

**Food and Nutrition
Guidelines for
Healthy Infants
and Toddlers (Aged 0–2)**
A background paper

Partially revised December 2012

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MANATU HAUORA

Foreword

E nga mana, e nga reo, e nga karangatanga maha, tena koutou. He mihi mahana tenei ki a koutou katoa.

Infants and toddlers exist in the context of a family. Early childhood is an important foundation for later health and wellbeing. Through early childhood, children are rapidly changing, growing in stature and developing in ability and personality. They are curious and continually challenging the relationship with their primary caregiver, asserting independence, but also needing guidance and protection. Good nutrition is essential for all of this.

Breastfeeding is the best and safest way to feed infants. Therefore, women and families need to be given all the advice and support possible to assist them in establishing and continuing breastfeeding for at least the first year of the infant's life, or beyond.

This fourth edition of *Food and Nutrition Guidelines for Healthy Infants and Toddlers (Aged 0–2): A background paper* brings together all the key areas of food and nutrition affecting the health of infants and toddlers at this time. It is intended for use by health practitioners, educators and caregivers, so they can provide sound advice and support to parents or caregivers and their children to achieve optimum growth and development and a healthy lifestyle.

This background paper supports three of the key priorities in the New Zealand Health Strategy (Minister of Health 2000). These three priorities are: to improve nutrition, reduce obesity, and increase the level of physical activity. This paper and the other background papers in the series of population group-specific background papers form the important technical basis for implementing the Healthy Eating – Healthy Action Strategy and achieving Target 8 of the Health Targets 2007/08 (Minister of Health 2007).

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Deputy-Director General
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Food and Nutrition Guidelines for Healthy Infants and Toddlers: A background paper was first published by the Public Health Commission in 1995. The major authors of that paper were Charles Essex, Carol Wham, John Birkbeck, Rhonda Akroyd and John Boulton. Jenny Reid prepared the second edition in 1999 and the third edition in 2000. This fourth edition significantly revises and updates the third edition.

Contents

Foreword	iii
Acknowledgements.....	iv
Introduction.....	1
Policy context.....	1
International context: Global Strategy for Infant and Young Child Feeding	1
Domestic context.....	2
He Korowai Oranga: Māori Health Strategy	2
Health Equity Assessment Tool	2
New Zealand Health Strategy and Healthy Eating – Healthy Action Strategy.....	3
Availability of Ministry of Health publications	3
Food and nutrition for infants and toddlers.....	3
Breastfeeding	4
Breastfeeding is a traditional practice	4
Support for breastfeeding	4
Barriers to breastfeeding	4
Comprehensive approach to breastfeeding is needed.....	5
Breastfeeding resources	5
1 New Zealand Food and Nutrition Guidelines	7
1.1 New Zealand Food and Nutrition Guideline Statements for Healthy Infants and Toddlers	7
1.2 The four food groups	8
1.3 Nutrient reference values for Australia and New Zealand.....	8
2 Dietary Practices and Nutrient Intakes in New Zealand Infants and Toddlers.....	9
2.1 Breastfeeding rates in New Zealand	9
2.2 Artificial feeding rates in New Zealand	11
2.3 Dietary practices and nutrient intakes.....	11
2.3.1 Introduction of complementary foods.....	12
2.3.2 Dietary patterns of toddlers.....	12
2.3.3 Intake of dietary supplements	13
3 Breastfeeding	14
3.1 Background.....	14
3.2 Importance of breastfeeding.....	15
3.2.1 Why breastfeeding is important for infants	15
3.2.2 Why breastfeeding is important for mothers	16
3.3 Composition of breast milk.....	17

3.4	Conditions affecting breastfeeding	17
3.4.1	Conditions affecting the mother	17
3.4.2	Conditions affecting the infant	18
3.5	Cup feeding.....	19
3.6	Storing and using expressed breast milk.....	19
3.7	Key points for breastfeeding	21
4	Complementary Feeding (Solids) and Joining the Family Diet	22
4.1	Complementary feeding.....	22
4.2	Importance of introducing complementary foods at around six months of age.....	22
4.2.1	Why complementary foods are needed.....	22
4.2.2	When complementary foods can be introduced	23
4.2.3	Risks associated with early introduction of complementary foods.....	23
4.2.4	Risks associated with late introduction of complementary foods	23
4.3	Importance of continued breastfeeding beyond period of exclusive breastfeeding	24
4.4	Introducing complementary foods (solids) and progressing to family foods.....	24
4.4.1	First complementary food (around six months of age).....	25
4.4.2	Increasing the texture, variety, flavour, and amount.....	26
4.4.3	Feeding the toddler	27
4.4.4	Creating a safe, positive feeding environment	33
	Babies and toddlers can choke on food quite easily.....	33
4.4.5	Preparing complementary infant food at home	35
4.4.6	Commercial infant complementary foods.....	35
4.5	Key points for complementary feeding (solids) and joining the family diet.....	35
5	Formula Feeding.....	37
5.1	Background	37
5.2	Types of formula	38
5.2.1	Infant formula	38
5.2.2	Follow-on formula	38
5.2.3	Cows' milk-based formula	38
5.2.4	Soy-based formula	39
5.2.5	Goats' milk-based formula	39
5.2.6	Specialised formula	40
5.3	Changing formula	40
5.4	Preparing formula for healthy full-term infants	40
5.4.1	Cleaning and sterilising feeding and preparation equipment	41
5.4.2	Preparing a feed using powdered infant formula.....	42

5.4.3	If formula must be prepared in advance for later use	43
5.4.4	Warming stored feeds	43
5.4.5	Transporting feeds safely	43
5.5	Number of feeds and amount of formula.....	44
5.6	Key points for formula feeding	44
6	Fluids.....	45
6.1	Background.....	45
6.2	Recommended fluid intakes	45
6.3	Recommended sources of fluid in the diet	46
6.3.1	Breast milk.....	47
6.3.2	Formula	47
6.3.3	Water.....	47
6.3.4	Cows' milk as a drink.....	48
6.3.5	Suitable alternatives to cows' milk for toddlers.....	49
6.3.6	Fruit juices and sweet drinks	49
6.3.7	Coffee, tea, herbal teas, other caffeine-containing drinks, smart or energy drinks, and alcohol.....	50
6.4	Key points for fluids.....	50
7	Considerations for Māori Infants and Toddlers and their Whānau.....	51
7.1	Cultural and spiritual significance of kai	51
7.2	Breastfeeding.....	51
7.2.1	Cultural perspective on breastfeeding	51
7.2.2	Breastfeeding rates among Māori.....	52
7.3	Current dietary practices of concern	52
7.4	Nutritional issues that need to be addressed.....	53
7.5	Traditional Māori foods: Ngā tino kai a te Māori	53
7.5.1	Kūmara (sweet potato)	53
7.5.2	Kamokamo (marrow)	53
7.5.3	Pūhā and watercress.....	53
7.5.4	Kai moana (seafood)	53
7.5.5	Rēwena (bread).....	53
7.6	Key points for considerations for Māori infants and toddlers and their whānau	54
8	Considerations for Pacific, Asian and Other Population Groups' Infants and Toddlers and their Families	55
8.1	Pacific infants and toddlers and their families.....	55
8.1.1	Breastfeeding	55
8.1.2	Current dietary practices	56

8.1.3	Nutrition issues.....	57
8.1.4	Traditional Pacific foods	57
8.1.5	Pacific staple foods.....	57
8.1.6	Tropical fruits of the Pacific	57
8.1.7	Green leafy vegetables	57
8.1.8	Breads and cereals.....	57
8.1.9	Lean meat, chicken and fish.....	58
8.1.10	Foods not recommended as first foods.....	58
8.2	Asian infants and toddlers and their families.....	58
8.2.1	Breastfeeding	59
8.2.2	Dietary practices	59
8.2.3	Nutrition issues.....	60
8.2.4	Traditional Chinese foods.....	60
8.3	Other population groups' infants and toddlers and their families.....	61
8.4	Key points for considerations for Pacific, Asian and other population groups' infants and toddlers and their families	61
9	Growth and Energy.....	62
9.1	Growth and rate of growth	62
9.1.1	Background	62
9.1.2	Body composition	62
9.1.3	Growth rate.....	62
9.1.4	Assessment of growth	63
9.2	Energy.....	65
9.2.1	Background	65
9.2.2	Sources of energy in the diet.....	66
9.3	Key points for growth and energy.....	67
10	Nutrients.....	68
10.1	Protein.....	68
10.1.1	Background	68
10.1.2	Recommended protein intakes.....	68
10.1.3	Sources of protein in the diet	68
10.1.4	Protein in breast milk and cows' milk-based formula	69
10.1.5	Key points for protein	69
10.2	Carbohydrate and dietary fibre	69
10.2.1	Carbohydrates	69
10.2.2	Dietary fibre	70
10.2.3	Recommended carbohydrate and dietary fibre intakes	71

10.2.4 Sources of carbohydrate and dietary fibre in the diet.....	72
10.2.5 Key points for carbohydrates and dietary fibre.....	72
10.3 Fat	72
10.3.1 Background	72
10.3.2 Recommended fat intakes.....	73
10.3.3 Sources of fat in the diet	74
10.3.4 Key points for fat.....	74
10.4 Minerals and trace elements	74
10.4.1 Iron.....	74
10.4.2 Zinc	79
10.4.3 Calcium.....	79
10.4.4 Iodine	81
10.4.5 Selenium	83
10.4.6 Fluoride	84
10.4.7 Sodium.....	86
10.5 Vitamins	87
10.5.1 Vitamin A.....	87
10.5.2 Vitamin D.....	88
10.5.3 Folate and vitamin C.....	91
10.6 Key points for nutrients	92
11 Physical Activity.....	93
11.1 Active Movement/Korīnga Hihiko	93
11.2 Benefits of physical activity.....	93
11.3 Key point for physical activity	94
12 Other Issues	95
12.1 Considerations for vegetarian and vegan infants and toddlers and their families	95
12.1.1 Vegetarian and vegan eating patterns.....	95
12.1.2 Relationship between vegetarian or vegan parent and health practitioner	95
12.1.3 Nutrition issues.....	95
12.1.4 First food for the vegetarian or vegan infant.....	96
12.1.5 Complementary foods for the vegetarian or vegan infant.....	96
12.1.6 Specific advice for vegan infants and toddlers and their families	97
12.1.7 Support for vegetarian and vegan families.....	98
12.1.8 Key points for vegetarian and vegan infants and toddlers and their families	98
12.2 Pacifiers.....	99
12.2.1 Implications of pacifier use	99

12.2.2	Key points for pacifiers	99
12.3	Bottles and teats.....	100
12.3.1	Recommended types of bottle and teat	100
12.3.2	Discouraged feeding position.....	100
12.3.3	Key points for bottles and teats	100
12.4	Supplements	100
12.4.1	Special indications for supplements.....	101
12.4.2	Key points for supplements.....	102
12.5	Food allergies and food intolerances	102
12.5.1	Food allergies	102
12.5.2	Prevention of food allergies.....	105
12.5.3	Diagnosis and management of food allergies	107
12.5.4	Food intolerance	109
12.5.5	Key points for food allergies and food intolerances.....	109
12.6	Colic	109
12.6.1	Definition of colic.....	109
12.6.2	Recommended treatments for colic	110
12.6.3	Key points for colic.....	110
12.7	Constipation and diarrhoea.....	110
12.7.1	Constipation	110
12.7.2	Diarrhoea.....	111
12.7.3	Key points for constipation and diarrhoea	112
12.8	Probiotics in infant formula	112
12.8.1	Definition and role of probiotics	112
12.8.2	Regulatory status of probiotics in infant formula.....	112
12.8.3	Efficacy of probiotics in infant formula	112
12.8.4	Key points for probiotics.....	113
12.9	Prebiotics in infant formula	113
12.9.1	Definition of prebiotic	113
12.9.2	Oligosaccharides	113
12.9.3	Regulatory status of prebiotics in infant formula.....	114
12.9.4	Key points for prebiotics.....	114
12.10	Gastro-oesophageal reflux	114
12.10.1	Definition of gastro-oesophageal reflux	114
12.10.2	Treatment for gastro-oesophageal reflux.....	114
12.10.2	Key points for gastro-oesophageal reflux	115

12.11 Overweight and obesity.....	115
12.11.1 Causes of and mitigating factors in childhood overweight and obesity	115
12.11.2 Key points for overweight and obesity	117
12.12 Oral health for healthy infants and toddlers	117
12.12.1 Fluoridated drinking-water most effective measure for preventing dental caries	117
12.12.2 Children’s entitlement to free basic dental care	117
12.12.3 Key points for oral health for healthy infants and toddlers.....	117
12.13 Food safety	118
12.13.1 General information.....	118
12.13.3 Key points for food safety	118
12.14 Food security.....	119
12.14.1 Definition of food security	119
12.14.2 Importance and effect of food security.....	119
12.14.3 Key points of food security.....	119
12.15 Feeding infants and young children in an emergency	119
Glossary	120
Abbreviations	127
Appendix 1: Summary of the World Health Organization’s International Code of Marketing of Breast-milk Substitutes	128
Appendix 2: World Health Organization and United Nation’s Children’s Education Fund Statement on the 10 Steps to Successful Breastfeeding	130
Appendix 3: Ministry of Health’s Policy Context for Food and Nutrition Guidelines for Healthy Infants and Toddlers (Aged 0–2): A background paper.....	131
Appendix 4: Reducing Health Inequalities: Health Equity Assessment Tool	132
Appendix 5: Priority Population Health Objectives in the New Zealand Health Strategy	134
Appendix 6: Key Population Health Messages Underpinning the Healthy Eating – Healthy Action Strategy and Implementation Plan	135
Appendix 7: Sample Meal Plans for Infants and Toddlers.....	136
Appendix 8: Nutrient Reference Values for Australia and New Zealand for Infants and Toddlers	141
Appendix 9: Breastfeeding Support Organisations	143
Appendix 10: Health Education Resources to Support Breastfeeding and Infant Nutrition Available from the Ministry of Health	145
Appendix 11: Summary of Evidence on the Importance of Breastfeeding for Infants.....	146
Appendix 12: World Health Organization Growth Standards – Length-for-age and Weight-for-age Percentiles for Boys and Girls from Birth to Two Years of Age	147
Appendix 13: Food-related choking in babies and young children	151

References.....	154
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Index.....	171
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Figures

Figure 1: Proportion of infants exclusively and fully breastfed at six weeks, three months and six months, 2003–2006.....	11
Figure 2: Ministry of Health’s policy context for <i>Food and Nutrition Guidelines for Healthy Infants and Toddlers (Aged 0–2): A background paper</i>	131
Figure 3: Intervention framework to improve health and reduce inequalities.....	133

Tables

Table 1: Definitions of nutrient reference value recommendations	8
Table 2: Breastfeeding rates at six weeks, three months and six months, by ethnicity, 1997–2006 and targets for 2007/08.....	10
Table 3: Guidelines for storing expressed breast milk.....	21
Table 4: Developmental stages and complementary foods for the first and second years of life.....	28
Table 5: Four major food groups: examples of foods and the nutrients they provide for infants and toddlers	31
Table 6: Guidelines for calculating fluid requirements.....	46
Table 7: Distribution of New Zealand Asian population by ethnic group, 2006	58
Table 8: Estimated energy requirements (EER) of infants and young children	66
Table 9: Classification of the major dietary carbohydrates.....	70
Table 10: Measurement of iron status and the spectrum of iron deficiency	76
Table 11: Fitzpatrick scale of skin types	89
Table 12: Three-day meal plan for infants aged 9 to 12 months	137
Table 13: Summary of the nutritional analysis of the three-day meal plan for infants aged 9 to 12 months, average per day.....	138
Table 14: Three-day meal plan for toddlers aged one to two years.....	139
Table 15: Summary of the nutritional analysis of the three-day meal plan for toddlers aged one to two years, average per day.....	140
Table 16: Daily recommendations for infants and toddlers.....	141
Table 17: Breastfeeding support organisations.....	143
Table 18: Ministry of Health health education resources.....	145
Table 19: Summary and strength of evidence of the importance of breastfeeding for infants.....	146
Table 20: Characteristics and examples of foods that pose a high choking risk for children under five years	152

Introduction

Food and Nutrition Guidelines for Healthy Infants and Toddlers (Aged 0–2): A background paper is one of a series of population group-specific background papers. The population groups are healthy infants and toddlers, children, adolescents, adults, older people, and pregnant and breastfeeding women.

This paper has been written to:

- provide up-to-date policy advice on nutrition and physical activity for achieving and maintaining the best possible health for healthy infants and toddlers, and is based on current evidence considered for the New Zealand context
- provide reliable, consistent information for using as a basis for programmes and education to support families and children (for example, technical background for health education resources for healthy infants and toddlers and District Health Board programmes)
- guide and support health practitioners (including dietitians, nutritionists, midwives, lead maternity carers, doctors, nurses, primary health care providers, health promoters and teachers) in the practice of healthy nutrition, and provide them with a detailed information resource
- provide a basis for preparing policies on the protection, promotion and support of breastfeeding, including compliance with the Baby Friendly Hospital Initiative and Baby Friendly Community Initiative for health services based in the community
- identify health inequalities relating to nutrition and physical activity so education and support for parents or caregivers and their children can be targeted to reduce health inequalities between population groups.

The policy advice in this paper is intended for healthy full-term infants and toddlers. Dietitians should adapt this advice if applying it to infants and toddlers with special nutrition and food requirements.

The guidelines are underpinned by the best practice for feeding infants and young children. In the complex role of parenting, parents and caregivers face many competing priorities (for example, paid work and other responsibilities), so advice and support must take into account an individual's family situation and facilitate the best decisions possible for the health of the infant or toddler.

Education resources on nutritional health are intended as the primary means of communicating the policy advice to the public. This background paper is a source of more detailed information for health practitioners.

The following definitions are used throughout these guidelines (see also the Glossary).

- An infant is a child in the first 12 months of life.
- A toddler is a child in the second year of life.
- The word 'child' may be used as proxy for infant and/or toddler.

Policy context

International context: Global Strategy for Infant and Young Child Feeding

In 2003, the World Health Organization (WHO) and the United Nations Children's Fund (UNICEF) jointly released the Global Strategy for Infant and Young Child Feeding to encourage governments to focus on nutrition and their role in achieving health for infants and young children (WHO 2003).

The strategy renewed a global commitment to the Baby Friendly Hospital Initiative and Baby Friendly Community Initiative, the International Code of Marketing of Breast-milk Substitutes (see Appendix 1) and the Innocenti Declaration on the Protection, Promotion and Support of Breast-feeding, which includes the Ten Steps to Successful Breastfeeding (see Appendix 2).

The strategy aims to improve, through optimal feeding, the nutritional status, growth and development, health and, thus, survival of infants and young children (WHO 2003).

This edition of the background paper is part of New Zealand's response to the strategy (Stewart 2006).

Domestic context

Food and nutrition guidelines for the New Zealand population are produced in the context of Ministry of Health policies and strategies. Appendix 3 provides a concise breakdown of the many policies and strategies that interact with and relate to this paper (see Figure 2).

He Korowai Oranga: Māori Health Strategy

He Korowai Oranga: Māori Health Strategy guides the health and disability sector's response towards improving Māori health and reducing inequalities for Māori (Minister of Health and Associate Minister of Health 2002). The strategy's framework helps to ensure interventions, services and programmes are accessible, effective and appropriate for Māori.

He Korowai Oranga promotes a vision of whānau ora, that is, a vision where whānau are supported to achieve maximum health and wellbeing. The key pathways to achieving whānau ora are:

- whānau, hapū, iwi and community development
- Māori participation
- effective service delivery
- working across sectors.

For nutrition activity to be implemented in a meaningful and sustainable way for Māori, it is important outcomes, actions, interventions, programmes and services are aligned with the four pathways framework. This will help to give effect to the vision of whānau ora.

You can view or download *He Korowai Oranga: Māori Health Strategy* from www.health.govt.nz

Pacific Health and Disability Action Plan

The Pacific Health and Disability Action Plan sets the strategic direction and actions to improve health outcomes and reduce inequalities for Pacific peoples (Ministry of Health 2002c). (The Pacific Health and Disability Action Plan is under review and a new plan will be finalised in 2008).

You can view or download the Pacific Health and Disability Action Plan from the Pacific Health website (www.health.govt.nz) or it is available from the Ministry of Health.

Health Equity Assessment Tool

The Government has identified reducing inequalities for different groups of New Zealanders as a key priority. Inequalities in health exist between socioeconomic groups, ethnic groups, people living in different geographic areas, and genders. People living in the most deprived circumstances have been

shown to have increased exposure to health risks, reduced access to health and disability services, and poorer health outcomes.

