MINISTRY OF EDUCATION
TE TĀHUHU O TE MĀTAURANGA

Ka Ora, Ka Ako | Healthy School Lunches programme

Nutrition Evaluation

Internal Report for the Ministry of Education

New Zealand Government

Contents

Executive summary

Introduction

The Ka Ora, Ka Ako | Healthy School Lunches programme was piloted in a selection of New Zealand primary schools in 2020, with the aim to reduce food insecurity by providing access to a nutritious lunch every school day. In May 2020, a major expansion of the lunch programme was announced from approximately 21,000 to approximately 220,000 students, including secondary school students, as part of the COVID-19 Response and Recovery scheme to help cushion the blow of COVID-19 impacts on students living in already socio-economically disadvantaged households. As a result, approximately 25 percent of Year 1-13 students across New Zealand currently receive a free lunch. Ka Ora, Ka Ako is one of more than 75 initiatives in the Programme of Action that supports the Child and Youth Wellbeing Strategy.

This evaluation provides an objective assessment of whether the lunches provided through Ka Ora, Ka Ako are 'nutritious' by national and international standards. Improved nutrition is one of the key pathways to achieving improvements in educational engagement, learning and wellbeing and therefore analysing the nutritional value of the lunches provided is crucial for determining whether Ka Ora, Ka Ako is achieving its objective of improving child wellbeing.

Nutrition guidelines for Ka Ora, Ka Ako have been in use for two years, since June 2020. Lunch programme evaluations internationally have found that it can take up to five years before the benefits to learning and achievement of a free school lunch programme are observed. A 2019 study of India's free school lunch programme stated that a majority of the literature which has found negligible learning and achievement benefits has examined the effects at a population level after a maximum of two years of programme initiation (Chakraborty and Jayaraman, 2019). Chakraborty and Jayaraman (2019)'s findings showed that exposure to the free lunch programme in India over approximately five years increased test scores in primary school students by 18 percent for reading and 9 percent for math, compared to children with less than a year of exposure to school lunches. They concluded that: "students may need prolonged exposure in order to reap substantive learning benefits from the program". Therefore, evaluating the nutritional value of the meals on Ka Ora, Ka Ako is a valuable measure of short-term programme success and a potential indicator of future observable benefits on learning and achievement. The programme's intended outcomes are unlikely to be achieved to their full potential if the kai (food) provided is not nutritious.

The aim of this study was to evaluate the nutritional content of Ka Ora, Ka Ako meals. The objectives of the study were to:

» determine the contribution of Ka Ora, Ka Ako lunch meals to the daily nutrient requirements of ākonga (assessed against New Zealand/Australia Nutrient Reference Values)

» compare the nutritional value of the Ka Ora, Ka Ako meals to international lunch programme nutrient standards.

Methodology

The nutritional content of 302 Ka Ora, Ka Ako meals was analysed using Foodworks 10 nutrient analysis software. The lunch suppliers covered by the 302 meals included in this analysis provide 161,699 students with a Ka Ora, Ka Ako lunch on a given day (74.9 percent of ākonga receiving a Ka Ora, Ka Ako lunch).

The nutrient contributions from Ka Ora, Ka Ako meals were compared against the New Zealand/Australia Nutrient Reference Values (NRVs), which are the "set of recommendations for nutritional intake based on currently available scientific knowledge" (National Health and Medical Research Council Australia & New Zealand Ministry of Health, 2006). For most of the micronutrients

(vitamins and minerals) considered in this analysis, as well as energy and protein, the levels in the meals were compared to the recommended dietary intake (RDI). The RDI is the "average daily intake levels sufficient to meet the nutrient requirements of nearly all (97–98 per cent) healthy individuals in a particular life stage and gender group" (National Health and Medical Research Council Australia & New Zealand Ministry of Health, 2006). Within each year group (0-3, 4-8, and 9+) the nutrient RDIs were calculated for a male and female in the lower and upper age bracket, ie. a 5-year-old and 8-year old for years 0-3. For this evaluation, we have used 33 percent of the RDIs as our target contribution from the programme.

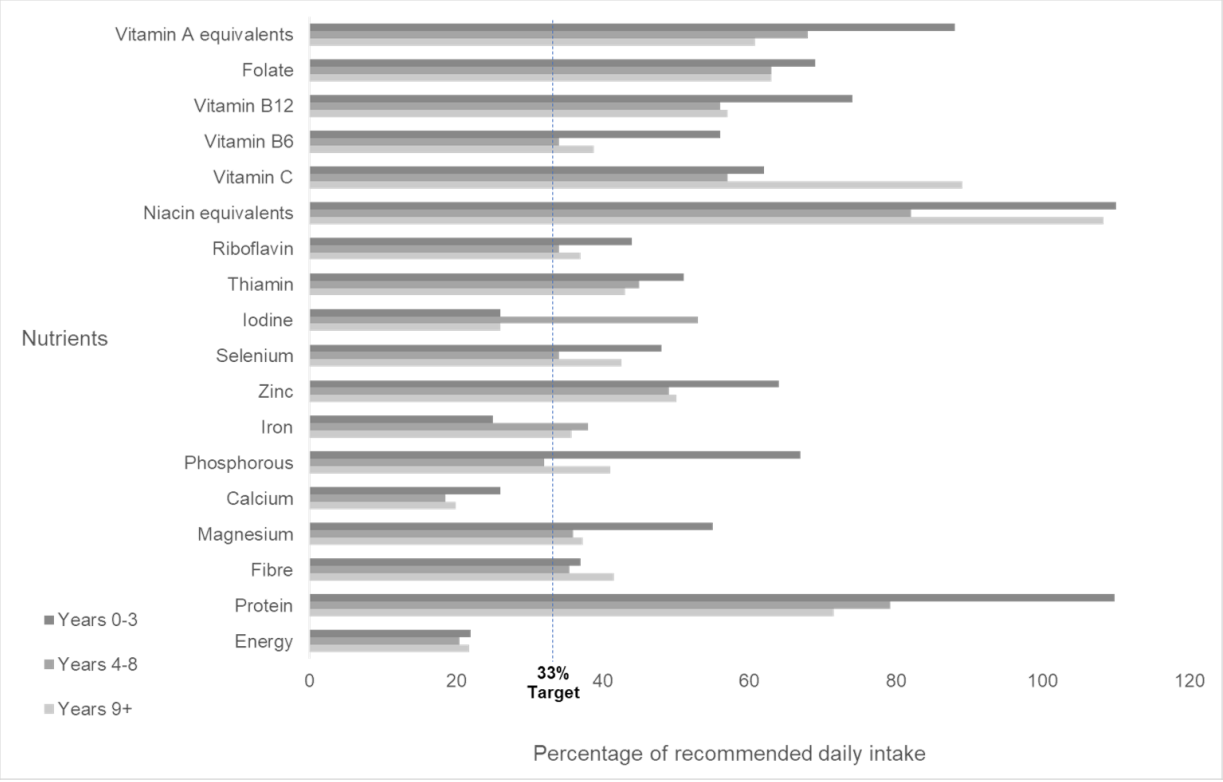
The levels of the key nutrients provided in the Ka Ora, Ka Ako meals were also compared to published nutrient-level standards for international school lunch programmes. The nutrition guidelines in Ka Ora, Ka Ako are food-based. This comparison allows the opportunity to check how the food-based Ka Ora, Ka Ako nutrition guidelines are interpreted by lunch providers (external suppliers and schools making lunches in-house) and translated into meals, and whether these align well with the international nutrient-level benchmarks.

Main findings

Overall, the analysed meals from Ka Ora, Ka Ako menus were nutrient dense, full of a range of high-quality nutritious foods to help support growth, development, wellbeing and learning. A total of 78.2 percent of the analysed nutrients surpassed the 33 percent target, including key nutrients involved with learning, behaviour and school achievement, such as folate, thiamin, vitamin B6, and vitamin B12 (Figure 1.).

Two nutrients, protein and niacin, were in levels which exceeded 100 percent of the daily needs of ākonga in some age groups; five of the 18 nutrients analysed were significantly below the 33 percent target: energy, iron, calcium, iodine, and carbohydrates (no target, but low compared to international standards).

Figure 1. Summary of average nutrient contributions from analysed Ka Ora, Ka Ako meals in the evaluation.



Conclusions and recommendations

Although protein and niacin levels were high in the analysed meals, with some age groups receiving more than 100 percent of their daily requirements, there is little evidence to suggest these nutrient levels will pose harm when consumed as part of an everyday diet.

Energy levels in the analysed Ka Ora, Ka Ako meals were low in all age groups, compared to the NRV target and to international standards. Providing 33 percent of energy needs for ākonga in a single meal is a high standard to achieve because it can be difficult for a child to consume the volume of food required in one sitting. On average, analysed meals on the programme significantly exceeded minimum weight requirements in the nutrition guidelines. Given that almost one in five New Zealand children (2-14 years) are overweight and one in eight are obese (New Zealand Ministry of Health, 2021a), and energy imbalance (consuming more energy than is used) is a main contributor to weight gain, it is likely that the overall diets of New Zealand children are energy-dense. Therefore, there may be some merit in providing a lunch that is nutrient dense but slightly lower in energy for ākonga.

However, carbohydrates on the programme were below international recommendations and so should be increased. Carbohydrates provide energy and therefore increasing carbohydrates on the programme will increase energy provision, although it is unlikely to increase energy provision to above the 33 percent target. An easy solution to increase the amount of carbohydrates provided on the programme is to add a minimum requirement for carbohydrate-rich foods into the nutrition guidelines, much like the minimum requirement for protein-rich foods.

Iron was below the 33 percent target in half of the age/sex groups analysed. With inadequate iron intake in 43.9 percent of menstruating females (2002 Child Nutrition Survey (CNS), New Zealand Ministry of Health, 2003), this is a nutrient of concern. Iron status has also been shown to be associated with cognition and academic performance in adolescents, further warranting an improvement of iron provision on Ka Ora, Ka Ako. One option to achieve an increase of iron provision in lunches is to recommend to suppliers that red meat (ie roast beef/lean mince) is provided in at least one lunch meal per week. The financial implications of this suggestion should be considered before implementation.

Calcium levels in the analysed Ka Ora, Ka Ako meals were below the 33 percent target in all age/sex categories and only passed four of the 22 international standards. The 2002 CNS findings indicated that close to one in five New Zealand females in the study had inadequate calcium intake and approximately 30 percent of 11-14 year olds (New Zealand Ministry of Health, 2003). The milk in schools programme, which previously provided milk to many New Zealand primary schools, ceased in 2021 and has been partially replaced by the breakfast kick start programme. It is unknown whether children will benefit from milk from the breakfast programme in the same way as they would have from the milk in schools programme as many breakfast programmes are run before school rather than as part of the school day, reducing the number of ākonga who access them. Regardless, the calcium requirements of the most vulnerable and food insecure ākonga in New Zealand should be a government priority. Many international lunch programmes offer milk as a drink. However, it is not feasible to mandate milk provision on Ka Ora, Ka Ako due to the current cost constraints. This is an important nutritional need that requires wider investment.

Iodine levels in the analysed Ka Ora, Ka Ako meals did not meet the 33 percent target in eight of the 12 age/sex categories. Since the fortification of most breads in New Zealand with iodised salt was mandated in 2009, modelled data shows that children's iodine intake had increased (Ministry for Primary Industries New Zealand, 2014). A study of iodine levels in New Zealand school children in 2015 (post-fortification) also showed adequate iodine status (Jones et al., 2016). Considering this, it was deemed not necessary to make any changes to the meals or standards to account for the low iodine provision. With iodised salt in bread being the main source of iodine in Ka Ora, Ka Ako meals, increasing the iodine content of lunches without also increasing sodium content is challenging and would require introducing other unfamiliar iodine-rich foods such as seaweed, shellfish and fish.

Saturated fat as a percentage contribution to energy was marginally higher than the NRV recommendations. However, the gram amounts of saturated fat in the analysed Ka Ora, Ka Ako meals

were not of concern by international standards (under 10 of the 11 recommendations for maximum saturated fat).

Sodium levels were high in the meals compared to NRVs. However, when compared to international standards, only the levels in the years 9+ meals need substantial reduction. Two of the main sodium sources in the years 9+ meals which could be reduced without having a significant negative impact on the other nutrients on the programme are sauces and processed meat. Therefore, it is recommended that to reduce sodium across Ka Ora, Ka Ako, and particularly in year 9+ meals, there is a maximum amount of processed meat that can be served and some restrictions around maximum sauce quantities when low-sodium options are unavailable.

All recommendations, except for calcium, are easily actionable. The findings from this analysis have been considered during the development of the revised nutrition standards for Ka Ora, Ka Ako. The new nutrition standards will be released in 2022.

The analysis conducted was on meals from approved menus on the programme. Therefore, these findings are a measure of expected provision, not actual provision nor intake. Provision data is essential for evaluating whether Ka Ora, Ka Ako is providing healthy kai for the needs of ākonga but *intake* data is also important to understand what nutrients are being consumed and therefore used in the body to improve health and learning outcomes. Future research and evaluation of Ka Ora, Ka Ako should consider analysing intake from lunches to assess how the meals contribute to the overall daily nutrient *intakes* of ākonga receiving a Ka Ora, Ka Ako lunch.

In this analysis we have compared nutrient provision to the ‘gold standard’ target, the NRVs. This is the best approach to ensuring Ka Ora, Ka Ako meals are providing sufficient nutrients for the needs of ākonga on the programme. Although the nutrient content of Ka Ora, Ka Ako lunches performs well compared to ideal intake levels, it is likely that this lunch provides an even higher proportion of a child’s actual daily nutrient intake. This is especially true for children in food insecure households, where their school lunch may be their only nutritious meal that day and therefore the main or sole source of some nutrients.

Background

Food insecurity in New Zealand

Approximately 1 in 6 children aged 0-17 years (187,300) in New Zealand are living in households considered to be in poverty (Department of the Prime Minister and Cabinet (DPMC), 2022). According to the 2017 UNICEF report card of 41 high-income countries, New Zealand was in the bottom three for the number of children living in a jobless household (one in seven) (UNICEF Office of Research, 2017). In our most disadvantaged communities, as high as 40 percent of parents indicated that they run out of food 'sometimes' or 'often' and around one in five children in New Zealand live in households that struggle to put enough good-quality food on the table (Duncanson et al., 2021).

