5)	1.88 (1.09-3.25)*
$30,000<$50,000	557 (61.1)	2.62 (2.25-3.06)***	87 (63.5)	1.77 (1.14-2.75)**	127 (69.0)	1.76 (1.10-2.81)*
$50,000<$70,000	607 (54.5)	2.00 (1.73-2.30)***	83 (61.0)	1.60 (1.03-2.47)**	87 (60.8)	1.23 (0.75-1.99)
$70,000+	1011 (37.5)	1.00 (Ref)	105 (49.5)	1.00 (Ref)	71 (55.9)	1.00 (Ref)
Equivalised income	***		***		*	
<25K	844 (64.8)	4.04 (3.42-4.78)***	179 (71.3)	4.74 (2.61-8.58)***	222 (67.9)	1.90 (1.20-3.03)**
25<35K	627 (58.0)	3.02 (2.54-3.59)***	98 (60.9)	2.96 (1.60-5.48)**	87 (63.5)	1.57 (0.92-2.67)
35<50K	710 (42.1)	1.59 (1.36-1.87)***	79 (57.7)	2.59 (1.38-4.86)**	50 (52.6)	1.00 (Ref)
50K+	369 (31.3)	1.00 (Ref)	21 (34.4)	1.00 (Ref)		
Neighbourhood deprivation	***		**			
Low deprivation	766 (39.1)	1.00 (Ref)	41 (44.1)	1.00 (Ref)	16 (51.6)	--
Medium deprivation	1218 (48.3)	1.37 (1.21-1.56)***	150 (49.1)	1.29 (0.78-2.14)	85 (69.7)	
High deprivation	1434 (59.8)	2.25 (1.97-2.56)***	334 (65.9)	1.91 (1.19-3.08)**	384 (65.2)	

** = p<0.05, **= p<0.01, ***=p<0.001 using chi square for counts, z statistics for logistic regression (within each cell), -- = model not run as tabulated association was not significant.*

Table 9: *Maternal and household characteristics of 54-month old children whose mother was forced to buy cheaper food to pay for other things she needed in the past 12 months, for total cohort, Māori and Pacific.*

	Total children **Total, n (row %)** **2137 (35.6)**	**Unadjusted** **(OR, 95% CI)**	**Tamariki Māori** **Total, n (row %)** **408 (53.4)**	**Unadjusted** **(OR, 95% CI)**	**Pacific children** **Total, n (row %)** **431 (58.2)**	**Unadjusted** **(OR, 95% CI)**
Maternal age	***					
<25 yrs	507 (49.7)	2.35 (2.00-2.77)***	152 (56.5)	--	137 (56.9)	--
25–34 yrs	1156 (34.1)	1.24 (1.09-1.41)**	197 (53.0)		214 (57.8)	
35yrs +	474 (29.5)	1.00 (Ref)	59 (47.2)		80 (61.5)	
Maternal education	***		***		***	
No qual / Sec school	798 (47.3)	3.02 (2.64-3.45)***	190 (57.2)	2.40 (1.63-3.54)***	244 (64.6)	2.58 (1.60-4.15)***
Diploma / Trade cer	760 (41.7)	2.40 (2.11-2.74)***	158 (59.2)	2.60 (1.74-3.89)***	148 (54.4)	1.69 (1.04-2.76)*
Bachelors or higher	571 (22.9)	1.00 (Ref)	58 (35.8)	1.00 (Ref)	36 (41.4)	1.00 (Ref)
Income-tested benefit	***		***		**	
Yes	676 (64.9)	4.46 (3.87-5.13)***	190 (69.3)	2.86 (2.09-3.90)***	152 (67.6)	1.77 (1.28-2.46)**
No	1458 (29.4)	1.00 (Ref)	217 (44.2)	1.00 (Ref)	277 (54.0)	1.00 (Ref)
Household income	***		***		***	
<$30,000	271 (49.1)	3.09 (2.57-3.71)***	58 (65.2)	2.90 (1.77-4.73)***	62 (71.3)	3.49 (2.04-5.97)***
$30,000<$50,000	411 (62.8)	5.41 (4.53-6.46)***	97 (71.9)	3.95 (2.55-6.11)***	92 (74.2)	4.04 (2.49-6.56)***
$50,000<$70,000	373 (48.6)	3.02 (2.57-3.55)***	72 (57.1)	2.06 (1.36-3.13)**	76 (65.0)	2.61 (1.64-4.15)***
$70,000+	820 (23.8)	1.00 (Ref)	126 (39.25)	1.00 (Ref)	91 (41.6)	1.00 (Ref)
Equivalised income	***		***		***	
<25K	649 (56.5)	6.07 (5.11-7.21)***	149 (67.4)	5.35 (3.21-8.37)***	181 (72.4)	3.73 (2.47-5.63)***
25<35K	390 (50.9)	4.84 (4.00-5.85)***	86 (62.3)	4.28 (2.47-7.41)***	69 (55.2)	1.90 (0.92-3.93)*
35<50K	543 (29.5)	1.95 (1.66-2.29)***	89 (42.8)	1.93 (1.16-3.22)*	71 (41.3)	1.00 (Ref)
50K+	294 (17.7)	1.00 (Ref)	29 (27.9)	1.00 (Ref)		
Neighbourhood deprivation	***		***		***	
Low deprivation	403 (22.7)	1.00 (Ref)	31 (35.2)	1.00 (Ref)	14 (34.2)	1.00 (Ref)
Medium deprivation	668 (32.1)	1.61 (1.39-1.86)***	105 (49.1)	1.77 (1.06-2.96)*	68 (49.6)	1.90 (0.92-3.93)
High deprivation	975 (52.8)	3.82 (3.31-4.41)***	258 (59.6)	2.71 (1.68-4.37)***	338 (62.9)	3.28 (1.68-6.39)**