Health inequalities in New Zealand are greatest between Māori and non-Māori/non-Pacific peoples and between Pacific peoples and non-Māori/non-Pacific peoples. Action to address health inequalities must consider the impact of social and economic inequalities on health and people's access to and the effectiveness of health and disability services. For this reason, programmes, resources, education and support for families should be planned and evaluated using the Health Equity Assessment Tool (see Appendix 4).

New Zealand Health Strategy and Healthy Eating – Healthy Action Strategy

The New Zealand Health Strategy sets the direction and priorities for the New Zealand health system (see Appendix 5) (Minister of Health 2000).

Three priorities – improve nutrition, reduce obesity and increase the level of physical activity (Health Target 8 (Minister of Health 2007)) – are addressed in the Healthy Eating – Healthy Action Strategy (Minister of Health 2003) and Implementation Plan (Ministry of Health 2004a).

Food and Nutrition Guidelines for Healthy Infants and Toddlers (Aged 0–2): A background paper provides a policy base for implementing the key messages of the Healthy Eating – Healthy Action Strategy for this population group (see Appendix 6 for the key population health messages underpinning the strategy). It also promotes breastfeeding, which contributes positively to five of the 13 priority population health objectives in the New Zealand Health Strategy: improve nutrition; reduce obesity; reduce the incidence and impact of cancer; reduce the incidence and impact of cardiovascular disease; and reduce the incidence and impact of diabetes.

Availability of Ministry of Health publications

All Ministry of Health publications can be downloaded from the Ministry's website (www.health.govt.nz) or ordered from Wickliffe Limited (email: moh@wickliffe.co.nz).

Food and nutrition for infants and toddlers

Infants and toddlers are entirely dependent on their parents or caregivers for providing them with nourishment. The first two years of life are also a time of great nutritional change for the child, from a diet consisting entirely of milk (breast milk and/or infant formula) to one consisting of a variety of foods. Optimal nutrition has a greater importance during this time of life than during any other because of its effect on brain growth, the development of the nervous system, overall growth and development, and future health.

Breastfeeding is well recognised for its short-term benefits for infants. More recent evidence indicates long-term benefits of breast feeding for infants and toddlers (Fewtrell 2004; WHO 2007). These long-term protective effects appear to be related to the duration and type of breastfeeding (Riordan 2005).

The influence of the in utero environment on immediate and later health is very important, and is addressed in *Food and Nutrition Guidelines for Healthy Pregnant and Breastfeeding Women: A background paper* (Ministry of Health 2006b), which complements this background paper.

This paper provides recommendations specific to the age of the infant, but these recommendations are only guidelines that are based on the rate of development of an ‘average’ infant. The food and nutrition needs of individual infants and toddlers and the rates at which they develop vary widely.

Recommended numbers or sizes of servings of food from the four main food groups have not been given in this paper. This is because milk (either breast milk or infant formula) is the most important energy and nutrient source in the first year of life. Once complementary foods and family foods are introduced, the emphasis for this age group is growth and development and on achieving a varied food intake, including food choice and texture, and appropriate eating behaviours and patterns. There are cultural differences in the foods used to feed infants and toddlers, and these are recognised in Tables 4 and 5. The two three-day meal plans in Appendix 7 (Tables 12 and 14) can be used as a guide to achieving the recommended nutrient intakes for infants and toddlers given in Appendix 8 (Table 16).

It is acknowledged that access to healthy food and good nutrition for infants and toddlers is influenced by the wider determinants of health. These determinants include cultural, social, historical and economic elements. Food insecurity is an issue for some households in New Zealand as it is in all other Western nations (see section 12.14: Food security). Access, both physical and economic, to healthy food is not the same for all. Breastfeeding for infants and toddlers whose mothers choose or need to return to the paid workforce is also a challenge. These mothers’ ability to continue breastfeeding (as recommended in this paper) is largely determined by whether workplace policies actively support breastfeeding.

This paper does not ignore these realities, but, in line with government priorities such as reducing inequalities, seeks to work with them, promoting access to healthy food and good nutrition for all.

Breastfeeding

Breastfeeding is a traditional practice

Breastfeeding is a traditional practice for most cultures. Māori view breastfeeding as imperative to maintaining and sustaining child development and wellbeing. At birth, the natural bonding between mother and infant may also be enhanced through breastfeeding.

Support for breastfeeding

New Zealand has high breastfeeding initiation rates, but breastfeeding rates in the first six weeks of infants’ lives decline steeply. Accessible, appropriate support for breastfeeding in families/whānau, communities and society is essential for improving breastfeeding rates.

Support services include programmes that foster and encourage breastfeeding in healthcare facilities, among women and infants at home, and among those who are in the paid workforce.

The Government has a role in creating policies and legislation that protect, promote and support breastfeeding by integrating breastfeeding into all health and development policies (Innocenti Declaration on the Protection, Promotion and Support of Breast-feeding 2005).

Barriers to breastfeeding

Evidence suggests the main barriers to breastfeeding are social, environmental and clinical (National Breastfeeding Advisory Committee 2007).

Social and environmental barriers to breastfeeding include a lack of family and broad social support, insufficient prenatal education, a lack of assistance in establishing breastfeeding, a lack of knowledge about the normal course of breastfeeding, and being in paid work with limited or no workplace support.

Clinical barriers to breastfeeding include infants who are separated from their mothers (most commonly, unwell infants who are in intensive or special care units); perceived clinical issues, particularly insufficient milk; using formula within the first month; and health practitioners' communication of negative or ambivalent attitudes and perceptions about breastfeeding to women and families; and inappropriate advice (for example, standard recommendations on supplementary feeding with formula).

Comprehensive approach to breastfeeding is needed

Many of the barriers to breastfeeding are interlinked, and demonstrate the need for a comprehensive approach if breastfeeding rates in New Zealand are to be improved. The Ministry of Health aims to protect, promote and support breastfeeding in its work, and the policy context given in Appendix 3 illustrates that work. The work is guided by the National Strategic Plan for Breastfeeding (NBAC 2008) and the Healthy Eating – Healthy Action implementation plan (Ministry of Health 2004a).

Breastfeeding rates are one of the key indicators for Target 8 of the Health Targets 2007/08 to improve nutrition, increase physical activity and reduce obesity. The breastfeeding indicator consists of increasing the proportion of infants exclusively and fully breastfed at six weeks to at least 74 percent, at three months to at least 57 percent, and at six months to at least 27 percent (Minister of Health 2007).

Breastfeeding resources

Organisations that support breastfeeding in New Zealand including their contact details are listed in Appendix 9.

The Ministry of Health produces a series of health education resources to support breastfeeding, infant nutrition and infant health. These resources are listed in Appendix 10.

In response to the International Code of Marketing of Breast-milk Substitutes (the International Code) (WHO 1981), the Ministry of Health has developed a code of practice to assist health workers in applying the International Code in New Zealand (Ministry of Health 2007).

The New Zealand Infant Formula Marketers' Association has developed a code of practice for marketing infant formula in New Zealand (NZIFMA 2007). For more information on the Code in New Zealand, see the Ministry of Health's website (www.health.govt.nz).

Structure of this background paper

Section 1: New Zealand Food and Nutrition Guidelines present the food and nutrition guideline statements, summarises the paper's key points, and presents the background for the use of the nutrient reference values (NRVs) for Australia and New Zealand (NHMRC 2006).

Section 2: Current Dietary Practices and Nutrient Intakes in New Zealand Infants and Toddlers discusses the sources of food and nutrient intake data for this paper, breastfeeding rates, partial and artificial feeding rates, dietary practices, nutrient and energy intakes, and identifies dietary practices of concern for infants and toddlers.

Section 3: Breastfeeding includes recommendations for the duration of exclusive breastfeeding and continued breastfeeding, the importance of breastfeeding for infant and maternal health, and provides guidelines for storing expressed breast milk.

Section 4: Complementary Feeding (Solids) and Joining the Family Diet discusses the developmental stages and skills that signal a child's readiness for complementary foods and the order for their introduction and progression to family foods.

Section 5: Formula Feeding advises on the appropriate preparation and use of formula.

Section 6: Fluids includes the recommended fluid intake levels and sources of fluid, and advises on the use of water and cows' milk as a drink.

Section 7: Considerations for Māori Infants and Toddlers and their Whānau discusses specific nutrition issues for Māori and traditional Māori foods and practices.

Section 8: Considerations for Pacific, Asian and Other Population Groups' Infants and Toddlers and their Families discusses specific nutrition issues for Pacific peoples and other ethnic groups.

Section 9: Growth and Energy includes information on growth rate, the assessment of growth, and recommended energy intakes along with sources of energy in the diet.

Section 10: Nutrients includes information on the role that each of the major nutrients play in infants' health. The section discusses current and recommended dietary intakes in New Zealand, identifies sources of various nutrients in the New Zealand diet, and summarises the evidence available on the topics covered. It makes suggestions that can form the basis for practical advice for feeding healthy infants and toddlers. These suggestions are only a guide because the nutritional needs of individuals depend on many factors.

Section 11: Physical Activity gives background information on the importance of physical activity for development, and refers readers to Sport and Recreation New Zealand (SPARC) for more information on SPARC's Active Movement programme for under-fives.

Section 12: Other Issues includes information on considerations for vegetarian and vegan infants and toddlers, the use of bottles and teats, and prebiotics and probiotics. The section also has information on specific areas of concern for infants and toddlers such as food allergies, gastro-oesophageal reflux and constipation.

The background paper concludes with:

- a glossary
- a list of abbreviations
- 13 appendices containing background information
- the references cited
- an index.

1 New Zealand Food and Nutrition Guidelines

1.1 New Zealand Food and Nutrition Guideline Statements for Healthy Infants and Toddlers

The New Zealand Food and Nutrition Guideline Statements for Healthy Infants and Toddlers are the key principles and recommendations for feeding infants and toddlers to ensure their appropriate growth and development.

The 11 guideline statements are as follows.

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

The recommendations for healthy infants and toddlers are based on the *New Zealand Food and Nutrition Guidelines for Healthy Adults* (Ministry of Health 2003a).

* Do not give small hard foods like whole nuts and large seeds until children are at least five years old.

1.2 The four food groups

The guideline statements (in section 1.1) refer to breast milk, infant formula and the four major food groups as the sources of nutrients for healthy infants and toddlers. Table 5 in section 4.4 describes each of the four major food groups in relation to infants' and toddlers' requirements and provides a broad indication of the main nutrients supplied by each food group. Not all of the foods in each group contain all these nutrients. Two three-day meal plans are also provided as examples of how to achieve these guidelines, including recommended dietary intakes (see Appendix 7).

1.3 Nutrient reference values for Australia and New Zealand

Nutrient reference values (NRVs) are a range of recommended levels of intake (see the definitions in Table 1).

For the specific NRVs for Australia and New Zealand for infants and toddlers, see Appendix 8.

Table 1: Definitions of nutrient reference value recommendations

Estimated average requirement (EAR)	A daily nutrient level estimated to meet the requirements of half the healthy individuals in a particular life stage and gender group.
Recommended dietary intake (RDI)	The average daily dietary intake level that is sufficient to meet the nutrient requirements of nearly all (97–98 percent) healthy individuals in a particular life stage and gender group.
Adequate intake (AI)	Used when an RDI cannot be determined. The average daily nutrient intake level based on observed or experimentally determined approximations or estimates of nutrient intake by a group (or groups) of apparently healthy people that are assumed to be adequate.
Estimated energy requirement (EER)	The average dietary energy intake that is predicted to maintain energy balance in a healthy adult of defined age, gender, weight, height and level of physical activity, consistent with good health. In children and pregnant and lactating women, the EER is taken to include the needs associated with the deposition of tissues or the secretion of milk at rates consistent with good health.
Upper level of intake (UL)	The highest average daily nutrient intake level likely to pose no adverse health effects to almost all individuals in the general population. As intake increases above the UL, the potential risk of adverse effects increases.

Source: NHMRC (2006).

The NRVs for infants and toddlers used in this paper are from *Nutrient Reference Values for Australia and New Zealand Including Recommended Dietary Intakes* (NHMRC 2006). They include recommended levels for estimated average requirement (EAR), recommended dietary intake (RDI), adequate intake (AI) and upper level of intake (UL).

For infants aged 0–6 months, all the NRVs are based on the average intake of breast milk (780 mL per day). For infants aged 7–12 months, all the NRVs are based on the average intake of breast milk (600 mL per day) and 200 g from complementary food. Note that most of the NRVs for infants aged up to 12 months and many of those for toddlers aged 1–2 years are AI values, which are based on data that are insufficient to develop EARs and RDIs. The reference bodyweights are 7 kg for infants 2–6 months of age, 9 kg for infants 7–11 months of age, and 13 kg for toddlers 1–2 years of age.

2 Dietary Practices and Nutrient Intakes in New Zealand Infants and Toddlers

2.1 Breastfeeding rates in New Zealand

In New Zealand, breastfeeding rates have not changed significantly in the nine-year period from 1997 to 2006. Table 2 shows breastfeeding rates at six weeks, three months, and six months by ethnicity from 1997 to 2006. Figure 1 shows breastfeeding rates at six weeks, three months, and six months from 2003 to 2006 compared with the target rates for 2007/08.

Breastfeeding data are collected by lead maternity carers and Well Child providers. The six-week, three-month and six-month rates reported for New Zealand are based on data from Plunket. The Plunket data cover approximately 90 percent of all births. One limitation of these data is their incomplete coverage of all births and population groups.

Breastfeeding is reported as being 'exclusive and full' because the infant is likely to be meeting their nutritional requirements and receiving significant benefits from breast milk, if they are being exclusively or fully breastfed.

The terms used to describe breastfeeding in Table 2 are defined as follows (from Ministry of Health 2002a).

- *Exclusive:* The infant has never, to the mother's knowledge, had any water, formula or other liquid or solid food. Only breast milk, from the breast or expressed, and prescribed¹ medicines have been given from birth.
- *Full:* The infant has taken breast milk only, and no other liquids or solids except a minimal amount of water or prescribed medicines, in the past 48 hours.
- *Partial:* The infant has taken some breast milk and some infant formula or other solid food in the past 48 hours.
- *Artificial:* The infant has had no breast milk but has had alternative liquid such as infant formula, with or without solid food, in the past 48 hours.

¹ Prescribed as per the Medicines Act 1981.

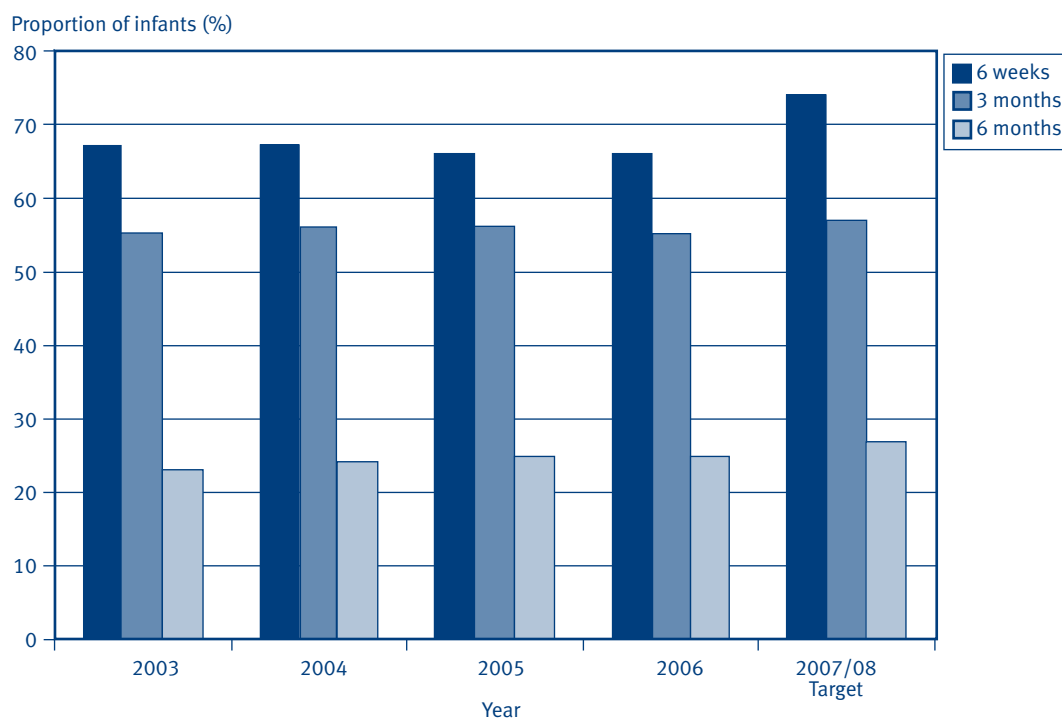
Table 2: Breastfeeding rates at six weeks, three months and six months, by ethnicity, 1997–2006 and targets for 2007/08

	Year	Māori (%)	Pacific (%)	Asian (%)	New Zealand European/Other (%)	All (%)
Exclusive and full breastfeeding at six weeks <i>Target rate 2007/08: 74 percent</i>	1997	54	54		67	
	1998	56	60		69	
	1999	57	56		69	
	2000	57	57		68	65
	2001	55	57		68	65
	2002	59	61		68	66
	2003	62	62	49	71	67
	2004	60	59	55	71	67
	2005	58	58	58	71	66
	2006	59	57	55	70	66
Exclusive and full breastfeeding at three months <i>Target rate 2007/08: 57 percent</i>	1997	36	41		53	
	1998	40	46		53	51
	1999	40	43		56	
	2000	40	45		56	50
	2001	41	43		56	51
	2002	47	50		58	55
	2003	46	49	49	59	55
	2004	47	49	51	60	56
	2005	45	48	52	60	56
	2006	45	48	53	60	55
Exclusive and full breastfeeding at six months <i>Target rate 2007/08: 27 percent</i>	1997	12	13		19	
	1998	14	17		19	
	1999	13	18		19	
	2000	13	17		20	18
	2001	13	17		21	19
	2002	16	20		25	23
	2003	16	19	20	26	23
	2004	18	20	22	27	24
	2005	18	19	23	28	25
	2006	17	19	25	29	25

Source: Plunket Management Information System.

Note: These data represent approximately 90 percent of all births in New Zealand.

Figure 1: Proportion of infants exclusively and fully breastfed at six weeks, three months and six months, 2003–2006



Source: Plunket Management Information System.

2.2 Artificial feeding rates in New Zealand

In 2003, around 9 percent of all infants were artificially fed with infant formula by two weeks of age (Ministry of Health 2006d). In 2005, based on Plunket data, the rate of artificial feeding for all infants was around 18 percent at six weeks, 29 percent at three months and 40 percent at six months, and these rates had not changed since 2003.

The rates of artificial feeding for Māori infants were the highest for all ages (25 percent at six weeks, 37 percent at three months and 49 percent at six months). The rates were next highest for Pacific infants, then New Zealand European/Other and Asian infants, which had similar rates.

2.3 Dietary practices and nutrient intakes

There are no current national data on the dietary practices and nutrient intakes of New Zealanders from birth to two years of age. The information on dietary practices and nutrient intakes discussed here is drawn from studies that were conducted on regional or selected population groups, often had small sample sizes and used different methods to collect data. Therefore, the information is not generalisable to the whole population. More research for this age group is needed.

The published studies suggest that many infants in New Zealand are:

- not breastfed long enough
- inappropriately introduced to complementary foods before four months of age (with one of the main reasons given by mothers being their not having enough breast milk (Heath et al 2002a))
- inappropriately introduced to cows' milk as a drink before one year of age (Ford et al 1995; Wham 1996; Soh et al 2002; Heath et al 2002b; Grant et al 2003)

- consuming foods that are considered inappropriate before one year of age such as regular breakfast cereals (for example, adult muesli, cornflakes and chocolate-flavoured rice bubbles) (Simons 1999), and salted or sweetened snacks (Grant et al 2003).

2.3.1 Introduction of complementary foods

A study of 72 New Zealand European infants from Dunedin noted the median age at which infants began eating complementary foods was five months (Simons 1999). Thirty-five percent of infants consumed complementary foods before four months of age. Formula-fed infants received complementary foods earlier than breastfed infants. The pattern of nutrient intake was different for those who were breastfed longer, suggesting differences in both the timing and type of complementary foods.