Food security for whānau is a growing concern, particularly given the recent large rise in inflation. In 2020, 30 percent of New Zealanders spent more than 30 percent of their incomes on housing alone (target for unaffordable housing (Statistics New Zealand, 2022)). In 2018, the United Nations, Food and Agriculture Organization, and the World Health Organization reported that approximately 14 percent of the New Zealand population is food insecure (FAO et al., 2019). Data from national health surveys show that the prevalence of food insecurity is much higher in Māori and Pacific populations. A recent Ministry of Health New Zealand Health survey found that 37.1 percent of Pacific children and 28.6 percent of Māori children lived in food-insecure households (New Zealand Ministry of Health, 2019). In the 2019 December quarter, 307,291 grants for food were provided at a cost of $30.3 million NZD, more than triple the number in 2014 (Ministry of Social Development, 2019). This number has grown substantially since the start of the COVID-19 pandemic. In the June 2020 quarter, 566,647 Special Needs Grants (totalling over $64 million) for food were approved (Ministry of Social Development, 2020). A 2022 study found that one of the coping strategies for families with a low income relative to essential household outgoings was to reduce the quantity and quality of food purchased (Macaulay et al., 2022).

Food insecurity impacts not just the quantity of food provided for New Zealand tamariki, but also the quality and variety of food, which in turn affects the range of nutrients available. Regular nutritious kai provides the nourishment brains and bodies need to function optimally and is vital for children's physical, mental and educational development.

Studies show that children in food insecure households are significantly more likely to:

- not meet fruit and vegetable dietary guidelines;
- not eat breakfast and/or lunch;
- eat fast food more often;
- eat processed snacks and fizzy drinks more often (New Zealand Ministry of Health, 2019; Utter et al., 2011).

A study in the United States found that after adjustment for other contributing variables, children between 6-11 years of age facing food insecurity had significantly lower arithmetic scores, were more likely to need to repeat a year level at school, and had social and behavioural difficulties (Alaimo et al., 2001). In the same study, food insecure teenagers also had a higher rate of social and behavioural issues and were more likely to have been suspended from school (Alaimo et al., 2001).

The Ka Ora, Ka Ako | Healthy School Lunches programme was piloted in a selection of New Zealand primary schools in 2020, with the aim to reduce food insecurity by providing access to a nutritious lunch every school day. In May 2020, a major expansion of the lunch programme was announced from approximately 21,000 to approximately 220,000 students, including secondary school students, as part of the COVID-19 Response and Recovery scheme to help cushion the blow of COVID-19 impacts on students living in already socio-economically disadvantaged households. As a result, approximately 25 percent of Year 1-13 students across New Zealand currently receive a free lunch. Ka Ora, Ka Ako is

one of more than 75 initiatives in the Programme of Action that supports the Child and Youth Wellbeing Strategy.

Nutrition status of New Zealand children

The New Zealand Child Nutrition Survey (CNS) conducted in 2002 is the most recent representative study of the nutritional status of New Zealand children (New Zealand Ministry of Health, 2003). The 2002 CNS was a cross-sectional population survey of 3,275 New Zealand children aged 5–14 years. Dietary intake was assessed using a 24-hour diet recall, with repeat 24-hour diet recalls performed on a subsample of children in the study to adjust for usual intake across more than a single day. Although dietary patterns are likely to have changed significantly in 20 years, the 2002 CNS remains the largest nationally representative data available to infer nutritional status of New Zealand children. The next child nutrition survey is currently being scoped.

Findings from the 2002 CNS highlighted that:

» overall, New Zealand children had adequate intake of most nutrients
» younger children (5-6 years) had substantially better nutritional status than the older children
» the younger children were more likely to have an appropriate body size.

Despite the general positive conclusions, there were some findings that should be highlighted:

» Although inadequate iron intake wasn't common overall (6.6 percent), it was significantly higher among females (12.0 percent) compared to males (1.6 percent) and there were clear ethnic differences. Pacific females had a higher prevalence of inadequate intake than NZ European/Other (NZEO) females (15.4 percent vs 10.5 percent). Of particular concern was that 43.9 percent of menstruating females had inadequate iron intake.

» One in five children in the CNS were overweight and one in ten were obese. These figures disproportionately affected Māori and Pacific children compared to NZEO children: Pacific males (33.9 percent overweight; 26.1 percent obese) and females (32.9 percent; 31.0 percent); Māori males (19.6 percent; 15.7 percent) and females (30.6 percent; 16.7 percent); and NZEO males (18.4 percent; 4.7 percent) and females (18.8 percent; 6.0 percent).

» Iodine status (blood measure) was low in children in the 2002 CNS. By the International Council for the Control of Iodine Deficiency (ICCIDD) standards, the median (6.6 µg/dL) status of CNS participants was indicative of mild iodine deficiency.

» Calcium intake was low in the 2002 CNS: 15.1 percent of children in the survey had inadequate intakes and children 11–14 years had a significantly higher rate of inadequate intake (males 28.7 percent; females 29.6 percent). Pacific children had the highest levels of inadequate calcium intake (40.5 percent of Pacific males and 45.2 percent of Pacific females).

» Protein intake in the CNS participants exceeded requirements in all age groups, with children consuming more than double their age-specific recommended intakes.

To summarise, the findings from the 2002 CNS found that inadequate iron intake was high in menstruating females; overweight and obesity rates were significantly higher in Māori and Pacific children compared to NZEO children; iodine status was low (however iodine fortification in 2009 should have mitigated this); calcium intake was low; and protein intakes exceeded recommendations in all age groups.

School lunches in New Zealand

Very few studies have investigated the nutritional content of school lunches in general in New Zealand.

One study analysed food consumed during school hours in 2,247 of the participants from the 2002 CNS (5-14 year olds) (Regan et al., 2008). They found that around one fifth of children's daily nutrient intake was consumed during 'lunch time' (12:00pm-2:00pm) and around 30 percent of their nutrient intake was consumed during school hours (9:00am – 2:00pm). The percentages of daily energy and nutrient intake consumed during these two time periods are summarised in *Table 1* below. Regan et al (2008) found that crisps and snack foods were the most frequently consumed foods during 9:00am-11:59am (28.6 percent of participants), followed by biscuits and fruit (21.3-22.3 percent). Snack foods and biscuits were found to contribute the most to energy intake and fat during the morning. Sandwiches were the most consumed food item during 12:00-2:00pm (44.0 percent), followed by fruit (35.8 percent). Sandwiches provided around one third of the energy and fat consumed at lunchtime. Biscuits, crisps and snacks, and sweetened beverages were consumed by approximately 16 percent of children during 12:00-2:00pm. Pies and sausage rolls were consumed by 16.3 percent of Pacific children compared to 9.6 percent of Māori children and 6.4 percent of NZEO children. Sweetened beverages were consumed by 24.6 percent of Pacific children compared to 18.4 percent of Māori children and 13.8 percent of NZEO children.

Another study utilising data from the 2002 CNS found that of the 3,275 students surveyed, 58 percent bought some or most of their food and drink from the school canteen or tuckshop (around half of the primary school children surveyed (school years 0 to 6), and almost three quarters of the intermediate and secondary school students surveyed (school years 7 to 11)) (Utter et al., 1248). Therefore, the findings in Regan et al (2008) reflect food consumption from lunches brought from home as well as purchased lunch items. The Youth'12 overview, a national survey of secondary school students (8,500 students) also found that 39 percent of students got their lunch from shops or takeaways rather than a packed lunch from home and revealed that purchasing a lunch was more common for students from high deprivation neighbourhoods (52 percent) (Clark et al., 2013).

Table 1: Nutrient contributions (percentage) from food consumed during school hours.

Nutrient %	9:00am-11:59am	12:00-2:00pm	Total 9:00am-2:00pm
Energy	11.1	20.4	31.5
Protein	7.7	17.7	25.4
Fat	12.0	19.6	31.6
Saturated fat	12.6	18.3	30.9
Carbohydrates	11.8	21.8	33.6
Sugars	12.9	20.0	32.9
Calcium	9.2	17.2	26.4
Iron	8.6	16.3	24.9
Vitamin A equivalents	8.2	14.0	22.2

A study conducted in 2009 investigated the school lunches of 927 children (5-11 years) from six urban primary schools in the Manawatu region (Dresler-Hawke et al., 2009). Two schools were selected with a lower decile (1 or 2), two schools with a medium decile (5 or 6), and two schools with a high decile (9 or 10). This research involved taking photos of lunch boxes to analyse what was provided and assessing food waste from disposal bins to calculate what was consumed.

Dresler-Hawke et al (2009) found that bread was the most common food item in the lunch boxes, with 71 percent of lunchboxes containing sandwiches. White bread was the most common bread variety included in lunch boxes. Other carbohydrate sources included wraps, ciabatta buns, noodles and hot chips, but these items were only in 1.6 percent of lunch boxes, leaving approximately 27 percent of lunches without a main carbohydrate source. Close to a third of lunches contained no fruit or vegetables and protein foods were in less than 5 percent of lunchboxes. However, this study was limited by not

being able to open sandwiches to reveal sandwich fillings, so it is plausible that some sandwiches would have contained vegetables and/or a protein source. Dairy items were found in 37 percent of the lunches and 44 percent of the lunches contained cakes/biscuits/muffins. Muesli bars were included in 45 percent of lunchboxes from home and crisps were in 57 percent of lunchboxes. On average, the lunches contained three serves of processed food such as biscuits, cakes, buns, chocolate and/or lollies. Lunches consumed at the lower decile schools contained higher fat and sugar contents, compared to lunches consumed at the higher decile schools.

The waste analysis found that more than 80 percent of the food waste was sandwiches, fruit, and dairy foods, compared to only 20 percent of processed food items. Interestingly, this did not differ between deciles. This reveals that although availability and provision differ according to deciles, acceptance of healthier food items and actual consumption might be similar. The lead authors of this study later went on to investigate children's awareness of healthy food choices and asked children to select items for a 'healthy' lunchbox and items for their 'dream' lunchbox if they were given free choice (Whitehead et al., 2012). Eleven of the fifteen items most commonly selected in the 'healthy' lunch boxes were fruits and/or vegetables, whereas only two of the fifteen items in the 'dream' lunch box were fruits (no vegetables). This paper emphasised that although children may recognise what foods have nutritional value, that doesn't translate into wanting to eat them.

Ka Ora, Ka Ako nutrition guidelines

Nourishing ākonga with a healthy lunch not only provides their bodies and brains with the nutrients needed to fuel their everyday needs but helps them to achieve their potential. Exposure to and acceptance of healthy kai during childhood influences future food choices. Our tamariki and rangatahi are our future. Improvements to nutrition in childhood and early adulthood are not just beneficial for the individual child but have the potential to influence the future health of New Zealand.

Ka Ora, Ka Ako introduced nutrition guidelines in June 2020, recognising that to best provide healthy kai to nourish ākonga, lunch providers on the programme (external suppliers and schools making lunches in-house) would benefit from guidance on what 'healthy kai' is. The nutrition guidelines on the programme are based on the Ministry of Health's guidance for food and drink in schools (Ministry of Health New Zealand, 2020). This guidance is based on a traffic light system which classifies food items as red, amber, or green. Suppliers are provided with guidance on which foods meet the different criteria. Meals on the programme should consist of mostly green category ingredients. Green items are a good source of nutrition, are generally lower in saturated fat, salt and sugar, and are mostly whole and less processed. Amber items are limited to 25 percent or less of the Ka Ora, Ka Ako meals. Amber items are not part of an everyday diet. They may have some nutritional value but are often more processed and in larger serving sizes can contribute to excess kilojoule (energy) consumption. Red items are not permitted on the Ka Ora, Ka Ako programme. Red items are food items with poor nutritional value; they are high in saturated fat, salt and/or sugar and they can contribute to consuming excess calories.

In addition to meeting the traffic light criteria, there are also minimum criteria that suppliers must meet regarding meal size (grams), protein-containing foods and vegetable content of the meal.

The Ka Ora, Ka Ako nutrition team at the Ministry of Education work with lunch providers to review and approve their menus each term, ensuring they meet the nutrition standards. The existing nutrition guidance has proved difficult to apply to a lunch meal. It was originally designed for increasing availability of healthy products in school canteens and does not necessarily result in a balanced meal. As a result, the nutrition guidance is under revision and revised standards are expected to be available for lunch providers from Term 4, 2022 and implemented from Term 1, 2023.

Aim and objectives

The aim of this study was to evaluate the nutritional content of Ka Ora, Ka Ako meals.

The objectives of the study were to:

» determine the contribution of Ka Ora, Ka Ako lunch meals to the daily nutrient requirements of ākonga (assessed against New Zealand/Australia Nutrient Reference Values (National Health and Medical Research Council Australia & New Zealand Ministry of Health, 2006))

» compare the nutritional value of the Ka Ora, Ka Ako meals to international lunch programme nutrient standards.

Methodology

The nutritional content of 302 Ka Ora, Ka Ako meals was analysed using Foodworks 10 nutrient analysis software. Meals were selected at random from suppliers' submitted menus between Term 3, 2021 and Term 2, 2022. Suppliers were selected at random using the list of suppliers for each participating school. Once all the data was entered, it was checked against the list of suppliers for each year group. Meals were added or removed where necessary in order to be representative and ensure that meals from each of the top ten suppliers were included as they cover a large number of ākonga, schools and kura participating in Ka Ora Ka Ako. The data was then quality checked and peer reviewed before being analysed.

The suppliers covered by the 302 meals included in this analysis provide 161,699 ākonga with a Ka Ora, Ka Ako lunch on a given day (74.9 percent of ākonga on the programme). The breakdown of the meals included in the analysis can be found in *Table 2*. Included in the analysis are meals from both suppliers (external model) and schools and kura preparing their own lunches (internal model). The external model is where a school is provided lunches by a food business (or other non-commercial entity). External suppliers usually operate a central kitchen and deliver lunches to one or more schools daily. Occasionally, an external supplier will set up a kitchen on school grounds, however the lunch supplier still operates as a business and manages the end-to-end lunch provision process. The internal model is where the school or kura takes on the responsibility of making their own lunches within the school, rather than outsourcing this to an external supplier.

Of the 302 meals, 100 meals were prepared for years 0-3 (including 19 internal model meals and 81 external model meals). The 100 meals covered a total of 50 suppliers, who service 36,560 (72 percent) of the years 0-3 students on the programme. A total of 97 meals were prepared for years 4-8 (including 17 internal model meals and 80 external model meals). The 97 meals covered a total of 44 suppliers, who service 73,427 (76 percent) of the years 4-8 students on the programme. A total of 105 meals were included which were prepared for years 9+ (including 26 internal model meals and 79 external model meals). The 105 meals covered a total of 58 suppliers, who service 51,712 (75 percent) of the Year 9+ students on the programme.

