The role of commercial processed baby foods in the diets of New Zealand toddlers

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Abstract

Background: It is recommended that by the age of 12 months toddlers should have progressed from consuming puréed foods to consuming family foods. Commercial processed baby foods (CPBFs) are manufactured foods designed to meet infants' food texture modification requirements, often by puréeing.

Objective: The primary aim of this study was to investigate the nutrient contribution of CPBFs to the diets of New Zealand toddlers. The secondary aim of this study was to investigate whether there were any significant differences in the nutrient intakes of toddlers who consume CPBFs compared to the toddlers who do not consume CPBFs.

Methods: Prior to this study there were no nutrient lines assigned to CPBFs or infant formulas and toddler milks (IFTMs) in Kai-culator (an online dietary assessment tool developed by the Department of Human Nutrition at the University of Otago). To determine New Zealand toddlers' intakes of CPBFs, CPBFs needed to be identified and then their nutrient lines entered into Kai-culator. The CPBFs were identified through three Dunedin supermarkets, manufacturers' websites, and a comprehensive document of all CPBFs manufactured by Heinz-Watties Ltd. A single nutrient line for each CPBF was developed in Kai-culator using the CPBF's Nutrition Information Panel and ingredients list. The macro- and micro-nutrients from the recipe were calculated within Kai-culator, based on the ingredients list, and then compared to the nutrient values from the CPBF's Nutrient Information Panel. If the macronutrient values calculated by Kai-culator differed from the Nutrient Information Panel by more than 5%, then the quantities of ingredients were altered.

The candidate developed a total of 151 CPBF recipes. Another Master of Science student entered nutrient lines for IFTMs into Kai-culator.

The CPBF nutrient lines in combination with the Eating Assessment in Toddlers study data were used to assess New Zealand toddlers' intakes of CPBFs. In 2012, two Master of Science students recruited 154 toddlers from Wellington, Dunedin and Christchurch to complete a 5-day diet record. Originally, the CPBFs in the diet records were entered as similar food items in Kai-culator. The candidate changed the food items to the new CPBF recipes. Kai-culator was then used to calculate the toddlers' nutrient intakes.

Results: Sixty percent of the participants consumed CPBFs. They consumed on average 1.03 CPBFs per day. Toddlers who consumed CPBFs had significantly lower intakes of sodium, and significantly higher intakes of iodine, vitamin A and vitamin C than non-consumers.

Thirty-three percent of the participants consumed an IFTM. Those who consumed IFTMs had significantly lower intakes of energy, saturated fat, total sugar, sodium and selenium, and significantly higher intakes of calcium, iron and iodine than non-consumers.

IFTMs contributed substantially more to the median daily energy intake (14.5%) than CPBFs (1.8%). Participants who consumed CPBFs were more likely to consume IFTMs than those who did not consume CPBFs.

Conclusion: The results of this study showed that there are significant differences in the nutrient intakes of toddlers who consume CPBFs compared to the toddlers who do not consume CPBFs. Participants who consumed CPBFs and IFTMs had more favourable nutrient intakes. However, due to the cost of the CPBFs, it is possible that participants' parent's characteristics, such as income and education, may be responsible for the more favourable intakes rather than the CPBFs themselves. Those who consumed CPBFs were also more likely to consume IFTMs which may help explain their more favourable nutrient intakes.

Preface

This study was carried out using Eating Assessment in Toddlers (EAT) study data, which was collected in 2011 to 2012 by two Master of Science students. In order to determine the EAT study intakes of commercial processed baby foods (CPBFs), 151 nutrient lines for CPBFs were developed in Kai-culator by the candidate. Another Master of Science candidate entered 23 nutrient lines for CPBF and all nutrient lines for infant formulas and toddler milks (IFTMs) into Kai-culator.

The candidate was responsible for:

- Establishing a definition to identify CPBFs available on the market.
- Requesting approval from supermarket managers to gather CPBF information on site.
- Visiting three of the largest supermarkets (Pak'n'Save, Countdown and New World) from the largest supermarket chains in Dunedin and photographing the Nutrition Information Panels of all CPBFs and IFTMs.
- Developing 151 recipes for CPBFs in Kai-culator.
- Identifying all CPBFs and IFTMs consumed by the EAT participants and entering them as CPBFs and IFTMs in the participants' diet records in Kai-culator.
- Calculating means and standard deviations for the EAT demographic data.
- Calculating median, 25th and 75th percentiles for all foods, all CPBFs, all IFTMs, CPBF subgroups and IFTM subgroups consumed by the EAT participants.

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I would like to dedicate this thesis to my son, Theo Kristel. You provided me with the inspiration to achieve my goals. I cannot thank you enough my son.

Finally, I would like to thank my partner Tarran Kristel for providing me with motivation and words of encouragement.

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List of Abbreviations

Cal/d	Calories per day
CNS	Children's Nutrition Survey
CPBF	Commercial processed baby food
CPBFs	Commercial processed baby foods
DLW	Doubly Labelled Water
EAR	Estimated average requirement
DNSIYC	Diet and Nutrition Survey of Infants and Young Children
EAT	Eating Assessment in Toddlers
FFQ	Food Frequency Questionnaire
FITs	Feeding Infants and Toddlers Study
FSANZ	Food Standards Australia New Zealand
g/d	grams per day
g/mL	grams per millilitre
g	grams
GLB	Growing Leaps and Bounds study
Govt.	Government
IFTM	Infant formula and toddler milk
IFTMs	Infant formula and toddler milks
InFANT	Infant Feeding Activity and Nutrition Trial
kJ	Kilojoules
LRNI	Lower Reference Nutrient Intake
mg	milligrams

NHANES	National Health and Nutrition Examination Survey
NHS	National Health Service
NIP	Nutrition Information Panel
RDI	Recommended Daily Intake
RNI	Reference Nutrient Intake
USDA	United States Department of Agriculture
WIC	Women, Infant and Children study
μg	micrograms

1. Introduction

The World Health Organisation, other health organisations (e.g., British Dietetic Association) and government health sectors in the United Kingdom, United States of America, Australia and New Zealand recommend that complementary feeding should begin at around 6 months of age (British Dietetic Association, 2013; Ministry of Health, 2008; National Health and Medical Research Council, 2012; National Health Service, 2013; World Health Organization, 2000). It is suggested that puréed foods should be the first foods introduced to an infant. Puréed foods may be homemade or purchased in the form of commercial processed baby foods (CPBFs).

As the infant matures, chopped foods followed by finger foods gradually replace puréed foods in an infant's diet (British Dietetic Association, 2013; Ministry of Health, 2008; National Health and Medical Research Council, 2012; National Health Service, 2013; World Health Organization, 2000). It is recommended that by the age of 12 months a toddler should be consuming family foods which have no or very little texture modification (British Dietetic Association, 2013; Ministry of Health, 2008; National Health and Medical Research Council, 2012; National Health Service, 2013; World Health Organization, 2000). Although not all CPBFs are puréed, they tend to have a softer and smoother consistency than homemade equivalents. Therefore, in theory, if these recommendations are followed, toddlers aged 12 months and older would not be consuming CPBFs. However, other research has shown that toddlers aged 12 to 24 months do consume CPBFs (Bell et al, 2013; Commonwealth Scientific Industrial Research Organisation et al, 2007; Department of Health & Food

Standards Agency, 2011; Fox et al, 2004; Fox et al, 2006; Lioret et al, 2013; Ponza et al, 2004; Sharma et al, 2013; Siega-Riz et al, 2010; Smithers, 2012; Szymlek- Gay et al, 2010).

Although studies have investigated the nutrient intake of toddlers, very few studies have investigated the contribution of CPBFs to toddlers' diets (Smithers, 2012). Furthermore, none of the studies that report intake of CPBFs have specifically compared the diets of toddlers who consume CPBFs to those of toddlers who do not consume CPBFs (Commonwealth Scientific Industrial Research Organisation et al, 2007; Department of Health & Food Standards Agency, 2011; Devaney et al 2004; Lioret et al, 2013; McLachlan et al, 2004; Ministry of Health, 2001a; Ponza et al, 2004; Sharma et al, 2013; Smithers, 2012; Soh et al, 2002; Watson, 2012). Consequently, it is not clear whether there are any nutritional implications of consuming CPBFs (a non-family food) after the age they were intended for. Therefore, the primary aim of this study was to investigate the macro- and micro-nutrient contribution of CPBFs to the diets of New Zealand toddlers (aged 12 to 24 months). The secondary aim of this study was to investigate whether there are any significant differences in the nutrient intake of the toddlers who consume CPBFs compared to toddlers who do not consume CPBFs.

2. Literature Review

2.1 Literature review methods

A search was conducted using Google (www.google.com) to find literature for section **2.2**, as this section was based on recommendations from government agencies and health organisations. Search words are displayed in **Table 2.1**.

Three electronic databases were searched, Scopus (1960 to November 2014), Medline (OvidSP) (1946 to November 2014) and Google Scholar (in November 2014) to find literature for sections **2.3 -2.5**. Reference lists of selected articles were reviewed for other relevant articles. Search words are displayed in **Table 2.1**.

2.2 Recommended feeding practices for toddlers

Recommendations for feeding toddlers are influenced by milestones that are set for infancy. In New Zealand it is recommended an infant is exclusively breastfed for the first 6 months (Ministry of Health, 2008). Around 6 months of age, it is recommended that puréed foods should be added to the diet. By the time an infant matures into a toddler, it is recommended that the texture of foods has progressed from puréed to foods with little of no texture modification (family food). Additionally, it is recommended that sugar and salt intake is limited (Ministry of Health, 2008). Although this is not specifically stated, it is assumed that at this age the toddler will be consuming less, if any, texture modified foods, including commercial processed baby foods (CPBFs).

Table 2.1 Search terms to identify literature for sections **2.2 to 2.5**[a]

	Section 2.2	Section 2.3	Section 2.4	Section 2.5
1)	"feeding guidelines"	"toddlers"	"toddler"	**"nutrient databases"**
2)	"weaning"	**"baby foods"**	"24 hour recall"	**"nutrient calculations"**
3)	"toddler"	Limit to"birth to 23 months"	"diet history"	**"dietary analysis"**
4)	"complementary"	Limit to "human"	"weighed food record"	
5)	"world health organisation”	"nutrient intake"	“estimated food record"	
6)	"NHS"	"dietary patterns"	"food frequency questionnaire"	
7)	"New Zealand"	**“1” AND “6”**	**"dietary assessment methods"**	
8)	"Australia"	**“1” AND “3” AND “4” AND “5”**	"DLW" OR "doubly labled water"	
9)	"America"	**“1” AND “2”**	"dietary assessment"	
10)	"USA"		**“1” AND “2”**	
11)	"Britain"		**“1” AND “3”**	
12)	"United Kingdom"		**“1” AND “4”**	
13)	**“8” OR “9” OR “10” OR “11” OR “12”**		**“1” AND “5”**	
14)	**"2" AND "12"**		**“1” AND “6”**	
15)	**"4" AND "5"**		**“1” AND “8”**	
16)	**"6" AND "2"**		**“1” AND “9”**	
17)	**"7" AND "4"**			
18)	**"8" AND "4"**			
19)	**"1"AND "3" AND 9**			

[a] Search terms in bold are research papers that were considered for the literature review.

Recommendations from other countries are similar to those in New Zealand (**Table 2.2**) (British Dietetic Association, 2013; National Health and Medical Research Council, 2012; World Health Organization, 2000). A point of difference between these recommendations lies in recommendations about CPBFs. Since 2005, the United Kingdom National Health Service (NHS) has specifically recommended homemade purées to be used instead of the commercial equivalent (National Health Service, 2013; National Health Service & Department of Health, 2005). Compared to homemade purées (without added salt and sugar), it is argued that CPBFs are not the better option, as they are expensive, have a large serving size and varieties have the same texture. It is further stipulated that the similar texture of the commercial products might decrease the toddlers' preference for other textures in the future. Other research has found that infants who were not exposed to lumpy food textures consumed less variety of foods than those who were exposed to lumpy textured foods (Coulthard et al, 2009; Northstone et al 2001). The British Dietetic Association has supported the NHS recommendation (British Dietetic Association, 2013). Commercial processed baby foods are not mentioned in the Australian recommendations (National Health and Medical Research Council, 2012). Conversely, in the New Zealand recommendations, CPBFs and homemade puréed foods are equally promoted (Ministry of Health, 2008).

Table 2.2. Recommended toddler feeding practices.

Reference	Population	Recommendations for infants	Recommendations for toddlers
(World Health Organization, 2000)	Developed and Developing countries	4-6 months: exclusive breast feeding. 6-7 months: homemade or specially prepared foods.	From 12 months cow's milk can be introduced.
(British Dietetic Association, 2013)	United Kingdom	0-6 months: exclusive breast-feeding or formula. 6-8 months: mashed or puréed foods (homemade purée is preferable to commercial purée). 8-9 months: finger or soft foods. 9-12 months: increase consumption of finger foods. Mashed, chopped minced foods can still be consumed. Avoid added salt and sugar	12 months: Mashed, chopped family foods and a variety of finger foods
(National Health Services, 2013; National Health Service and Department of Health, 2005)	United Kingdom	0-6 months: exclusive breastfeeding. Around 6 months: continuation of breast feeding, introduction of pureed foods (commercial baby foods not reccomended). 8-9 months: mixture of minced, chopped and soft finger foods. Avoid added salt and sugar.	12 months: Introduction to cow's milk (full fat) Toddler can consume a variety of textures with little texture modification (chopped of required).

Table 2.2 cont. Recommended toddler feeding practices.

Reference	Population	Recommendations for infants	Recommendations for toddlers
(National Health & Medical Council, 2012)	United States of America	0-6 months: exclusive breastfeeding. 6 months: introduction of iron containing solids, Begining with purée, progressing to mashed and soft foods. 8 months: finger foods. Limit sweetened beverages, cakes confectionary and potato chips. No fruit juice under the age of 12 months. Commercial baby and toddler foods not mentioned.	12 months: a wide variety of family foods. 12 months and older- introduction of cow's milk.
(National Medical Research Council, 2012)	Austraila	0-6months: exclusive breast feeding Around 6 months: Iron rich foods, progressing from pureed, to mashed, to chopped. By 8 months: finger foods. Homemade and commercial baby foods both promoted.	By 12 months: consuming a wide variety of family foods. Water and pasturised full-cream milk are recommended beverages. Fruit juices and other sugar sweetened beverages should be limited. Special complementary foods or milks for toddlers are not recommended for healthy children.
(Ministry of Health, 2008)	New Zealand	0-6 months: exclusive breast feeding. Around 6 months: introduction of complementary foods, texture progressing from puréed to mashed then chopped. Homemade purée and commercial baby foods both promoted.	12 to 24 months: continuation of breastfeeding, introduction of cow's milk, consuming a wide variety of family foods with very little or no texture modification.

2.3 Nutrient intake of toddlers

2.3.1 Nutrient intake from all foods

Nutrient intake from national surveys

No nutrient intake data have been collected from New Zealand toddlers on a national scale. This is because the national nutrition survey of New Zealand children, the Children's Nutrition Survey, only collected data from ages 5 years and over (Ministry of Health, 2001b, 2003) .

In 2007, Australia collected national nutrient data from the age of 2 to 16 years (Commonwealth Scientific Industrial Research Organisation et al, 2007). The Australian National Nutrition Survey found that 8%, 1% and 4% of 2 to 3 year olds had inadequate intakes for iodine, iron and vitamin C respectively (Commonwealth Scientific Industrial Research Organisation et al, 2007).

The United Kingdom collects nutrient data from children aged 4 months and older in their Diet and Nutrition Survey of Infants and Young Children (DNSIYC) study (results displayed in **Table 2.3. and Table 2.4**) (Department of Health & Food Standards Agency, 2011). The DNSIYC study found that approximately 12% of toddlers aged 12 to 36 months did not meet the estimated average requirements (EAR) for energy and 13% were not meeting the Lower Reference Nutrient Intake LRNI for iron (**Table 2.5**). As the LRNI is set lower than the EAR and Reference Nutrient Intake (RNI), it can be assumed that more of the toddler population aged 12 to 36 months is not meeting the EAR.