The Dunedin study provides information on the age at which certain foods were introduced to the participants in the study (Simons 1999). Eight percent of infants were given cows' milk as a drink before six months of age, 25 percent before eight months of age and 50 percent before one year of age. On average, exclusively breastfeeding mothers went on to introduce their infants to cows' milk as a drink at 10 months of age, formula feeders at 11½ months of age and partial breast feeders at nine months of age. Cows' milk is not recommended as a drink before one year of age. Sixty-five percent of infants received infant cereals as their first food, with the remaining 35 percent starting with puréed fruits or vegetables. Regular breakfast cereals (for example, wheat biscuits, cooked porridge, adult muesli, cornflakes and chocolate-flavoured rice bubbles) were consumed by 42 percent of infants before eight months and by 75 percent of infants in their first year, even though adult muesli, cornflakes and chocolate-flavoured rice bubbles are inappropriate for infants.

One study found that Māori and Pacific peoples were more likely than New Zealand Europeans to introduce complementary foods before six months of age (Tuohy et al 1997).

Food Standards Australia New Zealand reported that most of the New Zealand parents in its qualitative study introduced their infants to complementary foods at age four months or just before (FSANZ 2004). The New Zealand parents were likely to refer to the target as an age range of four to six months, although they acknowledged that six months, rather than four months, was recommended. The New Zealand participants were much more familiar with the physiological cues, such as the tongue extrusion reflex, that indicate an infant's readiness for complementary foods than were participants in Australia.

2.3.2 Dietary patterns of toddlers

The pilot study for the Children's Nutrition Survey (CNS) suggested that many toddlers are not eating enough vegetables and fruit, meat and meat alternatives, and milk and milk products (Ministry of Health 2001).

The CNS pilot study indicated the dietary patterns of children aged one to four years. The study included two groups: 91 children aged one to four years and 92 children aged five to 14 years. Of the 91 children, 42 were aged one to two years. The information reported here is for the children aged one to four years.

The children were recruited for the pilot from South and West Auckland, Feilding and Shannon.

The majority (90 percent) of children consumed a normal mixed diet, including a variety of all foods. Most children ate adequate quantities of cereals. Fifty-three percent ate less than the recommended number of servings² of vegetables (two servings), 26 percent ate less than the recommended servings of

² The numbers of servings described in the CNS pilot are based on the serving sizes for children aged two years and over. The Ministry of Health does not have recommended serving sizes or numbers of servings for children from birth to two years.

fruit (two servings), 20 percent ate less than the recommended servings of meat and meat alternatives (one serving) and 16 percent ate less than the recommended servings of milk and milk products (two servings). Takeaways were consumed by 13 percent of children between two and four times a week.

When asked about the types of food that they usually consumed, around 72 percent of children (or their caregivers) said they ate white bread. The next most popular bread was wholemeal. Standard homogenised milk was drunk by 70–80 percent of all children, with reduced fat (light blue top) being the next most consumed. Wheat biscuits, consumed by around 35 percent of all children, was the most common cereal eaten, followed by cornflakes and rice bubbles. Around 90 percent of children used a fat spread on bread. Butter and margarine blends and polyunsaturated margarines were the most popular fat spreads.

The most disliked foods, listed from the most to the least disliked, were broccoli, pumpkin, tomato, mushroom, peas, onion and beetroot. The most liked foods were McDonalds, pizza, chips, ice cream, chocolate, pies, burgers, fish, bananas and lollies.

The reasons children gave for liking or disliking a food varied, but taste and flavour were most commonly given as reasons.

2.3.3 Intake of dietary supplements

In the CNS pilot study one child only took fluoride tablets, while 15–16 percent of the children took vitamin and mineral tablets and around 5–6 percent took herbal or food supplements (Ministry of Health 2001).

Using data from the CNS pilot study, Crowley and Wall (2004) concluded that the use of dietary supplements was low: 9.8 percent of children reported taking supplements. Of the children who took supplements, young children and New Zealand European/Other children demonstrated higher levels of supplement intake than older children and children from other ethnic groups. The most commonly consumed supplements were multi-vitamins and vitamin C alone or in combination with herbal supplements or other vitamins.

3 Breastfeeding

3.1 Background

Breastfeeding is the biological norm for infant feeding and is a traditional practice in most cultures. It is the unequalled way of providing ideal food for the healthy growth and development of infants and toddlers. Breast milk is safe and clean and contains many functional components, including live cells and antibodies, which help to protect the infant against many common childhood illnesses.

Breastfeeding forms a unique biological and emotional basis for the health of both mother and child and plays an important and central role in protecting the health of the infant and promoting physical, neurological and emotional development in the short and long term (Fewtrell 2004; WHO 2007). These long-term protective effects appear to be related to the duration and type of breastfeeding (Riordan 2005).

For a discussion on the support required for breastfeeding, see the Introduction.

Exclusive breastfeeding is recommended until the infant is around six months of age. Exclusive breastfeeding means that only breast milk, from the breast or expressed, and prescribed medicines have been given from birth. (Breastfeeding terms are defined in section 2.1: Breastfeeding rates in New Zealand and the Glossary.) The protective effect of breastfeeding on infant and maternal health is significantly enhanced by exclusive breastfeeding (WHO 2002b). Exclusively breast-fed infants can meet their fluid requirements with breast milk and do not need additional fluids. The provision of water and other fluids reduces the intake of breast milk, and the infant will be less likely to meet its energy requirements. Exclusive breastfeeding protects the infant from infection by eliminating their exposure to food borne or waterborne pathogens and by supplying several components that improve the infant's ability to resist infection.

Supplementing breastfeeding with formula should be strongly discouraged. At all stages of breastfeeding, it is the reduced milk removal from the breast that leads to a reduction in milk production (Walker 2006). A breastfeeding mother who is considering supplementing breast milk with infant formula to settle an infant should be advised on settling the infant in other ways. This should include advice on increasing her supply of breast milk or introducing appropriate complementary foods if the infant is developmentally ready. Table 4 lists appropriate complementary foods.

While exclusive breastfeeding until around six months of age is recommended with continued breastfeeding beyond six months, it is important to emphasise that any breastfeeding will benefit the infant.

After six months of age exclusive breastfeeding alone is not enough for the satisfactory growth and development of some infants (Butte et al 2000). Complementary foods should be introduced with continued breastfeeding until at least one year of age, or beyond (see section 4: Complementary Feeding (Solids) and Joining the Family Diet).

3.2 Importance of breastfeeding

3.2.1 Why breastfeeding is important for infants

See Appendix 11 for a complete summary of the evidence on the importance of breastfeeding for infants and supporting references.³

Breastfeeding is important for infants because it:

- provides optimum nutrition for infants
- assists the physical and emotional development of infants
- decreases the incidence and severity of childhood infectious disease
- is associated with decreased infant mortality and hospitalisation
- is associated with the decreased risk of chronic disease for infants.

Breastfeeding provides optimum nutrition for infants

Breast milk meets the healthy full-term infant's complete nutritional needs for the first six months of life. Provided the infant is breastfed in response to their hunger cues,⁴ breast milk should be a major source of nutrients throughout the first year of life, even after complementary foods have been introduced.

Breastfeeding provides milk that is always at the right temperature, readily available and microbiologically safe, and allows the infant to self-regulate feeding and encourages emotional attachment between the mother and infant (American Dietetic Association 2005).

Breast milk:

- varies in composition over the lactation period and during a single feed to meet the child's individual and varying appetite and thirst, and hence nutrition and fluid requirements (Kunz et al 1999)
- contains many beneficial bioactive components such as antimicrobial factors, growth factors, anti-inflammatory factors, digestive enzymes, hormones, transporters, and nucleotides that assist in gut maturation, physiological development and immunity (United Nations University Press 1996; Rodrigues-Palmero et al 1999)
- provides nutrients that are more easily digested and bio-available (for example, protein, calcium and iron) than those in formula (Oddy 2002)
- contains the polyunsaturated fatty acids required for retina and brain development (Makrides et al 1994)
- contains taurine for fat absorption (Verner et al 2007).

Breastfeeding assists physical and emotional development

Breastfeeding:

- promotes the correct development of jaws, teeth and speech patterns (American Dietetic Association 2005)
- may have small long-term benefits for a child's cognitive development and visual acuity (Drane and Logemann 2000; Horwood et al 2001).

3 Recent evidence only is presented in section 3.2.1. For a complete reference list see Appendix 11.

4 Breastfeeding an infant or a toddler in response to their hunger cues is called 'cue feeding' or being 'cue fed' and is similar to the concept of 'demand feeding'.

Breastfeeding decreases the incidence and severity of childhood infectious disease

Breastfeeding decreases the incidence of:

- diarrhoea and gastro-enteritis, especially in less than optimal environments (Kramer et al 2001; Lopez-Alarcon et al 1997)
- acute respiratory infections (Wilson et al 1998; Galton et al 2003)
- otitis media (Aniansson et al 1994)
- urinary tract infection (Marild et al 2004)
- sepsis and meningitis (Hylander et al 1998).

Breastfeeding is associated with decreased infant mortality and hospitalisation

Breastfeeding is associated with reduced mortality during the first year of life and lower hospitalisation rates. Breast milk is especially important for low birth weight infants because it reduces the mortality associated with necrotising enterocolitis and offers advantages in cognitive function. Breastfeeding reduces the risk of sudden infant death syndrome (also known as sudden unexpected infant death).

Breastfeeding may decrease the risk of chronic disease for infants

Breastfeeding may reduce the risk of:

- food allergies in those with a family history of food allergies (Kramer and Kakuma 2003, Kemp and Kakakios 2004)
- eczema (Dell and To 2001)
- asthma (Gdalevich et al 2001)
- gastro-oesophageal reflux (Heacock et al 1996)
- childhood cancers, including childhood acute leukaemia and lymphoma (Bener et al 2001)
- coeliac disease in children at increased risk for the disease (Nash 2003; Norris et al 2005)
- Crohn's disease and ulcerative colitis and other chronic diseases (American Academy of Pediatrics 1997; Klement et al 2004)
- overweight and obesity (Burdette et al 2006)
- cardiovascular disease (Owen et al 2002)
- high blood pressure (Wilson et al 1997)
- Type 2 diabetes in later life (Owen et al 2006).

3.2.2 Why breastfeeding is important for mothers

Breastfeeding is important for mothers because it:

- may help the mother return to her pre-pregnancy weight (Dewey 2004)
- helps to protect a mother's iron status by minimising postpartum maternal blood loss (Dewey et al 2001; NHMRC 2006)
- reduces the risk of postpartum haemorrhaging (this effect relates to immediate post-birth breastfeeding)

- encourages contraction of the uterus after birth (Dewey et al 1993; Chua et al 1994)
- has a 98 percent contraceptive effect in the first six months after the infant's birth, provided the infant is exclusively breastfed in response to their hunger cues and the mother does not resume menstruation (Kennedy et al 1989; Guillebaud 1991)
- reduces the risk of pre-menopausal breast cancer (Zheng et al 2001; Collaborative Group on Hormonal Factors in Breast Cancer 2002)
- may reduce the risk of ovarian cancer (Riman et al 2004; Tung et al 2003)
- may reduce the risk of osteoporosis and hip fracture in later life (Karlsson et al 2005)
- may inspire healthier choices such as ceasing smoking, quitting recreational drugs or improving nutrition, which can be emotionally and physically satisfying and enhance self-esteem in the maternal role (American Dietetic Association 2005).

3.3 Composition of breast milk

The breast milk produced during the first few days after birth is called colostrum. Colostrum will provide sufficient energy for the newborn baby as long as the correct breast attachment technique is achieved. Mothers need to be reassured about this, especially if the newborn baby appears to be hungry during this time. Mothers worried about not having enough milk also need to be reassured that the more they breastfeed the more milk they will produce. The successful establishment of breastfeeding may take time, practice and patience.

Mature breast milk contains nutritional components (protein, fat, carbohydrate, vitamins, minerals and fluid, and non-nutritional components (antimicrobial factors, growth factors, cytokines, anti-inflammatory factors, digestive enzymes, hormones, transporters, and nucleotides) (United Nations University Press 1996).

Breast milk varies in composition over the lactation period and during a single feed to meet the child's individual and varying appetite and thirst, and hence nutrition and fluid requirements. The fat content of the milk received by the infant increases as the feed progresses and varies according to the fullness of the breast and the time of day.

The composition of breast milk can vary significantly between mothers and even between samples from the same mother. It is difficult, therefore, to give the precise nutritional content of breast milk, although average values of composition for mature breast milk are available.

3.4 Conditions affecting breastfeeding

3.4.1 Conditions affecting the mother

Mothers with human immunodeficiency virus infection

Mothers with human immunodeficiency virus (HIV) infection should not breastfeed (Ministry of Health 1999).

Mothers with untreated tuberculosis or local infectious lesions

Mothers with untreated tuberculosis or local infectious lesions affecting breast skin, such as herpes simplex, should not breastfeed (Croxson et al 1997; American Academy of Pediatrics 2005).

Mothers who are hepatitis B positive

Mothers who are hepatitis B positive may breastfeed provided the infant has had hepatitis B immunoglobulin immediately after birth and has begun a course of hepatitis B immunisation (Ministry of Health 2006c).

Mothers on medication

Mothers on medication may breastfeed. However, drugs may pass from the maternal blood stream into the breast milk and may be passed to the infant through the breast milk to a varying extent. Drugs that the infant has been exposed to throughout pregnancy, such as medication for epilepsy, are likely to present least risk when ingested via breast milk. An infant whose mother is taking medication should be observed for adverse responses.

If the mother must take medication that is incompatible with breastfeeding, the infant should be fed a breast milk substitute until the mother can resume breastfeeding if resumption is possible. If a mother who needs medication incompatible with breastfeeding plans to return to breastfeeding when the course of her medication ends, she needs to maintain her milk supply while on medication by expressing and discarding her milk. She should also be made aware of alternatives to bottle feeding (for example, cup feeding) that may improve the chances of the baby successfully re-establishing breastfeeding.

If breastfeeding is stopped suddenly, there is a risk that the mother may develop mastitis. If the mother cannot or is unlikely to return to breastfeeding, she will need careful guidance on how to reduce her breast milk supply to avoid mastitis.

For further information, practitioners should contact Drug Information Centres in the main cities in New Zealand. Recognised online references such as the Medsafe website (<http://www.medsafe.govt.nz>) can be consulted for information on prescribing medication during breastfeeding.

Mothers with breast cancer

Mothers with breast cancer may not be able to breastfeed if they need immediate treatment with cytotoxic drugs, which are incompatible with breastfeeding (Lawrence and Lawrence 2005). However, for women who have surgery and radiotherapy, breastfeeding is not contraindicated. If they have an unaffected breast, breastfeeding should be encouraged on that breast. Many women have successfully breastfed following breast cancer, although radiation and surgery may affect the ability of the affected breast to lactate (Neifert 1992; Helewa et al 2002).

3.4.2 Conditions affecting the infant

Infants with very rare metabolic conditions

Very rare metabolic conditions such as galactosaemia (which is an inherited condition where an infant is unable to metabolise galactose) require medically prescribed formula that is specific for the condition.

Infants with a physical disability

Infants with a physical disability such as a cleft lip, cleft palate or cerebral palsy may have difficulty sucking at the breast because they are unable to form an airtight seal around the breast or have a poor sucking response. However, even if they are unable to be breastfed, they can still be fed expressed breast milk. Mothers of these infants may need extra support and assistance to enable them to breastfeed or feed the infant expressed breast milk.

Infants requiring an individualised feeding plan

Sick infants in intensive care require an individualised feeding plan, but breast milk should be used whenever possible. Mothers need encouragement to sustain maternal milk production by expressing breast milk and resuming breastfeeding when the infant has recovered. Should re-lactation be required, the mother is likely to need intensive support from health practitioners.

Infants with mothers with severe dehydration and malnutrition

Severe dehydration and malnutrition in the mother may require the infant to be temporarily fed with donated breast milk or infant formula until the mother's breast milk production is re-established. However, breastfeeding should be encouraged and maintained if at all possible.

Infants with multiple food allergies

If an infant is diagnosed with multiple food allergies, the breastfeeding mother may need to eliminate those allergens from her diet. In some cases this will compromise both maternal and infant nutrition. Such mothers need comprehensive dietetic support in order to maintain adequate nutrition. However, cessation of breastfeeding and the prescription of appropriate formula may be indicated.

Infants with medical conditions affecting the absorption and utilisation of nutrients

Other medical conditions may also affect an infant's ability to absorb and utilise nutrients.

3.5 Cup feeding

If a mother is temporarily unable to breastfeed, it is recommended that she expresses breast milk, which is then fed to the infant. Cup feeding is an alternative to the bottle and teat method of feeding expressed breast milk to breastfed infants. UNICEF promotes cup feeding as a more appropriate infant-feeding method for expressed breast milk than the bottle and teat.

Cup feeding can have benefits over using a bottle and teat. The infant can pace their own intake, which makes it easier for the infant to control their breathing and swallow when the infant is ready (Lang 1994). Cup feeding fosters early positive body and eye contact.

Another benefit may be that the infant does not have to cope with an artificial nipple or teat in their mouth or develop a technique that is different from breastfeeding. The cup must be held so that the milk is just touching the infant's lips, but not poured into the infant's mouth.

Health practitioners should be able to teach a breastfeeding mother how to feed her infant expressed breast milk using a cup.

3.6 Storing and using expressed breast milk

Ideally, milk fed directly from the breast is best. Research shows a deterioration in some constituents of breast milk the longer it is stored (Hanna et al 2004; Ezz El Din et al 2004; Silvestre et al 2006). However, direct breast feeding is not always possible, so expressed breast milk that has been correctly stored is the next best option for infants.

Breast milk has unique bactericidal activity. Research has shown that for a limited period, the bacteria count in correctly stored breast milk can decrease. Pardou et al (1994) found the bacteria count of expressed breast milk stored in a fridge (at 0–4°C) significantly decreased. However, freezing expressed breast milk seems to inhibit this bacteriocidal action.

Guidelines for storing expressed breast milk under different storage conditions are shown in Table 3. Note that these guidelines are for expressed breast milk that is fed to healthy, full-term infants who live at home.

Hands should be washed before a woman expresses breast milk. Once expressed, breast milk can be stored in a plastic or glass container with an airtight sealed lid, for example, a food storage container or bottle. The container should be dated at the time of collection, and the caregiver should always ensure that the oldest milk is used first (Lawrence and Lawrence 2005). Fresh or refrigerated milk retains beneficial properties and is preferable to breast milk that has been frozen. The milk should be stored in small portions of around 100–300 mL to prevent waste.

Expressed breast milk that is being refrigerated or frozen should be stored in a new container rather than added to previously refrigerated or frozen breast milk (CDC 2007). Adding expressed breast milk to frozen milk can cause the milk to thaw and then refreeze, which increases the risk of bacterial growth in the milk.

Containers and feeding equipment should be washed in hot soapy water and then rinsed. If the infant is three months old or younger, the containers and equipment also need to be sterilised. Sterilising equipment and tablets to make sterilising solution are available from supermarkets and pharmacies. The manufacturer's instructions must be followed carefully. Alternatively, the containers and feeding equipment can be boiled (Lawrence and Lawrence 2005) (see also section 5.4.1: Cleaning and sterilising feeding and preparation equipment).

When refrigerating, expressed breast milk needs to be stored in the lower half, at the back, in a refrigerator where the mid-fridge temperature is 2–4°C (MAF, personal communication, 2012). However, a recent study showed the mean temperature of New Zealand domestic refrigerators was 5.2°C, and one-third of those refrigerators investigated had a mean temperature higher than 6°C (Gilbert et al 2007).

Options for the short-term storage of expressed breast milk include using an insulated cooler bag containing ice packs where refrigeration or freezing is not immediately available (CDC 2007; Jones and Tully 2006). The maximum storage time using this method is 24 hours. Little research has looked specifically at this form of storage. The recommendations include advice that the ice packs should be in contact with the milk containers at all times and there is limited opening of the cooler bag.

Frozen expressed breast milk can be thawed in the refrigerator or by placing the container of milk in warm water until the milk has thawed.

Expressed breast milk should not be thawed or heated using a microwave oven because microwaving destroys some of the milk's immunological components (Jones and Tully 2006). There is also a risk of uneven heating and scalding.

Expressed breast milk can be warmed by placing the cup or bottle containing the milk in hot water. Before feeding the infant, caregivers should swirl the container of milk to mix the fat portion back in and distribute the heat evenly (Lawrence and Lawrence 2005). They should test the temperature of the milk by shaking a few drops on the inside of their wrist. It should feel comfortably warm to the touch before being given to the infant.