Table 2: Details of the meals included in this evaluation

Year level	total meals	internal meals	external meals	total number of suppliers	number of students serviced by these suppliers (%)
0-3	100	19	81	50	36,560 (72%)
4-8	97	17	80	44	73,427 (76%)
9+	105	26	79	58	51,712 (75%)
Totals	**302**	**62**	**240**	**NA**	**161,699 (75%)**

The nutrient contributions from Ka Ora, Ka Ako meals were compared against the New Zealand/Australia Nutrient Reference Values (NRVs), which are the "set of recommendations for nutritional intake based on currently available scientific knowledge" (National Health and Medical Research Council Australia & New Zealand Ministry of Health, 2006). For most of the micronutrients (vitamins and minerals) considered in this analysis, as well as energy and protein, the levels in the meals were compared to the recommended dietary intake (RDI). The RDI is the "average daily intake levels sufficient to meet the nutrient requirements of nearly all (97–98 per cent) healthy individuals in a particular life stage and gender group" (National Health and Medical Research Council Australia & New Zealand Ministry of Health, 2006). Within each year group (0-3, 4-8, and 9+) the nutrient RDIs were calculated for a child in the lower and upper age bracket ie a 5-year-old and 8-year-old for years 0-3. Reference values from the NRVs were used when selecting height and weight brackets for the different age groups analysed.

The international literature shows that lunch programmes across the world use a range of nutrient targets or standards for their meals. For the purpose of this evaluation, we have chosen to use a blanket 33 percent of the recommended dietary intake for the nutrients analysed as our target contribution from the programme; this was used across a number of countries, including Japan (ranged from 33-50 percent depending on the nutrient), Taiwan (ranged from 33-40 percent depending on the nutrient), and South Korea (33 percent for all selected nutrients) (Kim et al., 2017). We do note however, that consuming 33 percent of daily energy needs within one meal is not always feasible for children. Therefore, comparisons of energy provision to a 33 percent standard should be interpreted with caution.

The levels of the key nutrients provided in the Ka Ora, Ka Ako meals were then compared to published nutrient-level standards for international school lunch programmes. Not all international school lunch programmes have publicly available nutrient-level standards, but many have been documented in the literature. In some instances, these are mandated for the programme, and in others they serve as recommendations for suppliers.

The nutrition standards on Ka Ora, Ka Ako are food-based. Food-based nutrition standards are the simplest and most practical way to ensure suppliers can comply with guidance to provide healthy school lunches. What this comparison allows is an opportunity to check how the food-based Ka Ora, Ka Ako nutrition standards are interpreted by suppliers into meals, and whether these align well with the international nutrient-level benchmarks.

Findings

The nutritional content of the Ka Ora, Ka Ako meals relative to the NRVs is displayed in *Table 3* and *Appendix 1.* Comparisons to international nutrient-level standards are displayed in *Tables 4 - 9*.

Of the 18 key nutrients analysed against the NRVs, 15 (83.3 percent) exceeded the 33 percent target in the 0-3- and 4-8-year groups, 16 (88.9 percent) exceeded the target in the 13-year-olds (young age of the year 9+ group), 14 (77.8 percent) in the 18-year-old females, and 12 (66.7 percent) in the 18-year-old males (*Table 3*).

Table 3: Nutritional contribution (percentage) of Ka Ora, Ka Ako meals to daily nutrient requirements

	Years 0-3 meals				Years 4-8 meals				Years 9+ meals			
Nutrients (% RDI)	**5-year-olds**		**8-year-olds**		**9-year-olds**		**12-year-olds**		**13-year-olds**		**18-year-olds**	
	female	male	female	male	female	male	female	male	female	male	female	male
Energy (kj)	25	23	21	19	23	21	20	18	24	21	24	18
Protein	**130**	**127**	91	91	96	90	67	64	83	77	76	50
Thiamin	51	51	51	51	45	45	45	45	48	48	40	36
Riboflavin	44	44	44	44	34	34	34	34	42	42	35	29
Niacin equivalents	**110**	**110**	**110**	**110**	82	82	82	82	**120**	**120**	**103**	90
Vitamin C	62	62	62	62	57	57	57	57	89	89	89	89
Vitamin B6	56	56	56	56	34	34	34	34	43	43	36	33
Vitamin B12	74	74	74	74	56	56	56	56	65	65	49	49
Folate -DFE	69	69	69	69	63	63	63	63	72	72	54	54
Vitamin A equivalents	88	88	88	88	68	68	68	68	69	69	59	46
Magnesium	55	55	55	55	36	36	36	36	46	46	30	27
Calcium	26	26	26	26	21	21	16	16	20	20	20	20
Phosphorous	67	67	67	67	32	32	32	32	41	41	41	41
Iron	25	25	25	25	38	38	38	38	44	44	23	32
Zinc	64	64	64	64	49	49	49	49	60	60	52	28
Selenium	48	48	48	48	34	34	34	34	48	48	40	34
Iodine	26	26	26	26	53	53	53	53	29	29	23	23
Fibre*	37	37	37	37	39	32	39	32	48	40	44	34

Notes: Blue cells represent ≥33 percent of daily requirements
Orange cells represent <30 percent of daily requirements
Yellow cells represent between 30-32 percent of daily requirements (within 10 percent of the target cut-off)
*Adequate intake
Contributions greater than 100 percent of daily requirements are in bold.

Micronutrients – Vitamins

Vitamin A equivalents

Vitamin A is a fat-soluble vitamin that can be obtained from two different sources:

» retinoids, found in animal products such as: liver, salmon, dairy products and eggs

» carotenoids (eg beta-carotene), which are then converted into vitamin A in the body. Carotenoids are found in plant-based foods such as spinach, broccoli, carrots, kumara, pumpkin, apricots and rock melon.

The different forms of vitamin A in the body have various functions including maintaining healthy vision, supporting a healthy immune system, reproduction, and growth and development. The most common signs of low vitamin A intake are vision problems including night blindness, corneal drying, softness of the cornea, grey spots on the eye, and blindness. Deficiency can also weaken the immune system.

Vitamin A (equivalents) levels in the analysed Ka Ora, Ka Ako meals exceeded the 33 percent target in all age/sex categories (ranging from 46-88 percent of daily requirements).

Levels of vitamin A (equivalents) in the years 0-3 meals passed all 10 international standards (*Table 5*); levels in the years 4-8 meals passed all seven standards (*Table 7*); and levels in year 9+ meals passed all four standards (*Table 9*).

The main sources of vitamin A (equivalents) on the programme were carrots, cheese, spinach, and other salad or mixed vegetables.

Although the 2002 CNS concluded that vitamin A intake was unlikely to be a concern in New Zealand children, the rates of inadequate intakes were significantly higher than other nutrients analysed (New Zealand Ministry of Health, 2003). Rates of inadequate intake (New Zealand Ministry of Health, 2003) were:

» 19.7 percent for Pacific males
» 37.4 percent for Pacific females
» 12.9 percent in Māori males
» 4.0 percent in Māori females
» 3.8 percent of NZEO males
» 7.9 percent of NZEO females.

With almost one in five Pacific males and more than one in three Pacific females in the 2002 CNS having inadequate vitamin A intake, it is reassuring that Ka Ora, Ka Ako meals will be providing ākonga at participating schools and kura with between 46-88 percent of their daily requirements in a single lunch meal.

Thiamin

Thiamin, also known as vitamin B1, helps the body turn food into energy. This vitamin is found in small quantities in various foods such as wholegrain breads and cereals, meat and fish, and legumes. Children who eat a nutritious diet that meets their energy needs will also be meeting their thiamin needs. Inadequate thiamin intake can cause neurological problems including confusion and memory loss, as well as muscle weakness and heart problems. Adequate thiamin intake is important for children's behavioural health. Studies have shown that thiamin deficiencies have been associated with increased aggression, irritability, and anti-social behaviour, particularly in adolescents (Benton et al., 1997).

Thiamin levels in the analysed Ka Ora, Ka Ako meals exceeded the 33 percent target across all age/sex categories (ranging from 36-51 percent of daily requirements).

Levels of thiamin in the years 0-3 meals passed four of the six international standards (*Table 5*); levels in the years 4-8 meals passed one of the three standards (*Table 7*); and levels in year 9+ meals were below the three published standards (*Table 9*). Although the levels of thiamin in Ka Ora, Ka Ako meals were lower than seven of the 12 international lunch programme standards, this is not of concern. The percentage contribution of thiamn from the Ka Ora, Ka Ako meals to New Zealand children's daily needs is sufficient and the 2002 CNS findings indicated that thiamin intake was adequate for most of the children surveyed (New Zealand Ministry of Health, 2003).

The main food sources of thiamin on the programme were wholemeal bread products, pork, chicken, and pasta.

Riboflavin

Riboflavin, also known as vitamin B2, helps turn food into energy. Riboflavin also has an antioxidant role, protecting the body from oxidative stress. It is important for the normal growth, development and function of body cells. A major food source of riboflavin is milk and milk products (cheese, yoghurt), but it can be sourced from dark green leafy vegetables and whole grain breads and cereals. Riboflavin deficiency can cause skin disorders, cracks and sores at the corners of the mouth, swollen and cracked lips, a sore throat, and pain, discolouration, and smoothness of the tongue.

Riboflavin levels in the analysed Ka Ora, Ka Ako meals exceeded the 33 percent target in 11 of the 12 age/sex categories (ranging from 34 to 44 percent of daily requirements). Riboflavin was marginally below the 33 percent target in 8-year-old males (29 percent).

Levels of riboflavin in the year 0-3 meals passed two of the six international standards (*Table 5*); levels in the years 4-8 meals were below the three standards (*Table 7*); and levels in year 9+ meals were below the two standards (*Table 9*). Although the riboflavin in Ka Ora, Ka Ako meals was below nine of the 11 international standards, riboflavin contents of the meals is not of concern. The percentage contribution to daily needs was between 29 to 44 percent which is adequate for provision from a single meal. Findings from the 2002 CNS indicated that there was very negligible risk of riboflavin deficiency in New Zealand children (New Zealand Ministry of Health, 2003).

The main sources of riboflavin on the programme were cheese, yoghurt, chicken, and wholemeal bread products.

Niacin

Niacin, also known as vitamin B3, is another B vitamin that helps turn food into energy. Importantly, unique to niacin, more than 400 enzymes depend on this vitamin for various chemical reactions in the body. It is found in a wide range of nutritious foods such as meat, chicken, fish, milk, eggs, wholegrains, legumes and nuts, but also can be made from an amino acid called tryptophan (found in high-quality protein foods). Inadequate intake of niacin results in symptoms such as diarrhoea, vomiting, stomach pains, swollen and red tongue, depression, extreme tiredness, memory loss, headaches, and rough skin.

Niacin levels in the analysed Ka Ora, Ka Ako meals exceeded the 33 percent target across all age/sex groups (ranging from 82 to 120 percent of daily requirements). In seven of the 12 age groups, niacin levels were above 100 percent of recommended daily intakes.

Niacin was not a nutrient of interest in international standards. As such, no comparisons to international standards were made.

The main food sources of niacin on the programme were chicken, cheese, beef, and wholemeal bread products.

Niacin intakes in the 2002 CNS were considered adequate for most children (New Zealand Ministry of Health, 2003). The Upper Level of Intake (UL) in the NRVs is the "highest average daily nutrient intake level likely to pose no adverse health effects to almost all individuals in the general population" (National Health and Medical Research Council Australia & New Zealand Ministry of Health, 2006). The upper

level for niacin intake is focused on intake from fortified foods or supplements. With chicken, cheese, and beef contributing more than 50 percent of niacin in the Ka Ora, Ka Ako meals (not niacin-fortified foods), the contribution of the lunch meals towards the UL is not likely to pose any health risk to ākonga at participating schools and kura.

Vitamin B6

Vitamin B6 plays a role in many different biochemical reactions in the body, particularly with the breakdown and formation of protein. Vitamin B6 also plays an important role in cognitive development and mood regulation and is important for the regulation of homocysteine levels in the body (Malouf & Evans, 2003). High homocysteine levels can damage neurons (the main cells in the brain and nervous system). Vitamin B6 is also involved in the formation of glucose, immune system function, and the formation of haemoglobin (protein in red blood cells). It is found in a wide range of foods such as chicken, fish, meat and organ counterparts, starchy vegetables such as potatoes, legumes, and non-citrus fruit. Insufficient vitamin B6 can cause a type of anaemia (microcytic anaemia), itchy rashes, mouth conditions such as cracks at the corners, scaly and cracked lips, and a swollen tongue. Very low intakes can lead to depression, confusion, convulsions, migraines, chronic pain, and a weak immune system.

Vitamin B6 levels in the analysed Ka Ora, Ka Ako meals met or exceeded the 33 percent target in all age/sex categories (ranging from 33 to 56 percent of daily requirements).

Vitamin B6 was not a nutrient of interest in international standards. As such, no comparisons to international standards were made.

The main sources of vitamin B6 on the programme were chicken and wholemeal bread products.

In the 2002 CNS, it was deemed that New Zealand children had sufficient vitamin B6 intake based on requirements relative to protein intake (New Zealand Ministry of Health, 2003).

Vitamin B12

Vitamin B12 is involved in the formation of DNA and genetic material. It helps keep the body's blood healthy, preventing a type of anaemia called megaloblastic anaemia. Vitamin B12 is also important for brain development, the maintenance of healthy nerve cells, and general cognitive function (Venkatramanan et al., 2016). Vitamin B12 is essentially only found in animal foods, such as: meat, chicken, fish, organs, dairy products, and eggs. Some plant-based cereals, spreads and milk alternatives may be fortified with vitamin B12. Vitamin B12 deficiency causes megaloblastic anaemia, which can cause extreme tiredness, weakness, poor concentration, and irritability. Additional symptoms include loss of appetite, weight loss, pale skin, sore tongue, depression, confusion, and poor memory.

Vitamin B12 levels in the analysed Ka Ora, Ka Ako meals exceeded the 33 percent target in all age/sex categories (ranging from 49 to 74 percent of daily requirements).

Vitamin B12 was not a nutrient of interest in international standards. As such, no comparisons to international standards were made.

The main sources of vitamin B12 on the programme were cheese, beef (including mince), and chicken.

The 2002 CNS showed that very few children had low B12 intakes (less than 0.1 percent had inadequate vitamin B12 intake) (New Zealand Ministry of Health, 2003).