Table 2.3. Mean macronutrient intake of toddlers aged 12 to 36 months.

Reference	Name of Study	Age	sex	Energy (kj)	Protein (g)	Carbohydrate (g)	Fat (g)	Saturated fat (g)	Fibre (g)	Total sugar (g)
(Ministry of Health, 2001a)	CNS pilot study	12 to 36 mo	Female	5028	42	156	46	22	10	83
			Male	4911	42	156	44	21	10	76
(McLahlan et al, 2004)	McLachlan, 2004	12 to 24 mo	Both	4162	36	-	-	-	-	-
(Watson, 2012)	EAT study	12 to 24 mo	Both	3494	33	111	28	-	8	-
(Commonwealth Scientific Industrial Research Organisation, 2007)	Australian Children's Survey	24 to 36 mo	Both	6038	60	188	51	24	16	99
(Department of Heath, 2011)	DNSIYC	12 to 18 mo	Both	4007	38	126	38	18		66
(Ponza et al, 2004)	Ponza, 2004	12 to 24 mo	Both[a]	5552	50	-	-	-	-	-
			Both[b]	5134	47	-	-	-	-	-
(Sharma et al, 2004)	GLB study	12-24 mo	Both	4698	38	156	40	-	-	84
(Lioret et al, 2013)	InFANT Study	18 mo	Both	4473	47	128	40	20	13	-
(Devaney et al, 2004)	Devaney, 2004	12-24 mo	Both	5371	47	165	46	-	-	-

[a] Woman, Infants and Children (WIC) Participants
[b] Non-Woman, Infants and Children (WIC) participants

Table 2.3 cont. Mean macronutrient intake of toddlers aged 12 to 36 months.

Reference	Name of Study	Age	Sex	Energy (kj)	Protein (g)	Carbohydrate (g)	Fat (g)	Saturated fat (g)	Fibre (g)	Total sugar (g)
(Skinner et al, 1997)	Skinner (1997)	12 mo	Both	4908	42	161	42	-	-	-
		16 mo	Both	5054	42	166	43	-	-	-
		20 mo	Both	5188	45	179	41	-	-	-
		24 mo	Both	5406	46	183	44	-	-	-
(Soh et al, 2002)	Soh (2002)	12 to 24 mo	Female	3956	34	-	-	-	7	-
			Male	4143	38	-	-	-	4	-
(Cheng et al, 2013)[c]	Cheng (2013)	10 to 36 mo	Both	3900	30	130	35	-	-	-
(Kylberg et al, 1986)[c]	Kylberg (1986)	15 mo	Both		36	-	32	-	-	-
		24 mo	Both		36	-	32	-	-	-
(Hoerr et al, 2006)	Hoerr, (2006)	11-24 mo	Both	5413	-	-	-	-	-	-
(Gubbels et al, 2014)	Gubbels (2014)	1 to 3 years	Both	5379	14	55	30	11	13	

[c] Means unavailable, medians reported.

Table 2.4. Mean micronutrient intake of toddlers aged 12 to 36 months.

Reference	Name of Study	Age	sex	Vitamin C (mg)	Vitamin E (mg)	Sodium (mg)	Calcium (mg)	Iron (mg)	zinc (mg)
(Ministry of Health, 2001a)	CNS pilot study	12 to 36 mo	Female	79	4	1445	529	8	6
			Male	66	5	1505	570	7	7
(McLahlan et al, 2004)	McLachlan, 2004	12 to 24 mo	Both	-	-	-	-	-	-
(Watson, 2012)	EAT study		Both	48	-	-	556	6	4
(Commonwealth Scientific Industrial Research Organisation, 2007)	Australian Children's survey	24 to 36 mo	Both	84	4	1675	805	8	8
(Department of Heath, 2011)	DNSIYC	12 to 18 mo	Both	63		907	790	6	5
(Ponza et al, 2004)	Ponza, 2004	12 to 24 mo	Both[a]	103	-	-	911	10	-
			Both[b]	54	-	-	925	5	-
(Sharma et al, 2004)	GLB study	12-24 mo	Both	-	-	1627	-	8	5
(Lioret et al, 2013)	InFANT Study	18 mo	Both	58	4	1064	774	7	7
(Devaney et al, 2004)	Devaney (2004)	12-24 mo	Both	91	5	-	939	10	7

[a] Woman, Infants and Children (WIC) Participants
[b] Non-Woman, Infants and Children (WIC) participants

Table 2.4 cont. Mean micronutrient intake of toddlers aged 12 to 36 months.

Reference	Name of Study	Age	Sex	Vitamin C (mg)	Vitamin E (mg)	Sodium (mg)	Calcium (mg)	Iron (mg)	zinc (mg)
(Skinner et al, 1997)	Skinner (1997)	12 mo	Both	82	5	1331	948	13	5
		16 mo	Both	63	4	1593	814	10	5
		20 mo	Both	87	4	1640	781	13	5
		24 mo	Both	70	3	1855	814	9	6
(Soh et al, 2002)	Soh (2002)	12 -24 mo	Female	58	-	-	644	5	-
			Male	59	-	-	687	4	-
(Cheng et al, 2013)[c]	Cheng (2013)	10 -36 mo	Both	56	-	-	525	5	4
(Kylberg et al, 1986)[c]	Kylberg (1986)	15 mo	Both	69	-	-	760	10	3
		24 mo	Both	58	-	-	680	8	6
(Hoerr et al, 2006)	Hoerr, 2006	11-25 mo	Both	85	-	-	838	9.9	6.6
(Gubbels et al, 2014)	Gubbels (2014)	1 to 3 years	Both	-	-	-	-	-	-

[c] Means unavailable, medians reported.

The United States National Health and Examination Survey (NHANES) collects data from birth onwards. However, it is difficult to examine the nutrient intake of toddlers from the NHANES survey as the macro- and micro-nutrient data have only been published for 2 to 5 years old combined (Centres for Disease Control and Prevention & National Center for Health Statistics, 2013).

Nutrient intake from smaller studies

Only two New Zealand studies have published data on toddlers' nutrient intakes in general (Ministry of Health, 2001a; Watson, 2012). A pilot study conducted for the Children's Nutrition Survey (CNS) reported that toddlers aged 12 to 36 months had inadequate intakes of calcium (percentage not specified) (Ministry of Health, 2001a). The mean intakes for macro- and micro- nutrients found in this study are displayed in **Table 2.3** and **Table 2.4.** The other New Zealand study that reported data on a range of toddlers' macro- and micro-nutrient intakes was the EAT study. This study did not report any data on the prevalence of inadequate intakes of vitamins or minerals, as this was not the main focus of the study (Watson, 2012). The mean intakes of macro- and micro-nutrients are displayed in **Table 2.3** and **Table 2.4**.

Two New Zealand studies have reported that toddlers aged 12 to 24 months had inadequate intakes of iron and selenium (McLachlan et al, 2004; Soh et al, 2002). Inadequate intake of iron may be due to parents not offering iron fortified baby cereals or red meats (Soh et al, 2002). Inadequate intake of selenium in New Zealand toddlers is most likely due to the low levels of selenium in New Zealand soils (Gibson, 2005).

Table 2.5. Adequacy of dietary intakes of toddlers aged 12 to 36 months.

Reference	**Study name**	**Country**	**n=**	**Age (months)**	**Dietary assessment methods**	**Reported inadequate intake [Definition]**	**Comments**
(Ministry of Health, 2001a)	CNS pilot study	New Zealand	42	12 to 36	4 day weighed diet records 24 hour recall	Low levels of calcium intake (percentage not specified). High levels of energy from sugar (22-28%). [Usual nutrient intakes < Australian New Zealand EARs.]	
(McLachlan et al, 2004)	McLachlan (2004)	New Zealand	188	12 to 24	3 day weighed diet records	Toddlers had inadequate intake of selenium (percentage not specified). [Usual selenium intake< US Canadian EAR.]	
(Watson, 2012)	EAT study	New Zealand	152	12 to 24	5 day weighed diet record 24 hour recall	-	
(Soh et al, 2002)	Soh (2002)	New Zealand	226	6 to 24	3 day diet records	66% of toddlers at risk of inadequate intakes of iron. [Usual iron intakes < UK EAR.]	
(Lioret et al, 2013)	InFANT	Australia	177	9 and 18	24 hour recall	At aged 18 months inadequate (percent not meeting EAR) intakes of iodine (10%), iron (11%), vitamin A (10%) and vitamin C (14%) [Usual nutrient intakes < Australian New Zealand EARs.]	
(Commonwealth Scientific Industrial Research Organisation et al, 2007)	Australian Children's survey	Australia	4487	24 to 36	24 hour recall	"Negligible" percentage reported not meeting EARs for vitamins and minerals. [Usual nutrient intakes < Australian New Zealand EARs.]	The number of participants aged 24 to 36 months was not reported

Table 2.5 cont. Adequacy of dietary intakes of toddlers aged 12 to 36 months.

Reference	Study name	Country	n=	Age (months)	Dietary assessment method	Reported inadequate intake	Comments
(Department of Health et al, 2011)	DNSIYC	United Kingdom	2683	4 to 18	4 day estimated diet record	88% of boys and girls exceeding EER. 13% of boys and girls not meeting lower RNI for iron. [Usual intakes < UK LRNI].	The number of participants in the 12 to 18 month age group was not reported
(Gibson et al, 2014)	Gibson (2014)	United Kingdom	1460	12 to 35	4 day diet record	12-17 months: 7% and 45% of toddlers were not meeting requirements for iron and vitamin D respectively. 18-35 months: 4% and 67% of toddlers not meeting requirements for iron and vitamin D respectively. [Usual intakes < UK EAR].	Combined DNSIYC and NDNS studies
(Sharma et al, 2013)	GLB study	USA	32	13 to 24	24 hour recall	-	-
(Devaney et al, 2004)	Devaney (2004)	USA	998	12 to 24	24 hour recall	58% not meeting EAR for vitamin E. 35% and 43% reaching UL for vitamin K and zinc.	

Table 2.5 cont. Adequacy of dietary intakes of toddlers aged 12 to 36 months.

Reference	Study name	Country	n=	Age (months)	Dietary assessment method	Reported inadequate intake	Comments
(Hoerr et al, 2006)	Hoerr (2006)	USA	100	11 to 25	24 hour recall	Mean adequacy ratio used to determine percent not meeting recommendations. A Score of 85 was used as a criterion for meeting recommendations. 15%, 6%, 22%, 21%, 16%, 5%, 10%,51% of toddlers not meeting recommendations for vitamin A, vitamin C, folate, iron, calcium, zinc, magnesium and vitamin D respectively.	
(Ponza et al, 2004)	Ponza (2004)	USA	205	12 to 24	24 hour recall	29-40% exceeded estimated energy requirements "Negligible" percent reported not meeting EARs for vitamins and minerals. 34 to 40% of the toddler population consumed over the UL for vitamin A	This study was conducted with WIC participants and non-participants. Those who are eligible to participants in WIC are low-income mothers, who receive supplements and nutrition education and health care.
(skinner et al, 1997)	Skinner (1997)	USA	94	12 to 24	24 hour recall	Mean intake not meeting RDI for: Vitamin D (12 months; energy, zinc, vitamin D and vitamin E (16 months); energy, calcium, zinc, vitamin D and vitamin E (20 months); energy, iron, zinc, vitmain D and vitamin E (24 months). Percentage of the toddler population not meeting RDI was not specified.	

Table 2.5 cont. Adequacy of dietary intakes of toddlers aged 12 to 36 months.

Reference	Study name	Country	n=	Age (months)	Dietary assessment method	Reported inadequate intake	Comments
(Cheng et al, 2013)	Cheng (2013)	Germany	67	10 to 36	Estimated diet record and weighed diet record	-	Median reported
(Kylberg et al, 1986)	Kylberg (1986)	Sweden	81	15 and 24	not specified	-	Median intakes reported
(Gubbels et al, 2014)	Gubbels (2014)	Netherlands	1016	12 to 36	Estimated diet record	Compared to the National Guidelines from the Netherlands Nutrition Centre, 2%, 2%, 17%,1% and 83% of toddlers were not meeting recommendations for carbohydrates, protein, total fat, saturated fat and dietary fibre (respectively).	

The main body of research available on the nutrient intake of toddlers is from overseas countries including: Germany (Cheng et al 2013), United Kingdom (Department of Health & Food Standards Agency, 2011; Gibson et al, 2014), United States of America (Devaney et al, 2004; Hoerr et al, 2006; Ponza et al, 2004; Sharma et al, 2013; Skinner et al, 1997), Australia (Commonwealth Scientific Industrial Research Organisation et al, 2007), Sweden (Kylberg et al, 1986) and the Netherlands (Gubbels et al, 2010). The mean intakes of macro- and micro-nutrients are displayed in **Table 2.3** and **Table 2.4**.

There is little consensus between overseas studies on which nutrient intakes are likely to be inadequate. This is partially due to different studies using different nutrient reference values. For example: Australian studies (Commonwealth Scientific Industrial Research Organisation et al, 2007; Lioret et al, 2013) used the Nutrient Reference Values for Australian New Zealand (Australian Government & Department of Health and aging, 2005); English studies (Department of Health & Food Standards Agency, 2011; Gibson & Sidnell, 2014) used the Dietary Reference values for Food Energy and Nutrients for the United Kingdom (Department of Health, 1991); American studies (Devaney et al, 2004; Ponza et al, 2004; Skinner et al, 1997) used the Recommended Dietary Allowances (Food and Nutrition Board, 1989); and Dutch studies used the National Guidelines from the Netherlands Nutrition Centre (Gubbels et al, 2010).

Three studies determined the proportion of the toddler population who had inadequate intakes of nutrients by comparing the mean nutrient intake to the RDI or RNI (Gibson & Sidnell, 2014; Kylberg et al, 1986; Skinner et al, 1997). Skinner et al (1997) reported that toddlers aged between 12 to 24 months had inadequate intakes of energy, calcium, zinc, vitamin D and vitamin E (percentages not specified). Gibson et al (2014) reported that 4% to 7% and 45% to 67% of toddlers, aged 12 to 35 months, had inadequate intakes of iron and vitamin D respectively. Kylberg et al (1986) reported that toddlers aged 15 months had inadequate intake of calcium, iron and zinc and toddlers aged 24 months had inadequate intakes of iron and zinc (percentages not specified). However, the approach of comparing the mean intakes of the participants to the RNI or RDI to determine the prevalence of inadequate intakes is not recommended. This is because the RDI and RNI are set 97% to 98% above individual's requirements for particular nutrients (Gibson, 2005). Therefore this method is likely to over-estimate inadequate intakes.

Two studies determined the proportion of the population who had inadequate intakes by comparing the mean intake of nutrients to the EAR (Devaney et al, 2004; Lioret et al, 2013), the correct approach. Lioret et al (2013) found that 10 to 14% of Melbourne (Australia) toddlers had inadequate intakes of iron, iodine, vitamin A and vitamin C (**Table 2.3**) (Lioret et al, 2013). Devaney et al (2004) found that 58% of American toddlers aged 12 to 24 months had inadequate intakes of vitamin E. However, some studies did not observe inadequate intakes of any nutrients (Cheng et al, 2013; Ponza et al, 2004; Sharma et al, 2013).

Compared to overseas studies, the evidence suggests New Zealand toddlers are not at high risk of inadequate intakes of vitamin E and zinc. However, similar to other studies, New Zealand toddlers are at risk of having inadequate intakes of iron. Inadequate intakes of iron may be common for a number of reasons. For example, the parent may choose complementary foods that are not high in iron and calcium (Daly et al, 1996; Soh, et al 2004). Additionally, unlike most other countries, New Zealand toddlers are at risk of having inadequate intakes of selenium (McLachlan et al. 2004). This is likely to be due to the inadequate amount of selenium found in New Zealand soil (Gibson, 2005).