Table 3: Guidelines for storing expressed breast milk

Storage conditions	Storage time	Comments
Room temperature (< 26°C)	4 hours	Cover containers and keep them as cool as possible (eg, surround the closed container with a cool towel to help to keep the milk cooler)
Refrigerated (2–4°C)	48 hours	Store milk in the lower half, at the back of the refrigerator
Frozen		Store milk toward the back of the freezer, where the temperature is most constant
• Freezer box in refrigerator	2 weeks	
• Separate door fridge/freezer	3–6 months	
• Separate deep freeze	6–12 months	

Sources: Hamosh et al (1996); Bjorksten et al (1980); Pardou et al (1994); Lawrence and Lawrence (2005); American Dietetic Association (2007); CDC (2007) and Jones and Tully (2006).

3.7 Key points for breastfeeding

- Breastfeeding is important for infants’ growth, development and health. Breastfeeding provides optimum nutrition, assists physical and emotional development, protects against infectious disease and may reduce the risk of some chronic diseases. Breastfeeding is also important for the mother’s health.
- Give only breast milk until the infant is ready for and needs extra food – this will be at around six months of age.
- Infants should be breastfeed until at least one year of age, or beyond.
- Breastfeeding is a learned skill and requires guidance and support. Mothers and their families/whānau should be provided with this guidance and support with the common problems.
- If the mother is feeding expressed breast milk, suggest she tries using a cup and seeks advice from a health practitioner if she has questions about this method.
- If the mother is feeding expressed breast milk and using a bottle, see sections 5.3.1: Cleaning and sterilising feeding and preparation equipment and 12.3: Bottles and teats.
- Strongly discourage the supplementing of breastfeeding with formula, water, herbal teas, milks or any other liquids. A breastfeeding mother who is considering supplementing breast milk with infant formula to settle an infant should be given advice on settling the infant in other ways. This should include advice on increasing the mother’s supply of breast milk or introducing appropriate complementary foods if the infant is developmentally ready (see Table 4 in section 4.4).
- Guidelines for handling and storing expressed breast milk are in section 3.6: Storing and using expressed breast milk.

4 Complementary Feeding (Solids) and Joining the Family Diet

4.1 Complementary feeding

Complementary feeding is defined as the gradual introduction of solid food and fluids along with the usual milk feed (breast milk or infant formula) to an infant's diet. The introduction of complementary foods has been known as weaning, which comes from the Anglo-Saxon word 'weanian' meaning 'to accustom'. However, the word weaning has come to be associated with stopping breastfeeding, and there is no reason to suggest or imply that mothers should stop breastfeeding when complementary feeding is started. For this reason, the term complementary feeding is preferred. This latter term means that breastfeeding continues and other foods are introduced to complement or add to the nutritional intake provided by breast milk or infant formula.

The recommendation for the total New Zealand population is that infants be fed exclusively on breast milk to around six months of age, at which time complementary foods can be introduced with continued breastfeeding until the infant is at least one year of age, or beyond.

For the individual infant and toddler and their family, the growth and development of the child, including the child's developmental stages and skills, ideally will guide decisions on the duration of exclusive breastfeeding, age for introducing complementary foods, and duration of continued breastfeeding for that child. However, individual family circumstances always need be considered too.

The recommendation has been adopted to try to increase the age at which complementary foods are introduced to New Zealand infants and increase the duration of breastfeeding in New Zealand. It appears from the limited data we have on breastfeeding and dietary patterns for New Zealand infants and toddlers that New Zealand infants are given complementary foods when they are too young (see section 2.3: Dietary practices and nutrient intakes).

The recommendation also takes account of the Global Strategy for Infant and Young Child Feeding (WHO 2003). This strategy states that infants should be exclusively breastfed until six months of age, at which time suitable complementary foods should be introduced, with breastfeeding continuing until the child reaches at least two years of age, or beyond. There are limitations in the WHO strategy, because it is based on two small controlled studies and 17 observational studies of varying quality and geographic location. Studies from different settings were included in the WHO strategy. Neither of the controlled trials was set in a developed country, so only data from the observational studies were considered in relation to developed countries for New Zealand policy setting.

4.2 Importance of introducing complementary foods at around six months of age

4.2.1 Why complementary foods are needed

An infant's nutritional needs influence the age at which complementary foods should be introduced. After around six months of age, it becomes increasingly difficult to meet nutrient requirements from breast milk alone (WHO and UNICEF 1998; Butte et al 2000). Stores of iron and zinc are likely to be depleted by six months of age, so iron and zinc must be supplied by complementary food. From the time the infant is around six months of age, complementary food makes an increasing contribution to

the infant's nutrient intake. A nutritionally adequate diet is essential for achieving optimal growth in the first year of an infant's life.

4.2.2 When complementary foods can be introduced

Before complementary foods can be introduced, the infant must be physically and physiologically able to cope with such foods. The development areas to consider are chewing, swallowing, digestion and renal function.

Once the infant is about five to six months of age, their teeth begin to erupt and feeding behaviour changes from sucking to biting and chewing. In the full-term infant, the swallowing reflex is fully developed by 9–12 weeks of age. Before this age, bolus formation, required for controlling swallowing, may not be achieved. Until an infant is four to six months of age they may not have sufficient co-ordination of their swallowing movements to deal with semi-solid foods (Barness 1990). While some digestive enzymes are fully developed at birth, pancreatic amylase levels are low before six months of age (Lebenthal 1985).

A newborn infant has limited renal capacity to conserve fluids and excrete dissolved solids. Once the infant is four months of age, their renal function has matured considerably (Butte et al 2004).

4.2.3 Risks associated with early introduction of complementary foods

The risks associated with the too early introduction of complementary foods, include:

- eczema (Dell and To 2001; childhood asthma (Gdalevich et al 200); and food allergies (Kemp and Kakakios 2004)
- respiratory disease (Forsyth et al 1993)
- increased vulnerability of the gut to infection (Popkin et al 1990)
- diarrhoea and dehydration (Forsyth et al 1993)
- impaired absorption of iron from breast milk (Zlotkin et al 1996) and iron deficiency (Oski 1993)
- infant malnutrition due to a decrease in maternal milk production or inadequate complementary foods (Zlotkin et al 1996).

4.2.4 Risks associated with late introduction of complementary foods

The risks associated with the late introduction of complementary foods, include:

- iron deficiency (Faldella et al 2003)
- wheat allergy (Poole et al 2006)
- growth faltering and micronutrient deficiencies in some infants (WHO 2001).

4.3 Importance of continued breastfeeding beyond period of exclusive breastfeeding

The evidence for the importance of breastfeeding for the first 12 months of life is strong (see section 3: Breastfeeding).

However, breastfeeding beyond the first year of life continues to make a nutritional and health contribution with the introduction of complementary foods (Brown et al 1998). It promotes normal growth and development, and protects the infant from acute and chronic illnesses.

Breast milk provides energy, essential fatty acids and fat-soluble vitamins. Many of the antimicrobial constituents of human milk, for example, secreted IgA, are still present in considerable amounts in the second year of lactation, so breastfeeding continues to offer immunological benefits into childhood (Goldman et al 1983; Oddy 2001; Piovonetti 2001). It has been found that breast milk intake is often desirable during episodes of diarrhoea and fever when the infant's appetite for other foods decreases, and it is useful in such instances for preventing dehydration and providing essential nutrients for recovery. Breast milk may provide additional protection for children with allergies.

The reduction in the risk of chronic disease in later life, such as obesity and cardiovascular disease, appears to be related to the duration and type of breastfeeding (Riordan 2005). A longer duration of breastfeeding has been associated with reducing the risk of childhood chronic illness and obesity and improving cognitive outcomes, although causality has not been established. Most of the studies have not considered the effect of breastfeeding beyond 12 months on these outcomes.

Breastfeeding enhances the mother and infant relationship and promotes neurological development, both of which are important for child development (American Academy of Pediatrics 1997).

As duration of breastfeeding increases, the risk of hip fractures in the mother in later life decreases in a dose-related relationship (Riordan 2005).

Sustained breastfeeding supports weight loss and healthy weight achievement in mothers (Riordan 2005).

A longer duration of breastfeeding is associated with a delay in natural fertility (Labbok 2001).

4.4 Introducing complementary foods (solids) and progressing to family foods

Breast milk or infant formula remains the most important nutrient source for the first year of life, and complementary foods must not be given in a way or in amounts that will dramatically reduce milk intake. This can be achieved at first by giving a milk feed before giving complementary foods, which are then used as a 'top-up' at the end of the meal. After the infant is eight to nine months of age, complementary foods can be offered *before* the milk feed. Gradually, complementary foods displace milk feeds, but breast milk or infant formula should remain a prominent part of the infant's diet until the infant is at least one year of age.

The NRVs (RDI, AI and UL recommended levels) for infants and toddlers used in this paper are from *Nutrient Reference Values for Australia and New Zealand Including Recommended Dietary Intakes* (NHMRC 2006). For infants aged 0–6 months, all the recommendations are based on the average intake

of breast milk (780 mL per day). For infants aged 7–12 months, all the recommendations are based on the average intake of breast milk (600 mL per day) and 200 g of complementary food. The reference bodyweights are 7 kg for infants aged 2–6 months of age, 9 kg for infants aged 7–12 months of age, and 13 kg for toddlers aged 1–3 years of age.

The aim of introducing complementary foods is to complement the nutrients and energy supplied by breast milk or infant formula, especially for energy (iron, zinc and vitamin C) to ensure appropriate growth and development (see sections 9: Growth and Energy, and 10: Nutrients).

The emphasis is on using the developmental stages and skills to guide the age for introducing complementary foods to the individual child, and progress in increasing the variety, texture, flavour and amount of food given to the child. Table 4 gives an order for introducing complementary foods, based on evidence and accepted convention, and emphasises the progression of texture, variety and flavour. Examples of foods and the contributions they make to the nutrient content of the diet are shown in Table 5.

By around one year of age, the infant should be eating more of the family foods on offer in the household (with adjustments to texture where needed, for more information see Appendix 13). This assumes the family food environment provides a variety of appropriate and adequate foods.

4.4.1 First complementary food (around six months of age)

Several developmental stages and skills of the infant signal their readiness for complementary foods and for progressing to family foods. Table 4 summarises these stages and skills. The ideal is to wait until the infant is around six months of age, but the timing of the developmental stages and skills that signal readiness vary from infant to infant. Many infants exhibit fussing and crying behaviour in the first three to four months of life, and this behaviour may be misinterpreted as hunger (Walker and Menahem 1994).

Traditionally, the infant's weight gain compared with a growth rate from standard percentile charts have been used as the signal for introducing complementary foods to breastfed infants. However, such charts are often drawn from data that includes formula-fed infants in whom complementary foods have been introduced fairly early. There is no reason to assume that slower growth rates are in themselves undesirable (see section 9.1: Growth and rate of growth).

Examples of suitable first complementary foods are given in Table 4. The examples include good sources of iron such as iron-fortified cereals, puréed vegetables, age-appropriate meats, and vegetarian alternatives.

The first complementary foods need not be bland in taste in order for infants to accept and enjoy them. Research suggests infants will accept flavours they were exposed to in the womb and in breast milk via the mother's diet (for example, curry and other spices) when they are presented as flavours in complementary foods (Mennella et al 2001).

It is recommended that fat, salt, sugar, honey and other sweeteners are not added to infants' food. These supply minimal nutrient benefit and may accustom the infant to their taste.

The first complementary food should be a thin smooth purée, that may need to be diluted with expressed breast milk or infant formula to achieve the right consistency.

As a guide, the first complementary foods should be introduced in small amounts starting with one-half to two teaspoons after breast or formula feeding.

4.4.2 Increasing the texture, variety, flavour, and amount

A variety of foods and flavours can be introduced gradually as the infant accepts the taste. New foods should be introduced one at a time, allowing two to four days between each new food to establish that the infant does not have an allergy to that food (Butte et al 2004).

Taste influences food acceptance and preferences at all ages. The introduction of complementary foods involves the infant learning to recognise and enjoy different tastes as well as textures. Successful food introduction has to overcome the infant's aversion to new eating experiences, which is a common reaction in most infants. Research has shown a new food may need to be offered between 8–15 times before it is accepted (Briefel et al 2004). Infants choose or refuse foods because of the sensory stimuli of taste, texture, and smell and the appearance of colour, shape and presentation. An infant's natural responses may make a caregiver think the child does not like a new taste when it is simply that the child is unfamiliar with it.

As varied a diet as possible is the best means of ensuring the infant has an adequate intake of all nutrients, as well as offering them opportunities to develop personal preferences and accept a variety of tastes and textures (Mennella and Beauchamp 1998).

The texture should progress from puréed to mashed to chopped. If infants are not encouraged to chew more textured foods, they may not develop this ability as they age. Teaching older infants to chew can be difficult. Breast milk or formula should continue to be used to obtain the right consistency and moisten food until the infant is one year of age. Food should be presented in a variety of ways, including as finger food such as soft fruit pieces, slightly overcooked vegetable pieces and toast – all cut to a size and shape small hands can easily hold.

The quantity of complementary foods should be increased gradually. Aim for about two tablespoons to half a cup at one meal before increasing the number of meals. Meals should be provided two to three times per day when the infant is six to eight months of age, then three to four times a day with one to two snacks as required (PAHO and WHO 2003). The amount of complementary food required will vary due to differences in the infant's breast milk intake and growth rate.

When introducing toast, start with white or wholemeal and age-appropriate infant cereals. Wheat breakfast biscuits contain a moderate level of fibre and can be given to the child once they are eight months of age. If wheat breakfast biscuits are given, they should be served not more than once a day and with breast milk or infant formula, then, after the infant is one year of age, with cows' milk. Cereals and similar foods should never be added to an infant's feeding bottle. They can make the feed too concentrated, so the infant will not receive sufficient fluids for normal kidney function and the feed will be too difficult to drink.

Although cows' milk should not be given as a drink until the infant is one year of age, milk products such as cheese, yoghurt, cottage cheese, custard and milk puddings can be introduced when the infant is around seven to eight months of age (see section 6.3.4: Cows' milk as a drink). Commercial infant foods containing milk and milk products can be introduced once the infant is around six months of age because the high temperatures required to manufacture these products denatures some of the proteins and makes the food easier for infants to digest.

For information on food allergies and food intolerances, see section 12.5: Food allergies and food intolerances.

4.4.3 Feeding the toddler

Infants should progress to eating a variety of foods and textures and be eating more family foods by around one year of age, assuming that the family food environment provides a variety of appropriate and adequate foods.*

Toddlers should be offered a variety of nutritious foods and fluids in small amounts and at regular intervals (three meals and two snacks) to meet the requirements for growth.

Ongoing breastfeeding will continue to benefit the toddler (see section 4.3: Importance of continued breastfeeding beyond period of exclusive breastfeeding).

The family diet should be based on the *Food and Nutrition Guidelines for Healthy Adults: A Background paper* (Ministry of Health 2003a), so that the family food environment provides a variety of appropriate and adequate foods. Note, however, that the food offered to infants and toddlers, compared with adults' food, need not be especially low in fat or high in fibre.

* Adjustment to the textures of some foods may be necessary to minimise the risk of food-related choking. For more information see section 4.4.4 and Appendix 13. Do not give small hard foods such as nuts or large seeds until children are at least five years old.

Table 4: Developmental stages and complementary foods for the first and second years of life

Development stage	Newborn Head up	Supported sitter	Independent sitter	Crawler	Beginning to walk Independent toddler
Approximate age	0–6 months (0–180 days)	6–7 months (180–210 days)	7–8 months (210–240 days)	8–12 months (240–365 days)	12–24 months
Physical skills	Needs head support	When placed on stomach, holds head up, supports weight on forearms, and pushes up on arms with straight elbows When sitting on person’s lap, holds head up, keeps head controlled when tipped, sits with less help and reaches out for toy Puts hands and toys frequently in mouth, explores fingers, thumbs and fists with great interest	Sits independently Can pick up and bring food to mouth	Learns to crawl May pull self up to stand	Pulls self to stand Stands alone Takes early steps Learns to walk alone Runs Climbs
Eating skills	Suckles, sucks and swallows Has tongue extrusion reflex (tongue protrudes so baby cannot take food from a spoon)	Shows signs of chewing movements Opens mouth easily when spoon touches lip or as food approaches Has no tongue extrusion reflex (ie, tongue does not protrude) and moves gently back and forth as food enters mouth Keeps food in mouth and swallows it, instead of spilling food out.	Learns to keep thick purées in mouth Leans towards food or spoon Is interested in finger foods Is learning to chew and bite Probably has some teeth present	Is interested in extended range of food and varied texture Can eat reasonably independent (but still needs some help to eat) Can bite well and can chew soft lumps Clears spoon with lips	Feeds self easily with fingers Can drink from a straw Can hold cup with two hands and take swallows Is more skilful at chewing (has a rotary chewing movement) Demands to spoon-self-feed Bites through a variety of textures Has molar teeth starting to appear

Development stage	Newborn Head up	Supported sitter	Independent sitter	Crawler	Beginning to walk Independent toddler
Approximate age	0–6 months (0–180 days)	6–7 months (180–210 days)	7–8 months (210–240 days)	8–12 months (240–365 days)	12–24 months
Baby's hunger and fullness cues	When hungry, the early signs are nuzzling, mouthing, increased alertness, hand sucking. Crying is a late sign of hunger. May open mouth during feeding, indicating desire to continue. When satisfied or wanting to stop eating, spits out nipple or falls asleep, stops sucking.	Seems hungry after the milk feed When hungry or wants more food, frequently cries, leans forward as food approaches, reaches for food or caregiver's hand, and opens mouth When satisfied or want to stop eating, turns head or body away from food, loses interest in food, pushes food or caregiver's hand away, loses mouth, looks distressed or cries	When hungry or wants more food, reaches for spoon or food, points to food When satisfied or wants to stop eating, slows down in eating, clenches mouth shut or pushes food away	When hungry or wants more food, reaches for food, points to food, shows excitement when food is presented When satisfied or wants to stop eating, pushes food away, slows down eating	When hungry or wants more food, expresses desire for specific foods with words or sounds, combines phrases with gestures, such as 'want that' and pointing, can lead caregiver to refrigerator and point to a desired food or drink When satisfied or wants to stop eating, shakes head to say 'no more' uses words like 'all done' and 'get down', plays with food or throws food
Appropriate textures and flavours	Liquids	<i>Puréed foods</i> Offer complementary foods after the milk feed Introduce new foods one at a time, starting with thin purées and gradually thickening consistency as tolerated Introduce new flavours	<i>Mashed foods</i> Offer complementary foods after the milk feed Offer an increasing variety of food, presented in different sizes and textures Serve some food as finger food Introduce new flavours	<i>Chopped foods</i> Offer complementary foods before the milk feed Offer an increasing variety of food, presented in different sizes and textures Serve some food as finger food Introduce new flavours	<i>Family foods (textures may need to be altered. See section 4.4.4 and Appendix 13)</i> Continue breastfeeding Introduce cows' milk or suitable alternatives* to drink instead of infant formula Offer an increasing variety of food, presented in different sizes and textures Introduce new flavours

Development stage	Newborn Head up	Supported sitter	Independent sitter	Crawler	Beginning to walk Independent toddler
Approximate age	0–6 months (0–180 days)	6–7 months (180–210 days)	7–8 months (210–240 days)	8–12 months (240–365 days)	12–24 months
Examples of foods	Breast milk Infant formula	Iron-fortified baby cereal Cooked and puréed meat (eg, beef, lamb or pork, chicken, or fish) or cooked and puréed vegetarian alternatives (eg, legumes) Puréeed plain rice, congee Cooked and puréed vegetables without skins, pips or seeds (eg, potato, kumara, pumpkin, cassava, tapioca, manioke ^(a)) (see Table 5) Puréeed fruit without skins, pips or seeds, cook to soften if necessary before puréeing (e.g., apple, pear, mango) (see Table 5) Age-appropriate commercial infant foods	Age-appropriate infant cereals Continue to cook and purée meat, fish and vegetarian alternatives Cooked and mashed egg Tofu, tempeh Mash (rather than purée) vegetables and fruit Use cows' milk or suitable alternatives* in cooked food (eg, custard, milk puddings) yoghurt, cottage cheese Age-appropriate commercial infant foods Finger food in pieces that can be easily picked up by infant (eg, ripe banana, well cooked pumpkin, toast fingers, thin slices of cheese)	Breakfast cereals (eg, porridge, wheat biscuits (iron-fortified), infant muesli) Meat, chicken and kai moana (seafood) minced or finely chopped and mixed with mashed cooked vegetables Thin scraping of peanut butter (smooth) Add chopped soft fruit to yoghurt or custard Age-appropriate commercial foods Slightly firmer finger foods: – soft ripe fruit or vegetables eg, kiwifruit or kumara – soft cooked carrot or apple (or finely grated if raw) – toast fingers, puffed crispbread – tender meat	All foods previously listed Tender finely chopped meats, chicken, kai moana or soft, slightly mashed vegetarian alternative Breads Small sandwiches with thinly sliced or spread filling Finely chopped salad vegetables (eg, lettuce, cucumber) Plain, pasteurised whole milk or suitable alternatives*
Liquids	Breast milk Infant formula	Breast milk Infant formula	Breast milk Infant formula	Breast milk Infant formula	Breast milk Milk Water

Source: Adapted from Butte et al (2004) and NHMRC (2003).