** = p<0.05, **= p<0.01, ***=p<0.001 using chi square for counts, z statistics for logistic regression (within each cell), -- = model not run as tabulated association was not significant.*

Table 10: *Maternal and household characteristics of 9-month old children living in households where the mother made use of special food grants or food banks in the past 12 months, for total cohort, Māori and Pacific.*

	Total children Total, n (row %) 733 (12.2)	Unadjusted (OR, 95% CI)	Tamariki Māori Total, n (row %) 206 (26.8%)	Unadjusted (OR, 95% CI)	Pacific children Total, n (row %) 231 (31.1)	Unadjusted (OR, 95% CI)
Maternal age	***		***			
<25 yrs	273 (26.7)	5.69 (4.44-7.29)***	96 (35.6)	2.76 (1.62-4.69)***	66 (27.4)	--
25–34 yrs	363 (10.7)	1.87 (1.48-2.36)***	89 (23.9)	1.57 (0.93-2.66)	128 (34.5)	
35yrs +	97 (6.0)	1.00 (Ref)	21 (16.7)	1.00 (Ref)	37 (28.5)	
Maternal education	***		***		*	
No qual / Sec school	356 (21.0)	9.06 (6.97-11.79)***	107 (32.1)	4.64 (2.60-8.28)***	128 (33.8)	2.10 (1.19-3.72)**
Diploma / Trade cer	303 (16.6)	6.75 (5.18-8.81)***	83 (31.0)	4.40 (2.43-7.94)***	84 (30.9)	1.84 (1.02-3.32)*
Bachelors or higher	71 (2.9)	1.00 (Ref)	15 (9.3)	1.00 (Ref)	17 (19.5)	1.00 (Ref)
Children in household	***					
1 child	179 (8.4)	1.00 (Ref)	45 (22.3)	1.00 (Ref)	34 (25.8)	--
2 children	223 (10.5)	1.28 (1.04-1.57)*	59 (25.4)	1.19 (0.76-1.85)	57 (32.0)	
3 children	159 (14.7)	1.87 (1.49-2.35)***	48 (28.4)	1.38 (0.86-2.22)	54 (29.8)	
4 or more children	171 (25.0)	3.63 (2.88-4.57)***	53 (32.3)	1.67 (1.05-2.65)*	86 (34.3)	
Income-tested benefit	***		***		***	
Yes	535 (35.8)	12.17 (10.19-14.53)***	169 (46.4)	8.60 (5.79-12.77)***	149 (45.4)	3.37 (2.43-4.66)***
No	198 (4.4)	1.00 (Ref)	37 (9.2)	1.00 (Ref)	82 (19.8)	1.00 (Ref)
Household income	***		***		***	
<$30,000	214 (40.5)	36.83 (26.43-51.32)***	69 (55.2)	13.55 (7.46-24.64)***	53 (50.5)	9.77 (4.82-19.81)***
$30,000<$50,000	191 (21.0)	14.34 (10.36-19.83)***	41 (29.9)	4.70 (2.56-8.61)***	72 (39.1)	6.16 (3.17-11.97)***
$50,000<$70,000	88 (7.9)	4.65 (3.25-6.64)***	13 (9.6)	1.16 (0.55-2.46)	37 (25.9)	3.35 (1.66-6.75)**
$70,000+	49 (1.8)	1.00 (Ref)	18 (8.3)	1.00 (Ref)	12 (9.45)	1.00 (Ref)
Equivalised income	***		***		***	
<25K	371 (28.5)	38.61 (21.59-69.05)***	98 (39.0)	9.13 (3.21-25.95)***	134 (40.98)	7.55 (3.54-16.10)***
25<35K	114 (10.5)	11.40 (6.25-20.79)***	28 (17.0)	2.91 (0.98-8.68)	32 (23.36)	3.31 (1.45-7.56)**
35<50K	45 (2.7)	2.66 (1.40-5.06)**	11 (8.0)	1.24 (0.38-4.07)	<10	1.00 (Ref)
50K+	12 (1.0)	1.00 (Ref)	<10	1.00 (Ref)		
Neighbourhood deprivation	***		***		*	
Low deprivation	72 (3.7)	1.00 (Ref)	11 (11.8)	1.00 (Ref)	<10	1.00 (Ref)
Medium deprivation	202 (8.0)	2.30 (1.73-3.10)***	61 (22.6)	1.58 (0.78-3.21)	30 (22.4)	2.20 (0.71-6.80)^{NS}
High deprivation	615 (25.6)	8.17 (6.20-10.78)***	170 (33.5)	3.15 (1.62-6.13)**	197 (33.5)	3.39 (1.17-9.83)*