2.3.2 Nutrient intake from commercial processed baby foods

No New Zealand studies have examined the impact of CPBFs on a range of nutrient intakes in toddlers. However, two studies have reported the effect of CPBFs on single nutrients. Soh et al (2004) found that CPBFs contributed 0% of iron to toddlers' diets. McLachlan et al (2004) found that CPBF contributed 4% of selenium to toddlers' diets. It could be assumed that the contribution of CPBFs to iron and selenium intakes was low because few toddlers in their studies were consuming CPBF products. However, Szymlek-Gay et al (2010) reported that 15% of New Zealand toddlers aged 12 to 24 months consumed meat based CPBFs. This is likely to be an under-estimation because they did not report the percentage of participants who consumed fruit or vegetable containing CPBFs.

Like New Zealand, overseas research on toddlers' nutrient intakes from CPBFs is limited. Smithers et al (2012) investigated 4 patterns of eating at 18 months ("home-made contemporary", "discretionary", "ready-prepared baby foods" and "home-made traditional"). They found that an increase in dietary pattern score at 18 months for "ready-prepared baby foods" was not significantly associated with any nutrient increase or decrease. The DYSIYC study in United Kingdom showed that the consumption of CPBFs contributed very little to sodium (0-2%), total sugar (0-2%), carbohydrate (0-2%), fat (0-1%), saturated fat (0-1%), protein (0-3%) and energy (0-2%) intakes of toddlers aged 12 to 18 months (Department of Health & Food Standards Agency, 2011). In comparison, other studies have shown that 0 to 0.3% (Department of Health & Food Standards Agency, 2011) and 29% (Ponza et al, 2004) of toddlers aged 12 to 24 months and 12 to 18 months consumed CPBF meat products.

2.4 Measuring dietary intake in toddlers

2.4.1 Methods for measuring dietary intake

There are four main dietary assessment methods (diet record, food frequency questionnaire, 24 hour recall, and diet history). These methods either measure actual or usual dietary intake or both (Gibson, 2005). Actual dietary intake is a measure of dietary intake on specific days. Usual dietary intake is more representative of dietary intake over a period of time (Gibson, 2005).

Diet records

When diet records are used, participants are required to record all food and beverages consumed for a number of days (Gibson, 2005). The number of days required depends on the nutrient of interest and what is realistic for the population. Participants may be asked to estimate their daily intake with household measures such as cups or spoons or may be required to weigh ingredients and foods (Gibson, 2005; Thompson & Byers, 1994). This dietary assessment method is deemed to be more accurate than others, and therefore is considered to be the gold standard of dietary assessment methods (Thompson & Byers, 1994). Diet records can be used to assess usual intake (by collecting dietary data over multiple days over a long period of time) or actual intake (by collecting dietary data on one occasion) (Gibson, 2005).

The advantages of diet records are: accuracy, and participants may be less likely to forget foods as they are recording throughout the day. The disadvantages of this method are: participants must be motivated and literate, eating patterns may be altered to avoid weighing cumbersome mixed dishes, healthy foods may be over consumed and unhealthy foods may be under consumed (Gibson, 2005; Thompson & Byers, 1994).

Food frequency questionnaire

A food frequency questionnaire (FFQ) is a questionnaire that comprises a list of foods and consumption frequencies (Gibson, 2005). This dietary method is designed to collect information on usual intake (Gibson, 2005; Thompson & Byers, 1994). Participants select how often they would normally consume each food. A validated FFQ should be used (Gibson, 2005). The advantages of this method are: that it can be self-administered, it is inexpensive, quick and has a low respondent burden (Gibson, 2005; Thompson & Byers, 1994). The disadvantages of this method are: it is required that the participant is literate, this method often over-estimates energy, many aspects of the diet are not measured, it can be relatively inaccurate compared to other dietary methods (due to incomplete food lists, reported frequencies, and use of "usual" serving sizes) and brands and food practices are not captured (Gibson, 2005; Thompson & Byers, 1994).

24 hour recall

A 24 hour recall requires the participant to recall all food and beverages consumed in a defined 24 hour time period (Gibson, 2005; Thompson & Byers, 1994). A trained interviewer or a computer survey (such as in the NHANES study) can be used to administer a 24 hour recall (Gibson, 2005; Thompson & Byers, 1994). The trained interviewer uses probing questions to obtain more detail on brands, portion sizes, or forgotten foods (such as butter, margarine, sugar or beverages) (Thompson & Byers, 1994). This dietary method can be used to collect information on usual or actual dietary intake, depending on the number of 24 hour recalls collected (Gibson, 2005).

The advantages of the 24 hour recall method are: the participants are not required to be literate, it is more affordable, it is associated with less respondent burden, and dietary behaviour change is not likely. The disadvantages of this dietary method are: it relies on memory, and it may not report certain nutrients accurately in some populations (Gibson, 2005; Thompson & Byers, 1994).

Diet history

The original diet history method included 3 parts: collecting actual dietary intake (by asking about meals consumed on the previous day) and usual dietary intake (by asking more detail on variations of daily intake), an FFQ, and a diet record for up to 3 days. At present, the third step is omitted (Gibson, 2005; Thompson & Byers, 1994).

The advantages of the diet history are: it can capture eating patterns and behaviour over a long duration of time. The disadvantages of this dietary method are: it is expensive, time consuming, highly dependant on the interviewer's skills and techniques, and does not give quantitative data (Gibson, 2005; Thompson & Byers, 1994).

2.4.2 Challenges in this age group

There are multiple challenges when assessing nutrient intake in toddlers. Firstly, toddlers do not have the skills to report their own dietary intake (Burrows et al, 2010; Livingstone et al, 2004). Therefore, dietary information must be collected from a surrogate such as a parent or caregiver (Burrows et al, 2010; Livingstone et al, 2004). However, there are often multiple people involved in the care of a toddler, therefore the parent or caregiver may not be aware what the toddler is consuming over the entire day (Collins et al, 2013). Other parents and caregivers can be included in the dietary collection process to try and address this (Livingstone et al, 2004).

Furthermore, there is debate over which dietary assessment method most accurately describes dietary intake in toddlers. Much of the literature in this area comes from pre-school or school-aged children. Very few studies have examined the accuracy of dietary methods in toddlers. Burrows et al (2010) reviewed dietary assessment methods. They found that estimated food records and weighed food records had a significant amount of under-reporting for energy (19-41% and 18-27% respectively). Furthermore, Burrows et al 2010 found that 24 hour recalls and FFQs had a significant amount of under reporting (7-22% and 59% respectively) compared to the Doubly Labelled Water (DLW) technique. This has been identified in other studies as well. Kaskoun et al (1994) found that an FFQ significantly over-estimated energy intake in young children aged 4.2 to 6.9 years when compared with energy expenditure determined by the DLW technique (Kaskoun et al, 1994). Fisher et al (2008) found that a 24 hour recall (when compared to diet records) significantly overestimated energy in toddlers. Conversely, Collins et al (2013) compared the accuracy of the Australian Child and

Adolescent Eating Survey (ACAES) FFQ with weighed diet records and the doubly labelled water (DLW) technique. They found in pre-school children, aged 3.2 years, that the FFQ (1183kcal/d) and weighed food records (1179kcal/d) correlated well with total energy intake (1251Kcal/d) from DLW.

Under- and over-estimation of energy intake may be due to the limitations of dietary assessment methods (such as those talked about in section 2.4.1). Furthermore, it has been shown that parents who are overweight may increase under-reporting of foods (Livingstone et al., 2004). This has been shown in children but has not been investigated in toddlers.

2.5 Determining nutrient composition for commercial recipes

The gold standard for analysing the nutrient composition of recipes is chemical analysis (Gebhardt et al, 1997). This method is the most accurate, however, it is costly and takes a large amount of time (Powers et al, 2008; Schakel et al, 1997) so other methods often need to be used instead.

According to Schakel et al (1997), nutrient values for a commercial product (such as CPBFs) can be established by creating recipes in a nutrient database. To create a recipe, the list of ingredients and any available nutrition information (such as those displayed on the Nutrition Information Panel on the packaging) should be used. The amount of each ingredient should be estimated by using the ingredient list on the package (ingredients are recorded in order of declining weights). When calculating the nutrient composition from the recipe, each ingredient should be converted into the edible portion and appropriate yield and retention factors should be used. This ensures the nutrient composition of the recipe resembles the final recipe (cooked recipe) rather than raw ingredients (United States Department of Agriculture, 2007).

The final step to determine the nutrient content of a recipe is to alter the amounts of the ingredients until the estimated nutrient composition is close to the expected nutrient composition values (Schakel et al, 1997).

3. Objective Statement

Many studies have investigated the nutritional intake of toddlers. However, no studies have specifically compared the diets of toddlers who consume commercial processed baby foods (CPBFs), to the diets of toddlers who do not consume CPBFs. In theory, according the New Zealand Ministry of Health guidelines (2008), toddlers should be consuming family foods with little or no texture modification by the age of 12 months (Ministry of Health, 2008). This means that toddlers should have moved away from puréed foods such as CPBFs by this age. However, it is evident from other research that toddlers are consuming some CPBFs (Bell et al., 2013; Commonwealth Scientific Industrial Research Organisation et al, 2007; Department of Health & Food Standards Agency, 2011; Fox et al, 2004; Fox et al, 2006; Lioret et al, 2013; Ponza et al, 2004; Sharma et al, 2013; Siega-Riz et al, 2010; Smithers, 2012; Szymlek- Gay EA et al, 2010).

Research aim: The aim of this research was to:

1) Investigate the nutrient contribution of commercial processed baby foods to the diets of New Zealand toddlers (aged 12 to 24 months).
2) Investigate whether there are any significant differences in the nutrient intakes of the toddlers who consume commercial processed baby foods compared to the toddlers who do not consume commercial processed baby foods.

Stages involved in identifying CPBFs and the dietary intakes of the EAT study toddlers:

1. Establish a definition that will be used to identify CPBFs on the market
2. Visit three supermarkets (Pak'n'Save, Countdown and New World) from the largest supermarket chains in Dunedin and photograph the Nutrition Information Panels of all CPBFS and infant formulas and toddler milks (IFTMs) identified.
3. Identify all CPBFs and IFTMs consumed by the EAT participants
4. Use the Recipe Development method in Kai-culator to develop recipes for CPBFs identified as having been consumed by the EAT participants.
5. Re-enter all previously entered CPBFs and IFTMs in the EAT participant diet records using the newly developed CPBF and IFTM nutrient lines.
6. Determine whether there are any significant differences in the nutrient intakes of the toddlers who consume commercial processed baby foods compared to the toddlers who do not consume commercial processed baby foods

4.0 Methods

4.1 Study design

Since 2010 the New Zealand Food Composition database has not included nutrient lines for commercial processed baby foods (CPBFs). To determine the nutrient contribution of CPBFs to the diets of New Zealand toddlers, CPBFs were first identified, and then nutrient lines were established in Kai-culator. The CPBFs available on the market were identified by three different methods; through the 'Baby Food" section at three Dunedin supermarkets (Centre City New World, Centre City Countdown and Pak'N'Save), CPBF manufacturers websites and a list of CPBFs provided to the candidate by Heinz-Watties Ltd. Nutrient lines for the CPBFs were calculated by developing individual recipes in Kai-culator using the ingredients listed and the macro- and micro-nutrients on the Nutrient Information Panel (NIP) from the product packaging for each item. Recipes were developed in the Recipe Development section in Kai-culator. These nutrient lines were then used to analyse the nutrient intakes of toddlers in an earlier study, the EAT study (Mills, 2012; Watson, 2012).

4.2 Determining nutrient composition of commercial processed baby foods

4.2.1 Selecting commercial processed baby foods

In January 2014, three Dunedin supermarkets from the largest supermarket chains were selected to identify CPBFs available on the market. These supermarkets were Centre City New World, Centre City Countdown, and Pak'N'Save. The supermarkets were chosen as it was assumed that the supermarkets from the largest supermarket chains would supply the majority of the CPBFs available. Furthermore, in New Zealand there are two main supermarket chains: FoodStuffs supply Pak'n'Save, New World and Four Square (Foodstuffs, 2014); and Woolworths Limited supplies Countdown (Woolworths Limited, 2012). Therefore by selecting retail outlets supplied by these major chains, it was assumed the majority of CPBFs available on the market would be identified.

Between January and March 2014, the candidate took photographs of the CPBFs product description (front of package), NIP, and ingredients (back of package) at all supermarkets visited. A list of foods was then developed from the photographs.

Two other approaches were taken to ensure the majority of CPBF varieties were identified. Firstly, if the CPBF manufacturers listed their products (including NIPs and ingredients) on their website, then the CPBFs from the supermarket list were cross checked against the Internet site. For example, Only Organic (Only Organic, 2011), and Natureland (Natureland, 2014) branded baby foods were crosschecked with the products available on their websites. Secondly, Heinz-Watties baby foods that were identified at the three supermarkets were crosschecked against a list of CPBFs provided to the candidate by Heinz-Watties Ltd. Any additional foods that were identified from the Internet sites or the list provided by Heinz-Watties were added to the list of CPBFs identified at the supermarkets (**Appendix A**). The information from the CPBFs that were identified through one of the three supermarkets took priority over the information collected from the Internet or the Heinz-Watties list. This is because it was unclear when NIP data was last updated on the manufacturers Internet information and the list provided by Heinz-Watties.

4.2.2 Inclusion and exclusion criteria for commercial processed baby foods

In this study, CPBFs were defined as:

(1) Foods specifically designed for infants or toddlers, such as baby foods found in the "baby foods" section at the supermarket (for example, "Heinz Watties for Baby" range), or

(2) Processed foods marketed at children that met the Food Standards Australia New Zealand (FSANZ) standards 2.9.2 (Food Standards Australia New Zealand, 2013b) and 2.9.3 (Food Standards Australia New Zealand, 2013c) e.g., "Heinz Watties Fruit Squirtz", and "Meadow Fresh Thomas the Tank Engine yoghurt", "Meadow Fresh Calci Strong", "Anchor Calci-Yum". Processed foods were considered to be foods that had been through a manufacturing process.

Although some foods were marketed for children, not all of these foods met the FSANZ standards 2.9.2 and 2.9.3 criteria (Food Standards Australia New Zealand, 2013b, 2013c). The foods that were excluded included: "Healtheries Rice Wheels", "Tasti Fruties", "Mother Earth Fruit Sticks", "Tasti Milkies", "Mainland Cheese Slices-high-calcium for kids", "Babybel Cheese" and "Healtheries Potato Stix" (which all exceeded the recommended amounts of sodium of 100-350mg/100g (Food Standards Australia New Zealand, 2013b), "Ribena Blackcurrant fruit drink" (which exceeded the recommended levels of sugar of 4mg/100g (Food Standards Australia New Zealand, 2013c) and "Bobby Bananas" (not a processed food).

Some foods identified in the EAT study diet records were no longer available on the market. These were classified into two groups. The first group were foods that were marketed for children but were not necessarily classified as a CPBF (e.g., "Healtheries Wiggles Fruit Fills", "My First Vegemite" and "Fresh and Fruity My First Yoghurt"). It was evident that these foods were marketed for children, however to classify these products as CPBFs their NIP and ingredients list would need to be compared to FSANZ standards 2.9.2 and 2.9.3 (Food Standards Australia New Zealand, 2013b, 2013c). As these products were no longer available on the market, the NIP and ingredients were unavailable. Therefore, these products were substituted in the EAT diet records as regular foods, such as "Vegemite".

The second group of foods that were no longer available on the market were foods that would be found in the "Baby Food" section of the supermarket (e.g., "Natureland Pear and Apple Cereal", "Natureland Pear, Pea and Broccoli", "Natureland Summer Fruit Porridge" and "Heinz-Watties Simply Create" range). When these CPBFs appeared in an EAT diet record they were substituted with a similar type of CPBF.

4.2.3 Recipe development for commercial processed baby foods

For each CPBF, the candidate created a recipe from the ingredient list on the product packaging. All recipes were added into Kai-culator (version 1.09, 2014, University of Otago, Dunedin, New Zealand), an Internet based dietary assessment programme developed by the Department of Human Nutrition at the University of Otago.

Kai-culator uses the nutrient information (such as macro- and micro- nutrient values) from FOODfiles (Plant and Food Research Ltd, 2010) database. Because FOODfiles no longer contains nutrient information for CPBFs and infant formula and toddler milk (IFTM), recipes had to be developed within Kai-culator to establish a nutrient line for each CPBF.