* Cows' milk as part of a varied diet is an important source of nutrients for children from one year of age. For some vegetarians, vegans and/or those who avoid cow's milk, there are suitable alternatives to cow's milk. For more information on suitable alternatives, see 'Plant-based milks' in section 12.1.1.3: Nutrition issues.

Additional Notes

- The ages of introduction are provided as guidelines only.
- Introduce new foods one at a time, allowing two to four days (Butte et al 2004) between each new food to establish that the infant does not have an allergy to the food. For those with a parent or sibling with a history of anaphylaxis or a severe food allergy or wanting more information on allergies, see section 12.5: Food allergies and food intolerances.

Table 5: Four major food groups: examples of foods and the nutrients they provide for infants and toddlers

Food group	Examples	Nutrients provided
<p>Vegetables and fruit (eg, fresh, frozen, canned and dried products*)</p> <p>(Remove stringy bits and skins for very young children)</p>	<p><i>Vegetables</i></p> <p>Potato, kūmara, pumpkin, taro, tapioca, cassava, manioke(a), carrot, kamokamo (marrow), parsnip, yam, green beans, pūhā, silverbeet, spinach, bok choy, Asian greens, broccoli, courgette (zucchini), cabbage, cauliflower, corn, parengo, peas, pele leaves, taro leaves (must be cooked), watercress, capsicum</p> <p>Salad vegetables</p> <p>Tomato</p> <p><i>Fruit</i></p> <p>Apple, apricot, avocado, banana, mango, melon, pawpaw, peach, plum, persimmon, pineapple, orange, berry fruit, kiwifruit</p> <p>Fruit salad</p>	<p>Energy</p> <p>Carbohydrates</p> <p>Dietary fibre</p> <p>Vitamins: especially folate, vitamin A (yellow and green vegetables), and vitamin C (dark green leafy vegetables and most fruit, potatoes)</p> <p>Minerals: magnesium, potassium</p>
<p>Breads and cereals (eg, breads, breakfast cereals, grains, rice and pasta)</p>	<p>Bread (eg, slice, roll, bun, pita, chapatti, rēwena)</p> <p>Baby muesli, cornflakes, infant cereal (eg, iron-fortified baby rice), porridge, wheat biscuits (iron-fortified)</p> <p>Plain rice, congee</p> <p>Pasta and noodles</p> <p>Steamed plain cake (mantou), steamed dumplings and buns</p> <p>Plain sweet biscuits, muffin, cake, rusks</p> <p>Crackers, puffed crispbread</p>	<p>Energy</p> <p>Carbohydrates</p> <p>Dietary fibre</p> <p>Vitamins: vitamins from the B group (except B12), vitamin E</p> <p>Minerals (particularly in wholegrain breads and cereals): magnesium, calcium, iron, zinc and selenium</p> <p>Protein</p>
<p>Milk and milk products (eg, milk, cheese, yoghurt) and suitable alternatives</p>	<p>Breast milk</p> <p>Whole (dark blue top) cows' milk</p> <p>Yoghurt</p> <p>Cheese</p> <p>Plant-based milk (calcium and vitamin B12–fortified) (eg, soy, rice)</p> <p>Soy yoghurt and cheese (calcium-fortified)</p> <p>Milk puddings (eg, custard, sago)</p>	<p>Protein</p> <p>Fats: higher proportion of saturated than poly- or monounsaturated fats especially in full fat products</p> <p>Energy</p> <p>Vitamins: riboflavin, vitamin B12, vitamin A, vitamin D</p> <p>Minerals: especially calcium, phosphorus, zinc and iodine</p>

* Dried fruit is high in sugar. It is also very sticky and can get stuck in teeth, contributing to dental decay. See section 12.12: Oral health for healthy infants and toddlers.

Food group	Examples	Nutrients provided
Lean meat, poultry, seafood, eggs, legumes, nuts and seeds	Casserole, mince Chicken Fish, kina, pipi, kōura (crayfish), pūpū (periwinkles), parengo (seaweed), pāua, eel Egg Hummus, baked beans, dhal, nut butters, patties/loaves Soy meat alternatives (eg, tofu, tempeh)	Protein Fats: both visible and marbled in meat (mostly saturated fat, cholesterol); mostly unsaturated fats in seafood, nuts and seeds) Carbohydrates: mainly legumes (dried peas and beans) Energy Vitamins: B12, niacin, thiamin Minerals: iron, zinc, magnesium, copper, potassium, phosphorus and selenium Iodine: particularly in seafood and eggs

Additional Notes

- Do not give:
 - salty meat such as corned beef, povi/pulu masima (salted brisket), and tinned fish as first foods
 - cows' milk before 12 months of age
 - honey before 12 months of age
 - whole nuts or large seeds before five years of age (because of the choking and inhaling risk)
 - foods with added fat, salt and sugar
 - alcohol, coffee, cordials, juice, soft drinks, tea (including herbal tea), and other drinks containing caffeine.

4.4.4 Creating a safe, positive feeding environment

Meals must be eaten while the infant is sitting in a high-chair or similar, and away from distractions such as the television or toys. Caregivers must always supervise an infant or toddler when they are eating, and be familiar with first aid for dealing with choking.

Family meals have an important impact on a child's dietary intake, psychosocial health and learning. Family meals can provide an opportunity to communicate, learn, transmit cultural and ethnic heritage, and develop family rituals. They are also an opportunity for positive role modelling by caregivers and other family members. There are positive nutritional and psychosocial outcomes from sharing meals. Traditions and routines are important to young children because they help to provide a sense of security (Story and Neumark-Sztainer 2005).

Responsive feeding is a term used to recognise that optimal feeding depends on how, when, where and by whom the child is fed, as well as what is fed (PAHO and WHO 2003). Responsive feeding calls for attention to be paid to signs of hunger and fullness to avoid underfeeding and overfeeding. Signs of hunger include nuzzling, mouthing, increased alertness, hand sucking and crying. Older infants may reach for the spoon or food, point to the food or show excitement when food is presented (Table 4). Signs of fullness can include spitting out the nipple, eating more slowly, clenching the mouth shut, or pushing food away.

Parents may be concerned if their child does not feed themselves early on and that the child's nutrition will suffer. In the Feeding Infants and Toddlers Study conducted on more than 3000 infants and toddlers in the United States in 2002, caregivers reported the ages that gross motor developmental milestones and fine motor skills required for self-feeding developed, and the food intakes at these ages were compared. Some differences in nutrient intakes were observed, but these differences disappeared as the children got older. By 15–18 months of age, self-feeding skills were comparable for all children, regardless of whether they self-fed earlier or later than the average (Clarke et al 2006).

Many caregivers experience times when their toddler is unusually fussy with their food. This is a common occurrence and is often associated with toddlers exerting their independence.

Babies and toddlers can choke on food quite easily

This is mainly because they have small air and food passages and are still learning to move food around in their mouths and how to bite, chew and grind food. To reduce their risk of choking:

- always make sure babies and toddlers sit down while they eat and that an adult is with them while they are eating or drinking
- offer food that matches their chewing and grinding ability

Be aware of foods that are more likely to cause choking – for example:

- **small hard foods** that are difficult for children to bite or chew (eg, nuts, large seeds⁺, popcorn husks, raw apple, carrot and celery)
- **small round foods** that can get stuck in children's throats (eg, grapes, berries, raisins/sultanas, peas, watermelon seeds, lollies)
- foods with **skins or leaves** that are difficult to chew (eg, sausages, chicken, lettuce, nectarines)
- **compressible* food** that can get stuck in children's throats (eg, hot dogs, sausages, pieces of cooked meat, popcorn)

⁺ For example, sunflower and pumpkin seeds.

* Compressible foods are those that can squash down into the shape of the child's throat and get stuck there.

- **thick pastes** that can get stuck in children’s throats (eg, chocolate spreads, thick peanut butter)
- **fibrous or stringy foods** that are difficult for children to chew (eg, celery, raw pineapple).

To reduce the risk of choking on these foods, you can:

- alter the food texture – grate, cook, finely chop or mash the food
- remove the high-risk parts of the food – peel off the skin or remove the strong fibres
- avoid giving small hard foods, such as whole nuts and large seeds until children are at least five years old.

For more information on choking see Appendix 13 and www.health.govt.nz

Meal time tips for caregivers with toddlers

- Establish a meal and snack-time routine.
- Make meal times sociable and relaxed.
- Sit with the toddler and eat as a family at the table.
- Where possible, let the toddler select their food from the food provided at the family meal.
- Offer food that matches the toddler’s chewing and grinding ability. This may mean you need to alter the textures of some foods.
- Be aware of foods which are more likely to cause choking. See Section 4.4.4 and Appendix 13.
- Serve small amounts and offer more if the toddler is still hungry after eating the serving.
- Give the toddler a choice of healthy foods for meals and snacks, and do not offer other options if the toddler chooses not to eat.
- Offer foods in a variety of ways (for example, in a bowl, as finger food, as soup or grated into main dish).
- Make food easy to eat – a size that is easy for toddlers to pick up is good.
- Limit a toddler’s milk consumption to no more than 500 mL per day. More than this can displace solid foods containing the other nutrients that children need.
- Involve the toddler in food preparation, as appropriate and possible.
- Try different ways of preparing food the toddler has previously refused.
- Ignore other people’s comments, particularly if they are comparing your child with their children.
- Accept that a toddler’s appetite and the amount they eat may vary from day to day.
- If your child is growing and developing appropriately, they are eating enough.
- Be a positive role model with food.
- Always supervise your child when they are eating.
- If you are unsure of issues regarding your child’s health, seek advice from your health practitioner.

4.4.5 Preparing complementary infant food at home

Initially, complementary food needs to be a thin, smooth purée. This may be achieved using a food processor, mouli or sieve. Many foods, such as banana or cooked apple, can be prepared by pushing them through a domestic sieve with a wooden spoon. Fibrous components, for example, the stringy bits in taro leaves and pele leaves, should be removed before processing. At a later stage, food needs only to be mashed with a fork.

Take care with food safety (see section 12.13: Food safety).

Do not add salt, soy sauce, sugar, honey, cream, butter or margarine, or artificial sweeteners to infant foods. Even though infant foods may taste bland to adults, the food will be attractive to infants.

4.4.6 Commercial infant complementary foods

All infant foods sold in New Zealand must be in accordance with the Australia New Zealand Food Standards Code (FSANZ 2002). Standard 2.9.2 of the Code provides for the compositional (including nutritional) and labelling requirements of foods intended and/or represented for use as foods for infants. The standard recognises the specific needs of infants relating to texture, digestion, renal capacity, growth and susceptibility to infection.

When using commercial complementary foods for infants, it is important to follow the principles of increasing the texture, variety, flavour and amount as the infant progresses through the developmental stages and skills. Commercial foods can be used to provide variety, texture and flavour in different amounts in the diet, and in conjunction with home-prepared complementary foods and family foods. They may also be useful when family foods are not suitable. For example, family foods can be higher in salt, sugar and protein than the recommended amounts for infants and toddlers, and contain additives and preservatives not permitted in commercial baby foods. Commercial complementary foods for infants can be useful when travelling, but they may be more expensive than meals adapted from the family meal for infants.

Commercial complementary foods for infants may look, taste and smell differently from family foods. Mixing commercially prepared infant foods with family foods can aid transition and acceptance.

Commercial infant foods containing milk and milk products can be introduced when the infant is around six months of age, because the high temperatures required to manufacture these products denatures some of the proteins and makes the food easier to digest.

4.5 Key points for complementary feeding (solids) and joining the family diet

- Maintain healthy growth and development of the infant and toddler by providing them with appropriate food and physical activity opportunities every day.
- Give only breast milk until the infant is ready for and needs extra food – this will be at around six months of age.
- Breastfeed until at least one year of age, or beyond.
- If the infant is not breastfed, then use an infant formula as the milk source until the infant is one year of age. After one year, cows' milk may be introduced.
- Increase the texture, variety, flavour and amount of food offered so the infant receives an additional intake of nutrients, especially iron and vitamin C, and is eating some family foods by around one year of age.

- Be aware of foods which are more likely to cause choking. See section 4.4.4 and Appendix 13.
- For infants, prepare or choose pre-prepared complementary foods with no added fat, salt, sugar, honey or other sweeteners.
- Offer toddlers a variety of nutritious foods from each of the major food groups each day. The food groups are:
 - vegetables and fruit
 - breads and cereals, including wholemeal
 - milk and milk products or suitable alternatives
 - lean meat, poultry, seafood, eggs, legumes, nuts and seeds.*
- For toddlers, prepare foods or choose pre-prepared foods, drinks and snacks that:
 - are low in salt, but if using salt, use iodised salt
 - have little added sugar (and limit the toddler’s intake of high-sugar foods).
- For toddlers, provide plenty of liquids each day such as water, breast milk or cows’ milk (although no more than 500 mL per day of cows’ milk).
- Do not give infants and toddlers alcohol, coffee, cordials, juice, soft drinks, tea (including herbal teas), and other drinks containing caffeine.
- Purchase, prepare, cook and store food in ways to ensure food safety.

* Do not give small hard foods like whole nuts and large seeds until children are at least 5 years old.

5 Formula Feeding

5.1 Background

If the infant is not breastfed, then an infant formula should be used until the infant is one year of age.

The compositions of breast milk and formula have important differences (see section 3.2: Importance of breastfeeding). The infant has a higher risk of infection with formula because people may use ineffective sterilisation techniques or unsafe water (Howie et al 1990) or incorrectly store milk powder and reconstituted milk (WHO and FAO 2007).

The composition of infant and follow-on formula (that is, formula marketed for infants six to 12 months of age) sold in New Zealand is required to be consistent with the Australia New Zealand Food Standards Code (FSANZ 2002). The Food Standards Code sets standards for infant and follow-on formula so the formula is nutritionally adequate to promote growth and development when used appropriately and is suitable for feeding to healthy full-term infants. The standard for infant formula requires that the formula meets the complete energy and nutritional requirements for a healthy full-term infant up to six months of age. After this age, an infant should also be receiving complementary foods.

Homemade formula (that is, formula not prepared commercially) is not recommended because of the risks associated with inadequate composition and unsafe preparation. The concerns are that such formula will not meet nutritional requirements, will contain harmful levels of some nutrients, may include inappropriate ingredients and may be contaminated (for example, with bacteria that cause food-borne illness).

All references to formula in the rest of this document are to commercially prepared products (that is, not homemade formula).

While stressing the superior benefits of breastfeeding for both infants and mothers, health practitioners must give mothers and families who decide to feed their infants infant formula objective, consistent and accurate advice on the proper use of formula (Ministry of Health 2007a). Such information should include the appropriate type of formula, how to prepare the formula and the equipment, and how to feed the infant.

When health practitioners advise on formula type and use, the most important considerations are as follows.

- Encourage and support the mother to try to maintain some breastfeeding if possible. An alternative is to encourage the mother to express her milk and bottle-feed the baby with it.
- The formula chosen should be appropriate for the infant's age.
- If an infant is thriving on regular or standard infant formula and complementary foods, there is generally no advantage in changing to a follow-on formula. The practice of introducing follow-on formula, instead of standard infant formula, in the second six months of life together with complementary foods is unnecessary (World Health Assembly 1986).
- Formula should be handled and stored carefully, and made up as close as possible to feeding time.
- Cows' milk-based formula is recommended for routinely feeding a healthy infant who is not breastfed.

- Different or more expensive formula is not necessarily better than regular or standard formula for the infant unless a health practitioner specifically recommends it.
- If there are concerns about the infant's health or tolerance to cows' milk-based formula, the health practitioner should assess the infant, so problems can be diagnosed and resolved promptly.
- Soy-based infant formula should not be used routinely. The only medical indication for using soy-based formula is for managing galactosaemia. Soy-based infant formula is appropriate only for vegan infants if they are not breastfed.

5.2 Types of formula

Many different types of formula are available in New Zealand.

5.2.1 Infant formula

If an infant is not breastfed, then an infant formula is the only appropriate alternative to be used until the infant is one year of age. Infant formula provides the nutrients required for the infant's normal growth and development.

The composition of infant formula is modelled on breast milk (for example, infant formula provides a similar amount of energy as that provided by breast milk). However, there are significant differences. Infant formula has higher concentrations of some nutrients (for example, iron) than breast milk to compensate for the lower bio-availability of these artificial nutrients in the infant formula.

Formula is unlikely to replicate breast milk completely because of the large numbers and complexity of the non-nutritional components in breast milk (see section 3.3: Composition of breast milk). Infant formula manufacturers are developing formula that contains additives similar to some of the components of breast milk, but it cannot be assumed that their inclusion in infant formula conveys the same benefits to the infant as they convey when in breast milk. Much research has been done, but more is needed to determine a benefit of these additives to standard formula.

5.2.2 Follow-on formula

Follow-on formula is marketed as suitable for infants aged six to 12 months. Follow-on formula generally has a higher protein, iron and mineral content and a higher renal solute load than in standard infant formula, although these nutrient levels vary between products (Wells 1998).

Follow-on formula may be useful in preventing and treating iron deficiency in an infant (see section 10.4.1: Iron). A health practitioner's advice should be sought regarding the use of follow-on formula for treating iron deficiency. Iron-fortified infant formula is one of several options for preventing and treating iron deficiency in infants unable to have a normal varied diet.

5.2.3 Cows' milk-based formula

The protein in cows' milk-based formula is sourced from cows' milk. Lactose, corn syrup solids and corn maltodextrin provide carbohydrates. Generally, vegetable oil blends provide fat. Cows' milk-based formula is not suitable for infants with galactosaemia, congenital lactose intolerance or cows' milk allergy.

Whey and casein-dominant formula

For information about whey and casein-dominant formula, see section 10.1.4: Protein in breast milk and cows' milk-based formula.

Alpha-lactalbumin formula and low beta-lactoglobulin formula

For information about alpha-lactalbumin formula and low beta-lactoglobulin formula, see section 10.1.4: Protein in breast milk and cows' milk-based formula.

Partially hydrolysed formula

Partially hydrolysed formula is a cows' milk-based formula that has been treated with enzymes to break down some of the cows' milk proteins it contains. It has been suggested that partially hydrolysed formula may delay or prevent some forms of allergy if used in place of standard cows' milk formula. See 'Formula feeding' in section 12.5.2: Prevention of food allergies.

Thickened or anti-reflux formula

A specially thickened formula that aims to decrease symptoms of reflux in infants is also available for infants who are formula fed.

5.2.4 Soy-based formula

Soy-based formula differs from cows' milk-based formula because the protein in the formula is derived from refined soy protein isolate. Since soy protein lacks sufficient amounts of the essential amino acid methionine, the formula must be fortified with methionine, which affects the taste. Soy-based formula also contains higher levels of phytates, aluminium and fluoride than contained in cows' milk-based formula. The amount of aluminium and fluoride allowed in soy-based formula is controlled by the Food Standards Code (see section 5.1: Background).

Soy-based formula is not recommended for general use in infant feeding (ESPGHAN 2006). The only medical indication for soy-based formula is for managing galactosaemia. Soy-based formula contains no lactose and cows' milk protein, but formulae are available in New Zealand for infants with cows' milk protein allergy and lactose intolerance, and these formulae are recommended in preference to soy-based infant formula. Soy-based formula is an appropriate option only for vegan infants if they are not breastfeed.

Infants with existing hypothyroidism should not be fed a soy-based formula or foods containing soy as a major part of their diet, unless they are under close medical supervision and their thyroid function is monitored. There have been isolated cases of goitre in infants fed soy-based formula, but they were resolved on the withdrawal of the formula (Ministry of Health 2005b; Chang and Doerge 2000).

Infants fed soy-based formula grow and develop normally and are reported to have normal metabolic functions (Lasekan et al 1999; Seppo et al 2005). Concern has been expressed about the possible physiological effects of phytoestrogens in soy formula on the developing endocrine system of infants. There is no clear clinical or scientific evidence of adverse effects to infants (Tuohy 2003).

5.2.5 Goats' milk-based formula

Goats' milk-based formula differs from cows' milk-based formula as the protein is sourced from the protein in goats' milk.