The high levels of vitamin B12 in Ka Ora Ka Ako meals (49 to 74 percent of daily needs) may be advantageous for achieving some of the desired outcomes of the programme, as studies have shown positive associations between vitamin B12 status and children's cognition and academic performance. For example, a longitudinal study in Colombia of 3,156 children aged 5-12 years found that vitamin B12 deficiency was associated with a significantly increased risk of needing to repeat a grade (2.36 fold) and increased school absences (1.89 fold) (Duong et al., 2015). Another piece of research conducted using 2,014 children 6-16 years of age from the NHANES-III study in the USA found that higher vitamin

B12 status was associated with higher math and digit span test results, which are measures of attention and short-term memory (Nguyen et al., 2013).

Folate

Folate is a B vitamin that plays an important role (alongside vitamin B12) in the formation of DNA and genetic material. Folate is required by the body for cell division, which is an important step for body cell growth and repair. Folic acid is the synthetic version of folate which is used in fortification and supplementation. Folate from food is found in leafy vegetables such as spinach, asparagus, brussel sprouts, broccoli, nuts and legumes. Deficiency of folate results in a type of anaemia called megaloblastic anaemia, which in turn causes weakness, extreme tiredness, poor concentration, irritability, headaches, shortness of breath and heart palpitations. Other symptoms of low folate include mouth and tongue sores, and colour changes to the skin, hair or fingernails.

Folate levels in the analysed Ka Ora, Ka Ako meals exceeded the 33 percent target in all age/sex categories (ranging from 54 to 72 percent of daily requirements).

Levels of folate in the years 0-3 meals passed the three international standards (*Table 5*); levels in the years 4-8 meals passed the three international standards (*Table 7*); and levels in year 9+ meals passed all five of the standards (*Table 9*).

The main food sources of folate on the programme were wholemeal bread products, fruit (such as apples and oranges), and salad vegetables.

Folate intakes in the 2002 CNS were adequate overall, with less than10 percent of New Zealand children experiencing inadequate intake (New Zealand Ministry of Health, 2003). However, females were significantly more at risk of inadequate intake (8.8 percent vs 0.6 percent males) and Pacific children were more at risk of inadequate intakes than NZEO and Māori children. Pacific females were twice as likely to have inadequate intakes compared to NZEO females and Pacific males were more than 10 times as likely to have inadequate intakes compared to NZEO males.

A study of 358 15-year-olds in Sweden found that folate intake was significantly associated with academic achievement (sum of school grades) and that this association remained significant even after adjustment for other predictors such as gender, smoking status, and mother's education (Nilsson et al., 2011). Nguyen et al (2013) also found in a study of 3,970 children 6-16 years of age from the US NHANES III cohort, that even after adjusting for confounding variables such as sex, age, race/ethnicity, and income-poverty ratio, children with the highest folate intake scored higher on reading and mean block design (assesses perceptional reasoning index and executive function) (Nguyen et al., 2013). This finding also remained significant after adjustment for other nutrients. These findings highlight that adequate folate intake is an important contributor to the academic achievement and learning potential of ākonga. Ka Ora, Ka Ako meals providing between 54 to 72 percent of ākonga daily folate needs is a positive contribution towards enhancing their wellbeing and learning.

Vitamin C

Vitamin C, also known as ascorbic acid, plays an important antioxidant role, helping to protect cells from general daily damage. Vitamin C is essential for making the wound-healing protein called collagen; vitamin C helps iron be absorbed by the body and supports an optimal working immune system. Vitamin C also plays a significant role in the production and release of important chemicals in the brain (Harrison & May, 2009). Vitamin C needs are easily obtained with a daily diet of colourful fruits and vegetables. Citrus fruits such as oranges and grapefruit are excellent sources, alongside kiwifruit, strawberries, mangoes, melons, capsicums, broccoli, cabbage, brussels sprouts, tomatoes, and potatoes. Children exposed to second-hand smoke, or those who smoke, have higher vitamin C needs because the body is continuously repairing the cell damage caused by smoking. Signs of low vitamin C intakes include bleeding of the gums, loose teeth, red/purple spots on the skin, poor wound healing, ongoing infections, joint pain, depression, and a type of anaemia called microcytic anaemia.

Vitamin C levels in the analysed Ka Ora, Ka Ako meals exceeded the 33 percent target in all age/sex groups (ranging from 57 to 89 percent of daily requirements).

Levels of vitamin c in the years 0-3 meals passed eight of the 10 international standards (*Table 5*); levels in the years 4-8 meals passed four of the seven standards (*Table 7*); and levels in year 9+ meals passed five of the six standards (*Table 9*).

The main food sources of vitamin C on the programme were citrus fruits (oranges and mandarins), capsicum, and a range of other fruits and vegetables.

In the 2002 CNS, less than 0.1 percent of children had inadequate vitamin C intakes.

Micronutrients – Minerals

Calcium

Calcium is the most available mineral in the body. It has a vital role in the building and maintenance of strong, healthy bones and teeth. Although only 1 percent of calcium is found in the blood, this too has a vital role in muscle movement, nerve signals, blood pressure, and release of hormones around the body. Milk and milk products (cheese, yoghurt) are excellent sources of calcium. Calcium can also be found in canned fish with bones, oysters, fortified milk alternatives, some brands of tofu, broccoli, kale, bok choy, almonds, and sesame seeds. Meeting calcium requirements is vital during childhood and adolescence, as bone development in these years determine one's optimal bone mass and density. Poor calcium intake during childhood can lead to low bone density, greater risk of fractures, and osteoporosis later in life.

Calcium levels in the analysed Ka Ora, Ka Ako meals were below the 33 percent target in all age/sex categories (ranging from 16 to 26 percent of daily requirements). Given how important calcium is in childhood and adolescence, the low levels provided in Ka Ora, Ka Ako meals, combined with the conclusion of the Milk in Schools programme, pose a public health concern. It is imperative that interventions should be considered to increase the availability of foods high in calcium for food insecure tamariki.

Levels of calcium in the years 0-3 meals passed two of the 11 international standards (*Table 5*); levels in the years 4-8 meals passed two of the seven standards (*Table 7*); and levels in year 9+ meals were below all the four standards (*Table 9*).

The main sources of calcium on the programme were cheese, yoghurt, and wholemeal bread products. Please note that bread products are not a rich calcium source but because of the quantity consumed on the programme, the small amounts made a significant overall contribution.

Calcium intake was inadequate for 12.2 percent of males and 18.2 percent of females in the 2002 CNS (New Zealand Ministry of Health, 2003), indicating that calcium intake may need to be improved in New Zealand tamariki.

Iron

Iron is a trace mineral with various functions in the body, the most well-known being for the proper function of red blood cells. Iron makes up haemoglobin, which is a protein within the red blood cell that transfers oxygen to the body tissues. Iron is essential for a healthy immune system and is also needed for many different chemical reactions, including turning food into energy. Iron is found in both animal (haem iron) and plant-based foods (non-haem iron) but is better absorbed from animal sources such as: red meat, organs, seafood, fish, and chicken. Iron deficiency anaemia, resulting from low iron intake and/or absorption, is the most common nutrition-related disorder worldwide. Symptoms include weakness, extreme tiredness, headaches, poor concentration, irritability, and frequent infections. Females who are in their menstruation years have higher iron requirements due to the loss of iron in their monthly cycles, and it is estimated one in three teenage girls do not meet their daily iron needs. Children and teenagers going through growth phases will need extra iron to support growth and development.

Iron levels in the analysed Ka Ora, Ka Ako meals exceeded the 33 percent target in six of the 12 age/sex categories (ranging from 38 to 44 percent of daily requirements). Iron was below the 33 percent target

in 5-year-olds and 8-year-olds (25 percent), and 18-year-olds (23 percent for females and 32 percent for males).

Levels of iron in the years 0-3 meals passed three of the 10 international standards (*Table 5*); levels in the years 4-8 meals met two of the seven standards (*Table 7*); and levels in year 9+ meals met one of the seven standards (*Table 9*).

The main sources of iron on the programme were wholemeal bread products, beef (including mince), chicken, and pasta.

Inadequate iron intake in the 2002 CNS was 6.6 percent (New Zealand Ministry of Health, 2003). However, this was higher among females (12 percent) compared to males (1.6 percent). Of particular concern was the finding that 43.9 percent of menstruating females had inadequate iron intake.

A systematic review published in 2022 assessed the findings from 50 studies (26 observational and 24 intervention studies) investigating iron status or iron-containing interventions and their association with cognition and academic performance in adolescents (Samson et al., 2022). Samson et al (2022) concluded that iron status may be linked to academic performance and that iron supplementation could improve performance, attention, and concentration.

Some of the larger studies conducted include:

» a study of 800 high school students in Iran which found a significant association between iron intake and average grades and GPA score in females (Kooshki et al., 2018)

» an intervention study in 288 iron-deficient primary school students (6-11 years) from South Africa found that iron supplementation increased verbal and non-verbal learning and memory (Baumgartner et al., 2012)

» a study of 5,398 US children 6-16 years (3 percent iron deficient) found that average math scores were lower for children with iron deficiency, having more than double the risk of scoring below average (Halterman et al., 2001)

» a study of 4,509 5-12 year olds from Chile found that iron intake was significantly associated with academic achievement (assessed through standard Spanish-language and math achievement tests) (Ivanovic et al., 2004).

With the importance of iron intake for growth, development, and educational achievement in children, combined with inadequate intakes in menstruating females, increasing iron provision in Ka Ora, Ka Ako meals to above the 33 percent target should be considered.

Iodine

Iodine is a trace mineral essential in the production of thyroid hormones. Iodine is important at all stages in life, including childhood and adolescence. Thyroid hormones control the body's metabolism (chemical processes needed for life), body temperature, and support reproduction, growth, healthy blood, nerve and muscle function. Deficiency symptoms include a visible lump in the neck called a goitre, with low intakes resulting in lower-than-average IQ scores and poor performance in school (Levie et al., 2019; Santiago-Fernandez et al., 2004). Because New Zealand soils are low in iodine, intake can be met using iodised salt. In 2009, it became mandatory in New Zealand to use iodised salt in most breads (Ministry for Primary Industries New Zealand, 2012). Iodine can also be sourced from seafood, seaweed, and dairy products.

Iodine levels in the analysed Ka Ora, Ka Ako meals exceeded the 33 percent target in four of the 12 age/sex categories (meeting 53 percent of daily requirements). Iodine was below the 33 percent target in 5-year-olds and 8-year-olds (26 percent), in 13-year-olds (29 percent) and in 18-year-olds (23 percent).

Iodine was not a nutrient of interest in international standards. As such, no comparisons to international standards were made.

The main sources of Iodine on the programme were seaweed, wholemeal bread products, and yoghurt.

The 2002 CNS measured iodine status and found that the median levels in New Zealand children fell into the category for mild iodine deficiency according to the International Council for the Control of Iodine Deficiency (ICCIDD) (New Zealand Ministry of Health, 2003). The ICCIDD also suggests that no more than 20 percent of children should have a urinary iodine concentration less than 5 µg/dL; whereas 28 percent of New Zealand children in the 2002 CNS had a urinary iodine concentration below that level. The findings from the 2002 CNS highlight that iodine status is concerningly low in New Zealand children. However, since mandatory fortification of bread with iodine, modelled data showed that it significantly improved the iodine intakes of New Zealand children (Ministry for Primary Industries New Zealand, 2014). As such, iodine deficiency/inadequacy is much less of a concern. However, given that the programme contains a high amount of wholemeal bread products, it is still concerning to see iodine levels in 8, 13, and 18-year-olds below the 33 percent target. Without international standards to compare to, it is difficult to assess if this will be a sufficient contribution to daily needs. It is recommended that future studies are conducted to get an up-to-date assessment of iodine intake in New Zealand children, particularly in tamariki with the highest risk of food insecurity, to determine whether the remaining 70+ percent of daily needs will be met from food consumption outside the lunch meal.

Sodium

Sodium is an important mineral found in salt (sodium chloride). It's main role in the body is to maintain fluid and electrolyte balance, as well as acid-base balance. Most of our sodium intake comes from foods such as bread, processed meats, breakfast cereals, cheese, and commercially made condiments and sauces. Reducing sodium (through reducing salt) intake is a global goal due to the associations a high intake has with increased cancer risk, high blood pressure and increasing the risk of heart disease and stroke; with research supporting reduced intakes with better health outcomes. Benefits of sodium reduction, such as lowering blood pressure, have also been observed in children (Gowrishankar et al., 2020; Hanevold, 2013; Leyvraz et al., 2018). This is particularly relevant as it has been found that blood pressure in childhood tends to persist into adulthood (Hanevold, 2013).

A New Zealand study found that processed foods were the major source of salt in New Zealander's diets, contributing between 60 to 80 percent of sodium intake (Thomson, 2009). The authors also found that more than or equal to 50 percent of children aged 5-6 years, boys aged 11-14 years and young males aged 19-24 years had sodium intakes that exceeded the UL, from processed foods alone. Bread was identified as the greatest salt contributor across all ages.

Unlike other nutrients analysed, sodium in Ka Ora, Ka Ako meals was not assessed against a minimum RDI percentage target. Instead, we wanted to assess whether sodium in the meals was exceeding safe levels of intake. One way to measure this is to check how much the programme is contributing towards the upper level of intake (UL), which is the "highest average daily nutrient intake level likely to pose no adverse health effects to almost all individuals in the general population" (National Health and Medical Research Council Australia & New Zealand Ministry of Health, 2006).

Sodium in the years 0-3 meals was contributing to 41 percent of the upper level of intake (UL); sodium in years 4-8 meals was contributing 32 percent; and sodium in years 9+ meals was contributing between 37 to 42 percent.

The main sources of sodium on the programme were cheese, sauces, and wholemeal bread products.

Although the sodium levels seem high compared to the NRVs, when compared to international standards, the sodium in years 0-3 and 4-8 meals was acceptable. Sodium in the years 0-3 meals was below four of the seven international standards with maximum sodium recommendations and levels in the years 4-8 meals were below four of the six standards. However, reducing sodium in the year 9+

meals should be given some consideration as it exceeded six of the seven maximum recommended levels in the standards.

Magnesium

Magnesium is found in different parts of the body including the bones, soft tissue and the fluid outside of the cells. The roles of magnesium in the body include in bone health, alongside calcium for proper muscle contraction, blood clotting, controlling blood pressure, and lung function. Magnesium is also needed for the body to use glucose, for protein building, and to support a healthy immune system. Magnesium is found in a range of nutritious foods such as legumes, nuts, seeds, wholegrains and dark green, leafy vegetables, seafood, and dark chocolate.

Magnesium levels in the analysed Ka Ora, Ka Ako meals exceeded the 33 percent target in 10 of the 12 age/sex categories (ranging from 36 to 55 percent of daily requirements). Magnesium levels were marginally below the 33 percent target for 18-year-olds (30 percent for females, and 27 percent for males). The 2002 CNS results found that magnesium intakes of New Zealand children were adequate (New Zealand Ministry of Health, 2003). Therefore, levels slightly under the 33 percent target are unlikely to pose a health risk to ākonga at participating schools and kura.