Using the methods explained in **4.2.1,** lists of ingredients, and macro- and micro-nutrient information from NIPs were collected from the following brands of baby foods: “Baby Mum Mum”, “Golden Circle”, “Green Monkey”, “Heinz-Watties”, “Farex”, “Little Bellies”, “Little Quaker”, “Natureland”, and “Only Organic”.

The candidate created 151 individual recipes within Kai-culator. All ingredients listed on the back of the CPBF product were entered into the recipe development section in Kai-culator. The weights of individual ingredients for each recipe were determined by percentages stated on the ingredient lists. An ingredient near the beginning of the ingredient list would appear in the recipe in larger quantities than an ingredient stated near the bottom of the list. This is because all manufacturers are required by FSANZ to list all ingredients in descending order (Food Standards Australia New Zealand, 2013a).

For most foods, the ingredients were entered as a cooked rather than raw version. If a cooked version was not available then a separate cooked recipe was created for that individual item. For example, raw mango was converted to a cooked recipe by entering 100 grams of raw mango, a nutrient retention factor for “fruit (not citrus), boiled”, and a moisture factor of 100 percent (nutrient retention factors and moisture factors used by Kai-culator software are values produced by the USDA (United States Department of Agriculture, 2010; United States Department of Agriculture, 2012).

Some recipes contained ingredients for which it was difficult to create a single cooked recipe, for example, japonica rice, potato starch, pumpkin powder, carrot powder and cabbage powder in "Baby Mum Mum Rice Rusks". In this and similar circumstances, all ingredients were added in the raw form and appropriate moisture and retention factors were added to each ingredient individually to create an overall cooked product.

When an ingredient was not available in Kai-culator, then a closest match ingredient was used. For example, pineapple juice was substituted with apple juice. When a closest match was not available, and it was assumed that the ingredient would not significantly change the nutrient information, then the ingredient was excluded. For example: herb extracts, vanilla extract, and food acids were excluded.

Additional rules applied to the development of recipes. These included: table salt was used in all recipes, unless iodised salt was stated on the ingredient list; if the product was made in Australia, then Australian oats were used in the recipe (this was to account for different iodine and selenium soil levels); and for every recipe, the total weight of ingredients equalled 100 grams.

Once the completed list of ingredients and estimated quantities was entered, the macro- and micro-nutrients from the recipe were calculated within Kai-culator. These values were then compared to the nutrient values from the NIP on the CPBF (**Appendix B**). A target of a 5% maximum difference between values produced by Kai-culator for energy, protein, fat, carbohydrate and total sugars compared with the NIP of the product was set. If the Kai-culator nutrient value differed from the NIP by more than 5%, then the quantities of ingredients were altered until a closest match was achieved. However, this was not always possible. For example, “Heinz-Watties Organic Fruity Pear and Apricot Swirl” contained 0.1g/100g of total fat (as stated on the NIP) and the recipe nutrient analysis performed in Kai-culator estimated the recipe to contain 0.2g/100g of total fat. This produced a 100% difference between the values for fat. However, given the very small amount per 100g it was considered acceptable as further alterations to the recipe would cause a greater than 5% difference in energy.

Additional vitamins and minerals were added to the final nutrient line if the CPBF stated in the ingredient list that it had been fortified. For example, an additional 30mg per 100g of vitamin C was added to vitamin C or ascorbic acid fortified CPBFs. The amount of vitamin C added (30mg/100g) was determined by FSANZ, standard 2.9.2, where it is stated that fruit based products must not contain more than 60mg/100g of vitamin C (Food Standards Australia New Zealand, 2013c). Therefore, in foods where vitamin C was stated as an ingredient but without a specified amount, it was assumed that half this amount would be a conservative figure to add. Furthermore, this assumption is supported by some varieties of Heinz-Watties fruit based products stating: “The recommended dietary intake of vitamin C for infants is 30mg per day. One serve of this food contains not less than 36mg of vitamin C”. Therefore, in the absence of other information, it was assumed all brands of CPBFs fortified with vitamin C or ascorbic acid would contain at least an additional 30mg/100g.

If it was stated on the CPBF NIP that the product contained iron, then the amount of iron in iron-fortified products was determined by the amount per 100g specified on the NIP. Where the iron content was not stated, an additional 50mg of iron per 100g was added, as per FSANZ standard 2.9.2 (Food Standards Australia New Zealand, 2013c).

If it was stated on the CPBF NIP that the product contained thiamine, riboflavin, niacin or folate, then the amount of thiamine, riboflavin, niacin or folate was determined by the amount per 100g specified on the ingredient list on the NIP. Where values were not stated for thiamine, riboflavin, niacin and folate an additional 0.25mg, 0.4mg, 2.5mg and 50ug was added per serving, respectively (Food Standards Australia New Zealand, 2013b). Per serving values were converted into per 100g values before entering into Kai-culator.

4.2.4 Nutrient line development for infant formulas and toddler milks

Another Master of Science student developed the nutrient lines for infant formulas and toddler milks (IFTMs) within Kai-culator. Two nutrient lines per infant formula or toddler milk were entered into the “new food items” function in Kai-culator. The first nutrient line entered into Kai-culator was the macro- and micro-nutrient amounts for 100g of infant formula or toddler milk powder. The second nutrient line entered into Kai-culator was nutrient amounts from the NIP for 100g of prepared infant formula or toddler milk.

As Kai-culator requires nutrient values to be entered as per 100g, and the NIP of the IFTMs contain nutrient information per 100mL, the density was calculated and added to the per 100g prepared infant formula or toddler milk nutrient line. The density was calculated by the total weight of the infant formula or toddler milk and water combined (e.g., 12.6g [infant formula or toddler milk] + 90mL [water]= 102.6g/100mL=1.026g/mL).

4.3 Determining New Zealand toddlers' nutrient intake from commercial processed baby foods

4.3.1 EAT study participants

One hundred and sixty parents of toddlers aged 12 to 24 months were recruited for the EAT study between September 2011 and March 2012 by two other Master of Science candidates (Mills, 2012; Watson, 2012). Participants were recruited from three main centres in New Zealand (Wellington, Dunedin and Christchurch) through social media, newspaper advertisements, posters and word of mouth. Participants were not eligible to take part in the EAT study if the toddler was born at less than 36 weeks gestation or suffered from a health condition that affected growth or food intake.

4.3.2 EAT study methods

Participants attended two interviews. At the first interview the primary caregiver read an information sheet, signed a consent form, and filled out a demographic questionnaire. During the first visit, the weighed diet record booklet, instructions and kitchen scales (Salter Electronic Model Selectronic 2200) were also provided. Participants were asked to fill out the diet records on 5 pre-determined, randomised non-consecutive days (including one weekend day) over a period of 4 weeks.

All diets were entered into Kai-culator by two other Master of Science candidates and were checked by two nutritionists.

4.3.3 Determining the EAT study participants' nutrient intake from commercial processed baby foods

Each five-day diet record from the EAT study was re-examined by the candidate. Commercial processed baby foods, IFTMs, and potential CPBFs were identified from each record. The candidate identified potential CPBFs by common knowledge of foods marketed for children or foods with words such as "kids", "toddler" or "my first". The NIP information from potential CPBFs was crosschecked with the FSANZ standards 2.9.2 and 2.9.3 (Food Standards Australia New Zealand, 2013b, 2013c) to ensure the foods met the CPBF criteria (as explained in **4.2.2**). If a food was identified as a possible CPBF but it was no longer on the market, it was substituted with a closest match item and was not considered as a CPBF (for example: "My First Vegemite", "Healtheries Wiggles Fruit Fills", "Meadow Fresh My First Yoghurt"), as the NIP was not available to crosscheck against FSANZ standards 2.9.2 and 2.9.3 (Food Standards Australia New Zealand, 2013b, 2013c).

Once all of the records had been re-examined a complete list of recipes needed for CPBFs was produced. All CPBFs identified in the diet records were changed to the appropriate CPBF recipe in Kai-culator. This change was necessary as the CPBFs first entered into Kai-culator were either a substitute for a similar item (for example, "Only Organic Mini Rice Cakes" were substituted with plain corn cakes) or an out-dated generic baby food that had been entered from FOODFiles.

Each food CPBF and IFTM that was consumed with a frequency of one or greater in the EAT study was assigned to a food group within the “food group systems” function of Kai-culator. **Table 4.1** shows the food groups. The food group system that the candidate used was a modified version of the one that was developed by another Masters of Science student (Mills, 2012). The original “Commercial processed baby foods” and “Infant formula and toddler milks” food groups were subdivided by the candidate in order to encompass a wider variety of sub groups.

A priority list was created to categories CPBFs that could be placed in more than one CPBF sub food group (i.e., Heinz Watties Farex Muesli with Apple).

The priority list was as follows (1 highest priority, 7 lowest priority):

1) Meat-red
2) Meat- other
3) Cereal- iron fortified
4) Dairy
5) Fruit
6) Vegetables
7) Cereal- not iron fortified

Table 4.1 Sixteen food groups and sub groups assigned to foods in Kai-culator that had been consumed in the EAT study.

Food Group	Sub Group	
01.00 Commercial processed baby foods	01.20	Ready-to-eat red meat
	01.21	Ready-to-eat non-red meat (e.g. chicken, fish, pork)
	01.22	Ready to eat vegetables
	01.23	Ready-to-eat fruit
	01.24	Ready-to-eat fruit and cereal
	01.25	Ready-to-eat fruit and dairy
	01.26	Ready-to-eat other
	01.27	Baby cereals iron fortified
	01.28	Baby cereals not iron fortified
	01.29	Junior juices
	01.30	Baby rusks
	01.31	Baby biscuits
02.00 Bread, pasta, rice and low sugar cereal	02.15	White bread, buns (not iced), crumpets
	02.16	Wholemeal or wholegrain bread, buns
	02.18	Rice cakes, rice wheels, crisp breads
	02.19	“Weet-Bix” “Fruity Bix”, etc
	02.20	Porridge (not instant sachets)
	02.12	Cornflakes, rice bubbles
	02.22	Other breakfast cereals (less than 15g sugar per 100g)
	02.24	Rice
	02.26	Canned spaghetti
	02.27	Other pasta
	02.84	Fruit bread, currant buns
03.00 Meat	03.29	Other chicken
	03.30	Other fish
	03.34	Mince and patties
	03.35	Other meat (beef lamb, pork, mutton)
04.00 Processed meat	04.28	Chicken nuggets or shapes, fish fingers or shapes, battered or crumbed fish
	04.31	Sausages, saveloys, hot dogs (including vegetarian)
	04.32	Ham, bacon, luncheon
	04.33	Meat pies and sausage rolls
05.00 Eggs and beans	05.36	Eggs
	05.37	Canned beans (including baked beans)
	05.38	Hummus

Table 4.1 cont. Sixteen food groups and sub groups assigned to foods in Kai-culator that had been consumed in the EAT study.

Food Group	Sub Group	
06.00 Vegetables	06.40	Potato and kumara (boiled, baked, microwaved, mashed)
	06.42	Frozen mixed vegetables
	06.43	Carrot
	06.44	Pumpkin
	06.45	Green peas
	06.46	Sweet corn
	06.47	Broccoli and cauliflower
	06.48	Green leafy vegetables (sliver beet, cabbage etc)
	06.49	Salad greens (e.g. lettuce cucumber)
	06.50	Raw tomato
	06.51	Cooked tomato (pasta sauces, canned tomato)
	06.52	Other vegetables
07.00 Fruit	07.54	Canned fruit
	07.55	Bananas
	07.56	Apples
	07.57	Pears
	07.58	Oranges and mandarins
	07.59	Kiwifruit
	07.60	Grapes
	07.61	Berries (fresh or frozen)
	07.62	Dried fruit
	07.63	Avocado
	07.64	Other fruit
08.00 Milk and milk products	08.65	Low-fat cows milk (green, light blue or yellow top) as a drink
	08.66	Low-fat cows milk (green, light blue or yellow top) on cereal or other foods (excluding custards or sauces)
	08.67	Cows milk (blue or silver top) as a drink
	08.68	Cows milk (blue or silver top) on cereal or other food (excluding custards or sauces)
	08.72	Other milk as a drink
	08.73	Cheese (including recipes)
	08.74	Yoghurt, dairy food
	08.75	Custard and other milk puddings
	08.77	White sauce
09.00 Breast milk	09.71	Breast milk

Table 4.1 cont. Sixteen food groups and sub groups assigned to foods in Kai-culator that had been consumed in the EAT study.

Food Group	Sub Group	
10.00 Infant formula and toddler milk	10.10	< 6 month formula (stage 1)
	10.11	Follow on formula (stage 2)
	10.12	Toddler formula (stage 3 and 4)
	10.13	Specialised infant formula (soy, goat, lactose free)
11.00 Spreads	11.78	Butter
	11.79	Margarine
12.00 Cakes, biscuits, puddings, confectionary, sweet snacks, sweet cereals	12.22	Other breakfast cereals (more than 12g of sugar per 100g)
	12.76	Ice cream
	12.80	Coasted biscuits (chocolate, yoghurt, icing)
	12.81	Biscuits other
	12.82	Cakes, muffins, scones, slices
	12.83	Croissants, sweet buns, iced buns, pastries
	12.85	Puddings not yet described
	12.86	Chocolate, lollies
	12.88	Muesli, nut, cereal or puffed rice bars
	12.89	Fruit leather, fruit strings, fruit roll-ups
13.00 Sweet drinks	13.91	Fruit drinks, Ribena, cordial sachets
	12.92	Fizzy drinks (lemonade, coke)
14.00 Hot chips, roast potato and kumara	14.41	Hot chips, potato shapes, roast potato or kumara
15.00 Savoury Snacks	15.17	Crackers (wheat, rice or corn-based)
	15.25	Instant noodles
	15.87	Crisps, corn chips, corn snacks (e.g. "Cheezels")
16.00 Nutritive drinks	16.90	Fruit juice ("Fresh Up", "Just Juice", freshly squeezed)
	16.93	Flavoured milk ("Milo", "NesQuick", drinking chocolate, "Up & Go")

Iron fortified cereals had a higher priority than fruit as it was assumed the iron would have a greater impact on nutrient intake. When a CPBF contained both dairy and fruit, dairy had a higher priority as it was assumed the dairy would have a greater impact on nutrient intake.

4.3.4 Determining the EAT study participants' nutrient intake from breast milk

The amount of breast milk consumed by the EAT study participants per day was estimated using breast milk estimates from the literature. The World Health Organisation (1998) estimated that toddlers from developed countries aged 12 to 24 months consumed approximately 448g/d of breast milk per day (World Health Organization, 1998).

In the present study, parents were instructed to record when their toddler was breastfed or to give an expressed breast milk amount. If an expressed amount was not available it was assumed the toddler consumed 448g/d of breast milk alone, or breast milk and infant formula or toddler milk combined. Any infant formula or toddler milk consumed was subtracted from the 448g/d, and then the remaining amount was divided by the number of breast-feeding occasions.

4.4 Statistical analysis

To generate Table 5.1, the candidate plotted histograms to examine distributions. As all demographic data was approximately normally distributed, means and standard deviations were calculated using Excel version 14.4.4 (Microsoft Corporation, California).

To generate Table 5.2, each CPBF and IFTM identified through the supermarket, Heinz-Watties information sheet or manufacturer's websites was categorised into CPBF or IFTM subgroups by the candidate. Percentages were calculated using Excel version 14.4.4 (Microsoft Corporation, California).

To generate Table 5.3, the candidate tallied each CPBF and IFTM consumed by the EAT participants into their appropriate sub groups. Percentages were calculated using Excel version 14.4.4 (Microsoft Corporation, California).

To generate Table 5.4 and Table 5.5, medians 25th and 75th percentiles were calculated for only the participants who consumed each specific CPBF, as the overall frequency of consumption of CPBFs was low. This was because the CPBFs contributed very little to the total macro- and micro-nutrients. The candidate calculated the median and 25th and 75th percentiles for each CPBF and IFTM sub group using Excel version 14.4.4 (Microsoft Corporation, California).