** = p<0.05, **= p<0.01, ***=p<0.001 using chi square for counts, z statistics for logistic regression (within each cell), -- = model not run as tabulated association was not significant.*

Table 11: *Maternal and household characteristics of 54-month old children whose mother made use of special needs grants or food banks in the past 12 months, for total cohort, Māori and Pacific.*

	Total children Total, n (row %) 506 (8.4)	**Unadjusted (OR, 95% CI)**	**Tamariki Māori Total, n (row %) 145 (18.9)**	**Unadjusted (OR, 95% CI)**	**Pacific children Total, n (row %) 175 (23.6)**	**Unadjusted (OR, 95% CI)**
Maternal age	***		***			
<25 yrs	190 (18.6)	4.42 (3.35-5.82)***	72 (26.8)	2.51 (1.39-4.53)**	57 (23.7)	--
25–34 yrs	237 (7.0)	1.45 (1.12-1.89)**	57 (15.3)	1.24 (0.69-2.26)	82 (22.1)	
35yrs +	79 (4.9)	1.00 (Ref)	16 (12.7)	1.00 (Ref)	36 (27.7)	
Maternal education	***		***		***	
No qual / Sec school	264 (15.6)	15.18 (10.35-22.27)***	65 (19.6)	6.33 (2.68-14.95)***	115 (30.3)	9.04 (3.24-25.24)***
Diploma / Trade cer	208 (11.4)	10.55 (7.16-15.56)***	73 (27.2)	9.73 (4.12-22.97)***	54 (19.9)	5.14 (1.80-14.64)**
Bachelors or higher	30 (1.2)	1.00 (Ref)	<10	1.00 (Ref)	<10	1.00 (Ref)
Income-tested benefit	***		***		***	
Yes	334 (32.0)	13.14 (10.76-16.05)***	106 (38.6)	7.27 (4.84-10.92)***	92 (40.7)	3.56 (2.50-5.07)***
No	172 (3.5)	1.00 (Ref)	39 (7.9)	1.00 (Ref)	83 (16.2)	1.00 (Ref)
Household income	***		***		***	
<$30,000	104 (18.8)	19.71 (13.51-28.77)***	29 (32.6)	11.45 (5.63-23.30)***	37 (42.1)	13.72 (6.55-28.74)***
$30,000<$50,000	178 (27.2)	31.83 (22.30-45.45)***	58 (43.0)	17.85 (9.31-34.23)***	44 (35.5)	10.4 (5.12-21.14)***
$50,000<$70,000	82 (10.7)	10.15 (6.89-14.94)***	20 (15.9)	4.47 (2.15-9.30)***	38 (32.5)	9.10 (4.43-18.67)***
$70,000+	40 (1.2)	1.00 (Ref)	13 (4.05)	1.00 (Ref)	11 (5.02)	1.00 (Ref)
Equivalised income	***		***		***	
<25K	264 (23.0)	99.10 (40.75-240.96)***	76 (34.4)	26.73 (6.42-111.33)***	97 (38.5)	17.43 (7.42-40.90)***
25<35K	99 (12.9)	49.16 (19.93-121)***	30 (21.7)	14.17 (3.30-60.80)***	27 (21.6)	7.62 (3.04-19.11)***
35<50K	36 (2.0)	6.63 (2.60-16.94)***	12 (5.8)	3.12 (0.69-14.22)	<10	1.00 (Ref)
50K+	<10	1.00 (Ref)	<10	1.00 (Ref)		
Neighbourhood deprivation	***		***		***	
Low deprivation	34 (1.9)	1.00 (Ref)	<10	1.00 (Ref)	<10	1.00 (Ref)
Medium deprivation	108 (5.2)	2.80 (1.90-4.14)**	25 (11.7)	2.78 (0.94-8.23)	19 (13.9)	1.49 (0.48-4.66)
High deprivation	353 (19.1)	12.13 (8.48-17.37)**	115 (26.5)	7.57 (2.72-21.11)***	149 (27.7)	3.54 (1.24-10.11)*