Magnesium was not a nutrient of interest in international standards. As such, no comparisons to international standards were made.

The main sources of magnesium on the programme were rice, chicken, and wholemeal bread products.

Phosphorous

Phosphorous is needed for the body to make energy. It is another important mineral found in bones and teeth, as well as in DNA and RNA. It is important for growth and various chemical processes. Low intake of phosphorous is rare because it is naturally found in a wide range of foods including dairy products, grains, nuts and seeds, legumes, meat, chicken, eggs, and fish. However, a loss of appetite, anaemia, muscle weakness, bone pain, higher risk of infection, prickling sensations and confusion can result if phosphorous needs are not met.

Phosphorous levels in the analysed Ka Ora, Ka Ako meals exceeded the 33 percent target in eight of the 12 age/sex categories (ranging from 41 to 67 percent of daily requirements). Phosphorous was marginally below the 33 percent target in 9-year-olds and 12-year-olds (years 4-8 meals) at 32 percent of daily needs. Phosphorous intakes in the 2002 CNS were deemed adequate (New Zealand Ministry of Health, 2003) and therefore this marginally low level in the year 4-8 meals is likely to have a negligible effect on the health of ākonga.

Phosphorous was not a nutrient of interest in international standards. As such, no comparisons to international standards were made.

The main sources of phosphorous on the programme were cheese, chicken, yoghurt, and wholemeal bread products.

Zinc

Zinc is a trace mineral found in cells throughout the body. It has a wide range of important roles in supporting health, including fighting bacteria and viruses, wound healing, the formation of proteins, DNA and genetic materials in all cells, formation and function of insulin, a role in blood clotting, thyroid function, vision, and taste and smell senses. It may also play a role in learning and behaviour (Warthon-Medina et al., 2015). Zinc is found in a wide range of foods, and good sources include red meat, shellfish, chicken, wholegrains and fortified cereals. Children and adolescents experiencing rapid growth and development have higher zinc needs to support this life stage. Deficiency results in delayed growth and development, including delayed sexual development, poor cognitive/learning performance, hair loss, eye and skin sores, loss of appetite, diarrhoea, weight loss, slow wound-healing, and loss of taste.

Zinc levels in the analysed Ka Ora, Ka Ako meals exceeded the 33 percent target in 11 of the 12 age/sex categories (ranging from 49 to 64 percent of daily requirements). Zinc levels were marginally below the 33 percent target in 18-year-old males (28 percent).

Levels of zinc in the years 0-3 meals passed five of the six international standards (*Table 5*); levels in the years 4-8 meals passed three of the five standards (*Table 7*); and levels in year 9+ meals passed three of the four standards (*Table 9*).

The main sources of zinc on the programme were cheese, beef (including mince), chicken, and wholemeal bread products.

Inadequate zinc intake in the 2002 CNS was low overall, however the rates were higher in older children, particularly females (9.2 percent in 5-6 years and 16.4 percent in 11-14 years) (New Zealand Ministry of Health, 2003). Therefore, although 28 percent does not fall far under the 33 percent target, ways to increase zinc in the year 9+ meals should be considered, as it is possible that the remaining 82 percent of daily needs might not be met through the rest of the day's food intake.

Selenium

Selenium is a trace mineral and an important antioxidant in the body. Selenium protects the body from cell-damaging free radicals. It also plays an important supporting role in thyroid hormone function, DNA production, and reproduction. Food sources of selenium depend on the selenium content of the soil. New Zealand typically has low soil selenium levels, and families that eat only locally grown foods may have more trouble meeting their selenium needs compared to those who eat food from various regions. Brazil nuts are a commonly known source of selenium, alongside seafood and meat. Wholegrains, vegetables and fruits are also sources of selenium, with amounts depending on the soil content. Selenium deficiency is rare but can cause a type of heart disease called Keshan disease.

Selenium levels in the analysed Ka Ora, Ka Ako meals exceeded the 33 percent target in all age/sex categories (ranging from 34 to 48 percent of daily requirements).

Selenium was not a nutrient of interest in international standards. As such, no comparisons to international standards were made.

The main sources of selenium on the programme were chicken, cheese, and wholemeal bread products.

The 2002 CNS findings showed that the median selenium intake of the older children (11–14 years) was below the recommended daily intakes, indicating that they were likely at risk of inadequate selenium intake (New Zealand Ministry of Health, 2003). Therefore, Ka Ora, Ka Ako meals providing between 34 to 48 percent of RDIs is a positive step towards ensuring our ākonga are getting sufficient selenium to meet their daily needs.

Macronutrients

Protein

Protein is the body's main 'building blocks', forming our muscles, organs, hair, nails, and skin. Protein also has an important role in various bodily functions such as the formation of enzymes and hormones, maintaining fluid and electrolyte balance and acid-base balance, and supporting our immune system. Protein is an energy source, although it is not the preferred energy source in the body. Dietary protein is essential for healthy growth, repair and maintenance of body proteins in children and adults. Consequently, not getting enough high-quality protein from food can lead to poor growth and development in children.

Protein levels in the analysed Ka Ora, Ka Ako meals exceeded the 33 percent target across all age/sex categories (ranging from 50 to 130 percent of daily requirements). For half of the age groups analysed the protein in the meals exceeded 90 percent of RDIs, including 130 percent of daily requirements for 5-year-old females and 127 percent of daily requirements for 5-year-old males. It is worth noting that

RDIs set for children are based on limited data(National Health and Medical Research Council Australia & New Zealand Ministry of Health, 2014). RDIs account for how much protein is needed for growth and for maintenance of fat free mass, however they do not account for increased protein requirements due to physical activity. The Ministry of Health recommends children aged 5 to 17 years engage in at least one hour of moderate to vigorous physical activity every day, including strength building activity at least 3 days a week (New Zealand Ministry of Health, 2021b). Consequently, greater protein intakes may be required to support children to meet the recommended physical activity levels.

Protein amounts (in grams) in the years 0-3 meals passed 10 of the 12 international standards (*Table 4*); amounts in the years 4-8 meals passed seven of the eight standards (*Table 6*); and amounts in the year 9+ meals passed all seven standards (*Table 8*).

The main sources of protein on the programme were chicken, cheese, beef, and wholemeal bread products.

The 2002 CNS found that New Zealand children were getting at least double their age-specific protein needs (New Zealand Ministry of Health, 2003). Therefore, the high protein levels in the Ka Ora, Ka Ako meals, particularly in the years 0-3 meals, should be monitored to avoid further increases. However, as noted above, RDIs account for how much protein is needed for growth and for maintenance of fat free mass, without accounting for protein requirements due to physical activity. Consequently, greater protein intakes may be required to support children to meet the recommended physical activity levels. There is also little evidence to indicate any adverse effects of high protein intake from foods consumed as part of everyday diets, unless it is displacing other important nutrients (National Health and Medical Research Council Australia & New Zealand Ministry of Health, 2006).

Saturated fat

Although fat plays a vital role in the body, not all fats are equally beneficial. Saturated fats are a type of fat found in butter, cream, full-fat dairy products, fatty meat, processed meat, coconut and coconut oils, lard, shortening, pastries, cakes, biscuits, and typically fast food. Saturated fats can increase chronic disease. Whilst omega-3 and other unsaturated fatty acids have beneficial health effects, saturated fatty acids can increase the risk of diseases such as heart disease, obesity, and cancer. Because these chronic diseases can occur from a build-up of poor nutrition and lifestyle habits, it is important that children and adolescents are replacing foods high in saturated fat with foods high in unsaturated fat — a worldwide recommendation.

Unlike the micronutrient assessments, saturated fat in the Ka Ora, Ka Ako meals is not compared against an RDI. Instead, the recommendation in the NRVS is that saturated fat and trans fats (another form of fat that is associated with adverse health consequences) combined should be limited to 8 to 10 percent of energy (National Health and Medical Research Council Australia & New Zealand Ministry of Health, 2006).

Saturated fat in years 0-3 meals was 4.9 grams (11.3 percent of energy); 5.3 grams (10.5 percent) in years 4-8 meals; and 6.5 grams (10.2 percent) in years 9+ meals. Although the analysed Ka Ora, Ka Ako meals contained more than 10 percent saturated fat as a contribution of energy, they were only marginally above the NRV recommendation (10.2 to 11.3 percent).

It was also found that the analysed Ka Ora, Ka Ako meals were low in energy and carbohydrates (*see below*); increasing carbohydrates in future meals will in turn increase energy provision and reduce the contribution of saturated fat to energy, providing a very simple and easily achievable solution to the marginally high saturated fat (as a percentage of energy).

The main sources of saturated fat on the programme were cheese (predominantly reduced fat cheese), chicken, and beef (including mince).

The gram amounts of saturated fat in the analysed Ka Ora, Ka Ako meals are not of concern by international standards. Levels of saturated fat in the years 0-3 meals were below the three international recommendations for maximum grams of saturated fat in school lunch meals (*Table 4*); levels in the

years 4-8 meals were below three of the four recommendations (*Table 6*); and levels in year 9+ meals were below all four recommendations (*Table 8*).

In the 2002 CNS, saturated fat contributed 14.5 percent of energy and the median daily intake was 32.8 grams (New Zealand Ministry of Health, 2003). Therefore, if today's tamariki were consuming similar amounts to those found in the 2002 CNS, then the amounts in Ka Ora, Ka Ako lunch meals would only be contributing around 15 to20 percent of daily saturated fat intake.

Carbohydrates

Carbohydrates are the body's main source of 'fuel' (energy). Not only do children and adolescents need fuel for growth and physical activity, but also for concentrating and learning. There are various types of carbohydrates, which have been grouped into either 'simple' or 'complex' carbohydrates. Each has a role to play in the body, but for optimal brain function and general health, high- quality carbohydrates should be the focus. This means choosing wholegrain breads and cereals (brown rice, wholemeal pasta, couscous, polenta, bulghur wheat etc), fruit, starchy vegetables, and legumes.

There are no RDIs for carbohydrates in the NRVs, instead the carbohydrate levels in Ka Ora, Ka Ako analysed meals were compared to the acceptable macronutrient distribution range (AMDR) detailed in the NRVs (National Health and Medical Research Council Australia & New Zealand Ministry of Health, 2006). The AMDR for carbohydrates is 45 to 65 percent of energy. Carbohydrate (as a percentage of contribution to energy) was 43.9 percent in years 0-3 meals, 45.6 percent in years 4-8 meals, and 43.3 percent in years 9+ meals.

Although the carbohydrate percentage contribution to energy falls only marginally under the minimum AMDR, the total grams of carbohydrates in the meals are low by international standards. Levels of carbohydrates (grams) were below the minimum recommended amounts in all 11 international standards (*Tables 4, 6, 8*).

The main sources of carbohydrates on the programme were wholemeal bread products, rice, and fruit.

Fibre

Dietary fibre is found in plant-based carbohydrate foods such as wholegrain breads and cereals (oats, brown rice, wholemeal pasta, polenta), vegetables, fruit, and legumes. Fibre passes through the intestine undigested, thus being well known for maintaining regular healthy bowel movements. Fibre is classed as either insoluble fibre, soluble fibre or resistant starch, each having different roles and health benefits. Soluble fibre can help reduce cholesterol and improve blood sugar control in the body, making it useful for the prevention and management of diabetes. Insoluble fibre's main role is in keeping bowel movements regular and in doing so, keeping our gut and bowels healthy. Some specific types of fibre are also 'food' for the healthy bacteria that live in our gut. Healthy gut bacteria have important roles in immune system function, blood sugar control, and brain function (Cryan & Dinan, 2012).

In the New Zealand/Australia NRVs there is no RDI for fibre, so values in the analysed Ka Ora, Ka Ako meals were compared to the Adequate Intake (AI) which is "the average daily nutrient intake level based on observed or experimentally-determined approximations or estimates of nutrient intake by a group (or groups) of apparently healthy people that are assumed to be adequate" (National Health and Medical Research Council Australia & New Zealand Ministry of Health, 2006).

Fibre in analysed Ka Ora, Ka Ako meals exceeded the 33 percent target in 10 of the 12 age/sex categories (ranging from 37 to 48 percent of daily requirements). Fibre was marginally below the 33 percent target in 9-year-old and 12-year-old males (32 percent).

Levels of fibre in the year 0-3 meals passed five of the six international standards (*Table 4*); levels in the years 4-8 meals passed four of the five standards (*Table 6*); and levels in year 9+ meals passed four of the five standards (*Table 8*).

The main sources of fibre on the programme were wholemeal bread products, carrots, pasta, and fruit.

Fibre intake in the 2002 CNS was considered adequate overall (New Zealand Ministry of Health, 2003).

The fibre levels in analysed Ka Ora, Ka Ako meals are a testament to the quality of carbohydrates offered on the programme. Considering the carbohydrate levels in the meals were very low, below all eleven international standards, it is exceptional to see the fibre levels meet 13 of the 16 international standards.

Energy

Food and beverages provide us with the energy needed for all bodily processes, growth, repair of new tissues, and for physical activity. Carbohydrates, fats, and protein are our body's source of energy. Energy balance is a complex system. Children and adolescents who do not meet their energy needs are at risk of malnutrition, stunted growth and wasting. On the other hand, overconsumption of energy relative to output (metabolic needs + physical activity) can result in excess body fat, overweight and obesity, and associated health problems such as cardiovascular diseases and diabetes.

Energy levels in the analysed Ka Ora, Ka Ako meals were below 33 percent in all age/sex categories (ranging from 18 to 25 percent) and below 30 of the 31 international standards. The lowest levels were in males in each age group and this is not unexpected as both males and females receive the same meal but males have higher energy needs.

Although this is a facet of Ka Ora, Ka Ako meals that clearly needs consideration, it is important to note that providing 33 percent of daily requirements of energy in one meal is a lot of food, especially when food on the programme is nutrient-dense, not calorie-dense. According to the weights of the analysed Ka Ora, Ka Ako meals, the students are already receiving a meal which weighs on average 274g for years 0-3 (94g over minimum requirement on the programme), 320g for years 4-8 (80g over minimum requirement on the programme), and 412g for years 9+ (112g over minimum requirement on the programme).

The main sources of energy on the programme were cheese, chicken, and wholemeal bread products.

Considerations

While the findings from this analysis are useful to draw conclusions about the nutritional quality of the meals provided by Ka Ora, Ka Ako, there are some methodological limitations that require consideration.