Infants fed goat's milk-based formula have similar growth rates to those fed cows' milk-based formula (Grant et al 2005). The main carbohydrate in goats' milk-based formula is lactose, so it is not suitable for infants with lactose intolerance or galactosaemia. It is unsuitable for infants with cows' milk protein allergy due to the cross-reactivity between cows' milk and goats' milk (Bellioni-Businco et al 1999).

5.2.6 Specialised formula

Specialised formula is used for infants with allergies, malabsorption and metabolic disorders. It should be used only on a paediatrician's recommendation.

The overall nutrient profile of this formula is similar to other formula, except that component-modified specialised ingredients have been added or altered. In partially hydrolysed and extensively hydrolysed formula, the cows' milk protein they contain has been broken down into peptides and/or amino acids. In general, the more extensive the hydrolysis of the proteins, the less likely the formula is to cause an allergic response. Elemental formula is made from individual amino acids and is considered the least likely formula to cause an allergic response. This formula is extremely expensive because of the complexity of the manufacturing process. It is designed to provide all the nutrients required for normal infant growth and development.

Other formula available in New Zealand have ingredients added to them, such as long-chain polyunsaturated fatty acids (see section 10.3: Fat), nucleotides, prebiotics (see section 12.8: Probiotics in infant formula) and probiotics (see 12.9: Probiotics in infant formula). In general, these ingredients are found in breast milk, so are added to infant formula to make it more like breast milk. However, it should not be assumed their inclusion confers the same benefits to the infant as they confer in breast milk. Much research has been done, but more evidence is required to demonstrate the proven benefit of these additives to standard formula.

5.3 Changing formula

Formula is often blamed for a variety of symptoms such as vomiting, spilling, reflux, crying, diarrhoea and constipation. Many of these symptoms are associated with normal development, and it is preferable to teach parents coping strategies rather than changing from one formula to another. There is no evidence of benefit from switching brands of formula.

If symptoms persist and are affecting the infant's health, it is preferable the caregiver seeks a health practitioner's advice before changing the brand of formula or changing to a formula of a different composition.

5.4 Preparing formula for healthy full-term infants

Formula is available in two forms: powdered and ready-to-use.

Ready-to-use formula is a sterile product until its packaging is first opened. It is used mainly in hospitals but is available in the community. Powdered formulae are not sterile, even though they have been manufactured to meet hygiene standards.

Powdered formula may, albeit rarely, contain pathogens which can cause serious illness, for example, *Enterobacter sakazakii*, and *Salmonella*. These bacteria are found throughout the environment and have been found in food, including powdered formula. Contamination by such bacteria is not usually associated with illness in healthy full-term infants. However, there have been rare cases, in preterm or immuno-compromised infants in neonatal units, of serious illness and, occasionally, death.

All hospitals' neonatal units use ready-to-use formula where possible. If a preterm or immuno-compromised infant is formula fed in the community, it is important the best formula-feeding option is discussed with the infant's neonatologist or paediatrician.

The Food and Agriculture Organization of the United Nations and WHO convened, in 2004 and 2006, two expert consultations on *Enterobacter sakazakii* and *Salmonella* in powdered infant formula, and commissioned a risk assessment model (FAO and WHO 2004; FAO and WHO 2006). The Codex Committee on Food Hygiene is developing a Code of Hygienic Practice for Powdered Formulae for Infants and Young Children. It will then be adopted by the Codex Alimentarius Commission. Utilising these bodies of work and in light of the New Zealand situation, the following advice is considered appropriate to minimise the risk of infection from pathogens in reconstituted powdered formula for infants and young children.

For further information about *Enterobacter sakazakii*, see the Ministry of Health website (www.health.govt.nz) or the New Zealand Food Safety Authority website (www.nzfsa.govt.nz).

5.4.1 Cleaning and sterilising feeding and preparation equipment

To reduce the risk of contamination, the equipment used to prepare formula for feeding must be sterilised before use in the first three months of an infant's life. Equipment can be sterilised with sterilising solutions, in boiling water or in a steam-sterilising unit designed for use in a microwave. A dishwasher will not sterilise equipment.

If boiling water is used for sterilising equipment, great care should be taken to keep children away from it. Boiling (or even hot) water is a significant safety risk to children.

Steps for cleaning and sterilising feeding equipment

The steps for cleaning and sterilising feeding equipment are as follows.

- 1 Wash hands thoroughly with soap and water and dry them using a clean cloth or single-use paper towel.
- 2 Wash feeding and preparation equipment (for example, cups, bottles, teats and spoons) thoroughly in hot soapy water. If using feeding bottles, use clean bottle and teat brushes to scrub the inside and outside of bottles and teats to ensure all remaining feed is removed.
- 3 Rinse the feeding and preparation equipment well in hot water and air dry it, or wash it in a dishwasher.
- 4 If using a commercial home steriliser (for example, an electric or a microwave steam steriliser or a chemical steriliser), follow the manufacturer's instructions.
- 5 If sterilising by boiling:
 - fill a large pot with water
 - submerge all the washed feeding and preparation equipment in the water, ensuring no air bubbles are trapped under the equipment
 - cover the pot with a lid and bring the water to a rolling boil
 - turn off the element and keep the pot covered until the equipment is needed.

- 6 Before removing the feeding and preparation equipment from the steriliser or pot, wash hands thoroughly with soap and water, and dry them using a clean cloth or single-use paper towel. Sterilised kitchen tongs should be used for handling sterilised feeding and preparation equipment.
- 7 To prevent recontamination, remove feeding and preparation equipment from the boiled water or steriliser just before it is to be used. If equipment is removed from the steriliser and not used immediately, cover and store in a clean place. Feeding bottles can be fully assembled to prevent the inside of the sterilised bottle and the inside and outside of the teat from becoming contaminated.

Sterilise all equipment until the infant is three months old, after which it is sufficient just to wash the equipment thoroughly with hot soapy water and then rinse it.

5.4.2 Preparing a feed using powdered infant formula

Formula is best made up fresh for each feed and for immediate consumption. The formula must be made up according to the instructions on the container.

The scoop provided with the container of formula should be used for that formula only. The scoop has been designed to measure the correct amount of that particular formula to achieve the correct formula concentration. Use only level scoops of formula powder.

The formula should not be diluted or concentrated or have any food, beverage or medicine added unless on the advice of a health practitioner.

Steps for preparing a feed using powdered infant formula

The steps for preparing a feed using powdered infant formula are as follows.

- 1 Clean and disinfect a surface on which to prepare the feed.
- 2 Wash hands thoroughly with soap and water, and dry them using a clean cloth or single-use paper towel.
- 3 Boil a sufficient volume of water to last the day. If using an automatic kettle, wait until the kettle switches off, or if using a non-automatic kettle let the water come to a rolling boil.
- 4 Cool boiled water by placing it in a covered, sterilised container in the refrigerator with its mid-fridge temperature at 2–4°C. Keep this water for no longer than 24 hours.
- 5 Measure the appropriate amount of cooled boiled water into the cleaned and sterilised bottle. Add the powdered formula as instructed on the product label.
 - If using bottles, assemble the cleaned and sterilised teat and bottle according to the manufacturer’s instructions. Shake or swirl the bottle gently until the contents are mixed thoroughly.
 - If using feeding cups, mix the product thoroughly by stirring it with a clean and sterilised spoon.

Volume indicators on baby bottles marked with the EN14350 standard are considered accurate to within 5 percent at the 100 ml mark. Therefore, the Ministry recommends using bottles marked with the EN14350 standard to measure the water and make up infant formula. Baby bottles sold without the standard may have significantly inaccurate volume markings.

Household measuring cups and jugs are suitable for general kitchen use, but are not recommended for measuring small amounts of fluid such as for making up infant formula.

Use cooled boiled water until the infant is three months old, then use tap water from reticulated water supplies. If using bore water or tank water, boil the water until the infant is 18 months' of age. If using bore water, the quality of the water should be checked with local authorities or local public health units, especially for nitrate levels (Ministry of Health 2005a). See section 6.3.3: Water

5.4.3 If formula must be prepared in advance for later use

Prepared formula may be stored at up to 4°C in the lower half of the fridge, at the back, but should be kept for only a maximum of four hours.

If transporting a prepared bottle, keep the bottle cold in a chilly bin or an insulated carrier. Throw out prepared formula that has been out of the refrigerator for more than two hours. Ideally, when transporting formula, the cooled boiled water and powder should be kept separate, then mixed just before use (see section 5.3.5: Transporting feeds safely).

5.4.4 Warming stored feeds

Formula should be warmed gradually by placing the bottle containing the formula in hot water. Before feeding, caregivers must thoroughly shake the bottle containing the formula then test the temperature of the formula. The temperature of the formula can be tested by shaking a few drops onto the inside of the wrist. The formula is safe for the infant when it is comfortably warm to the touch.

Microwaves are not recommended for warming feeds because it is very easy to overheat formula. Microwaves can cause variations in temperature throughout the formula with 'hot spots', and the formula may continue to heat after it has been removed from the microwave (hence manufacturers' recommendations for standing time). This can cause extremely high temperatures, which may cause scalding (James 1989). Despite not being recommended, some caregivers will still use a microwave to warm feeds. In this case, they must shake the formula after heating, leave it to stand for two to three minutes, then shake it again before using. They should test the formula's temperature on their wrist as described above.

Discard made up formula that is not used after two hours at room temperature. Do not reheat used feeds.

For more information on warming infant formula see www.foodsmart.govt.nz

5.4.5 Transporting feeds safely

Transporting feeds increases the potential for harmful bacteria to grow. To minimise the risk of this occurring do the following.

- Before leaving home, measure cooled boiled water into cleaned (and sterilised, if infant is less than three months old) bottles. Screw the bottle's lid on tightly.
- Carry formula powder in measured amounts in a clean and sterilized container.
- When a feed is required, add the measured powder to the water in the bottle, replace the lid and shake the bottle gently to mix the formula.
- If possible, warm formula as described in section 5.4.4: Warming stored feeds
- Discard made up formula that is not used after two hours at room temperature.
- Do not reheat used feeds.

5.5 Number of feeds and amount of formula

The number of feeds and the amount of formula taken at each feed varies between infants and over time. An infant's needs vary with activity, illness and variations in growth rate. Infants should be fed in response to hunger cues, because their appetite and thirst will dictate their needs. Infants' fluid requirements must also be met; healthy infants should generally have six or more very wet nappies a day. Guidelines for quantities and frequency of feeds are printed on the formula cans. However, these are approximations and should be used only as a guide. For more information on adequate intakes for infants, see section 6.2: Recommended fluid intakes.

5.6 Key points for formula feeding

- Wash and dry hands well before preparing formula or feeding an infant.
- Wash all equipment thoroughly in hot soapy water. Rinse it well in hot water and air dry it.
- Sterilise all equipment until infants are three months old. Boil bottles and teats or use an appropriate sterilising solution, following the manufacturer's instructions.
- Prepare formula in a clean environment and exactly to the instructions on the label, using level scoops from scoop provided.
- Prepare formula as close as possible to feeding time.
- Use cows' milk formula. If concerns arise, consult a health practitioner rather than switch to an alternative.

6 Fluids

6.1 Background

Breast milk and infant formula are the sole sources of nutrients and fluid for an infant up to around six months of age. Once an infant has started with complementary foods, milk (breast milk and/or formula) remains the main source of fluid throughout their first year of life. Water can also be given throughout the day if necessary.

A balance between fluid input and output is essential for good health. Fluid is lost through urine, faeces, perspiration and breath. If too much fluid is lost, such as with diarrhoea, or not enough fluid is provided, the infant or toddler can become dehydrated.

Symptoms of dehydration include a non-demanding infant who sleeps for long periods and whose parents describe as quiet or rarely crying, diminished urine and stool outputs, greater than 7 percent weight loss *with other indicators* such as fewer than three stools per day, dry mucous membranes, feeding difficulties, or excessive sleeping (Walker 2006; Whaley and Wong 1999).

Clinical signs of dehydration can be subtle at first and may go unnoticed by parents who might be aware only of a sleepy infant who is difficult to feed. As dehydration progresses, symptoms include (Walker 2006; Whaley and Wong 1999):

- unusual sleepiness or lack of energy and/or difficulty feeding
- reduced urine production (fewer wet nappies)
- dry lips and mouth
- clammy skin
- poor skin turgor
- skin colour that may be pale, with pallor progressing to grey or mottled skin
- decreased tears in eyes, progressing to sunken looking
- sunken fontanelle
- increased pulse rate.

Inadequate fluid intake may contribute to constipation. If an infant becomes constipated or dehydrated, it is advisable to check that any formula being used is being made up correctly and that breast milk is being offered in response to hunger cues (see section 12.7: Constipation and diarrhoea).

Children up to the age of two years are almost entirely dependent on their caregivers to provide them with fluid. It is the responsibility of the parent or caregiver to monitor the child's fluid intake and not rely on the child requesting a drink. Aim for six or more very wet cloth nappies a day for infants. Toddlers should be offered fluids frequently. In older infants and toddlers, the colour of their urine can be used as an approximate guide to the sufficiency of their fluid intake – urine should be clear to light yellow. Additional fluids will often be required, if the infant or toddler is unwell or the weather is hot.

6.2 Recommended fluid intakes

The NRVs describe the AIs for infants and toddlers (NHMRC 2006). (See Table 6 for the guidelines for calculating fluid requirements.)

For infants from birth to six months of age the AI is 700 mL per day of total fluid (met by cue feeding with breast milk or formula). Note that the fluid intake for newborn infants does not start at 700 mL from birth. Colostrum and then the breast milk supply build up gradually from birth.

For infants aged seven to 12 months, the AI is 800 mL per day of total fluids. This comprises 600 mL (about 2½ cups) per day of fluids (breast milk, formula and water) with the remaining 200 mL coming from complementary foods.

For toddlers aged one to two years, the AI of total fluids is 1400 mL per day, of which 1000 mL per day (four cups) is from fluids (breast milk, formula and water) with the remaining 400 mL coming from complementary foods.

Table 6: Guidelines for calculating fluid requirements

Age	Millilitres per kilogram per day (mL/kg/day)
First week	80–100
Second week	125–150
Three months	140–160
Six months	150–200
Nine months	120–150
One year	90–100
Two years	80–90

Source: Cormack (2003) and Cormack (2007).

6.3 Recommended sources of fluid in the diet

The recommended sources of fluid for infants and toddlers are:

- breast milk (or formula if breast milk is not available) for infants from birth to six months of age
- breast milk (or formula, including follow-on formula⁵ if breast milk is not available) and water for infants seven to 12 months of age
- breast milk, whole milk or suitable alternatives,⁶ and water for toddlers one to two years of age.

The role of fluids in the diet is also considered in sections 3: Breastfeeding and 4: Complementary Feeding (Solids) and Joining the Family Diet.

Fluids other than breast milk fed from the breast can be given by a cup or bottle and teat (see section 3.5: Cup feeding).

5 See section 5.1.2: Follow-on formula.

6 Cows' milk as part of a varied diet is an important source of nutrients for children from one year of age. For some vegetarians, vegans and/or others who avoid cows' milk, there are suitable alternatives to cows' milk. For more information on suitable alternatives, see 'Fortified milk alternatives' in section 12.1.3: Nutrition issues.

6.3.1 Breast milk

See also section 3: Breastfeeding.

Infants who are healthy and exclusively breastfed in response to their hunger cues (that is, cue fed) are unlikely to suffer from fluid depletion. Exclusively breastfed infants should be breastfed more often than usual if the weather is particularly hot or the infant is unwell.

6.3.2 Formula

See also section 4: Complementary Feeding (Solids) and Joining the Family Diet.

Formula must be made according to the instructions on the container (see section 5.3: Preparing formula for healthy full-term infants).

In hot weather or if the infant or child is unwell, a formula-fed infant or toddler may need extra fluid. Watch for signs of thirst and dehydration and provide extra fluid as necessary.

6.3.3 Water

Healthy exclusively breastfed infants do not require water.

Formula-fed infants may require water. If water is needed for a formula-fed infant aged up to three months, boil the water for three minutes on the stove, then cool it to at least room temperature before giving it to the infant.

For infants aged three months or older, it is not necessary to boil water from community drinking water supplies (also called reticulated or town supply). However, if the water is of poor quality, it should be boiled and cooled for infants up to six months of age. To check the quality of a water supply, ask the health protection officer at the public health unit of the local District Health Board, or check the Register of Community Drinking-Water Supplies in New Zealand. The register summarises the health risks of all community drinking-water supplies known to the Ministry of Health (Ministry of Health 2005a). All public libraries hold a copy of the register, and it is available on the Ministry of Health website (<http://www.health.govt.nz>).

If water is not from a community drinking-water supply (for example, it is from tanks or bore holes), it should be boiled for at least three minutes and then cooled before being given to any infant or toddler aged up to 18 months.

Bore water should be checked for its nitrate concentration (from nitrates leaching from fertilisers or sewage into underground water sources). Excessive nitrate consumption can produce methaemoglobinemia in infants. If water contains an elevated concentration of nitrate, care must be taken to ensure that the water is not subjected to prolonged boiling, which will concentrate the nitrate. The alternatives are to use a filter that filters out nitrate or to use water from a source that has low nitrate levels. Contact the local public health unit for advice.

Bottled water is often thought to be 'pure' or 'natural', but it has been found to contain significant amounts of contaminants and impurities (Hunter and Burge 1987).

Water being used directly from the tap should be taken from the cold tap. Many New Zealand waters are aggressive (corrosive) and will leach heavy metals from some pipes and fittings. Running the tap for 10–15 seconds will flush away most of the corrosion. If the piping is copper, run the tap until the water gets as cold as it will get (Ministry of Health 2005a).

6.3.4 Cows' milk as a drink

Cows' milk as a drink for infants

Cows' milk should not be given as a drink until infants are older than one year (American Academy of Pediatrics 1992). Infants fed cows' milk before one year of age are at particular risk of developing depleted iron stores (American Academy of Paediatrics 1992). This is because the concentration and bioavailability of iron is low and cows' milk may cause gastrointestinal blood loss (Ziegler et al 1990).

The use of cows' milk as a drink for infants can increase renal solute load because of the proportions of protein, sodium, potassium and chloride in the milk.

Cows' milk as a drink for toddlers

Cows' milk is an important food for toddlers because it provides key nutrients such as energy, protein, calcium, riboflavin and vitamin B12, some of which are difficult for a toddler to obtain from other foods in sufficient quantity.

The energy contribution of whole milk is beneficial for toddlers (see section 9: Growth and Energy).

Toddlers may find cows' milk palatable, and can tend to consume so much that it displaces other foods from their diet. However, milk contains very little vitamin C, folate and iron, and no dietary fibre. It is not a complete food and should not be treated as such.

Up to 500 mL of milk or breast milk as part of a varied food intake is sufficient for growth and development (see Appendix 7). It is recommended that toddlers consume no more than 500 mL of cows' milk or suitable alternatives each day.

Whole (dark blue) cows' milk is recommended for toddlers. Reduced-fat milks should not be used for infants and toddlers because of the low energy content of these milks at a time when children have high energy requirements (American Academy of Pediatrics 1992). Reduced-fat milks might be prescribed in special circumstances, following consultation with a dietitian who has reviewed the child's diet as a whole.

If toddlers are given cows' milk, it should be plain milk with no flavouring or sugar added.

Milk and milk products should be pasteurised because there is considerable risk of contracting an infectious disease such as campylobacteriosis or tuberculosis from unpasteurised milk and milk products.

Misinformation suggests that cows' milk is, for example, 'mucus-forming' or responsible for a variety of health problems. Avoiding cows' milk products on the basis of unfounded claims may have adverse health consequences if infants and toddlers are deprived of essential nutrients. When cows' milk or milk products are excluded from the child's diet, the family must be aware of suitable alternatives and use fortified brands, and refer to a dietitian if necessary.

Toddler milks

Toddler milks are cows' milk-based drinks that are fortified with minerals and vitamins, such as iron, iodine, vitamin D and vitamin C, and are promoted as alternatives to cows' milk for infants over 12 months of age. The premise is that these vitamin and mineral additions make toddler milks nutritionally superior to cows' milk for these infants.

If a toddler is eating a variety of foods, including good sources of iron, and is not consuming more than 500 mL of cows' milk per day, then the extra nutrients in toddler milks generally provide no benefits.

For toddlers aged one to two years, whole (dark blue) cows' milk or a suitable alternative as part of a balanced and varied diet is quite suitable.