To generate Table 5.6 and 5.7 the candidate identified all EAT participants who consumed CPBFs and IFTMs. The candidate calculated medians, 25th and 75th percentiles for all participants who were identified as CPBF or IFTM consumers. A two-sided unpaired t-test was used to determine if there were any significant differences between the macro- and micro-nutrient intakes of the participants who consumed CPBFs or IFTMs, and the intakes of the participants who did not consume CPBFs or IFTMs. Levene's test of equal variance was used prior to conducting the t-test. If Levene's test showed that the groups (e.g., "Ready-to-eat red meat" CPBF consumers versus CPBF non-consumers, or "Follow on formula" [IFTM] consumers versus IFTM non-consumers) had unequal variances, a two-sample t-test without the equal variances assumption was undertaken in Stata version 13.1 (Stata Corporation, Texas). If Levene's test showed that the groups did not have unequal variances, a two sample unpaired t-test with equal variances was used. P-values were calculated and $p<0.05$ was considered to indicate statistical difference. A Biostatistician conducted the Levene's tests and t-tests.

5. Results

5.1 Participant Characteristics

One hundred and sixty participants were recruited in 2011 to 2012 to take part in the EAT study. One hundred and fifty-five participants completed the study and one participant was excluded from this analysis, as there was one missing diet record. One hundred and fifty-four participants were included in the present analysis. The mean age of the participants was 17.1 months. Over half of the participants were male (53%), and participants were mostly New Zealand European (77%) (**Table 5.1**).

Table 5.1 Participant characteristics (n=154).

Characteristics	Mean (SD)	n (%)
Age (months)	17.1 (3.6)	
Sex		
Male		80 (52.6)
Female		72 (47.4)
Ethnicity		
New Zealand European		117 (77.0)
Māori		12 (7.9)
Pacific Islanders		4 (2.6)
Other		19 (12.5)
Birth characteristics		
Birth weight (g)[a]	3600.8 (604.4)	
Length of gestation (weeks)[b]	39.7(1.5)	
New Zealand Deprivation Index 2006 [c]		
1-3		59 (41.5)
4-7		67 (47.1)
8-10		16 (11.3)

[a] Data available for 142 participants
[b] Data available for 143 participants
[c] (Salmond et al, 2007)

Table 5.2 Number of commercial processed baby foods (CPBFs) and infant formulas and toddler milks (IFTMs) identified and assigned nutrient values.

Food Group	Sub Group		Number of CPBFs identified by: Supermarkets	Heinz-Watties information sheet	Company websites	Total identified	Assigned nutrient values n (%)
01.00 Commercial Processed baby food	1.20	Ready-to-eat red meat	28	1	0	30	27 (90)
	1.21	Ready-to-eat non-red meat (e.g. chicken, fish, pork)	15	1	0	16	15 (94)
	1.22	Ready to eat savoury vegetables	20	3	1	24	14 (58)
	1.23	Ready-to-eat fruit	50	10	1	61	56 (92)
	1.24	Ready-to-eat fruit and cereal	8	6	1	16	16 (100)
	1.25	Ready-to-eat fruit and dairy	16	9	2	27	24 (89)
	1.26	Ready-to-eat dairy other	12	7	2	20	16 (80)
	1.27	Ready-to-eat other	10	1	1	12	7 (58)
	1.28	Baby cereals iron fortified	9	0	0	9	9 (100)
	1.29	Baby cereals not iron fortified	0	0	0	0	0
	1.30	Junior juices	2	0	0	2	1 (50)
	1.31	Baby rusks	6	0	0	6	5 (83)
	1.32	Baby biscuits	4	0	0	4	3 (75)
	1.33	Baby muesli bars	5	5	0	10	4 (50)
10.00 Toddler and Infant formula	10.10	< 6 month formula (stage 1)	16	0	0	16	9 (56)
	10.11	Follow on formula (stage 2)	15	0	0	15	9 (60)
	10.12	Toddler milk (stage 3 and 4)	14	0	0	14	11 (79)
	10.13	Specialised infant formula (soy, goat, lactose free)	16	0	0	16	10 (63)

As displayed in **Table 5.2**, the majority of commercial processed baby foods (CPBFs) were identified from the three main supermarkets (Centre City New World, Centre City Countdown and Pak'n'Save Dunedin) in Dunedin. Around 81% of identified CPBFs and 64% of identified infant formulas and toddler milks (IFTMs) were assigned nutrient values in Kai-culator. The main reason why a CPBF or IFTM was not assigned a nutrient line in Kai-culator was that the CPBF or IFTM was not consumed by EAT participants. These products included "Green Monkey", "Heinz Watties Simply" range, and stage 1 infant formulas.

Sixty percent of the EAT participants consumed a CPBF at least once during the 5 day diet record. **Table 5.3** represents the number of participants who consumed CPBFs and IFTMs. The most commonly consumed CPBFs were; "Ready-to-eat fruit " (48%), "Ready-to-eat red meat" (31%) and "Ready-to-eat fruit and dairy" (34%). The most commonly consumed IFTM was "Toddler milk (stage 3 and 4)" (24%).

Table 5.4 and **Table 5.5** depict the median macro- and micro-nutrient intakes from each CPBF and IFTM consumed for the EAT participants who consumed that particular CPBF or IFTM. As **Table 5.4** and **Table 5.5** describe the median intakes of the EAT participants who consumed CPBF and IFTMs, the number of participants (n) who consumed each food group within CPBF and IFTMs is different. On average, the participants who consumed CPBFs consumed 1.03 CPBFs on each of the 5 days of diet recording. The median total energy contribution from CPBFs was very low (68kJ), whereas, IFTMs contributed a substantial amount to the median total energy (535kJ).

Table 5.3 Number of EAT participants consuming commercial processed baby foods and infant formulas and toddler milks on at least one of the five days of diet recording.

Food Group	Sub Group		no (%)
Commercial Processed baby food	1.20	Ready-to-eat red meat	47 (30.7)
	1.21	Ready-to-eat non-red meat (e.g. chicken, fish, pork)	23 (15.0)
	1.22	Ready to eat savoury vegetables	4 (2.6)
	1.23	Ready-to-eat fruit	73 (47.7)
	1.24	Ready-to-eat fruit and cereal	13 (8.5)
	1.25	Ready-to-eat fruit and dairy	52 (34.0)
	1.26	Ready-to-eat dairy other	39 (25.5)
	1.27	Ready-to-eat other	36 (23.5)
	1.28	Baby cereals iron fortified	16 (10.5)
	1.29	Baby cereals not iron fortified	0 (0)
	1.30	Junior juices	1 (0.7)
	1.31	Baby rusks	12 (7.8)
	1.32	Baby biscuits	5 (3.3)
	1.33	Baby muesli bars	20 (13.1)
Infant formula and toddler milk	9.00	Breast milk	39 (25.5)
	10.10	< 6 month formula (stage 1)	0 (0)
	10.11	Follow on formula (stage 2)	9 (5.9)
	10.12	Toddler milk (stage 3 and 4)	37 (24.2)
	10.13	Specialised infant formula (soy, goat, lactose free)	9 (5.9)

Median macro- and micro-nutrient intakes for all EAT participants is shown in **Table 5.6** and **Table 5.7**. There was no significant difference in energy (p= 0.742), protein (p=0.900), fat (p=0.331), carbohydrate (p=0.928), saturated fat (0.296), total sugar (p=0.179), calcium (p=0.070) iron (p=0.478), zinc (p=0.348) and selenium (p=0.716) intakes between the participants who consumed CPBFs and those who did not consume CPBFs. However, the participants who consumed CPBFs had a significantly lower sodium intake (p=0.0125) and significantly higher intakes of iodine (p=0.034), vitamin A (p=0.004) and vitamin C (p=0.005).

Table 5.4. The median (25th, 75th percentile) macronutrient intakes per day from all commercial processed baby foods (CPBFs), all infant formulas and toddler milks (IFTMs), breast milk, and individual CPBFs and IFTMs (for the EAT participants who were consumers of the food)

	Energy (kJ)	**Protein (g)**	**Fat (g)**	**Carbohydrates (g)**	**Saturated fat (g)**	**Total Sugars (g)**
All CPBFs	68.0	0.4	0.3	2.7	0.09	1.23
	(35.0, 135.0)	(0.2, 1.0)	(0.1, 0.7)	(1.5, 5.5)	(0.0, 0.3)	(0.4, 3.6)
Ready-to-eat red meat (n=26)	69.5	0.9	0.5	2.15	0.2	0.7
	(49.75, 152.25)	(0.525, 2)	(0.4, 1.1)	(1.2, 4.7)	(0.1, 0.4)	(0.3, 1.2)
Ready-to-eat non-red meat (e.g. chicken, fish, pork) (n=17)	61.0	0.7	0.4	1.7	0.1	0.4
	(39.0, 80.0)	(0.5, 1.2)	(0.2, 0.5)	(1.4, 2.5)	(0.1, 0.2)	(0.3, 0.6)
Ready to eat savoury vegetables (n=3)	42.0	0.4	0.2	1.8	0.0	0.5
	(31.5, 72.0)	(0.3, 0.6)	(0.1, 0.2)	(1.4, 3.3)	(0.0, 0.0)	(0.4, 0.9)
Ready-to-eat fruit (n=38)	102.0	0.2	0.2	5.0	0.1	4.1
	(43.3, 180.3)	(0.1, 0.9)	(0.1, 0.4)	(2.2, 8.6)	(0.0, 0.1)	(1.3, 6.9)
Ready-to-eat fruit and cereal (n=20)	66.5	0.3	0.1	3.2	0.0	1.8
	(39.8, 78.0)	(0.1, 0.4)	(0.1, 0.4)	(2.1, 3.8)	(0.0, 0.2)	(1.3, 3.3)
Ready-to-eat fruit and dairy (n=13)	77.0	0.4	0.2	3.6	0.1	3.0
	(68.0, 83.0)	(0.3, 0.5)	(0.2, 0.4)	(2.9, 4.2)	(0.1, 0.2)	(1.8, 3.9)
Ready-to-eat-dairy other (n=49)	165.0	1.4	1.1	5.4	0.6	4.3
	(77.0, 317.0)	(0.6, 2.3)	(0.4, 2.6)	(3.0, 9.2)	(0.2, 1.5)	(2.1, 7.9)
Ready-to-eat other (n=29)	25.0	0.1	0.1	1.0	0.0	0.2
	(16.0, 46.0)	(0.1, 0.2)	(0.0, 0.3)	(0.7, 1.6)	(0.0, 0.2)	(0.1, 0.5)
Baby cereals iron fortified (n=14)	86.0	0.6	0.5	3.2	0.1	0.3
	(39.0, 185.0)	(0.3, 1.1)	(0.2, 0.7)	(1.7, 7.2)	(0.0, 0.3)	(0.2, 0.7)
Junior juices (n=1)	16.0	0.1	0.0	0.9	0.0	0.9
	(16.0, 16.0)	(0.1, 0.1)	(0.0, 0.0)	(0.9, 0.9)	(0.0, 0.0)	(0.9, 0.9)

Table 5.4 cont. The median (25th, 75th percentile) macronutrient intakes per day from all commercial processed baby foods (CPBFs), all infant formulas and toddler milks (IFTMs), breast milk, and individual CPBFs and IFTMs (for the EAT participants who were consumers of the food)

	Energy (kJ)	Protein (g)	Fat (g)	Carbohydrates (g)	Saturated fat (g)	Total Sugars (g)
Baby rusks (n=12)	26.5	0.2	0	1.5	0	0.3
	(19.5, 45.8)	(0.1, 0.2)	(0.0, 0.0)	(1.0, 2.3)	(0.0, 0.0)	(0.1, 0.4)
Baby biscuits (n=6)	19	0.1	0.1	0.8	0	0.3
	(17.0, 31.5)	(0.1, 0.2)	(0.1, 0.2)	(0.7, 1.4)	(0.0, 0.0)	(0.3, 0.5)
Baby muesli bars (n=17)	44	0.2	0.2	2	0.1	1.3
	(43.0, 100.0)	(0.2, 0.5)	(0.2, 0.4)	(2.0, 4.6)	(0.0, 0.1)	(1.2, 2.9)
Breast milk[a] (n=42)	1291	5.7	18.4	30.9	8.7	30.9
	(978.5, 1291.0)	(4.4, 5.7)	(13.9, 18.4)	(23.4, 30.9)	(6.6, 8.7)	(23.4, 30.9)
All infant formula and toddler milks	535.0	4.9	5.6	17.3	0.0	0.0
	(342.0, 996.0)	(2.9, 7.7)	(3.7, 10.9)	(9.7, 29.2)	(0.0, 3.2)	(0.0, 1.3)
< 6 month formula stage 1 (n=0)						
Follow on formula stage 2 (n=9)	343	2.5	4	9.7	0	0
	(284.0, 802.0)	(2.1, 5.8)	(3.3, 9.3)	(8.3, 21.0)	(0.0, 0.0)	(0.0, 0.0)
Toddler milk stage 3 and 4 (n=22)	561.5	5.2	5.3	16.6	1.6	0
	(358.3, 856.5)	(3.3, 8.1)	(3.3, 7.9)	(10.8, 25.5)	(0.0, 3.8)	(0.0, 7.7)
Specialised infant formula soy, goat, lactose free (n=8)	724	7	13	27.7	0	0
	(399.3, 1210.8)	(3.9, 7.7)	(9.6, 14.8)	(18.9, 30.4)	(0.0, 3.6)	(0.0, 0.6)

[a] Breast milk estimation based on 448g/d (World Health Organization, 1998)

Table 5.5. The median (25th, 75th percentile) micronutrient intakes per day from all commercial processed baby foods (CPBFs), all infant formulas and toddler milks (IFTMs), breast milk, and individual CPBFs and IFTMs (for the EAT participants who were consumers of the food)

	Sodium (mg)	Calcium (mg)	Iron (mg)	Zinc (mg)	Iodine (mg)	Selenium (µg)	Vitamin A (µg)	Vitamin C (mg)
All CPBFS foods	4.9 (1.9, 11.1)	3.7 (1.4, 12.3)	0.1 (0.0, 0.2)	0.1 (0.0, 0.2)	0.2 (0.1, 0.6)	0.1 (0.0. 0.3)	6.3 (1.0, 25.3)	1.0 (0.1, 4.3)
Ready-to-eat red meat (n=26)	8.3 (3.8, 26.8)	3.7 (2.3, 8.4)	0.1 (0.1, 0.3)	0.2 (0.1, 0.4)	0.2 (0.1, 0.3)	0.2 (0.1, 0.6)	71.2 (33.0, 154.3)	2.5 (1.4, 4.3)
Ready-to-eat non-red meat (e.g. chicken, fish, pork) (n=17)	8.0 (5.8, 10.5)	2.8 (2.5, 5.7)	0.1 (0.1, 0.2)	0.1 (0.1, 0.2)	0.1 (0.1, 0.2)	0.5 (0.3, 0.8)	37.0 (15.8, 93.7)	2.1 (1.3, 3.0)
Ready to eat savoury vegetables (n=3)	1.3 (1.0, 2.8)	3.4 (2.5, 5.6)	0.1 (0.1, 0.2)	0.1 (0.1, 0.2)	0.2 (0.1, 0.2)	0.0 (0.0, 0.1)	66.6 (41.0, 134.2)	4.1 (2.2, 4.6)
Ready-to-eat fruit (n=38)	2.7 (1.3, 6.3)	3.5 (1.4, 5.5)	0.1 (0.1, 0.2)	0.1 (0.0, 0.2)	0.1 (0.1, 0.3)	0.1 (0.1, 0.4)	9.1 (4.3, 21.0)	9.8 (4.3, 18.9)
Ready-to-eat fruit and cereal (n=20)	1.4 (0.9, 5.0)	3.7 (2.0, 15.8)	0.1 (0.0, 0.2)	0.1 (0.0, 0.1)	0.2 (0.1, 0.6)	0.1 (0.0, 0.2)	1.6 (0.5, 5.3)	5.4 (1.1, 12.7)
Ready-to-eat fruit and dairy (n=13)	3.3 (2.5, 5.1)	7.7 (6.6, 16.0)	0.0 (0.0, 0.1)	0.1 (0.0, 0.1)	0.4 (0.4, 0.6)	0.2 (0.1, 0.2)	3.3 (3.0, 5.2)	4.6 (0.9, 8.6)
Ready-to-eat-dairy other (n=49)	20.8 (8.0, 32.8)	56.5 (21.9, 109.6)	0.0 (0.0, 0.0)	0.2 (0.1, 0.3)	2.3 (0.9, 3.8)	0.3 (0.1, 0.5)	20.5 (11.9, 42.3)	0.2 (0.0, 0.9)
Ready-to-eat other (n=29)	1.5 (0.6, 4.1)	0.4 (0.1, 1.2)	0.1 (0.0, 0.2)	0.0 (0.0, 0.0)	0.0 (0.0, 0.10	0.0 (0.0, 0.1)	0.4 (0.0, 2.5)	0.1 (0.0, 0.2)
Baby cereals iron fortified (n=14)	6.2 (2.1, 11.1)	1.7 (0.7, 8.8)	0.4 (0.1, 0.70)	0.1 (0.0, 0.3)	0.1 (0.1, 0.6)	0.2 (0.0, 0.3)	0.2 (0.0, 1.3)	0.1 (0.1, 0.3)
Junior juices (n=1)	1.2 (1.2, 1.2)	0.5 (0.5, 0.5)	0.0 (0.0, 0.0)	0.0 (0.0, 0.0)	0.1 (0.1, 0.1)	0.0 (0.0, 0.0)	0.0 (0.0, 0.0)	6.3 (6.3, 6.3)