Firstly, the analysis conducted was on meals from approved menus on the programme. Therefore, these findings are a measure of expected provision, not actual provision, nor intake by ākonga. This is particularly important to consider when addressing nutrients that were found to be very high (above 100 percent of the daily requirements) or low (below the 33 percent target). For example, if we consider protein levels of the meals (which in some age groups was above 100 percent of their daily needs), it is imperative we remember that these are only an accurate indicator of intake if that entire meal is consumed. It is not realistic to assume that all students consume 100 percent of the lunch meals received on the programme. The only way to get an accurate picture of what is being consumed is to collect intake data. Provision data is essential for evaluating whether Ka Ora, Ka Ako is providing healthy kai for the needs of our ākonga but intake data is also important to understand what nutrients provided are actually being consumed and therefore used in the body to improve health and learning outcomes. Analysing intake data was outside the scope of this evaluation due to time constraints but should be prioritised in future research and evaluation of the programme.

The New Zealand 2002 CNS is the most recent representative study of the nutritional status of New Zealand children and as such, the findings from this study have been used as a reference throughout this report. It is likely that dietary patterns have changed significantly over the past 20 years and therefore this may not be relevant to typical intake of New Zealand children in 2022. It is also important to consider the limitations of research in general, in that the CNS relied on an opt-in consenting process. This means that a parent, guardian or caregiver (and also the child) needed to be fully informed of the research and provided consent to being involved. This opt-in consenting process can result in biased

data (Junghans et al., 2005). Therefore, it is possible that research findings, including those in the 2002 CNS, are not accurately capturing dietary intake of our most vulnerable and food insecure tamariki.

NRVs are a 'gold standard' target for nutrition intake. Particularly when comparing nutrient levels to RDIs, which are the levels where 97 to 98 percent of all healthy individuals within that age/gender/life stage would be getting sufficient amounts to meet their needs. Comparing Ka Ora, Ka Ako meals to this 'gold standard' is the best approach to ensuring Ka Ora, Ka Ako meals are providing sufficient nutrients for the needs of the ākonga at participating schools and kura. However, we should also consider how these meals are contributing to the overall daily *intakes* of nutrients for ākonga. If we were to analyse consumption rather than provision, we may find that the percentage contribution of nutrients from the Ka Ora, Ka Ako lunch meal is substantially higher. For example, we know that iron intake is low in New Zealand children and that they are likely to not be meeting RDIs, particularly in areas of disadvantage (New Zealand Ministry of Health, 2003). Therefore, although the lunch meal may only be contributing 23 percent of the RDI, it may be contributing 50 percent+ to their daily *intake*. Future research and evaluation of the programme should be conducted to assess what percentage of daily *intake* of nutrients Ka Ora, Ka Ako meals are providing. Another consideration when using NRVs to calculate percentage contribution to RDIs for energy and protein, is that a reference weight and height is required for each year group analysed. For this analysis, the reference weights and heights published in the NRV summary tables were used. These reference values appear to be lower than we might observe and may not be representative of all ākonga at participating schools and kura.

Finally, it is worth noting that this evaluation analysed meals from both internal models and external supplier models. There were some substantial differences in the nutritional content of the meals from the different models. A summary of these findings can be found in Appendix 2.

Conclusions and recommendations

The analysed meals from Ka Ora, Ka Ako menus were nutrient dense, full of a range of high-quality nutritious foods to help support ākonga growth, development, wellbeing and learning. Overall, 78.2 percent of the analysed nutrients surpassed the 33 percent NRV target, including key nutrients involved with learning, behaviour and educational achievement, such as folate, thiamin, vitamin B6, and vitamin B12.

Two nutrients, protein and niacin, were provided in levels which exceeded 100 percent of the daily needs of ākonga in some age groups. This could pose a potential health risk if the ākonga consumed the entire meal *and* the remainder of their diet was high in these nutrients. This is an unlikely scenario but should still be considered. However, there is very little evidence to indicate any adverse effects of high protein intake from foods consumed as part of everyday diets, unless it is displacing other important nutrients (National Health and Medical Research Council Australia & New Zealand Ministry of Health, 2006). It is also worth highlighting that common breakfast meals, such as cereals and toast are often low in protein, so it would not be unreasonable for the lunch meal to provide 50 percent or more of the daily requirements. Protein-rich foods are also some of the most expensive everyday foods and therefore, are likely to be more limited in households experiencing food insecurity. Ka Ora, Ka Ako meals providing 50 percent or more of daily requirements should be seen as a strength of the programme. Therefore, it is not recommended to reduce the protein-containing foods in the Ka Ora, Ka Ako meals. The upper level for niacin intake is focused on intake from fortified foods or supplements. With chicken, cheese, and beef contributing more than 50 percent of niacin in the Ka Ora, Ka Ako meals (not niacin-fortified foods), the contribution of the lunch meals towards the UL is not likely to pose any health risk to tamariki on the programme.

There were five nutrients which were substantially below the 33 percent target in analysed Ka Ora, Ka Ako meals: energy, carbohydrates (no target, but low compared to international standards), iron, calcium, and iodine.

Energy levels in the analysed Ka Ora, Ka Ako meals were low in all age groups, compared to the NRV target and when compared to international standards. As mentioned previously, providing 33 percent of ākonga energy needs in a single meal is a high standard from a consumption perspective. Analysed meals on the programme weighed on average 274g for years 0-3 (94g over minimum requirement on the programme), 320g for years 4-8 (80g over minimum requirement on the programme), and 412g for years 9+ (112g over minimum requirement on the programme). The meals were below the 33 percent energy target but most nutrients analysed were above the 33 percent target, this indicates that the meals on the programme were very nutrient-rich, low-kilojoule meals. Given that one in five New Zealand children in the 2002 CNS were overweight and one in ten were obese, it is likely that overall diets of New Zealand children are energy-dense (high in kilojoules), as energy imbalance (consuming more energy than is used) is a main contributor to weight gain. Therefore, there may be some merit in providing a lower energy, nutrient-dense lunch for ākonga to potentially mitigate the negative effects of less healthy options on offer outside of the lunch programme. One observation from the analyses is that fruit was contributing a big portion of grams in the meals which will have contributed to the high nutrient content and low energy content of the meals. It is recommended that meal weight minimums should be considered without fruit or with a restricted amount of fruit able to be included to reach the minimum weight requirements.

Relative to international standards, the carbohydrate content of the analysed Ka Ora, Ka Ako meals was very low. This is an aspect of the programme that should be addressed. An easy solution to increase the amount of carbohydrates provided on the programme is to add a minimum requirement for carbohydrate-rich foods into the nutrition standards, much like the minimum requirement for protein-rich foods. The fibre content of the analysed meals was high, especially relative to the carbohydrate content, emphasising that the carbohydrates provided on the programme were predominantly nutrient-rich wholemeal/wholegrain options. As fibre is already meeting the 33 percent target and majority of

international standards, increasing the carbohydrates on the programme through readily accessible and well tolerated food sources should be considered (such as white couscous (which is currently an amber item), white rice, and noodles, which often aren't available in wholemeal so would usually fall into the amber category). Expanding the range of green category carbohydrate sources may also be a useful way to reduce costs for lunch providers and increase meal uptake. Increasing carbohydrates will in turn increase energy content of the meals.

Iron was below the 33 percent target in half of the age/sex groups analysed. With inadequate iron intake in 43.9 percent of menstruating females in the 2002 CNS, this is a nutrient of concern. Iron status has also been shown to be associated with cognition and academic performance in adolescents, further warranting an improvement of iron provision on Ka Ora, Ka Ako. One option to achieve an increase of iron provision in the Ka Ora, Ka Ako meals is to include a recommendation to suppliers that red meat (ie roast beef/mince dish etc) is provided in at least one lunch meal per week. The financial implications of this suggestion would need to be considered before implementation, as the cost of red meat is much higher than the alternative protein options such as chicken.

Calcium levels in the analysed Ka Ora, Ka Ako meals were below the 33 percent target in all age/sex categories and only passed four of the 22 international standards. This is particularly concerning given that the 2002 CNS findings indicated that close to one in five New Zealand females in the study had inadequate intake. The Milk in Schools programme, which previously provided milk in many primary schools on Ka Ora, Ka Ako, ceased in 2021 and has been partially replaced by the breakfast kick start programme. It is unlikely that the same number of children will benefit from milk as part of the breakfast programme in the same way as they would have from the Milk in Schools programme. Regardless, calcium needs of the most vulnerable and food insecure tamariki in New Zealand should be a priority. Many international lunch programmes include milk as a drink (including the USA, Finland (Finnish National Agency for Education, 2022), Sweden (Swedish Food Agency, 2022), and England (The School and Nursery Milk Alliance, 2015)). However, it is not feasible to mandate milk provision on Ka Ora, Ka Ako due to the cost constraints. Providing milk as a drink would involve an additional cost for the milk itself but also an investment in infrastructure to serve milk as a drink (ie cups, dishwashers, refrigerated storage).

Iodine levels in the analysed Ka Ora, Ka Ako meals did not meet the 33 percent target in eight of the 12 age/sex categories. Since the mandated fortification of most breads in New Zealand with iodised salt in 2009, modelled data showed that children's iodine intake had increased significantly since the low levels reported in the 2002 CNS (Ministry for Primary Industries New Zealand, 2014). However, given the regular use of wholemeal bread products on the programme, a low level of iodine in analysed Ka Ora, Ka Ako meals was not expected. Since the fortification of most breads in New Zealand with iodised salt was mandated in 2009, modelled data shows that children's iodine intake had increased (Ministry for Primary Industries New Zealand, 2014). A study of iodine levels in New Zealand school children in 2015 (post-fortification) also showed adequate iodine status (Jones et al., 2016). In light of this, it was deemed not necessary to make any changes to the meals or standards to account for the low iodine provision.

Other nutrients on the programme that require further discussion are saturated fat and sodium.

Saturated fat as a percentage of energy was higher than the NRV recommendations (less than 8 to 10 percent E of trans fats and saturated fats combined), but only marginally (10.2 percent to 11.3 percent). However, the gram amounts of saturated fat in the analysed Ka Ora, Ka Ako meals were not of concern by international standards (under 10 of the 11 recommendations for maximum saturated fat). As detailed previously, the analysed Ka Ora, Ka Ako meals were low in energy and carbohydrates; increasing carbohydrates in future meals will in turn increase energy provision and reduce the contribution of saturated fat to energy. This is a very simple and easily achievable solution to the marginally high saturated fat (as a percentage of energy).

Sodium levels were high in the meals compared to NRV ULs. However, when compared to international standards it was the levels in the years 9+ meals that were of greatest concern and would benefit substantially from a reduction. The main contributor of sodium on the programme were wholemeal bread products. A reduction in wholemeal bread products on the programme should not be

recommended as they contribute largely to other important nutrients, especially iodine and carbohydrates which are already low. Nutrition standards on Ka Ora, Ka Ako include sodium limits for 'green' breads, and it is not practical to tighten these without heavily limiting the options for suppliers. Two of the main sodium sources in the years 9+ meals which could be reduced without having a substantial negative impact on the other nutrients on the programme are sauces and processed meat. Therefore, it is recommended that to reduce sodium across Ka Ora, Ka Ako and particularly in year 9+ meals that there is a maximum amount of processed meat that can be served and some clearer restrictions around maximum sauce quantities when low-sodium options are unavailable.

The findings from this analysis have been considered during the development of the new nutrition standards for the programme. The new nutrition standards are scheduled to be released in Term 4, 2022, and implemented from Term 1, 2023.

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Tables

Table 4. **Comparison of nutrients in years 0-3 Ka Ora, Ka Ako meals to international nutrient-level standards**

		Age (years)	Energy (cals)	Protein g (% of energy)	Carbohydrate g (% of energy)	Fat g (% of energy)	Saturated Fat g (% of energy)	Fibre g	Sodium mg
Ka Ora, Ka Ako		**5-8**	**382**	**21.2 (22.6)**	**42.1 (43.9)**	**12.6 (29.3)**	**4.9 (11.3)**	**6.6**	**571**
England[1]		5-11	530 ± 5%	≥7.5	≥70.6	≤20.6	≤6.5	≥4.2	≤499
Wales[2]		5-11	530 ± 5 %	≥7.5	≥70.6	≤20.6	≤6.5	≥4.2	≤499
Finland[3]		6-9	550	(13-17)	(45-50)	(30-40)	(≤10)		
Sweden[4]		6-9	500	12-24 (10-20)	55-73 (45-60)	14-22 (25-40)	≤6 (≤10)	≥6	≤480
China[5]		6-11	621	≥17.4	(50-65)	(20-30)			
USA (CNR meal guidelines)[6]			665	≥10		(≤30)	(≤10)		
USA (HHFKA meal guidelines)[9]		5-11	550-650	≥15.2		(≤30)	(≤10)	≥8.5	≤640
Japan[7]		6-7	530	≥20 (16-26)		(25-30)		≥4	≤800
		8-9	640	18-32		(25-30)		≥5	≤1000
Korea[8]	Males	7-9	534	≥8.4					
	Females	7-9	500	≥8.4					
Taiwan[8]		7-9	670	≥22		≤20			≤800

Notes:
[1](The Education (Nutritional Standards and Requirements for School Food) (England) Regulations 2007, 2007)
[2](Department for Education and Skills, 2014)
[3](National Nutrition Council, 2017)
[4](The National Food Agency Sweden, 2013)
[5](Huang et al., 2017)
[6](Smith & Cunningham-Sabo, 2014)
[7](Morimoto & Miyahara, 2018)
[8](Kim et al., 2017)
[9](Nutrition Standards in the National School Lunch and School Breakfast Programs; Final Rule, 2012)

Table 5: Comparisons of nutrients in years 0-3 Ka Ora, Ka Ako meals to international nutrient-level standards (continued)

		Age (years)	Vitamin A (µg)	Vitamin C (mg)	Thiamin (µg)	Riboflavin (µg)	Folate (µg)	Calcium (mg)	Iron (mg)	Zinc (mg)
Ka Ora, Ka Ako		**5-8**	**350**	**22**	**304**	**261**	**138**	**184**	**2.5**	**2.5**
England[1]		5-11	≥175	≥10.5			≥53	≥193	≥3	≥2.5
Wales[2]		5-11	≥175	≥10.5			≥53	≥193	≥3	≥2.5
Sweden[3]		6-9	≥120	≥12	≥270	≥330	≥39	≥210	≥2.7	≥2.1
China[4]		6-11	≥199	≥26	≥390	≥390		≥390	≥5.14	≥2.81
USA (CNR meal guidelines)[5]			≥224	≥15				≥286	≥3.5	
USA (HHFKA meal guidelines)[8]		5-11	≥192	≥24				≥332	≥3.4	
Japan[6]		6-7	≥150	≥20	≥300	≥400		≥300	≥2	≥2
		8-9	≥170	≥20	≥400	≥400		≥350	≥3	≥2
Korea[7]	Males	7-9	≥97	≥13.4	≥200	≥240		≥184	≥2.4	
	Females	7-9	≥90	≥13.4	≥170	≥200		≥184	≥2.4	
Taiwan[7]		7-9						270		