6.3.5 Suitable alternatives to cows' milk for toddlers

Fortified plant-based milk

Fortified plant-based milk is a suitable alternative to cows' milk for toddlers. It should be calcium fortified at the least. Vegan toddlers need plant-based milk to be fortified with vitamin B12 if they have no other regular source of B12 in their diet. For more information on fortified milk alternatives, see section 12.1.3: Nutrition issues.

It is recommended that toddlers consume no more than 500 mL of fortified plant-based milk per day. More than this can displace solid foods containing the other nutrients toddlers need.

Goats' milk

Goats' milk is an alternative to cows' milk for toddlers.

It is recommended that toddlers consume no more than 500 mL of goats' milk per day. More than this can displace solid foods containing the other nutrients toddlers need.

6.3.6 Fruit juices and sweet drinks

Sweet drinks such as fruit juice, fruit drinks, cordials and soft drinks are not recommended for infants and toddlers. Other than breast milk or formula, water is the only fluid that should be given to infants. Toddlers need only breast milk, cows' milk or suitable alternatives, and water.

The excessive consumption of fruit juice by young children has been associated with gastrointestinal symptoms, a failure to thrive, decreased appetite, loose stools and a failure to gain weight (Hoekstra et al 1993; Hourihane and Rolles 1995; Kneepens et al 1989; Lifshitz et al 1992; Smith and Lifshitz 1994). Flat lemonade is sometimes given to infants as a remedy for various intestinal disorders, such as diarrhoea or colic, but this is not recommended because the high concentration of carbohydrate in the lemonade may temporarily draw fluid into the intestine and cause further diarrhoea and worsen the dehydration.

The consumption of fruit juices and sweet drinks may also affect the intake of nutrients such as calcium if those drinks displace milk in the diet (American Academy of Pediatrics 2001).

Drinking sweet drinks from an early age may cause an infant to develop a preference for sweet foods (Beauchamp and Moran 1982).

Fruit juices and sweet drinks all contain sugars, either from the fruit or added. Sweet drinks can contribute to tooth decay from their sugar or acid content (Sorvari and Rytomaa 1991). An infant should not be left with a bottle of juice or sweet drink or milk as a way of settling them because the drink leaves the teeth bathed in sugar, including lactose, increasing the risk of tooth decay. (There are also risks for ear, nose and throat infections and of choking.)

The use of artificial sweeteners in food and drinks for infants and toddlers is not recommended because of the limited amount of data available about their safety when consumed by infants and toddlers (American Dietetic Association 2004).

Some juices and sweet drinks are advertised as containing a variety of vitamins and minerals, including vitamin C. (See sections 10.5.3: Folate and vitamin C and 12.4: Supplements.)

These drinks are not recommended for infants or toddlers because they also have a high sugar content. Vitamin C requirements are best met through vegetables and fruit. If a toddler is eating a variety of foods, including good sources of iron, and not consuming more than 500 mL of cows' milk or suitable alternatives per day, then they do not need supplements.

6.3.7 Coffee, tea, herbal teas, other caffeine-containing drinks, smart or energy drinks, and alcohol

Coffee, tea, other caffeine-containing drinks, smart or energy drinks, herbal teas and alcohol are unsuitable for infants and toddlers.

Caffeine, and similar substances, are found in coffee, tea, cocoa, cola-flavoured drinks and drinks containing guarana or cola nut. Coffee contains about three or four times as much caffeine as an equal volume of cola-flavoured drink. Caffeine is a central nervous system stimulant, which can cause irritability and restlessness.

Tea is not recommended because its tannin content inhibits the absorption of iron from the gut (Bothwell et al 1989). This impact was confirmed by a New Zealand study that observed a significant association between tea drinking in infants and the presence of an iron deficiency (Grant et al 2003).

Herbal teas can have adverse effects on infants and toddlers, so are not recommended (Allen et al 1989; Ridker 1989).

Alcoholic drinks are inappropriate for infants and toddlers. In metabolising the alcohol, the child may become hypoglycaemic. Their blood sugar may then fall to such a low level that the child becomes unconscious and may have a convulsion or suffer brain damage.

6.4 Key points for fluids

- Breastfeed the infant until it is at least one year of age, or beyond.
- If the infant is not breastfed, then use an infant formula until the infant is one year of age.
- An adequate fluid intake by infants will result in six or more very wet cloth nappies a day. In older infants and toddlers, clear or light-coloured urine indicates a sufficient fluid intake.
- Additional breastfeeds or fluids (in formula-fed infants) may be required if the infant or toddler is unwell or the weather is hot.
- It is recommended that toddlers consume no more than 500 mL of cows' milk each day.
- Whole milk is recommended for toddlers, either cows' milk or suitable alternatives. Fortified cows' milk is generally not necessary.
- Fruit juices or sweet drinks are not recommended for infants and toddlers. Infants need only milk (breast milk or infant formula) to drink. Toddlers need only breast milk, cow's milk and water to drink.
- Coffee, tea, herbal teas, caffeine-containing beverages, smart or energy drinks, carbonated beverages and alcohol are not recommended for infants and toddlers.

7 Considerations for Māori Infants and Toddlers and their Whānau

7.1 Cultural and spiritual significance of kai

Kai (food) plays an integral and diverse role in both traditional and contemporary Māori life. It holds spiritual, social and physical significance for Māori. Kai is a highly prized taonga (treasure) that is valued for its spiritual origins, delicacy status, numerous healing properties, and potential to sustain physical, mental, spiritual and cultural wellbeing.

According to ancient Māori beliefs, kai has great spiritual significance. It has been recognised as sacrifices of the atua (gods). For example, the ability to eat food from the forests and seas comes from the sacrifices of Tāne and Tangaroa. In a social context, mahikai (the gathering of food) is a practice that many whānau still follow today. A person's skill and ability to provide kai for the marae is a chiefly quality. Not only does it raise the respect from other whānau, hapū and iwi, but it is a way to maintain and strengthen social connections between the groups. This is particularly so for events on the marae with many manuhiri (visitors) needing to be fed. Obligations to support and help with the provision of food and labour among tangata whenua (the whānau, hapū, iwi hosts) exist. This is usually seen as a reciprocal act among them, and maintains the importance of the interdependency of relationships. The success of the hosts can be measured by the abundance and type of kai given to manuhiri, as this is indicative of the mana (prestige) of tangata whenua in demonstrating manaakitanga (the acts of caring well for guests).

Kai is critical to the lives of all peoples. It sustains and nurtures whānau, hapū and iwi. It connects the past, the present and the future. It provides physical sustenance to all. It is a taonga to be cared for and protected from threats to its survival. Kai is what we need for the physical wellbeing of te tinana (the body). The nutritional value in the kai we eat is essential in maintaining good physical health. Toddlers and infants rely on their mothers, fathers, caregivers and whānau to provide them with the types of food that will give them a healthy start in life. As previously mentioned, kai in its many forms holds great cultural, physical and spiritual significance, and given the value that is placed on tamariki (children) and mokopuna (grandchildren) we need to ensure that everyday they are given kai that is of good nutritional value.

7.2 Breastfeeding

7.2.1 Cultural perspective on breastfeeding

For Māori, breastfeeding is a traditional practice originating, according to some Māori beliefs, in the ancient stories of Papatūānuku (earth mother) and Rangi (sky father) and their youngest child Rūaumoko (god of volcanoes and heat). Stories depict Rūaumoko at the ū (breast) of Papatūānuku, his ūkaipō (mother), as she nurtures her new born child. Ūkaipō (breast, mother) is the source of sustenance, of offspring, the source of blood relationships and of descendants. Ūkaipō is synonymous with Papatūānuku (earth, the mother) and te tinana (the body). All are compatible and interchangeable with reference to the physical domain, and together they invoke the importance of nourishment, protection, sustenance and continuity for Māori health (Rimene et al 1998). Breastfeeding is traditionally viewed as imperative in maintaining and sustaining child development and wellbeing.

7.2.2 Breastfeeding rates among Māori

In 2006, the rate of exclusive and full breastfeeding for Māori infants at six weeks of age was 59 percent compared with 66 percent for infants in all ethnic groups, 70 percent for New Zealand European infants, 55 percent for Asian infants and 57 percent for Pacific infants. These rates are from Plunket and represent approximately 90 percent of all births.

Overall the breastfeeding rates for Māori at all ages have increased since 1997. The Ministry of Health's 2007 breastfeeding targets for all ethnicities have not been reached. These targets are 74 percent at six weeks of age, 57 percent at three months of age, and 27 percent at six months of age (Minister of Health 2007).

Heath et al (2000) published a survey of a survey of knowledge, attitudes and practices associated with infant feeding in a New Zealand Māori population. Fifty-nine New Zealand Māori mothers of infants aged three to eight weeks born in Gisborne between July 1996 and August 1997 volunteered to be interviewed. The survey found that while breast-feeding initiation was high (87%), many mothers had stopped exclusive breastfeeding by three weeks of age. The most commonly reported reason for stopping was 'not enough milk' (43%). Eighty-three percent reported they were not encouraged to breastfeed and that they considered breast-feeding in public embarrassing. The researchers concluded more support is needed for breastfeeding Māori mothers and that society needs to address the social issue of embarrassment many Māori mothers feel when breast-feeding in public.

The Ministry of Health sees a whānau ora approach as important for achieving increased breastfeeding rates for Māori. (This approach is outlined in He Korowai Oranga: Māori Health Strategy (Minister of Health and Associate Minister of Health 2002).)

To reduce inequalities in breastfeeding rates, the priority audiences for breastfeeding work are Māori, Pacific and other groups with relatively low breastfeeding rates.

7.3 Current dietary practices of concern

There are very few studies of dietary practices with Māori infants and toddlers and their whānau. One study showed that Māori were more likely than Europeans to introduce complementary foods before an infant was six months old (Tuohy et al 1997).

On the basis of anecdotal observations, health workers are divided on whether parents today are holding off introducing complementary foods and cows' milk for longer than in the past. These observations include the following.

- While some mothers seem aware of the importance of breastfeeding, younger Māori mothers seem to be breastfeeding for only two to three months.
- Some parents and caregivers seem aware of appropriate foods and drinks for toddlers, so are giving them a good variety of foods that covers all four food groups and water (rather than juice), but fruit is missing from toddlers' diets, and packaged and convenience foods high in sugar and fat and takeaways are used commonly.
- Some parents and caregivers appear to be introducing cows' milk too early. The common reasons given for this are that the infant does not like formula and formula is more expensive than cows' milk.
- Some parents and caregivers are feeding inappropriate drinks, such as Milo, tea, juice, soft drink and Farex, in feeding bottles.

These concerns are not unique to Māori, and we do not know if they are more common in Māori communities than in other communities. More research is needed to better understand dietary practices with Māori infants and toddlers and their whānau.

7.4 Nutritional issues that need to be addressed

Very few studies of nutrition have been conducted with Māori populations. Anecdotal observations suggest the main nutritional issues facing some Māori infants and toddlers are the:

- short duration of breastfeeding
- high rates of artificial (formula) feeding
- high likelihood of complementary foods being introduced before the child is six months of age
- high likelihood of children being given tea to drink.

7.5 Traditional Māori foods: Ngā tino kai a te Māori

The following subsections give examples of traditional Māori foods that are suitable for infants and toddlers. However, always check with the family, as use may vary.

7.5.1 Kūmara (sweet potato)

Kūmara is a special food that is believed to offer spiritual sustenance that is not found in other foods.

Kūmara can be mashed or puréed as a first food for an infant at around six months of age and a staple vegetable for older infants and toddlers.

7.5.2 Kamokamo (marrow)

Kamokamo can be mashed or puréed as a first food for an infant at around six months of age and a staple vegetable for older infants and toddlers.

7.5.3 Pūhā and watercress

Green leafy vegetables, such as pūhā and watercress, can be puréed as a first food for an infant at around six months of age. These foods provide an excellent source of beta-carotene (provitamin A) and vitamin C.

7.5.4 Kai moana (seafood)

Traditional kai moana (seafood) includes kina (sea-eggs), pipi, kōura (crayfish), pūpū (periwinkles), parengo (a type of seaweed), pāua and eels. The recommended age for introducing kai moana is eight to 12 months.

Care must be taken to avoid seafood when there is any possibility of marine biotoxin and food poisoning bacteria to which infants are particularly sensitive. Kai moana must be collected only from safe and unpolluted areas.

7.5.5 Rēwena (bread)

Rēwena (bread) makes excellent toast fingers for the teething infant, and can be introduced at about seven to eight months of age.

7.6 Key points for considerations for Māori infants and toddlers and their whānau

- Kai holds spiritual, social and physical significance for Māori.
- Many traditional Māori foods are nutritious and appropriate for infants and toddlers.
- The main nutrition issues facing some Māori infants and toddlers are the:
 - short duration of breastfeeding
 - high rates of artificial (formula) feeding
 - high likelihood of complementary foods being introduced before the infant is six months of age
 - high likelihood of the infant being given tea to drink.
- He Korowai Oranga: The Māori Health Strategy is key for working with Māori. The framework helps to ensure interventions, services or programmes are accessible, effective and appropriate for Māori (see 'Policy context' in the Introduction).
- More research is needed into dietary practices with Māori infants and toddlers and their whānau.

8 Considerations for Pacific, Asian and Other Population Groups' Infants and Toddlers and their Families

8.1 Pacific infants and toddlers and their families

The category 'Pacific peoples' encompasses the seven largest Pacific communities in New Zealand (Samoan, Cook Island Māori, Tongan, Niuean, Tokelauan, Fijian and Tuvaluan) as well as other smaller Pacific groups.

Pacific peoples in New Zealand represent about 22 ethnic groups each with its own culture, language and traditions. (Note: The Fijian ethnic group does not include Fiji Indians (Gray 2001).)

8.1.1 Breastfeeding

The rate of exclusive and full breastfeeding for Pacific infants at six weeks of age in 2006 was 57 percent compared with 66 percent for infants from all ethnicities, 70 percent for New Zealand European infants, 55 percent for Asian infants and 59 percent for Māori infants. These rates are from Plunket and represent approximately 90 percent of all births.

Breastfeeding rates for Pacific peoples of all ages have increased from 1997 to 2002–2003 (see section 2: Table 2). However, the Ministry of Health's 2007 breastfeeding targets have not been reached (see section 7.2.2: Breastfeeding rates).

Data from 1376 Pacific mothers collected in the Pacific Islands Families: First Two Years of Life Study showed that factors associated with not exclusively breastfeeding at hospital discharge included: smoking, being unemployed before the pregnancy, years in New Zealand, not seeing a midwife during pregnancy, having a caesarean delivery, and having a twin birth status (Schluter et al 2006).

Factors associated with the cessation of exclusive breastfeeding before the infant was six weeks of age (for mothers who initially breastfed exclusively) included smoking, being employed before the pregnancy, being in current employment, high parity, using a pacifier with the infant, not receiving a visit from Plunket, not having the infant discharged at the same time as the mother, not having the infant share the same room as the parent(s) at night, having regular child care, and having a home visit for the infant from a traditional healer (Butler et al 2004).

Of particular note are the findings in the study for Tongan women, who appeared to be at greater risk of having a wide range of feeding problems compared with women in the other Pacific ethnic groups (Butler et al 2004).

These findings are important for demonstrating that Pacific communities should not be seen as a homogeneous group. While some beliefs, behaviours and experiences may be common across groups, many differences exist.

Abel et al (2001) studied infant care practices. This qualitative study described and compared the infant care practices and beliefs of 150 Māori, Tongan, Samoan, Cook Island, Niuean and Pākeha primary caregivers of infants aged under 12 months who resided in Auckland, New Zealand.

The study focused on four factors: sources of support and advice, infant feeding, infant sleeping arrangements, and traditional practices and beliefs. Similarities were found across all ethnic groups in the perceived importance of breastfeeding and in terms of the difficulties experienced in establishing and maintaining this practice.

Breastfeeding was one of the areas with the most consensus among ethnic groups. Most women were keen to breastfeed because of the perceived physical and emotional benefits for them and their infant.

All but a few of the 150 participants had attempted to breastfeed. Many had been successful and had fed for several months or were still feeding at the time of the study.

Factors affecting continued breastfeeding included difficulty establishing breastfeeding, cracked and sore nipples, breast engorgement, and the perception of not having enough milk. The confusion caused by inadequate and conflicting advice from practitioners and, in some cases, from relatives presented another barrier to continued breastfeeding.

As of 2007, 82 primary health organisations (PHOs) have been established throughout the country. Of these PHOs, three are Pacific-focused: AuckPAC PHO and Langimalie Clinic Tongan Health Society (Auckland District Health Board region), and Ta Pasefika Health Trust PHO (Counties Manukau District Health Board region).

In 2007, nearly 98 percent of the Pacific peoples were enrolled in a PHO (Statistics New Zealand 2008). Pacific-focused PHOs present an opportunity for positive and appropriate messages on breastfeeding and infant nutrition to be tailored to Pacific peoples.

8.1.2 Current dietary practices

One study showed that Pacific peoples were more likely than Europeans to introduce their infants to complementary foods before the infant was six months of age (Tuohy et al 1997).

The Infant Care Practices Study reveals information about feeding practices for Pacific infants and toddlers (Abel et al 2001). Common early foods for all Pacific ethnic groups were puréed fruit and vegetables and soft cereals. In addition, Samoan women mentioned *sua alaisa* (a sweetened creamy rice) and Cook Islands women mentioned *pia* (arrowroot starch) and *mokomoko* (coconut milk). Although some Samoan-raised mothers indicated that, traditionally, caregivers pre-masticated their infant's food, none of the Pacific mothers in the study mentioned doing this herself.

The choice of complementary foods was an area in which differing opinions were evident between New Zealand-raised Samoan and New Zealand-raised Tongan parents and the generally older, Pacific-raised generation. The latter considered fresh fruit and vegetables optimal for the infant and did not condone pre-prepared foods.

Views also differed about the age at which complementary foods should be introduced. The Infant Care Practices Study reported that several Māori, Pacific and young Pākehā women mentioned that they introduced their infants to complementary foods at three months of age. A few Pacific caregivers began their infant on complementary foods as early as six to eight weeks of age. The main reasons given for the early introduction of complementary foods was that the infant would not settle after feeding and was not sleeping well. Once complementary foods were introduced, the infant settled and slept better, and it was possible to reduce the frequency of night feeding. Some Cook Island participants believed Pacific infants were hungrier than Pākehā infants so the age limit advice did not apply to them (Abel et al 2001).

8.1.3 Nutrition issues

From the few studies conducted with Pacific populations on their breastfeeding and dietary practices with infants and toddlers, the main nutritional issues facing Pacific peoples are:

- short duration of breastfeeding,
- high likelihood of complementary foods being introduced before the infant is six months of age
- high likelihood of allowing infants and toddlers to drink tea than non-Pacific peoples.

8.1.4 Traditional Pacific foods

Some common foods are traditionally eaten by Pacific infants and toddlers or were introduced in Pacific cultures and now have a special place in Pacific cuisine for children. Not all the foods listed below are eaten by all Pacific groups. For example, sago is more commonly eaten by Samoans and not by Tongans or Cook Island Maori. It is always good to check with the family as use may vary.

8.1.5 Pacific staple foods

Pacific staple foods are unique foods for Pacific peoples, and these foods are becoming more available and accessible in regions with large Pacific populations such as Auckland. Common staples in New Zealand include taro, cassava (tapioca, manioke/a), yam, kūmara and pumpkin. (Note that the yam referred to here is not the small pinkish yam available in the supermarket.) These Pacific staples can be cooked and puréed on their own or boiled with other vegetables and meat, and then puréed with the cooking water as first foods for infants around six months of age. For older children, the staples can be mashed together and their consistency and texture adjusted to suit the child's developmental cues.

8.1.6 Tropical fruits of the Pacific

Ripe banana, mango and pawpaw are favourite tropical fruits that can be puréed or mashed for infants and can be given as finger foods for toddlers. Mango, pawpaw and avocado can be expensive in New Zealand, but have traditionally been used to relieve constipation in infants, toddlers and young children. The juice from the young coconut can be used as a drink for toddlers. The flesh of the young coconut can also be given to infants and toddlers.

8.1.7 Green leafy vegetables

Taro and pele leaves are common to all Pacific peoples. Pele is sometimes sold at markets around Auckland, although it can be expensive. Many Pacific families also import these foods from the islands. Taro and pele leaves must be cooked. They are usually boiled together with staples and meat, then puréed or mashed and served to infants and toddlers. It is important to remove the 'stringy bits' before offering the vegetables to infants and toddlers. In New Zealand, substitutes include silver beet and, although to a lesser extent, spinach.