Table 5.5 cont. The median (25th, 75th percentile) micronutrient intakes per day from all commercial processed baby foods (CPBFs), all infant formulas and toddler milks (IFTMs), breast milk, and individual CPBFs and IFTMs (for the EAT participants who were consumers of the food)

	Sodium (mg)	Calcium (mg)	Iron (mg)	Zinc (mg)	Iodine (mg)	Selenium (μg)	Vitamin A (μg)	Vitamin C (mg)
Baby rusks (n=12)	4.8 (4.1, 7.6)	0.4 (0.2, 1.3)	0 (0.0, 0.2)	0 (0.0, 0.0)	0 (0.0, 0.1)	0 (0.0, 0.1)	0 (0.0, 0.0)	0 (0.0, 0.0)
Baby biscuits (n=6)	2.8 (2.5, 4.7)	1.5 (1.4, 2.3)	0 (0.0, 0.0)	0 (0.0, 0.0)	0.1 (0.1, 0.1)	0 (0.0, 0.0)	0.4 (0.3, 0.5)	0 (0.0, 0.0)
Baby muesli bars (n=17)	2 (1.6, 4.3)	2.1 (1.6, 4.1)	0.1 (0.1, 0.2)	0 (0.0, 0.1)	0.1 (0.1, 0.2)	0.1 (0.1, 0.2)	1.3 (0.4, 1.8)	1.2 (0.2, 1.5)
Breast milk[a] (n=42)	67.2 (51.0, 67.2)	152.3 (115.4, 152.3)	0.3 (0.2, 0.3)	1.3 (1.0, 1.3)	13.4 (10.2, 13.4)	9 (6.8, 9.0)	277.8 (210.5, 277.8)	17.9 (13.6, 17.9)
All infant formula and toddler milk	75.0 (40.9, 115.1)	237.8 (120.6, 306.5)	2.5 (1.5, 3.6)	1.0 (0.7, 2.1)	28.3 (15.6, 49.6)	0.0 (0.0, 2.2)	82.6 (58.6, 178.0)	11.9 (8.8, 25.2)
< 6 month formula stage 1 (n=0)	0.0 (0.0, 0.0)	0.0 (0.0, 0.0)	0.0 (0.0, 0.0)	0.0 (0.0, 0.0)	0.0 (0.0, 0.0)	0.0 (0.0, 0.0)	0.0 (0.0, 0.0)	0.0 (0.0, 0.0)
Follow on formula stage 2 (n=9)	33.9 (31.1, 90.1)	96.7 (80.1, 267.5)	1.5 (1.1, 3.5)	0.7 (0.5, 2.2)	17.1 (16.1, 35.6)	2.4 (2.0, 5.8)	79.5 (75.9, 201.2)	9.9 (6.6, 26.2)
Toddler milk stage 3 and 4 (n=33)	75.7 (46.9, 121.2)	242.3 (163.7, 382.1)	2.6 (1.8, 3.9)	1 (0.6, 1.4)	25.2 (14.9, 37.6)	0 (0.0, 0.0)	70.1 (46.0, 120.1)	10.8 (8.5, 17.5)
Specialised infant formula soy, goat, lactose free (n=8)	87.5 (58.3, 100.0)	262 (153.8, 291.4)	3.4 (2.1, 3.6)	2.6 (1.6, 2.6)	49.8 (39.4, 60.4)	6.1 (5.1, 7.5)	219.3 (178.7, 301.3)	27.9 (24.2, 35.2)

[a] Breast milk estimation based on 448g/d (World Health Organization, 1998)

There was no significant difference in protein (p=0.121), fat (p=0.060), carbohydrate (p=0.161), zinc (p=0.114), vitamin A (p=0.175) and vitamin C (0.220) intakes between the participants who consumed IFTMs and those who did not consume IFTMs. However, the participants who consumed IFTMs had significantly lower intakes of energy (p=0.045), saturated fat (p=0.000), total sugar (p=0.000), sodium (p=0.032) and selenium (p=0.030) and significantly higher intakes of calcium (p=0.030), iron (<0.001) and iodine (<0.001). Participants who consumed CPBFs were more likely to consume IFTMs than those who did not consume CPBFs (44% of the participants who consumed CPBFs consumed IFTMs whereas only 16% of the participants who did not consume CPBFs consumed IFTMs).

Table 5.6 The median (25th, 75th percentile) nutrient intakes (averaged over 5 days) for all participants, CPBF consumers and CPBF non-consumers and infant and toddler milk (IFTM) consumers and IFTM non-consumers.

	All participants	**CPBF non-consumers**	**CPBF consumers**	***p-value***	**IFTM non-consumers**	**IFTM consumers**	***p-value***
Energy (kJ)	3805 (3338, 4342)	3751 (3308, 4294)	3834 (3409, 4353)	0.742	3922.5 (3393, 4429)	3691 (3283, 4034)	**0.045**
Protein (g)	34.7 (30.1, 40.4)	35.2 (30.1, 40.0)	34.1 (30.0, 40.4)	0.900	35.2 (29.8, 41.8)	32.6 (30.2, 37.7)	0.121
Fat (g)	33.6 (27.4, 39.5)	31.6 (27.0, 38.2)	34.4 (28.0, 40.7)	0.331	35.0 (28.1, 40.5)	30.4 (26.3, 37.9)	0.060
Carbohydrates (g)	119.6 (104.6, 136.9)	117.4 (103.5, 139.5)	120.3 (105.8, 136.8)	0.918	120.9 (104.9, 139.7)	116.0 (103.9, 129.9)	0.161
Saturated fat (g)	14.9 (11.8, 18.5)	13.9 (11.26, 17.6)	15.4 (12.9, 18.9)	0.296	15.6 (12.8, 19.1)	13.6 (9.3, 16.3)	**≤0.001**
Total Sugars (g)	63.8 (52.4, 75.9)	62.6 (51.1, 69.0)	64.7 (54.7, 77.5)	0.179	67.3 (57.7, 80.1)	55.5 (45.7, 64.6)	**≤0.001**

Table 5.7 The median (25th, 75th percentile) nutrient intakes (averaged over 5 days) for all participants, CPBF consumers and CPBF non-consumers and infant and toddler milk (IFTM) consumers and IFTM non-consumers.

	All participants	CPBF non-consumers	CPBF consumers	*p*	IFTM non-consumers	IFTM consumers	*p*
Sodium (mg)	951.8	1031.5	885.6	**0.013**	992.7	854.0	**0.032**
	(775.9, 1127.5)	(832.9, 1189.3)	(747.0, 1047.3)		(805.1, 1172.0)	(675.3, 1026.1)	
Calcium (mg)	634.9	613.7	678.4	0.070	592.4	723.9	**0.030**
	(481.2, 828.3)	(429.5, 803.7)	(523.4, 837.1)		(435.7, 832.4)	(611.7, 820.3)	
Iron (mg)	5.6	5.3	5.6	0.478	4.8	6.9	**≤0.001**
	(4.2, 6.8)	(4.1, 6.6)	(4.3, 6.8)		(3.7, 5.9)	(6.0, 9.1)	
Zinc (mg)	4.6	4.5	4.6	0.348	4.5	4.7	0.114
	(3.9, 5.2)	(3.9, 5.0)	(4.0, 5.2)		(3.8, 5.0)	(4.3, 5.4)	
Iodine (mg)	40.5	32.1	41.4	**0.034**	32.2	54.8	**≤0.001**
	(27.3, 53.4)	(22.5, 48.6)	(31.8, 55.4)		(23.3, 45.4)	(43.1, 75.2)	
Selenium (µg)	19.1	18.7	19.5	0.716	20.0	18.1	**0.030**
	(15.1, 24.1)	(14.7, 23.1)	(15.2, 24.7)		(15.9, 25.6)	(14.2, 22.3)	
Vitamin A (µg)	471.7	401.3	533.6	**0.004**	438.7	533.0	0.175
	(352.5, 314.1)	(300.7, 492.4)	(389.4, 620.4)		(320.6, 572.6)	(406.3, 639.0)	
Vitamin C (mg)	51.0	46.1	58.1	**0.005**	48.3	58.0	0.220
	(33.6, 74.9)	(30.2, 67.7)	(41.5, 79.1)		(30.5, 73.0)	(44.5, 77.3)	

6. Discussion

6.1 Main findings

Many studies around the world have investigated toddlers' dietary intakes. However, no studies have specifically compared the intakes of toddlers who consume commercial processed baby foods (CPBFs) to those who do not consume CPBFs. In this study, toddlers who consumed CPBFs had significantly lower intakes of sodium, and significantly higher intakes of iodine, vitamin A and vitamin C. Although 60% of the participants consumed CPBFs, the median total energy contribution from CPBFs was very low (68kJ) and participants who consumed CPBFs only consumed on average 1.03 CPBFs per day.

Thirty-three percent of the toddlers in this study reported consuming some form of infant formula or toddler milk (IFTM). The participants who consumed IFTMs had significantly lower intakes of energy, saturated fat, total sugar, sodium and selenium, and significantly higher intakes of calcium, iron and iodine. Participants who consumed CPBFs were more likely to consume IFTMs.

6.2 Contribution of commercial processed baby foods to toddlers' diets

The present study found that 60% of the EAT study participants consumed CPBFs. This finding is similar to the results found in the InFANT study conducted in Melbourne, Australia (Lioret et al, 2013). The InFANT study found that 50.8% of the participants aged 18 months consumed "baby food in jars" (Lioret et al, 2013). It is difficult to compare the present study results with other research findings as other studies have not reported the percentage of the population who consumed CPBFs as a single food group. Most studies have reported the percentage of the population that consumed CPBF subgroups (such as; infant cereals) (Bell et al, 2013; Department of Health & Food Standards Agency, 2011; Fox et al, 2004; Ponza et al, 2004; Sharma et al, 2013; Siega-Riz et al, 2010; Szymlek- Gay EA et al, 2010).

Although over half (60%) of the EAT study participants consumed CPBFs on at least one of the five days of diet recording, the median amount of energy from all CPBFs over the 5 day diet record was very low (68kJ). This equates to CPBFs contributing 1.8% of median daily total energy intake. This is difficult to compare to other studies, because other studies that have investigated the nutritional intake of toddlers have not reported the amount of energy that CPBFs as a single food group contributed to the toddlers' diets. However, the Diet and Nutrition Survey of Infants and Young Children (DNSIYC) study conducted in the United Kingdom found that in 12 to 18 month old toddlers "other savory dishes" and "dairy" CPBFs each contributed 0%, "cereal based", "snacks" and "fruit" CPBFs each contributed 1% and "meat and fish based" CPBFs each contributed 2% to average daily total energy intake (Department of Health & Food Standards Agency, 2011). The Australian Children's Nutrition Survey found that in pre-school children aged 2 to 3 years "infant formula and foods" provided 0.5% (boys) and 0.6% (girls) of total dietary energy (Commonwealth Scientific Industrial Research Organisation et al., 2007). A study conducted in Baltimore, United States of America found that infants aged 7 to 12 months consumed 2.6% of energy from "baby foods and mixed dishes"(Sharma et al, 2013). This suggests that our finding that CPBFs contributed low amounts of energy to toddlers' diets is not uncommon.

The present study found that the participants who consumed CPBFs had significantly lower intakes of sodium and significantly higher intakes of iodine, vitamin C and vitamin A. As the median total energy from all CPBFs was very low, it is unlikely that CPBFs were responsible for the significant results. As CPBFs are relatively expensive, it may be more likely that the parents who feed their toddlers CPBFs have a higher income and education. It has been shown that the mothers of infants who have a higher level of education are more likely to consume healthier foods themselves and to follow complementary-feeding recommendations (Hendricks et al, 2006). Furthermore, people with higher education and incomes have been shown to consume diets which are higher in fruits, vegetables and lean meats (Drewnowski & Specter, 2004). This in turn impacts on the foods they provide for their children. It would be expected the healthier diets would be lower in sodium and higher in vitamin A and vitamin C.

Participants who consumed CPBFs were also more likely to consume IFTMs (44% of the participants who consumed CPBFs consumed IFTMs whereas only 16% of the participants who did not consume CPBFs consumed IFTMs). As the participants who consumed IFTMs had significantly higher intakes of iodine, the consumption of IFTM may be an explanation for the significantly higher intakes of iodine in the group that consumed CPBFs.

No studies that have investigated toddler nutrient intakes have compared nutrient intakes of toddlers who consumed CPBFs with those who did not consume CPBFs. However, the Avon Longitudinal Study of Parents and Children (ALSPAC) investigated 4 patterns of eating at 18 months ("home-made contemporary", "discretionary", "ready-prepared baby foods" and "home-made traditional"). Although the ALSPAC study found that a higher dietary pattern score at 18 months for “ready-prepared baby foods” was not significantly associated with any changes in nutrient intakes (Smothers et al, 2013), the study was comparing different levels of consumption rather than consumers and non-consumers.

6.3 Contribution of infant formulas and toddler milks to toddlers’ diets

This present study found that 33% of the EAT participants consumed some form of IFTM. Compared to overseas research, it appears a greater percentage of participants from the EAT study consumed IFTMs than has been reported elsewhere, where the percentage of participants that consume IFTMs varies greatly from 1.5% (Fox et al, 2004) to 15.8% (Lioret et al, 2013). However, it is difficult to determine whether the EAT study participants’ intakes of IFTM are typical of other New Zealand toddlers’ intakes. This is because other New Zealand studies did not report the percentage of the population who consumed IFTMs (McLachlan et al, 2004; Soh et al, 2004; Soh et al, 2002; Szymlek- Gay EA et al, 2010). However, a study conducted in Dunedin, New Zealand, by Heath et al (2002) found that 4% to 25% of the participants aged 12 to 24 months consumed infant formula. This study was only conducted in one New Zealand centre (Dunedin), and therefore the participants of this particular study may not represent the whole New Zealand toddler population. However, the study by Heath et al (2002) indicates that the younger participants had higher intakes of IFTMs than the older participants. The varying IFTM intakes by different studies may partially reflect the different average ages of the participants.

This present study found that the participants who consumed IFTMs had significantly lower intakes of energy, saturated fat, total sugar, sodium and selenium, and significantly higher intakes of calcium, iron and iodine than participants who did not consume IFTMs. The median total energy from IFTMs was 535kJ. This would equate to IFTMs contributing 14.1% of the median daily total energy intake. As this is a considerable amount of energy, it is possible that intake of IFTMs could be responsible for the significantly lower intakes of energy and sodium and significantly higher intakes of calcium, iron and iodine. Certainly IFTMs contain calcium, iron and iodine. The consumption of IFTMs may also be displacing foods that are higher in energy, sugar, saturated fat and sodium leading to lower intakes of these nutrients. However, there is a high cost associated with IFTMs, so it is also possible participant characteristics (such as high parent income and education) could have influenced the results (section **6.2**).