Notes
[1](The Education (Nutritional Standards and Requirements for School Food) (England) Regulations 2007, 2007)
[2](Department for Education and Skills, 2014)
[3](The National Food Agency Sweden, 2013)
[4](Huang et al., 2017)
[5](Smith & Cunningham-Sabo, 2014)
[6](Morimoto & Miyahara, 2018)
[7](Kim et al., 2017)
[8](Nutrition Standards in the National School Lunch and School Breakfast Programs; Final Rule, 2012)

Table 6: Comparisons of nutrients in years 4-8 Ka Ora, Ka Ako meals to international nutrient-level standards

	Age (years)	Energy (cals)	Protein g (% of energy)	Carbohydrate g (% of energy)	Fat g (% of energy)	Saturated Fat g (% of energy)	Fibre g	Sodium mg
Ka Ora, Ka Ako	**9-12**	**450**	**24.3 (21.9)**	**51.6 (45.6)**	**14.3 (28.2)**	**5.3 (10.5)**	**7.8**	**646**
England[1]	5-11	530 ± 5%	≥7.5	≥70.6	≤20.6	≤6.5	≥4.2	≤499
Wales[2]	5-11	530 ± 5%	≥7.5	≥70.6	≤20.6	≤6.5	≥4.2	≤499
Finland[3]	10-13	700	(13-17)	(45-50)	(30-40)	(≤10)		
Sweden[4]	10-12	645	16-32 (10-20)	71-95 (45-60)	18-29 (25-40)	≤7 (≤10)	≥8	≤720
China[5]	12-15	783	≥23.4	(50-65)	(20-30)			
Slovenia[6]	10-13	630-735	15-28 (10-15)	≥78 (>50)	21-29 (30-35)	≤3 (≤10)	≥6	≤720
India[7]	6-14	450	≥12					
USA (CNR meal guidelines)[8]		665	≥10		(≤30)	(≤10)		
USA (HHFKA meal guidelines)[10]	11-14	600-700				(≤10)		≤710
Japan[9]	9-11	750	22-38		(25-30)		≥6	≤1000

Notes
[1](The Education (Nutritional Standards and Requirements for School Food) (England) Regulations 2007, 2007)
[2](Department for Education and Skills, 2014)
[3](National Nutrition Council, 2017)
[4](The National Food Agency Sweden, 2013)
[5](Huang et al., 2017)
[6](Gregorič et al., 2015)
[7](El-Rifai, 2020)
[8](Smith & Cunningham-Sabo, 2014)
[9](Morimoto & Miyahara, 2018)
[10](Nutrition Standards in the National School Lunch and School Breakfast Programs; Final Rule, 2012)

Table 7. Comparisons of nutrients in years 4-8 Ka Ora, Ka Ako meals to international nutrient-level standards (continued)

	Age (years)	Vitamin A (µg)	Vitamin C (mg)	Thiamin (µg)	Riboflavin (µg)	Folate (µg)	Calcium (mg)	Iron (mg)	Zinc (mg)
Ka Ora, Ka Ako	**9-12**	**411**	**22.8**	**402**	**306**	**190**	**214**	**3.0**	**3.0**
England[1]	5-11	≥175	≥10.5			≥53	≥193	≥3	≥2.5
Wales[2]	5-11	≥175	≥10.5			≥53	≥193	≥3	≥2.5
Sweden[3]	10-12	≥180	≥15	≥330	≥390	≥60	≥270	≥3.3	≥3.3
China[4]	12-15	≥258	≥36	≥500	≥480		≥413	≥6.3	≥3.7
Japan[5]	9-11	≥200	≥25	≥500	≥500		≥400	≥4	≥3
USA (CNR meal guidelines)[6]		≥224	≥15				≥286	≥3.5	
USA (HHFKA meal guidelines)[7]	11-14	≥192	≥24				≥332	≥3.4	

Notes:
[1](The Education (Nutritional Standards and Requirements for School Food) (England) Regulations 2007, 2007)
[2](Department for Education and Skills, 2014)
[3](The National Food Agency Sweden, 2013)
[4](Huang et al., 2017)
[5](Morimoto & Miyahara, 2018)
[6](Smith & Cunningham-Sabo, 2014)
[7](Nutrition Standards in the National School Lunch and School Breakfast Programs; Final Rule, 2012)

Table 8: Comparisons of nutrients in years 9+ Ka Ora, Ka Ako meals to international nutrient-level standards

	Age (years)	Energy (cals)	Protein g (% of energy)	Carbohydrate g (% of energy)	Fat g (% of energy)	Saturated Fat g (% of energy)	Fibre g	Sodium mg
Ka Ora, Ka Ako	**13-18**	**570**	**33.1 (24)**	**61.1 (43.3)**	**18 (28.3)**	**6.5 (10.2)**	**9.6**	**846.4**
England[1]	11-18	646 ± 5%	≥13.3	≥86.1	≤25.1	≤7.9	≥5.2	≤714
Wales co-ed schools[2]	11-18	646 ± 5%	≥13.3	≥86.1	≤25.1	≤7.9 (≤10)	≥5.2	≤714
Finland[3]	14-16	850	(13-17)	(45-50)	(30-40)	(≤10)		
Sweden[4]	13-15	735	18-36 (10-20)	81-108 (45-60)	21-33 (25-40)	≤8 (≤10)	≥9	≤720
	16-18	790	19-39 (10-20)	87-116 (45-60)	22-36 (25-40)	≤9 (≤10)	≥10	≤720
China[5]	15-18	844	≥25.3	(50-65)	(20-30)			
India[6]	14-18	700	≥20					
USA (HHFKA meal guidelines)[7]	14-18	750-850				(≤10)		≤740
Japan[8]	12-14	820	25-40		(25-30)			≤1200

Notes: [1](The Education (Nutritional Standards and Requirements for School Food) (England) Regulations 2007, 2007)
[2](Department for Education and Skills, 2014)
[3](National Nutrition Council, 2017)
[4](The National Food Agency Sweden, 2013)
[5](Huang et al., 2017)
[6](El-Rifai, 2020)
[7](Nutrition Standards in the National School Lunch and School Breakfast Programs; Final Rule, 2012)
[8](Morimoto & Miyahara, 2018)

Table 9: Comparisons of nutrients in years 9+ Ka Ora, Ka Ako meals to international nutrient-level standards (continued)

	Age (years)	Vitamin A (µg)	Vitamin C (mg)	Thiamin (µg)	Riboflavin (µg)	Folate (µg)	Calcium (mg)	Iron (mg)	Zinc (mg)
Ka Ora, Ka Ako	**13-18**	**413**	**35.5**	**436**	**382**	**216.3**	**264**	**3.5**	**3.6**
England[1]	11-18	≥245	≥14			≥70	≥350	≥5.2	≥3.3
Sweden[2]	13-15		≥23			≥90		≥4.5	
	16-18		≥23			≥120		≥4.5	
Wales - co-ed schools[3]	11-18	≥245	≥14			≥70	≥300	≥4.4	≥2.8
China[4]	15-18	≥272	≥38	≥540	≥510		≥375	≥6.4	≥3.8
Japan[5]	12-14	≥300	≥35	≥500	≥600		≥450	≥4	≥3

Notes: [1](The Education (Nutritional Standards and Requirements for School Food) (England) Regulations 2007, 2007)
[2] (The National Food Agency Sweden, 2013)
[3] (Department for Education and Skills, 2014)
[4](Huang et al., 2017)
[5](Morimoto & Miyahara, 2018)

Appendix 1

Figures demonstrating the percentage contribution of nutrients from the analysed Ka Ora, Ka Ako meals to daily recommended intakes.

Figure 2. Nutrient provision in years 0-3 meals, compared to recommended dietary intakes (RDIs) from the Nutrient Reference Values (NRVs) for Australia and New Zealand. *compared to Adequate Intake as no RDIs available. DFE - dietary folate equivalents.

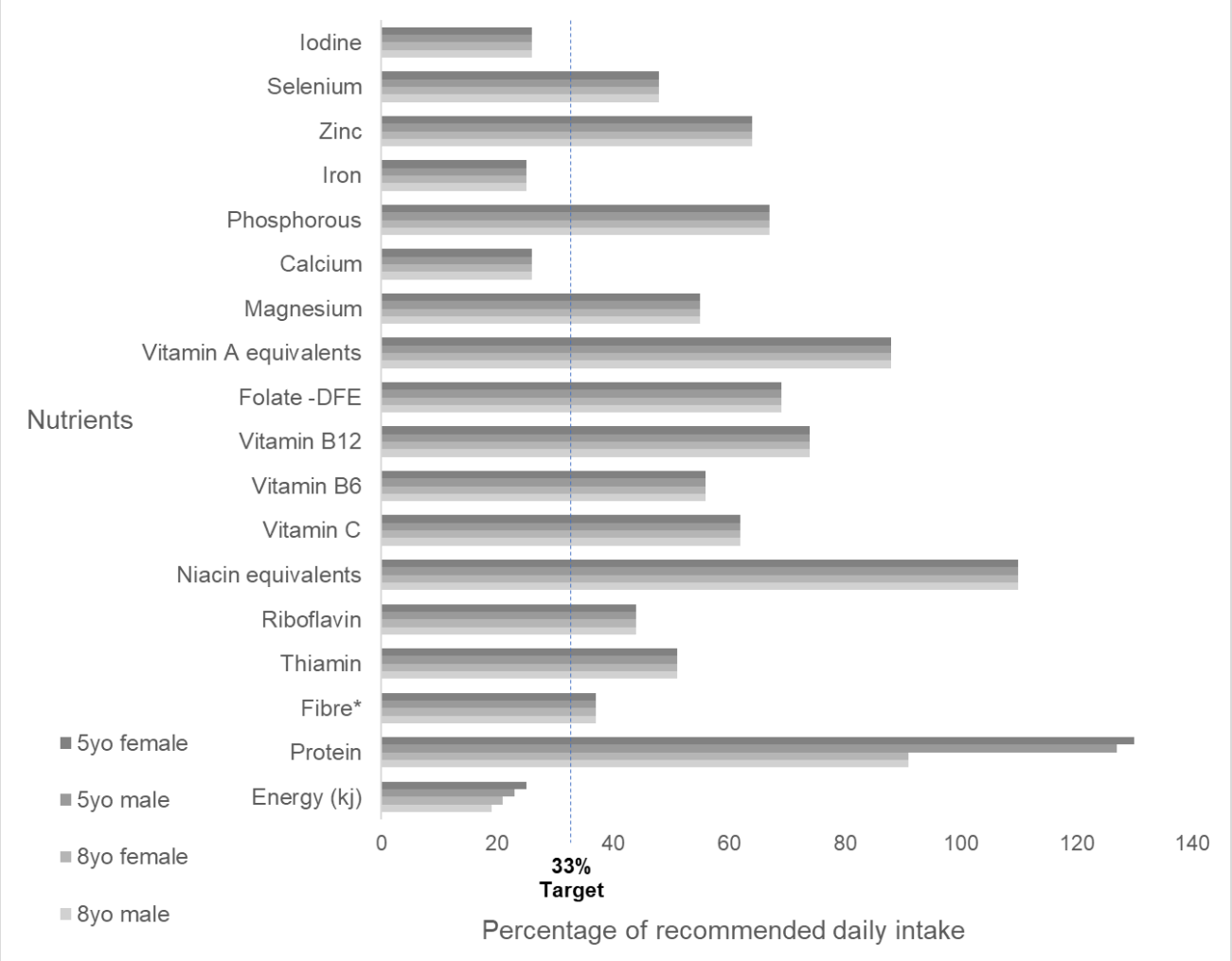


Figure 3. Nutrient provision in years 4-8 meals, compared to recommended dietary intakes (RDIs) from the Nutrient Reference Values for Australia and New Zealand. *compared to Adequate Intake as no RDIs available. DFE - dietary folate equivalents.