** = p<0.05, **= p<0.01, ***=p<0.001 using chi square for counts, z statistics for logistic regression (within each cell), -- = model not run as tabulated association was not significant.*

Table 12: *Maternal and household characteristics of 9-month old children living in households where the mother went without fresh fruit and vegetables to pay for other things in the past 12 months, for total cohort, Māori and Pacific.*

	Total children		Tamariki Māori		Pacific children	
	Total, n (row %) 695 (11.5)	**Unadjusted (OR, 95% CI)**	**Total, n (row %) 70 (18.4%)**	**Unadjusted (OR, 95% CI)**	**Total, n (row %) 221 (29.8)**	**Unadjusted (OR, 95% CI)**
Maternal age	***				***	
<25 yrs	186 (18.2)	2.44 (1.90-3.14)***	54 (20.0)	--	50 (20.8)	0.68 (0.42-1.12)
25–34 yrs	379 (11.2)	1.24 (1.00-1.55)**	71 (19.1)		135 (36.4)	1.49 (0.96-2.32)
35yrs +	130 (8.1)	1.00 (Ref)	23 (18.3)		36 (27.7)	1.00 (Ref)
Maternal education	***		**		*	
No qual / Sec school	324 (19.1)	4.98 (3.98-6.23)***	76 (22.8)	3.13 (1.71 -5.72)***	127 (33.5)	1.93 (1.10-3.39)*
Diploma / Trade cer	255 (13.9)	3.41 (2.71-4.29)***	57 (21.3)	2.86 (1.53-5.32)**	75 (27.6)	1.46 (0.81-2.61)
Bachelors or higher	113 (4.5)	1.00 (Ref)	14 (8.6)	1.00 (Ref)	18 (20.7)	1.00 (Ref)
Children in household	***				*	
1 child	190 (8.9)	1.00 (Ref)	41 (20.3)	--	28 (21.2)	1.00 (Ref)
2 children	214 (10.1)	1.14 (0.93-1.40)	40 (17.2)		49 (27.5)	1.41 (0.83-2.40)
3 children	137 (12.6)	1.48 (1.17-1.86)*	27 (16.0)		56 (30.9)	1.66 (0.99-2.81)
4 or more children	153 (22.3)	2.94 (2.33-3.71)***	39 (23.8)		88 (35.1)	2.01 (1.27-3.28)**
Income-tested benefit	***		***			
Yes	344 (23.0)	3.56 (3.02-4.19)***	105 (28.9)	3.40 (2.31-5.02)***	94 (28.7)	--
No	351 (7.7)	1.00 (Ref)	43 (10.6)	1.00 (Ref)	127 (30.7)	
Household income	***		***		***	
<$30,000	154 (29.2)	10.82 (8.22-14.34)***	50 (40.0)	5.59 (3.19-9.81)***	42 (40.0)	3.57 (1.94-6.61)***
$30,000<$50,000	159 (17.4)	5.55 (4.26-7.22)***	24 (17.5)	1.78 (0.96-3.30)	64 (34.8)	2.85 (1.62-5.02)***
$50,000<$70,000	133 (11.9)	3.56 (2.72-4.66)***	22 (16.2)	1.62 (0.86-3.04)	33 (23.1)	1.61 (0.87-2.97)
$70,000+	99 (3.7)	1.00 (Ref)	23 (10.7)	1.00 (Ref)	20 (15.8)	1.00 (Ref)
Equivalised income	***		***		*	
<25K	293 (22.5)	12.35 (8.26-18.49)***	69 (27.5)	2.19 (1.02-4.68)*	117 (35.78)	3.51 (1.88-6.58)***
25<35K	145 (13.3)	6.56 (4.31-9.98)***	30 (18.2)	1.28 (0.57-2.89)	29 (21.17)	1.69 (0.83-3.46)
35<50K	80 (4.7)	2.12 (1.36-3.31)**	11 (8.0)	0.50 (0.20-1.29)	13 (13.68)	1.00 (Ref)
50K+	27 (2.3)	1.00 (Ref)	<10	1.00 (Ref)		
Neighbourhood deprivation	***		**		*	
Low deprivation	113 (5.8)	1.00 (Ref)	11 (13.6)	1.00 (Ref)	<10	--
Medium deprivation	198 (7.8)	1.60 (1.23-2.08)***	35 (14.2)	1.06 (0.51-2.19)	31 (23.1)	
High deprivation	468 (19.5)	4.41 (3.47-5.59)***	102 (23.1)	1.91 (0.98-3.75)	215 (31.7)	