Care should be exercised when interpreting the reported lower intakes of total sugar and saturated fat and higher intakes of selenium in the group who consumed IFTMs compared to the group who did not consume IFTMs. This is because Nutrition Information Panels (NIPs) were used to develop nutrient lines for the IFTMs and the NIPs do not list all macro- and micro-nutrients. Only 6%, 41% and 76% of IFTMs consumed by the participants listed the amounts of total sugar, saturated fat and selenium (respectively) on the NIPs.

6.4. Study strengths and limitations

The method used in the current study to develop recipes to determine the macro- and micro-nutrient composition of CPBFs (i.e. entering the product’s ingredients list into the recipe development section of Kai-culator and then modifying the amounts to achieve the best match with the product’s NIP) was inexpensive and enabled a large number of nutrient values to be assigned to CPBFs in Kai-culator in a short period of time.

The largest limitation of using this method was it was hard to achieve a maximum 5% difference for all of the macro- and micro-nutrients between the recipe calculation estimate (from Kai-culator) and the information provided on the NIP. Some CPBFs had such a small amount of a macro- or micro-nutrient that it was difficult to achieve a maximum 5% difference. For example, the NIP stated that “Heinz-Watties Fruity Pears” had 0.5g/100g of protein. The recipe calculation estimated “Heinz-Watties Fruity Pears” contained 0.4g/100g of protein. This is a 20% difference. However, a 0.1g/100g difference of protein was so small it was considered negligible, therefore a greater than 5% error in this case was not considered important.

Another limitation was that vitamins or minerals were estimated in CPBFs that were fortified if the level of fortification was not stipulated in the NIP.

Infant formulas and toddler milks were entered into Kai-culator using the macro- and micro-nutrients stated on the NIP. Many of the IFTMs did not report the amounts of selenium, total sugar and saturated fat. The intake of these nutrients is therefore likely to be underestimated.

A limitation when assessing the dietary intake of the EAT participants was the need to estimate breast milk intake. It was estimated 448g/d was consumed by participants who recorded that breast milk was consumed (World Health Organization, 1998). If this amount of breast milk was not correct for that participant then the amount of macro- and micro-nutrients may be over- or under-estimated in the participant.

Another limitation was that the consumption of CPBFs might have been underestimated. For example, “puréed apple” may have been documented in the diet record, however the parent of the participant may have meant “Heinz-Watties Apples for Babies”. This would not have been included as a CPBF as it would have been assumed it was a homemade purée. However, participants were encouraged to record brands.

6.5 Further research

Further research is needed to determine whether the intake of CPBFs was the reason for the more favourable nutrient intakes of the participants who consumed CPBFs. Adjusting the results for maternal characteristics, such as income, education and New Zealand Deprivation Index could achieve this.

6.6 Conclusion

The results of this study showed that there are significant differences in the nutrient intakes of toddlers who consume CPBFs compared to the toddlers who do not consume CPBFs.
This study suggests that the participants who consumed CPBFs had more favourable intakes of sodium, iodine, vitamin A and vitamin C than participants who did not. However, due to the cost of the CPBFs, it is possible participants’ parent characteristics, in particular income and education, may be responsible for the more favourable nutrient intakes rather than the CPBFs themselves. Those who consumed CPBFs were also more likely to consume IFTMs, which may help explain the higher intakes.

7. Application to Practice

All Dietitians are required by the New Zealand Dietitians Board to “apply research design and methodologies for evidenced informed practice”. This means all information provided to a client, a patient or the public must be evidence based. As this present study is the first of its kind, it would be premature to make recommendations from this study alone. Further research is needed to determine whether there is a true association between increased consumption of commercial processed baby foods (CPBFs) and lower intakes of sodium and increased intakes of iodine, vitamin A and vitamin C, and its relevance to New Zealand toddlers. In particular, the role of income, New Zealand Deprivation Index, and education in this association needs to be determined. It would be useful to know what factors contributed to the more favourable intakes so this information could be built into the development of future toddler feeding recommendations.

This present study has indicated that infant formulas and toddler milks (IFTMs) contribute a considerable amount to median daily total energy (14.5%). In addition, the participants who consumed IFTMs had significantly higher intakes of calcium, iron and iodine. This information is of particular interest to Dietitians as it has been shown that New Zealand toddlers have suboptimal iron status and iodine status (McLachlan et al, 2004; Skeaff et al, 2005). It could be recommended that New Zealand toddlers at high risk of low intakes of iron and iodine could introduce IFTMs to their diets in place of unmodified cow’s milk.

Furthermore, this present study has developed nutrient lines for CPBFs currently available in New Zealand. Dietitians furthering their studies at the University of Otago will have access to these nutrient lines. In the future, Kai-culator may become available to other professionals so that Dietitians in the field could have access to these nutrient lines. This would mean easier and more accurate assessment of toddlers' diets because CPBFs would no longer need to be substituted with other food items that may not reflect the nutrient content of the CPBFs available. In addition, the Dietitian could use the methods outlined here to add more CPBFs and calculate their nutrient lines as newer CPBFs come onto the market.

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9. Appendices

Appendix A	List of identified commercial processed baby foods
Appendix B	Sub set of nutrient lines for commercial processed baby foods from recipes developed in Kai-culator

Appendix A: List of identified commercial processed baby foods

Brand	Name of food	Location	Food group
Heinz-Watties	Simply beef bolognese with vegetables 120g	Heinz-W sheet	1.2
Heinz-Watties	Simply lamb with vegetables and polenta	Heinz-W sheet	1.2
Heinz-Watties	Organic vegetable and chicken casserole jar 170G	Heinz-W sheet	1.21
Heinz-Watties	Simply pea, pumpkin and sweet potato 120g	Heinz-W sheet	1.22
Heinz-Watties	Simply pumpkin, sweet potato and carrot 120g	Heinz-W sheet	1.22
Heinz-Watties	Simply pumpkin, vegetable and couscous 120g	Heinz-W sheet	1.22
Heinz-Watties	Fruity pears jar 110 G	Heinz-W sheet	1.23
Heinz-Watties	Organic apple, raspberry & blackberry 120g	Heinz-W sheet	1.23
Heinz-Watties	Organic banana and mango P&S 120g	Heinz-W sheet	1.23
Heinz-Watties	Organic fruity pear and apricot swirl 110 G	Heinz-W sheet	1.23
Heinz-Watties	Pear and kiwifruit jar 110 G	Heinz-W sheet	1.23
Heinz-Watties	Simply apple, peach and mango 120g	Heinz-W sheet	1.23
Heinz-Watties	Simply pear, banana and apple 120g	Heinz-W sheet	1.23
Heinz-Watties	Simply pear, mixed berries and banana 120g	Heinz-W sheet	1.23
Heinz-Watties	Simply Pumpkin with Apricot & Couscous 120g	Heinz-W sheet	1.23
Heinz-Watties	Strawberry and rice yoghurt dessert jar 170 G	Heinz-W sheet	1.23
Farex	Breakfast on the go apple and oatmeal pouch 120g	Heinz-W sheet	1.24
Farex	Pear and banana baby rice cereal 125g	Heinz-W sheet	1.24
Farex	Porridge with fruit 150g	Heinz-W sheet	1.24
Heinz-Watties	Organic baby bircher with apple and banana P&S 120g	Heinz-W sheet	1.24
Heinz-Watties	Organic creamy oats with fig and sultanas P&S 120g	Heinz-W sheet	1.24
Heinz-Watties	Simply apple and oatmeal 120g	Heinz-W sheet	1.24
Heinz-Watties	Simply apple and raspberry bircher with yoghurt 120g	Heinz-W sheet	1.24
Heinz-Watties	Custard with banana pouch 120g	Heinz-W sheet	1.25
Heinz-Watties	Simply banana custard 120g	Heinz-W sheet	1.25
Heinz-Watties	Simply chocolate raspberry custard 120g	Heinz-W sheet	1.25

Complan	Vanilla 500g	Heinz-W sheet	1.26
Complan	Chocolate 500g	Heinz-W sheet	1.26
Complan	Double chocolate 500g	Heinz-W sheet	1.26
Complan	Strawberry 500g	Heinz-W sheet	1.26
Heinz-Watties	Simply vanilla custard 120g	Heinz-W sheet	1.26
Heinz-Watties	Vanilla custard pouch 120g	Heinz-W sheet	1.26
Heinz-Watties	Little kids mini corn cakes apple and banana 8g	Heinz-W sheet	1.27
Heinz-Watties	Little kids Fruit and bran bars apricot 15g	Heinz-W sheet	1.33
Heinz-Watties	Little kids fruit and bran bars with strawberry 15g	Heinz-W sheet	1.33
Heinz-Watties	Little kids wholegrain Cereal Bars Apple & Cinnamon 15g	Heinz-W sheet	1.33
Heinz-Watties	Little kids wholegrain cereal bars apple & strawberry with yoghurt flavour 15g	Heinz-W sheet	1.33
Heinz-Watties	Little kids yoghurt muesli fingers sultana and apple	Heinz-W sheet	1.33
Only Organic	Vegetable risotto	Internet	1.22
Only Organic	Baby rice and prune puree	internet	1.23
Only Organic	Oatie apple breakkie	Internet	1.24
Only Organic	Banana berries and yoghurt	Internet	1.25
Only Organic	Mango and yogurt breakkie	Internet	1.25
Only Organic	Carrot red lentils and cheddar	Internet	1.26
Only Organic	Chocolate custard	Internet	1.26
Only Organic	Carrot and apple mini rice cakes	Internet	1.27
Green Monkey	NZ Beef, apple beetroot and pumpkin	Supermarket	1.2
Green monkey	NZ wild venison beetroot pumpkin polenta and blackcurrant	Supermarket	1.2
Heinz-Watties	Alphagetti bolognese can 220g	Supermarket	1.2
Heinz-Watties	Alphagetti, tomato and beef jar 170g	Supermarket	1.2
Heinz-Watties	Beef bolognese with vegetables 120g	Supermarket	1.2
Heinz-Watties	Beef, brown rice and vegetables jar 170g	Supermarket	1.2
Heinz-Watties	Lamb with vegetables and polenta 120g	Supermarket	1.2
Heinz-Watties	Little kids hearty beef casserole can 220g	Supermarket	1.2
Heinz-Watties	Little kids lamb moussaka can 220g	Supermarket	1.2
Heinz-Watties	Little kids macaroni and meatballs can 220g	Supermarket	1.2
Heinz-Watties	Little kids savoury rice and beef can 220g	Supermarket	1.2
Heinz-Watties	Little kids spaghetti bolognese can 220g	Supermarket	1.2
Heinz-Watties	Organic beef pumpkin spinach and rice P&S 120g	Supermarket	1.2
Heinz-Watties	Organic pumpkin and kumara with beef 110g	Supermarket	1.2
Heinz-Watties	Organic spring lamb with baby vegetables 170g	Supermarket	1.2
Heinz-Watties	Organic tender vegetables and beef jar 170g	Supermarket	1.2
Heinz-Watties	Pasta, vegetables and beef jar 170g	Supermarket	1.2
Heinz-Watties	Pumpkin, potato and beef can 120g	Supermarket	1.2
Heinz-Watties	Steak and vegetables can 220g	Supermarket	1.2
Heinz-Watties	Vegetables, lambs fry and bacon can 120g	Supermarket	1.2

Natureland	Pumpkin, potato and beef mash	Supermarket	1.2
Natureland	Shepherds pie mash	Supermarket	1.2
Natureland	Spaghetti bolognese mash	Supermarket	1.2
Only Organic	Minted peas blackcurrant and lamb	Supermarket	1.2
Only Organic	Pasta bolognese	Supermarket	1.2
Only Organic	Pumpkin potato and beef	Supermarket	1.2
Only Organic	Tender beef and vegetables	Supermarket	1.2
Only Organic	Wild rice risotto and spring lamb	Supermarket	1.2
Heinz-Watties	Chicken casserole can 220g	Supermarket	1.21
Heinz-Watties	Chicken pumpkin and sweet corn with rice 120g	Supermarket	1.21
Heinz-Watties	Chicken, pasta and vegetables jar 170g	Supermarket	1.21
Heinz-Watties	Harvest vegetable and chicken jar 170g	Supermarket	1.21
Heinz-Watties	Little kids chicken paella can 220g	Supermarket	1.21
Heinz-Watties	Little kids pasta chicken and vegetables can 220g	Supermarket	1.21
Heinz-Watties	Little kids pumpkin and chicken risotto can 220g	Supermarket	1.21
Heinz-Watties	Little kids sweet and sour chicken can 220g	Supermarket	1.21
Heinz-Watties	Mango chicken with vegetables 170g	Supermarket	1.21
Heinz-Watties	Organic chicken and kumara mash with peas jar 170g	Supermarket	1.21
Heinz-Watties	Organic sweet corn and carrot with chicken 110g	Supermarket	1.21
Heinz-Watties	Vegetables with chicken noodles can 120g	Supermarket	1.21
Natureland	Chicken, pasta and vegetable mash	Supermarket	1.21
Only Organic	Chicken bolognese	Supermarket	1.21
Only Organic	Vegetable and chicken risotto	Supermarket	1.21
Green Monkey	New Zealand carrot and sweet potato	Supermarket	1.22
Green monkey	NZ pumpkin silverbeet and sweet potato	Supermarket	1.22
Heinz-Watties	Carrots and rice 120g	Supermarket	1.22
Heinz-Watties	Carrots, broccoli and sweet corn jar 110g	Supermarket	1.22
Heinz-Watties	Organic butternut pumpkin pilaf jar 170g	Supermarket	1.22
Heinz-Watties	Organic golden mash jar 110g	Supermarket	1.22
Heinz-Watties	Organic sweet baby vegetables jar 110g	Supermarket	1.22
Heinz-Watties	Organic sweet baby vegetables P&S 120g	Supermarket	1.22
Heinz-Watties	Organic vegetable and ricotta pasta 170g	Supermarket	1.22
Heinz-Watties	Parsnips, carrots and kumara jar 110g	Supermarket	1.22
Heinz-Watties	Pumpkin, kumara and carrot 120g	Supermarket	1.22
Heinz-Watties	Pumpkin and sweet corn can 120g	Supermarket	1.22
Heinz-Watties	Pumpkin and sweet corn jar 110g	Supermarket	1.22
Heinz-Watties	Pumpkin carrot and peas with couscous 120g	Supermarket	1.22
Heinz-Watties	Potato, peas and broccoli	Supermarket	1.22
Only Organic	Kumara sweet corn and baby rice	Supermarket	1.22
Only Organic	Mango sweet potato and quinoa	Supermarket	1.22
Only Organic	Pear purple carrot and quinoa	Supermarket	1.22
Only Organic	Pumpkin and wild rice	Supermarket	1.22
Only Organic	Vegetable lasagna	Supermarket	1.22
Green Monkey	NZ apple and blueberry	Supermarket	1.23
Heinz-Watties	Apple and mango jar 110g	Supermarket	1.23
Heinz-Watties	Apple blackcurrant and strawberry 120g	Supermarket	1.23
Heinz-Watties	Apple, peach and mango 120g	Supermarket	1.23
Heinz-Watties	Apples can 120g	Supermarket	1.23
Heinz-Watties	Apples with prune juice jar 110g	Supermarket	1.23
Heinz-Watties	Apricot rice pudding jar 110g	Supermarket	1.23