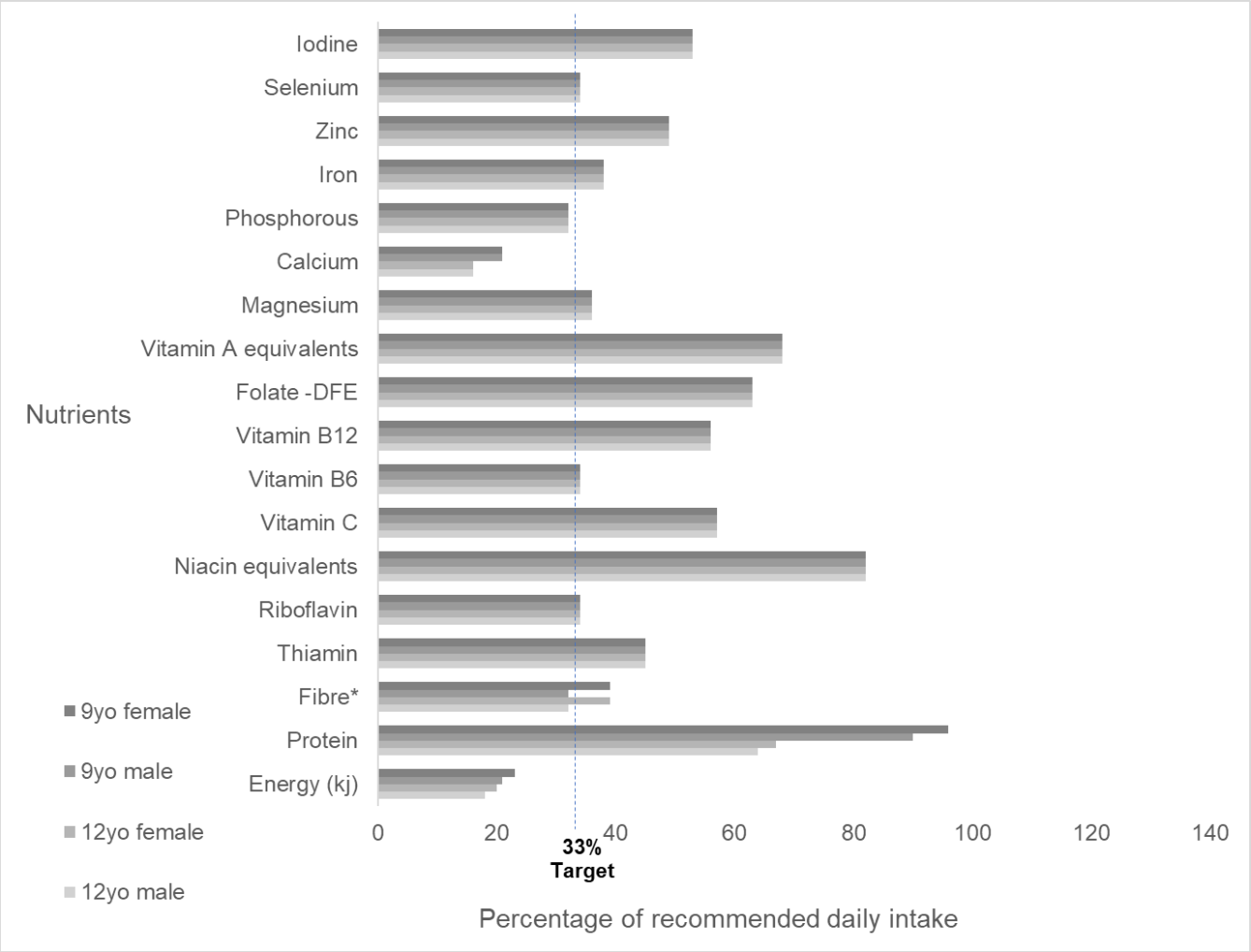
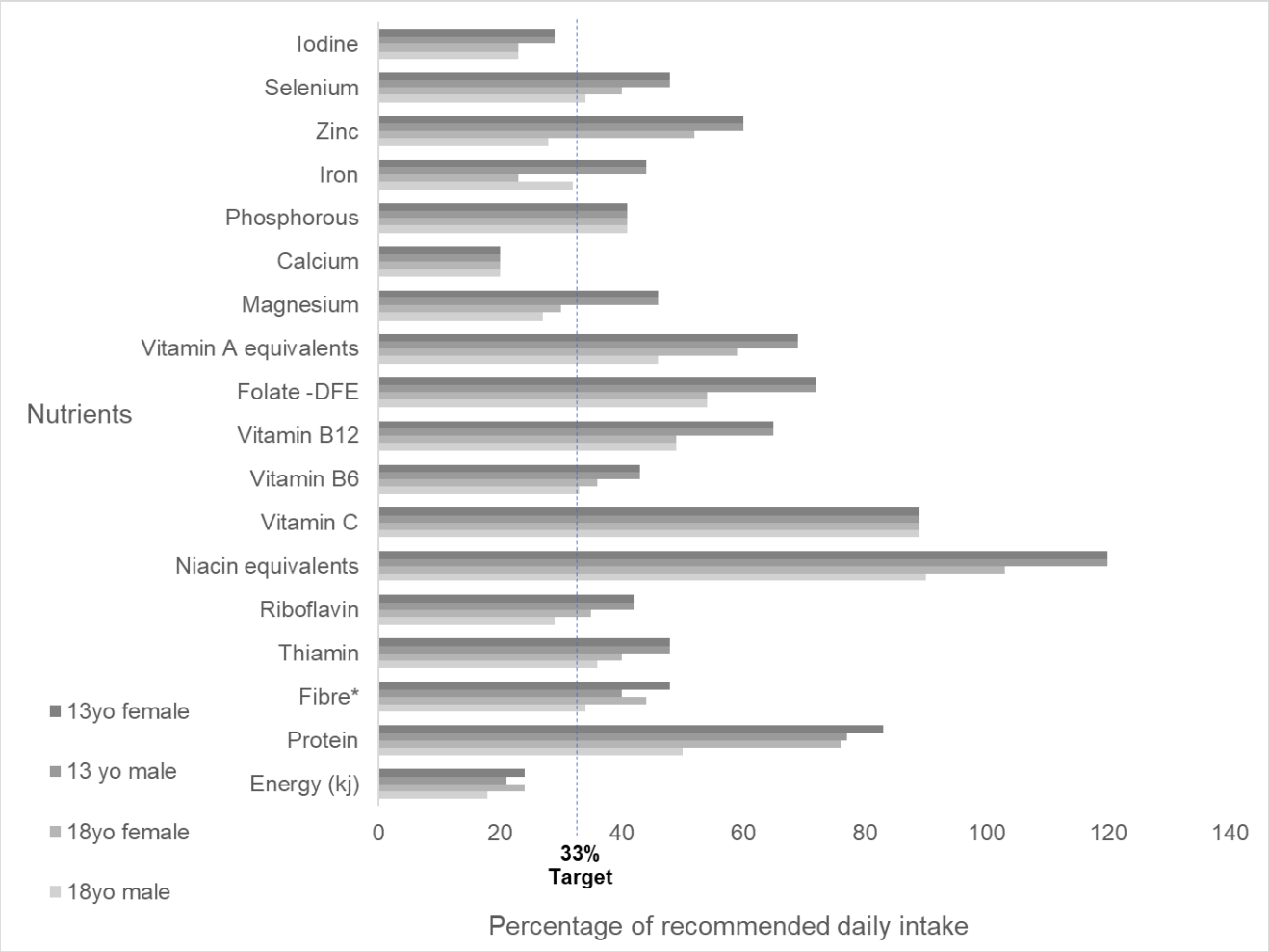


Figure 4. Nutrient provision in years 9+ meals, compared to recommended dietary intakes (RDIs) from the Nutrient Reference Values for Australia and New Zealand. *compared to Adequate Intake as no RDIs available. DFE - dietary folate equivalents.



Appendix 2

Sub-analysis comparing nutritional content of meals from suppliers/schools and kura on the internal model vs external model.

The nutritional content of the Ka Ora, Ka Ako internal and external meals relative to the NRVs are displayed in *Tables 10 and 11*.

Overall, internal meals had a consistently higher nutritional contribution to daily requirements than the external meals provided in the same year group. Of the nutrients analysed, 82.4 percent met the 33 percent target from the internal meals compared to 74.1 percent of the nutrients analysed in the external meals.

Meal weights

Meal weights on average were substantially higher in meals from the internal model, compared to those from the external model. The average weight of years 0-3 internal meals was 375.4 grams compared to 250.2 grams from external meals; the average weight of years 4-8 internal meals was 396.6 grams compared to 303.2 grams from external meals; and the average weight of years 9+ internal meals was 492.5 grams compared to 385.1 grams from external meals.

Despite the significantly higher meal volumes provided on the internal model, this did not substantially increase the energy content of the meals relative to the external meals. This implies that the additional food provided in the internal model meals is nutrient-dense rather than calorie dense. This is reflected in the higher levels of nutrients in the internal meals compared to the external meals.

Below are details of the nutrients which did not meet the 33 percent target in all age/sex categories, focusing on the difference in the levels of those nutrients between the internal and external meals.

Riboflavin

Riboflavin levels in the analysed internal meals exceeded the 33 percent target in all 12 age/sex categories (ranging from 34 to 49 percent of daily requirements). However, riboflavin was marginally below the 33 percent target in all four categories for years 4-8 (32 percent). Riboflavin was also below the target in the external meals for 18-year-old males (28 percent).

Vitamin B6

Vitamin B6 levels in the analysed internal meals exceeded the 33 percent target in all 12 age/sex categories (ranging from 37 to 77 percent of daily requirements). However, vitamin B6 was marginally below the 33 percent target in all four categories for years 4-8 (32 percent).

Calcium

Calcium levels in the analysed internal and external meals were below the 33 percent target in all age/sex categories (ranging from 16 to 27 percent of daily requirements). Calcium levels in the internal meals were lower in years 0-3 meals compared to external meals (23 vs 27 percent), whereas the calcium levels in the internal meals were higher in years 4-8 (18 to 24 percent vs 16 to 21 percent) and years 9+ meals (23 vs 19 percent).

Iron

Iron was below the target in external meals in the four categories for years 0-3 (24 percent) and only marginally below the target in internal meals in the four categories for years 0-3 (32 percent). Iron levels were below the 33 percent target in 18-year-old females in both the internal (25 percent) and external (23 percent) meals and were marginally below the target for 18-year-old males in external meals (31 percent).

Iodine

Iodine was below the target in both internal and external meals in the four categories for years 0-3 (27 vs 26 percent), and the four categories for years 9+ (23 to 30 percent, differing by only 1 percent between the internal and external meals in each category).

Sodium

Sodium in the years 0-3 internal meals contributed to 36 percent of the upper level of intake (UL) compared to 42 percent in the external meals. Sodium in years 4-8 internal meals contributed to 31 percent of the UL compared to 33 percent in the external meals. Sodium in years 9+ internal meals contributed to between 36 to 42 percent of the UL compared to 37 to 42 percent in the external meals.

Magnesium

Magnesium levels in the analysed internal meals were marginally below the 33 percent target in 18-year-old males (30 percent), whereas the magnesium levels in the external meals were below the 33 percent target in 18-year-old females (29 percent) and males (25 percent).

Phosphorous

Phosphorous levels in the analysed external meals were marginally below the 33 percent target in all four categories for years 4-8 (31 percent), whereas phosphorous levels in internal meals were above the target for all age/sex categories (ranging from 36 to 73 percent of daily requirements).

Zinc

Zinc levels in the analysed meals exceeded the 33 percent target in all age/sex categories except 18-year-old males which was only 26 percent in the external meals.

Saturated fat

Saturated fat in internal years 0-3 meals was 4.5 grams (9.4 percent of energy) compared to 5.0 grams (11.8 percent of energy) in external meals. Saturated fat in internal years 4-8 meals was 5.7 grams (10.5 percent of energy) compared to 5.3 grams (10.5 percent of energy) in external meals. Saturated fat in internal years 9+ meals was 7.2 grams (9.9 percent of energy) compared to 6.2 grams (10.3 percent of energy) in external meals.

Carbohydrates

Carbohydrate (as a percentage of contribution to energy) was 44.0 percent in internal years 0-3 meals and 43.8 percent in external years 0-3 meals; 44.7 percent in internal years 4-8 meals and 45.8 percent in external years 4-8 meals; 42.9 percent in internal years 9+ meals and 43.4 percent in external years 9+ meals.

Fibre

Fibre levels in analysed external meals were marginally below the 33 percent target in 9-year-old and 12-year-old males (32 percent).

Energy

Although energy levels were higher in analysed internal meals (19 to 28 percent compared to 17 to24 percent in external meals), energy levels were below 33 percent in all age/sex categories.

Table 10: Nutritional contribution of internal and external model meals to daily nutrient requirements for female students

	Years 0-3 meals				Years 4-8 meals				Years 9+ meals			
Nutrients (% RDI)	**5-year-olds**		**8-year-olds**		**9-year-olds**		**12-year-olds**		**13-year-olds**		**18-year-olds**	
	internal	external	internal	external	internal	external	internal	external	internal	external	internal	external
Energy (kj)	28	24	23	20	24	23	21	19	27	22	27	22
Protein	159	123	111	86	111	93	77	65	99	78	91	72
Thiamin	56	49	56	49	46	44	46	44	50	48	41	39
Riboflavin	44	43	44	43	44	32	44	32	49	40	40	33
Niacin	141	103	141	103	91	80	91	80	144	112	123	96
Vitamin C	107	52	107	52	92	50	92	50	113	81	113	81
Vitamin B6	77	51	77	51	40	32	40	32	44	43	37	36
Vitamin B12	92	70	92	70	83	50	83	50	77	62	57	46
Folate -DFE	77	67	77	67	75	61	75	61	86	68	65	51
Vitamin A equivalents	103	84	103	84	62	70	62	70	73	67	63	58
Magnesium	71	51	71	51	42	35	42	35	52	43	35	29
Calcium	23	27	23	27	24	21	18	16	23	19	23	19
Phosphorous	73	65	73	65	36	31	36	31	46	39	46	39
Iron	32	24	32	24	46	36	46	36	47	43	25	23
Zinc	81	60	81	60	61	47	61	47	75	55	64	47
Selenium	58	46	58	46	35	34	35	34	54	46	45	38
Iodine	27	26	27	26	34	57	34	57	30	29	24	23
Fibre*	46	35	46	35	40	39	40	39	53	46	48	42

Notes: Blue cells represent ≥33 percent of daily requirements
Orange cells represent <30 percent of daily requirements
Yellow cells represent between 30-32 percent of daily requirements (within 10 percent of the target cut-off)
*Adequate intake
Contributions greater than 100 percent of daily requirements are in bold.

Table 11: Nutritional contribution of internal and external model meals to daily nutrient requirements for male students

	Years 0-3 meals				Years 4-8 meals				Years 9+ meals			
Nutrients (% RDI)	**5-year-olds**		**8-year-olds**		**9-year-olds**		**12-year-olds**		**13-year-olds**		**18-year-olds**	
	internal	external	internal	external	internal	external	internal	external	internal	external	internal	external
Energy (kj)	25	24	22	19	23	21	19	18	24	20	21	17
Protein	154	120	111	86	104	87	73	62	92	72	59	47
Thiamin	56	49	56	49	46	44	46	44	50	48	37	36
Riboflavin	44	43	44	43	44	32	44	32	49	40	34	28
Niacin	141	103	141	103	91	80	91	80	144	112	108	84
Vitamin C	107	52	107	52	92	50	92	50	113	81	113	81
Vitamin B6	77	51	77	51	40	32	40	32	44	43	34	33
Vitamin B12	92	70	92	70	83	50	83	50	77	62	57	46
Folate -DFE	77	67	77	67	75	61	75	61	86	68	65	51
Vitamin A equivalents	103	84	103	84	62	70	62	70	73	67	49	45
Magnesium	71	51	71	51	42	35	42	35	52	43	30	25
Calcium	23	27	23	27	24	21	18	16	23	19	23	19
Phosphorous	73	65	73	65	36	31	36	31	46	39	46	39
Iron	32	24	32	24	46	36	46	36	47	43	34	31
Zinc	81	60	81	60	61	47	61	47	75	55	35	26
Selenium	58	46	58	46	35	34	35	34	54	46	39	33
Iodine	27	26	27	26	34	57	34	57	30	29	24	23
Fibre*	46	35	46	35	33	32	33	32	44	39	38	33

Notes: Blue cells represent ≥33 percent of daily requirements
Orange cells represent <30 percent of daily requirements
Yellow cells represent between 30-32 percent of daily requirements (within 10 percent of the target cut-off)
*Adequate intake
Contributions greater than 100 percent of daily requirements are in bold.

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