** = p<0.05, **= p<0.01, ***=p<0.001 using chi square for counts, z statistics for logistic regression (within each cell), -- = model not run as tabulated association was not significant.*

Table 13: *Maternal and household characteristics of 54-month old children whose mother went without fresh fruit and vegetables to pay for other things in the past 12 months, for total cohort, Māori and Pacific.*

	Total children		Tamariki Māori		Pacific children	
	Total, n (row %) 506 (8.4)	**Unadjusted (OR, 95% CI)**	**Total, n (row %) 145 (18.9)**	**Unadjusted (OR, 95% CI)**	**Total, n (row %) 175 (23.6)**	**Unadjusted (OR, 95% CI)**
Maternal age	***				*	
<25 yrs	164 (16.1)	2.44 (1.90-3.14)***	45 (16.3)	--	62 (25.7)	0.54 (0.34-0.85)**
25–34 yrs	301 (8.9)	1.24 (1.00-1.55)	64 (17.2)		111 (29.9)	0.66 (0.44-1.00)
35yrs +	117 (7.3)	1.00 (Ref)	13 (10.3)		51 (39.2)	1.00 (Ref)
Maternal education	***		**		**	
No qual / Sec school	292 (17.3)	7.44 (5.67-9.77)***	58 (17.5)	3.22 (1.60-6.48)**	144 (38.0)	5.31 (2.58-10.92)***
Diploma / Trade cer	218 (12.0)	4.84 (3.66-6.40)***	53 (19.8)	3.75 (1.85-7.60)***	69 (25.4)	2.95 (1.40-6.19)**
Bachelors or higher	68 (2.7)	1.00 (Ref)	10 (6.2)	1.00 (Ref)	<10 (10.3)	1.00 (Ref)
Income-tested benefit	***		***		**	
Yes	278 (26.7)	5.59 (4.67-6.70)***	75 (27.3)	3.54 (2.37-5.29)***	88 (38.9)	1.79 (1.28-2.49)**
No	303 (6.1)	1.00 (Ref)	47 (9.6)	1.00 (Ref)	135 (26.3)	1.00 (Ref)
Household income	***		***		***	
<$30,000	94 (17.0)	7.72 (5.69-10.48)***	21 (23.6)	5.52 (2.77-11.03)***	37 (42.1)	6.50 (3.53-11.97)***
$30,000<$50,000	170 (26.0)	13.24 (10.07-17.41)***	41 (30.4)	7.80 (4.23-14.37)***	64 (51.6)	9.55 (5.43-16.79)***
$50,000<$70,000	107 (13.9)	6.08 (4.54-8.16)***	18 (14.3)	2.98 (1.48-5.99)**	45 (38.5)	5.60 (3.14-9.96)***
$70,000+	89 (2.6)	1.00 (Ref)	17 (5.30)	1.00 (Ref)	22 (10.1)	1.00 (Ref)
Equivalised income	***		***		***	
<25K	259 (22.6)	24.00 (15.10-38.06)***	53 (24.0)	10.62 (3.23-34.88)***	128 (51.0)	10.89 (6.07-19.54)***
25<35K	104 (13.5)	12.87 (7.91-20.95)***	28 (20.3)	8.57 (2.53-29.05)**	25 (20.0)	2.62 (1.32-5.20)**
35<50K	77 (4.2)	3.60 (2.19-5.91)***	13 (6.3)	2.24 (0.63-8.06)	15 (8.7)	1.00 (Ref)
50K+	20 (1.2)	1.00 (Ref)	<10	1.00 (Ref)		
Neighbourhood deprivation	***		***		*	
Low deprivation	45 (2.5)	1.00 (Ref)	<10	1.00 (Ref)	<10	1.00 (Ref)
Medium deprivation	126 (6.0)	2.48 (1.75-3.51)***	21 (9.8)	1.81 (0.66-4.95)	31 (22.6)	3.70 (1.07-11.82)*
High deprivation	396 (21.4)	10.53 (7.68-14.44)***	96 (22.1)	4.71 (1.86-11.96)**	186 (34.6)	6.69 (2.04-21.97)**