Heinz-Watties	Banana and apple porridge 120g	Supermarket	1.23
Heinz-Watties	Fruit salad can 120g	Supermarket	1.23
Heinz-Watties	Fruity apples jar 110g	Supermarket	1.23
Heinz-Watties	Organic apple banana and avocado P&S 120g	Supermarket	1.23
Heinz-Watties	Organic apple berry blush P&S 120g	Supermarket	1.23
Heinz-Watties	Organic apple raspberry and blackberry 110g	Supermarket	1.23
Heinz-Watties	Organic banana and blueberry delight 110g	Supermarket	1.23
Heinz-Watties	Organic banana and mango 110g	Supermarket	1.23
Heinz-Watties	Organic pear and blackberry with baby rice 110g	Supermarket	1.23
Heinz-Watties	Organic Pear, banana and blueberries P&S 120g	Supermarket	1.23
Heinz-Watties	Organic red delicious and granny smith apples with guava P&S 120g	Supermarket	1.23
Heinz-Watties	Peach, apricot and semolina can 120g	Supermarket	1.23
Heinz-Watties	Pear and banana jar 110g	Supermarket	1.23
Heinz-Watties	Pear and banana jar 170g	Supermarket	1.23
Heinz-Watties	Pear, banana and apple 120g	Supermarket	1.23
Heinz-Watties	Pear, guava and strawberry jar 110g	Supermarket	1.23
Heinz-Watties	Pear, mango and pineapple jar 170g	Supermarket	1.23
Heinz-Watties	Pear, mixed berries and banana 120g	Supermarket	1.23
Heinz-Watties	Pears can 120g	Supermarket	1.23
Heinz-Watties	Apple and peach	Supermarket	1.23
Heinz-Watties	Organic apple and raspberry with red delicious apples	Supermarket	1.23
Heinz-Watties	Apple and peach can 120g	Supermarket	1.23
Heinz-Watties	Garden peas, courgettes apple and spinach 120g	Supermarket	1.23
Natureland	Apple and mango puree	Supermarket	1.23
Natureland	Apple pear and grape puree	Supermarket	1.23
Natureland	Apple puree	Supermarket	1.23
Natureland	Banana and berries puree	Supermarket	1.23
Natureland	Pear and rice porridge	Supermarket	1.23
Only Organic	Apple banana and mango	Supermarket	1.23
Only Organic	Apple berry and vanilla	Supermarket	1.23
Only Organic	Apple peach and apricot	Supermarket	1.23
Only Organic	Banana and apple	Supermarket	1.23
Only Organic	Banana kumara and quinoa	Supermarket	1.23
Only Organic	Banana raspberry and vanilla	Supermarket	1.23
Only Organic	Carrot pumpkin and apple	Supermarket	1.23
Only Organic	Mango banana bliss	Supermarket	1.23
Only Organic	Orchard apple	Supermarket	1.23
Only Organic	Peach mango sunset	Supermarket	1.23
Only Organic	Pear and mango	Supermarket	1.23
Only Organic	Pear banana and apple	Supermarket	1.23
Only Organic	Purely pear	Supermarket	1.23
Only Organic	Sweet potato and apple	Supermarket	1.23
Only Organic	Banana blueberry and quinoa	Supermarket	1.23
Heinz-Watties	Apple and blueberry muesli jar 110g	Supermarket	1.24
Heinz-Watties	Apple and cereal can 120g	Supermarket	1.24
Heinz-Watties	Apple and cereal jar 110g	Supermarket	1.24
Natureland	Fruit muesli	Supermarket	1.24
Natureland	Banana puree porridge	Supermarket	1.24
Only Organic	Golden fruit porridge	Supermarket	1.24

Only Organic	Pear and rice cereal	Supermarket	1.24
Heinz-Watties	Apple blueberry and yoghurt smoothie 120g	Supermarket	1.25
Heinz-Watties	Apple custard can 120g	Supermarket	1.25
Heinz-Watties	Banana and peach yoghurt dessert jar 170g	Supermarket	1.25
Heinz-Watties	Creamy banana porridge jar 110g	Supermarket	1.25
Heinz-Watties	Custard with banana can 120g	Supermarket	1.25
Heinz-Watties	Custard with strawberry and banana jar 110g	Supermarket	1.25
Heinz-Watties	Fruit salad yoghurt dessert jar 110g	Supermarket	1.25
Heinz-Watties	Organic creamy vanilla rice with apple P&S 170g	Supermarket	1.25
Heinz-Watties	Organic creamy oats with fig and sultanas 110g	Supermarket	1.25
Heinz-Watties	Strawberry and rice yoghurt dessert jar 110g	Supermarket	1.25
Natureland	Banana custard	Supermarket	1.25
Natureland	Fruit custard	Supermarket	1.25
Only Organic	Apple custard	Supermarket	1.25
Only Organic	Fruit muesli	Supermarket	1.25
Only Organic	Mango Custard	Supermarket	1.25
Only Organic	Mango rice pudding	Supermarket	1.25
Farex	Dinners couscous with cheesey vegetables	Supermarket	1.26
Farex	Dinners multigrain with cauliflower broccoli and cheese	Supermarket	1.26
Heinz-Watties	Custard with egg can 120g	Supermarket	1.26
Heinz-Watties	Organic creamy vegetable pasta jar 170g	Supermarket	1.26
Heinz-Watties	Vanilla custard can 120g	Supermarket	1.26
Heinz-Watties	Vanilla custard jar 110g	Supermarket	1.26
Natureland	Chocolate custard	Supermarket	1.26
Natureland	Vanilla custard	Supermarket	1.26
Only Organic	Cauliflower broccoli and cheddar	Supermarket	1.26
Only Organic	Creamy rice pudding	Supermarket	1.26
Only Organic	Vanilla bean custard	Supermarket	1.26
Only Organic	Banana kindy sticks	Supermarket	1.26
Heinz-Watties	Little kids creesy ravioli	Supermarket	1.27
Heinz-Watties	Little kids 12 cheeseymite bread sticks	Supermarket	1.27
Heinz-Watties	Little kids mini corn cakes tomato	Supermarket	1.27
Only Organic	Apple mini rice cakes	Supermarket	1.27
Only Organic	Blueberry and purple carrot mini rice cakes	Supermarket	1.27
Only Organic	Roasted tomato and basil kindy pasta sauce	Supermarket	1.27
Only Organic	Strawberry yoghurt kindy rice cakes	Supermarket	1.27
Only Organic	Yogurt kindy rice cakes	Supermarket	1.27
Only Organic	Zoo kindy pasta	Supermarket	1.27
Little bellies	Mini gingerbread men	Supermarket	1.27
Farex	Breakfast on the go creamy baby porridge with apple 120g	Supermarket	1.28
Farex	Muesli with apple 150g	Supermarket	1.28
Farex	Muesli with pear and banana 125g	Supermarket	1.28
Farex	Baby rice cereal 125g	Supermarket	1.28
Farex	Original multigrain cereal 125g	Supermarket	1.28
Heinz-Watties	Finely ground baby muesli 150g	Supermarket	1.28
Heinz-Watties	Muesli and apple 175g	Supermarket	1.28
Heinz-Watties	Organic apple and cinnamon porridge 170g	Supermarket	1.28
Heinz-Watties	Rice cereal 125g	Supermarket	1.28
Golden cricle	Apple blackcurrant 150ml	Supermarket	1.3
Golden cricle	Citrus crush fruit and vegetable juice 150ml	Supermarket	1.3

Baby mum mum	Banana rice rusks	Supermarket	1.31
Baby mum mum	Original rice rusks	Supermarket	1.31
Baby mum mum	Vegetable rice rusks	Supermarket	1.31
Farex	Teething rusks	Supermarket	1.31
Heinz-Watties	Farley's rusks original	Supermarket	1.31
Only Organic	Teething rusks	Supermarket	1.31
Heinz-Watties	Biscottini chocolate	Supermarket	1.32
Heinz-Watties	Biscottini original	Supermarket	1.32
Little quaker	Rice biscuit banana	Supermarket	1.32
Little quaker	Rice biscuit strawberry	Supermarket	1.32
Heinz-Watties	Little kids fruit and veg SHREDZ berries apple and veg	Supermarket	1.33
Heinz-Watties	Little kids fruit and veg SHREDZ peach apple and veg	Supermarket	1.33
Heinz-Watties	Little kids wholegrain cereal bars apple and blueberry	Supermarket	1.33
Heinz-Watties	Little kids yoghurt muesli fingers fruit salad	Supermarket	1.33
Heinz-Watties	Little kids yogurt muesli fingers apple and black currant	Supermarket	1.33
A2	Platinum (1)	Supermarket	10.1
Heinz	Nurture gold plus (1) 29g	Supermarket	10.1
Heinz	Nurture gold plus (1) tin	Supermarket	10.1
Heinz	Nurture original (1) 29g	Supermarket	10.1
Heinz	Original (1)	Supermarket	10.1
Karicare	Aptamil gold plus (1)	Supermarket	10.1
Karicare	Aptamil gold plus junior	Supermarket	10.1
Karicare	Gold plus (1) tin	Supermarket	10.1
Karicare	New baby (1) tin	Supermarket	10.1
Karicare	Gold plus (1) 15.4g	Supermarket	10.1
Karicare	New baby (1) 16g	Supermarket	10.1
Nestle	NAN HA gold (1)	Supermarket	10.1
Peak NZ	Infant formular (1)	Supermarket	10.1
S-26	Gold newborn (1) 17g	Supermarket	10.1
S-26	Gold newborn (1) tin	Supermarket	10.1
S26	Orginal newborn (1)	Supermarket	10.1
A2	Platinum (2)	Supermarket	10.11
Heinz	Nurture gold plus digestiplus (2) tin	Supermarket	10.11
Heinz	Nurture gold plus digestiplus (2) 31g	Supermarket	10.11
Heinz	Nurture gold digesti plus (2)	Supermarket	10.11
Heinz	Nurture original (2)	Supermarket	10.11
Karicare	Aptamil gold plus (2)	Supermarket	10.11
Karicare	Follow on formula (2)	Supermarket	10.11
Karicare	Gold plus (2) 32.8g	Supermarket	10.11
Karicare	Growing baby (2) 31.2g	Supermarket	10.11
Nestle	NAN HA gold (2)	Supermarket	10.11
Peak NZ	Follow-on formula (2)	Supermarket	10.11
S-26	Gold progress (2)	Supermarket	10.11
S-26	Gold progress (2) 26g	Supermarket	10.11
S-26	Gold progress (2) ready made	Supermarket	10.11
Karicare	Gold Plus (2)	Supermarket	10.11
A2	Platinum (3)	Supermarket	10.12
Heinz	Nurture gold plus (4) digestiplus	Supermarket	10.12

Heinz	Nurture gold plus digesti plus (3)	Supermarket	10.12
Heinz	Nurture original (3)	Supermarket	10.12
Karicare	Aptamil gold plus toddler (3)	Supermarket	10.12
Karicare	Gold Plus Junior (4)	Supermarket	10.12
Karicare	Gold Plus Toddler (3)	Supermarket	10.12
Karicare	Toddler (3) tin	Supermarket	10.12
Karicare	Toddler (4)	Supermarket	10.12
Karicare	Gold plus (3) 38.8g	Supermarket	10.12
Nestle	NAN HA toddler (3)	Supermarket	10.12
Peak NZ	Toddler (3) tin	Supermarket	10.12
S-26	Gold toddler (3) ready made	Supermarket	10.12
S-26	Gold toddler (3) tin	Supermarket	10.12
Baby Steps	Goat milk follow on formula (2)	Supermarket	10.13
Baby Steps	Goat milk toddler formula (3)	Supermarket	10.13
Heinz	Nurture plus gold (all)	Supermarket	10.13
Karicare	Aptamil gold AR	Supermarket	10.13
Karicare	Aptamil gold delact	Supermarket	10.13
Karicare	Aptamil gold plus HA	Supermarket	10.13
Karicare	Goat (1)	Supermarket	10.13
Karicare	Goat (2)	Supermarket	10.13
Karicare	Gold plus comfort (all)	Supermarket	10.13
Karicare	Plus comfort (all)	Supermarket	10.13
Karicare	Plus Goat (2)	Supermarket	10.13
Karicare	Soy (all)	Supermarket	10.13
S-26	Gold AR (all)	Supermarket	10.13
S-26	Gold lactose free (all)	Supermarket	10.13
S-26	Gold soy (all)	Supermarket	10.13
Wyeth	SMA balanced nutrition	Supermarket	10.13

Appendix B: Sub set of nutrient lines for commercial processed baby foods from recipes developed in Kai-culator

Recipe name		En	Prot	Fat	CHO	NA	Sat fat	SUGAR	CA	I	FE	SE	ZN	VITA	VITC	VITE
Heinz-Watties Carrots broccoli sweet corn jar 110g (From:HN000362)	CPBF NIP	165	1.6	0.3	6.3	15		3.4								
	Kai-culator nutrient line	164	1.7	0.7	6.6	14.9	0.11	2.52	18.7	0.46	0.41	0.98	0.36	493.5	16.6	0.72
	% difference	0.6	-6.2	-133.3	-4.8	0.7		25.9								
Heinz-Watties Pumpkin and sweet corn jar 110g (From:HN000363)	CPBF NIP	190	1.9	0.6	7.0	3		5.1								
	Kai-culator nutrient line	183	1.5	0.7	7.8	2.9	0.16	2.12	14.8	0.67	0.47	0.19	0.39	65.9	17.6	0.81
	% difference	3.7	21.1	-16.7	-11.4	3.3		58.4								
Heinz-Watties Parsnip, carrot and kumara jar 110g (From:HN000364)	CPBF NIP	120	1.7	0.2	3.8	13		1.1								
	Kai-culator nutrient line	118	0.5	0.6	5.3	13.4	0.12	1.04	9.6	0.29	0.19	0.06	0.07	96.4	4.8	0.28
	% difference	1.7	70.6	-200.0	-39.5	-3.1		5.5								
Heinz-Watties Potato, peas and broccoli jar 110g (From:HN000365)	CPBF NIP	185	2.8	0.6	6.3	13		1.6								
	Kai-culator nutrient line	220	2.5	0.4	9.7	13	0.1	1.2	8.5	0.4	1	0.6	0.56	23.9	13.3	0.18
	% difference	-18.9	10.7	33.3	-54.0	-1.5		23.8								

Heinz-Watties Organic fruity pear and apricot swirl 110g (From:HN000366)	CPBF NIP	250	0.6	0.1	13.3	3		9.1								
	Kai-culator nutrient line	252	0.9	0.2	13.9	2.9	0.03	6.44	7.3	1.18	0.19	0.09	0.18	4.3	4	0.33
	% difference	-0.8	-50	-100	-4.5	3.3		29.2								
Heinz-Watties Organic sweet baby vegetables 110g (From:HN000367)	CPBF NIP	175	1.5	0.4	7.3	15		2.8								
	Kai-culator nutrient line	175	1.1	0.5	8.3	15	0.1	2.1	10.3	0.3	0	0.21	0.26	213.3	6.4	0.28
	% difference	0	26.7	-25	-13.7	0.7		24.6								
Heinz-Watties Organic golden vegetable mash 110g (From:HN000368)	CPBF NIP	255	1.8	0.2	10.4	9		2.9								
	Kai-culator nutrient line	254	1.5	1.4	10.5	11	0.4	5.2	29.3	0.7	0	0.34	0.32	744.8	18.5	1.68
	% difference	0.4	16.7	-600	-1.0	-18.9		-78.3								
Heinz-Watties organic apple and raspberry	CPBF NIP	260	0.5	0.2	13.1	2		12.8								
	Kai-culator nutrient line	250	0.5	0.6	13.3	2.1	0.14	12.23	9.9	0.24	0.36	0.12	0.07	8.7	40	0.47
	% difference	3.8	0	-200	-1.5	-5		4.5								

Heinz-Watties organic pear and blackberry	CPBF NIP	270	2.0	0.0	13.4	3		7.3								
	Kai-culator nutrient line	258	0.7	0.4	13.9	4.5	0.03	9.15	12.8	0.12	0.42	0.76	0.23	2.1	33.6	0.41
	% difference	4.4	65	100	-3.7	-50		-25.3								
Heinz-Watties Organic banana and mango 110g (From:HN000371)	CPBF NIP	325	0.9	0.1	17.4	10		11.9								
	Kai-culator nutrient line	325	0.6	0.2	18.4	9.9	0.05	7.07	5.6	0.24	0.39	0.4	0.14	39.8	10.4	0.35
	% difference	0	-50	50	5.4	-1.0		-68.3								
Heinz-Watties Organic pumpkin and kumara with beef 110g (From:HN000372)	CPBF NIP	235	3.0	1.8	6.2	13		3.0								
	Kai-culator nutrient line	235	3.1	1.9	6.8	12.8	0.78	2.59	17.2	0.61	0.57	0.5	0.63	530	8.6	0.93
	% difference	0	-3.3	-5.6	-9.7	1.5		15.8								