** = p<0.05, **= p<0.01, ***=p<0.001 using chi square for counts, z statistics for logistic regression (within each cell), -- = model not run as tabulated association was not significant.*

Appendix 3: Nutrition indicators related to food hardships: multivariate analyses

Table 14: *Adjusted multivariate nutrition indicators for those children in households who reported being forced to buy cheaper food to pay for other things*

		Total children		Tamariki Māori		Pacific children	
		N in model	Adjusted Odds Ratio 95%CI)	N in model	Adjusted Odds Ratio 95%CI)	N in model	Adjusted Odds Ratio 95%CI)
Breastfeeding duration	**Less than 12 months** **12 months or more**	4,591	1.12 (0.98-1.28) 1.00 (Ref)	--	--	--	--
Fruit served daily 9m	**Less than twice** **Twice or more**	5,141	1.24* (1.10-1.39) 1.00 (Ref)	--	--	--	--
Veg served daily 9m	**Less than twice** **Twice or more**	5,142	1.03 (0.91-1.17) 1.00 (Ref)	--	--	--	--
Tried unhealthy drinks	**Yes** **No**	5,144	1.05 (0.92-1.19) 1.00 (Ref)	606	1.24 (0.87-1.76) 1.00 (Ref)	--	--
Tried unhealthy foods	**Yes** **No**	5,144	1.20* (1.06-1.35) 1.00 (Ref)	606	1.17 (0.78-1.75) 1.00 (Ref)	--	--
Variety of fruit 54m	**Low** **Moderate** **High**	5,040	1.06 (0.92-1.23) 0.88 (0.70-1.11) 1.00 (Ref)	--	--	--	--
Variety of veg 54m	**Low** **Moderate** **High**	5,040	0.99 (0.84-1.18) 0.87 (0.66-1.14) 1.00 (Ref)	--	--	--	--
Weekly soft drink consumption	**Three or more** **Less than three**	5,037	1.10 (0.89-1.34) 1.00 (Ref)	637	1.63* (1.07-2.50) 1.00 (Ref)	--	--

Multivariate regression adjusted for child ethnicity (in total cohort analyses), maternal age, maternal education, household equivalised income, neighbourhood deprivation
** = statistically significant (P < 0.05), -- = model not run as univariate association was not significant.*

Table 15: *Adjusted multivariate nutrition indicators for those children in households who reported having made use of special food grants or food banks*

		Total children		Tamariki Māori		Pacific children	
		N in model	Adjusted Odds Ratio 95%CI)	N in model	Adjusted Odds Ratio 95%CI)	N in model	Adjusted Odds Ratio 95%CI)
Breastfeeding duration	**Less than 12 months** **12 months or more**	4,591	1.23 (0.96-1.58) 1.00 (Ref)	--	--	--	--
Fruit served daily 9m	**Less than twice** **Twice or more**	5,141	1.11 (0.89-1.40) 1.00 (Ref)	610	0.92 (0.58-1.47) 1.00 (Ref)	--	--
Veg served daily 9m	**Less than twice** **Twice or more**	5,142	1.09 (0.85-1.40) 1.00 (Ref)	--	--	--	--
Tried unhealthy drinks	**Yes** **No**	5,144	1.45* (1.17-1.80) 1.00 (Ref)	610	1.80* (1.16-2.78) 1.00 (Ref)	--	--
Tried unhealthy foods	**Yes** **No**	5,144	1.44* (1.15-1.81) 1.00 (Ref)	610	1.71 (0.97-3.02) 1.00 (Ref)	--	--
Variety of fruit 54m	**Low** **Moderate** **High**	5,044	1.39* (1.08-1.79) 1.20 (0.78-1.77) 1.00 (Ref)	637	1.76* (1.08-2.88) 2.24* (1.10-4.60) 1.00 (Ref)	522	1.56 (0.96-2.53) 1.04 (0.51-2.07) 1.00 (Ref)
Variety of veg 54m	**Low** **Moderate** **High**	5,044	1.39* (1.04-1.84) 1.91* (1.29-2.83) 1.00 (Ref)	637	1.25 (0.73-2.14) 1.53 (0.76-3.09) 1.00 (Ref)	522	1.38 (0.82-2.34) 2.55* (1.30-4.98) 1.00 (Ref)
Weekly soft drink consumption	**Three or more** **Less than three**	5,041	1.27 (0.95-1.68) 1.00 (Ref)	637	1.88* (1.13-3.10) 1.00 (Ref)	--	--

Multivariate regression adjusted for child ethnicity (in total cohort analyses), maternal age, maternal education, household equivalised income, neighbourhood deprivation
** = statistically significant (P < 0.05), -- = model not run as univariate association was not significant.*

Table 16: *Adjusted multivariate nutrition indicators for those children in households who reported having gone without fresh fruit and vegetables so that they could pay for other things*

		Total children		Tamariki Māori		Pacific children	
		N in model	Adjusted Odds Ratio 95%CI)	N in model	Adjusted Odds Ratio 95%CI)	N in model	Adjusted Odds Ratio 95%CI)
Breastfeeding duration	**Less than 12 months** **12 months or more**	--	--	544	1.73* (1.01-2.98) 1.00 (Ref)	--	--
Fruit served daily 9m	**Less than twice** **Twice or more**	5,148	1.41* (1.133-1.75) 1.00 (Ref)	--	--	555	2.19* (1.35-3.55) 1.00 (Ref)
Veg served daily 9m	**Less than twice** **Twice or more**	5,149	1.17 (0.93-1.47) 1.00 (Ref)	--	--	555	1.94 (1.17-3.21) 1.00 (Ref)
Tried unhealthy drinks	**Yes** **No**	5,151	1.67* (1.37-2.05) 1.00 (Ref)	610	1.89 (1.20-2.96) 1.00 (Ref)	555	2.17* (1.41-3.33) 1.00 (Ref)
Tried unhealthy foods	**Yes** **No**	5,151	1.15 (0.94-1.41) 1.00 (Ref)	610	1.28 (0.74-2.21) 1.00 (Ref)	--	--
Variety of fruit 54m	**Low** **Moderate** **High**	5,043	1.03 (0.81-1.31) 1.44* (1.02-2.02) 1.00 (Ref)	637	1.19 (0.72-1.97) 1.44 (0.69-2.99) 1.00 (Ref)	--	--
Variety of veg 54m	**Low** **Moderate** **High**	5,043	1.35* (1.03-1.75) 1.96* (1.36-2.81) 1.00 (Ref)	637	1.42 (0.82-2.45) 1.53 (0.75-3.14) 1.00 (Ref)	--	--
Weekly soft drink consumption	**Three or more** **Less than three**	5,040	1.69* (1.30-2.20) 1.00 (Ref)	637	2.29* (1.38-3.80) 1.00 (Ref)	--	--

Multivariate regression adjusted for child ethnicity (in total cohort analyses), maternal age, maternal education, household equivalised income, neighbourhood deprivation
** = statistically significant (P < 0.05), -- = model not run as univariate association was not significant.*

School of Population Health
Building 507
Park Ave, Grafton
Auckland, New Zealand
64 9 923 4262
www.auckland.ac.nz

The University of Auckland
Private Bag 92019, Auckland 1142
New Zealand

THE UNIVERSITY OF AUCKLAND
Te Whare Wānanga o Tāmaki Makaurau
NEW ZEALAND

MEDICAL AND HEALTH SCIENCES
SCHOOL OF POPULATION HEALTH