8.1.8 Breads and cereals

Common breads and cereals consumed by Pacific infants and toddlers include sago, boiled white rice mixed with warm milk, and bread or cabin bread soaked in Milo (preferably with no sugar added).

Tea must not be used to soften bread or cabin bread; freshly brewed lemon leaves or lemon grass is recommended for this process.

8.1.9 Lean meat, chicken and fish

Any lean meat, such as beef and lamb, chicken and fish can be puréed or mashed for infants and toddlers to consume.

8.1.10 Foods not recommended as first foods

Excepting fish, salty meat such as corned beef, povi/pulu masima (salted brisket), tinned fish, and seafood (for example, shellfish and octopus) should not be used as first foods.

Foods that cause bloating and an upset stomach, including cabbage, should not be served as first foods.

8.2 Asian infants and toddlers and their families

Asian peoples make up more than 9 percent of the New Zealand population, and this percentage is projected to increase to 15 percent by 2021 (Statistics New Zealand 2008). The *Asian Health Chart Book 2006* uses the Statistics New Zealand definition of ‘Asian’ (Ministry of Health 2006a). This definition includes people with origins in the Asian continent from Afghanistan in the west to Japan in the east, and from China in the north to Indonesia in the south. It excludes people originating from the Middle East, Central Asia and Asian Russian. Asian New Zealanders differ widely in many ways: language, culture, socioeconomic status, English language ability, and settlement history.

The Chinese and Indian communities are the two largest Asian communities. (See Table 7.)

Table 7: Distribution of New Zealand Asian population by ethnic group, 2006

Ethnic group	2006 census count	Percentage of total Asian population
Chinese	147,570	42%
Indian	104,583	29%
Korean	30,792	9%
Filipino	16,938	5%
Japanese	11,910	3%
Sri Lankan	8,310	2%
Cambodian	6,918	2%
Total number	354,552	

Source: Statistics New Zealand, 2006 Census Data: QuickStats about culture and identity.

Note: People can choose to identify with more than one ethnic group, therefore figures may not sum to totals.

Asian ethnic groups increased in numbers by almost 50 percent from the 2001 to 2006 Census; the fastest growing of all ethnic groups. Chinese, Indian and Other Asian peoples in New Zealand all have markedly different age distributions compared with the total population. These ethnic groups are characterised by youthful population structures.

8.2.1 Breastfeeding

In India, breastfeeding commonly continues until the infant is at least one year of age, but may be supplemented by modified cow, buffalo or goat milks depending on availability and cost. Complementary foods are infrequently given before the infant is six months of age and usually not until the infant is nine months to one year of age. The infant is given texture-appropriate versions of the family foods. Food cooked with chilli is not introduced until the child is at least two years old, but other spices and salt are used.

Migration has affected breastfeeding patterns among Indian women, with the introduction of complementary foods being brought forward, exclusive breastfeeding rates falling and supplementation beginning earlier than would occur in India.

The rate of exclusive and full breastfeeding for Asian infants at six weeks of age in 2006 was 55 percent, compared with 66 percent for infants in all ethnic groups, 70 percent for New Zealand European infants, 59 percent for Māori infants and 57 percent for Pacific infants. These rates are from Plunket and represent approximately 90 percent of the population.

While breastfeeding rates have mostly increased for Asian infants at all ages from 2003 to 2006, the Ministry of Health's breastfeeding targets have not been achieved (see section 7.2.2 Breastfeeding rates).

8.2.2 Dietary practices

A cross-sectional survey of 17 healthy preschool children (aged 12–60 months) born to Chinese immigrant families living in Dunedin was carried out in 1998 (Soh et al 2000). Three 24-hour diet recalls were collected during February and March. The parents were mainly Chinese (82 percent), with 12 percent from Taiwan and 6 percent from other Asian countries.

The most common foods consumed by the children for breakfast were bread, noodles, milk and eggs. Cold breakfast cereal was not often consumed by these children, which differed from the habits of European New Zealand children. Children who attended preschool facilities that offered meals ($n = 8$) were introduced to Western foods, such as sausages, cheese on toast or crackers, Vegemite sandwiches, cold meats and diluted cordial drinks. These foods were not eaten in the homes of the survey participants.

Rice, vegetables, meat, fruit and eggs were the most common foods consumed by the children for lunch and dinner. Soup was often part of the evening meal, and was home-made from chicken or pork bones or pieces with Chinese herbs and vegetables such as sweet corn, bok choy and carrots. Common snacks were milk, yoghurt, biscuits, fruit, and sweets and chips.

The most common fruit and vegetables consumed were apples, oranges, bananas, bok choy, green pepper, mushrooms, Chinese cabbage, eggplant, bean sprouts, carrots, cauliflower, mixed vegetables, broccoli, sweet corn, potatoes and spring onions.

Less than 40 percent of Asian children were meeting recommendations for vegetable and fruit consumption, whereas more than 75 percent were meeting recommendations for the consumption of meat and meat alternatives.

The results from this survey found the Yin and Yang philosophy played a role in the eating habits of 71 percent of families. This philosophy has a belief that foods have characteristic properties or energies that are released when the food is metabolised and produce a heating condition (feeling hot) or a cooling condition (feeling cold). Foods are chosen to achieve a balance between the energies of the

foods and the energies of the conditions inside and outside the body to aid good health. Parents reported that when their children were in a heating condition, they restricted the consumption of fried foods, chocolates, biscuits and chips, and encouraged the consumption of herbal tea, rice porridge, steamed foods and soups made from dried Chinese vegetables, Chinese herbs, pork bones, carrots and parsnips. For children in a cooling condition, parents restricted fruits, such as oranges and bananas, and cold foods, such as ice cream and cold drinks. The study reported that children living in Dunedin tended to be more in a heating condition than in a cooling one.

The mothers also preferred, in general, to give their children cooked foods instead of cold or raw foods, such as salads, sandwiches and cold breakfast cereals.

8.2.3 Nutrition issues

From the limited studies conducted with Asian populations in New Zealand about breastfeeding and dietary practices, the main nutritional issues facing Asian infants and toddlers in New Zealand appear to be their relatively short duration of breastfeeding and not meeting recommended intakes of vegetables and fruit (Soh et al 2000).

See the Auckland Regional Public Health's Asian health website for more information (<http://www.asianhealth.govt.nz>).

8.2.4 Traditional Chinese foods

The following subparagraphs discuss traditional Chinese foods and the customs associated with those foods (Auckland Regional Public Health Service 2005). However, it is always good to check with the family, as use may vary between families.

Congee

Congee is made from white rice and water but can be very thin, so low in energy and nutrients. The texture and nutritional value can be increased by thickening the mixture with infant rice or adding cooked meat, chicken purée, or egg yolk.

Noodles

Plain noodles (not instant or flavoured noodles) can be introduced when the infant is around six months of age.

Soy foods

Tofu and soy custard can be introduced when the infant is eight months of age.

Steamed manatou, dumplings and buns

Infants can be offered steamed manatou (plain cake), dumplings and buns with a bland filling. Infant foods do not need added salt, soy sauce, sugar or honey for flavouring.

Traditional customs and practices

Traditional customs and practices, for example, carrot soup and boiled rice water to balance 'heatiness', may be followed. It is important that these foods are not used to replace a meal or milk because this will reduce the infant's energy and nutrient intake. These foods should be given only after the milk feed or complementary food.

Finger foods

Appropriate Asian finger food for infants include plain noodles, steamed plain cakes, buns, cooked vegetable pieces, or soft fruit.

8.3 Other population groups' infants and toddlers and their families

In 2006, the Middle Eastern, Latin American and African grouping totalled 34,743 people, or 0.9 percent, of New Zealand's usually resident population (Statistics New Zealand 2008).

Very little information is available about the lifestyle behaviours, diseases, physical activity or nutritional adequacy of these groups living in New Zealand. However, there may be at-risk subgroups within these populations. For example, newly immigrated, non-English-speaking peoples are more likely to be unemployed, have low incomes, and have acculturation issues which may impact on their food choices.

8.4 Key points for considerations for Pacific, Asian and other population groups' infants and toddlers and their families

- Many traditional Pacific and Asian foods are nutritious and appropriate for healthy infants and toddlers. This is also likely to be true of the traditional foods of other ethnic and cultural groups living in New Zealand.
- The main nutrition issues facing some Pacific infants and toddlers appear to be a relatively short duration of breastfeeding, a high rate of artificial (formula) feeding, the introduction of complementary foods before six months of age, and tea drinking.
- The main nutrition issues facing some Asian infants and toddlers appear to be a relatively short duration of breastfeeding and not meeting the recommended intakes for vegetables and fruit.
- More research is needed into the dietary practices of infants, toddlers and their families from Pacific, Asian and other cultural groups living in New Zealand.

9 Growth and Energy

9.1 Growth and rate of growth

9.1.1 Background

During infancy and childhood, the focus is on maintaining a rate of growth and development that is consistent with the expected norms for age, sex and stage of physiological maturity.

Growth refers to the acquisition of tissue and increase in body size. Development refers to the increased ability of the body to function physically and intellectually. Physical development and intellectual development proceed at different rates in different individuals.

A positive energy and nutrient balance is critical in achieving and maintaining normal growth and development. There is increasing evidence of the importance of growth and nutrition in relation to cognitive development.

Growth during infancy influences current and future bone mass (NHMRC 2003; Ministry of Health 2006a). Weight is also a good indicator of acute changes in intakes, while height reflects long-term nutrition. Infants and toddlers are more vulnerable than adults to rapid changes in nutritional intake. Acute and chronic childhood illnesses impair appetite and may cause a reduction in food intake to the detriment of growth. Many chronic diseases, for example, kidney, heart and metabolic problems, can also retard growth.

The term 'failure to thrive' is used for infants and young children who do not achieve normal or expected rates of growth. Under-nutrition is the primary cause of a failure to thrive (Shaw and Lawson 2001.) Many children who are failing to thrive are simply not getting enough nutritious food to meet their needs. This can extend to children who have been placed on a very restrictive diet because of allergies or who are eating the same foods as adults in the family who have been placed on low-fat diets. Some infants and toddlers may have their food intake compromised by poverty or culturally restricted diets.

In the period of rapid growth that occurs during infancy, any intentional restriction of weight gain (for example, through dieting or by withholding food) is usually inappropriate (NHMRC 2003).

9.1.2 Body composition

On average, the full-term infant at birth has about 550 g of body fat, mostly as adipose (fatty) tissue. This body fat represents about 20,000 kJ of energy that acts as an energy reserve. The fat also serves to conserve heat by insulating the body. The amount of fat varies markedly between infants: heavy infants can have more than 25 percent of their bodyweight as fat.

9.1.3 Growth rate

Between birth and 18 years of age, a person's bodyweight increases about 20-fold. During infancy the rate of growth is fast and decelerates rapidly over the first year of life to a slower rate in the second year of life. The rate of increase in weight and length (or height) is essentially linear; the rate of increase in weight generally keeps pace with the rate at which length (or height) increases.

Exclusive breastfeeding is widely agreed to be the optimal form of infant feeding, hence other modes of feeding should be measured against exclusive breastfeeding in terms of growth (American Academy of Pediatrics 2005). Dewey (2003) has shown that the height of 12-month-old infants who were exclusively

breastfed to age six months was identical to that of 12-month-old formula-fed infants, yet they weighed slightly less than the formula-fed infants. Furthermore, in some populations breastfed infants have lower rates of illness than formula-fed infants (Dewey et al 1995).

Rapid weight gain (or upward percentile crossing) during the first two years of life has been linked to general and central adiposity (fat around the torso) at age five years. More recently, rapid weight gain during the first week or months of life has been shown to be associated with an increased risk of excess weight and obesity, on the basis of body mass index (kg/m²) in childhood and in young adulthood (Ekelund et al 2006).

Rapid weight gain in low birth weight infants may lead to increased rates of coronary heart disease, stroke, hypertension and Type 2 diabetes (Barker 2004).

9.1.4 Assessment of growth

Growth is best assessed by measuring weight, length (infants) or height (toddlers), and head circumference. Growth is considered normal when weight and length (or height) are on similar percentiles. It is important to note any difference between the weight and length (or height) percentiles. In cases of acute nutritional problems, the weight percentile is likely to be substantially lower than the length (or height) percentile. Where there are endocrine deficiencies or other long-term diseases, both weight and length (or height) will be substantially depressed. Investigation is appropriate when there are changes in a child's growth velocity or there is concern about the child's growth, health or development. In general, the more pronounced the change in the growth rate, the younger the child and/or the more extreme the change in percentile, the greater the concern.

Serial measurements indicate growth trends, which reveal more about a child's nutrition or health than the position of one measurement on a growth chart. Whenever a new measurement varies greatly from the previous measurement, the accuracy of the measurement and recording should be confirmed first.

A child's percentile indicates the position of the child relative to the reference population. In the case of premature infants, allowances can be made for their small size at birth by subtracting the number of weeks of prematurity from the infant's age before plotting on a growth chart. After 24 months of age, it is no longer necessary to allow for prematurity.

An accurate record of growth on a growth chart is one of the most useful assessment tools for both healthy children and children suffering from disease. The commonly used growth charts are prepared with several percentiles marked, usually ranging from the third percentile to the 97th percentile, with different charts for boys and girls. In New Zealand two growth charts are predominantly in use. These are:

- New Zealand growth charts (1991)
- United States Centers for Disease Control (CDC) growth charts (CDC 2000).

In 2006 World Health Organization (WHO) released new growth standards (see Appendix 12). The Ministry of Health recommends the use of these standards as an assessment tool to measure growth for healthy infants and toddlers.

New Zealand growth charts

The New Zealand growth charts have been used by Plunket and Well Child providers in New Zealand since the early 1990s. They are based on a 1989 study of 12,311 children aged one month to five years (Binney et al 1991). Breastfed and formula-fed children were represented in this study. The children were from 10 areas (Southland, Timaru, Christchurch, Wellington, Hutt Valley, Palmerston

North, Rotorua, South Auckland, Auckland and Takapuna). Of the sample, 78.5 percent were European, 9.0 percent Māori, 6.8 percent Pacific, 5.6 percent Other and 0.1 percent unspecified. The data were based on children from the New Zealand population. However, given that some groups within this total population were under-represented, for example, Māori and Pacific children, it does not give a true picture of the current New Zealand population.

The growth charts provide length, weight and head circumference for boys and girls up to two years of age. There are also weight and height charts for boys and girls from two to five years.

United States Centers for Disease Control growth charts

The United States CDC growth charts are used by some paediatric specialists in clinical practice in New Zealand (CDC 2000). Pediatric growth charts have been used by pediatricians, nurses, and parents to track the growth of infants, children, and adolescents in the United States since 1977. These growth charts cover birth to 20 years of age and include a body mass index for those aged two to 20 years. The 1977 charts were also adopted by the WHO for international use.

World Health Organization growth standards (2006)

The data from the WHO Multicentre Growth Reference Study (MGRS), which was undertaken between 1997 and 2003, were used to generate the new WHO growth standards (WHO 2006). The MGRS collected growth data and related information from around 8500 children from widely different ethnic backgrounds and cultural settings in Brazil, Ghana, India, Norway, Oman and the United States. The children included in the study were raised in environments that minimised constraints to growth, such as poor diets and infection. In addition, their mothers followed health practices such as breastfeeding and not smoking during and after pregnancy.

The WHO standards establish the breastfed infant as the normative model for growth and development. The adoption of these growth standards aligns with the recent WHO and now New Zealand recommendation that infants are exclusively breastfed to around six months of age. The lower weight gain in late infancy, seen in breastfed infants as seen in the WHO growth standards may be beneficial to health (Dewey et al 1995).

The study results reiterated that child populations grow similarly across the world's major regions when their needs for health and care are met. However, the appropriateness of the growth standards for Pacific children has been questioned. Recent research found Pacific children born in New Zealand are bigger and grow at a faster rate than other New Zealand children (Rush et al 2007). When the growth of Pacific infants was compared with the WHO growth standards, those who were breastfed and had non-smoking mothers were significantly heavier than the standards. It is unclear the different contributions genetics and the environment have on the growth of Pacific infants, so further research is required. As a result, the WHO growth standards must be interpreted carefully when being used to monitor the growth of Pacific children.

Care is also needed when interpreting the growth pattern of any individual infant and toddler, using the WHO standards. Individual circumstances need to be considered in the assessment of growth and development.

A British report on the application of the WHO growth standards in the United Kingdom recommended that the WHO standards be used *from* two weeks of life, but not before (SACN and RCPCH Expert Group 2007). This is to take into account the differences in birthweight and gestational age and the adjustment in weight that often occurs in the first two weeks from birth.

The MGRS study did not include infants from multiple births or preterm infants, so is not directly applicable to these groups (SACN and RCPCH Expert Group 2007).

Comparison of New Zealand and Centers for Disease Control growth charts with World Health Organization growth standards

The WHO has developed ‘standards’ rather than the ‘growth charts’ of New Zealand the CDC. The standards describe the growth of a ‘healthy’ population and suggest an aspirational model or target (SACN and RCPCH Expert Group 2007). The growth reference charts include data from children raised under various conditions, some likely to favour ‘ideal’ growth, but others not likely to.

Estimates of overweight and underweight may change because of differences in the pattern of growth between the new standards and the old charts, especially during infancy. This is predominantly caused by the different study designs and the different growth patterns found with breastfed and formula-fed infants. The WHO growth standards, which are based on breastfed infants, show an initial increase in growth rate until around six months. This is followed by a slowing in growth rate. By comparison the New Zealand and CDC charts do not show an initial increase and then a slowing of growth rate at this age.

Compared with the WHO Growth Standards, the CDC growth charts reflect a heavier and somewhat shorter sample of children (de Onis et al 2007). The difference associated with CDC growth charts, may be attributed to variations in age, sex and growth indicators resulting in lower rates of under-nutrition (except for the first six months) and higher rates of overweight and obesity. There has been concern that because of the increased growth for the first six months of life expected by the WHO standards (but not seen in the CDC charts), mothers breastfeeding may introduce formula ‘top ups’ or complementary food if they perceive their child is not growing adequately (Binns 2006).

9.2 Energy

9.2.1 Background

Food is converted into energy that is used for movement, growth and development, and metabolic functions, such as breathing, heart contractions, digestion and keeping warm. Previously measured in calories (cal) and kilocalories (kcal), energy is now measured in kilojoules (kJ) or mega joules (mJ). One kilojoule is equivalent to 4.2 kcal.

The young infant uses a considerable amount of energy for growing and metabolism and relatively little for physical activity. In the first three months of life, about 35 percent of energy intake is used for growth.

As the infant grows, these proportions in energy use change, and the energy used for growing falls to 5 percent by 12 months and less than 2 percent over the second year of life (NHMRC 2006). Metabolic needs increase as the child grows, and the amount of energy used in physical movements increases substantially as the child learns to roll, crawl and walk.

The estimated energy requirements for infants and toddlers are shown in Table 8. These energy requirements were estimated using the total energy expenditure and the additional need for growth of 730 kJ per day for infants up to three months of age, 230 kJ per day for infants from four to six months of age, 90 kJ per day for infants from seven to 12 months of age and 85 kJ per day for infants one to two years of age (NHMRC 2006). Physical activity levels were not used in calculating the energy requirements of infants.

Four studies comparing breastfed and formula-fed infants have shown higher total energy expenditure in formula-fed infants (Butte et al 1990, 2000; Jiang et al 1998; Davies et al 1990), averaging an additional 12 percent total energy expenditure at three months of age, 7 percent at six months of age, 6 percent at nine months of age, and 3 percent at 12 months. However, no differences were seen at 18 and 24 months (Butte 2001).

The child's appetite and growth are the best guides to adequacy of energy intake. There may be substantial variation between energy intakes in different children. Between one and two years of age, there is even greater variation in energy needs due to varying levels of physical activity.

Table 8: Estimated energy requirements (EER) of infants and young children

Age (months)	Reference weight (kg)		EER (kJ/day)	
	Boys	Girls	Boys	Girls
1	4.4	4.2	2000	1800
2	5.3	4.9	2400	2100
3	6.0	5.5	2400	2200
4	6.7	6.1	2400	2200
5	7.3	6.7	2500	2300
6	7.9	7.2	2700	2500
7	8.4	7.7	2800	2500
8	8.9	8.1	3000	2700
9	9.3	8.5	3100	2800
10	9.7	8.9	3300	3000
11	10.0	9.2	3400	3100
12	10.3	9.5	3500	3200
15	11.1	10.3	3800	3500
18	11.7	11.0	4000	3800
21	12.2	11.6	4200	4000
24	12.7	12.1	4400	4200

Source: NHMRC (2006).

9.2.2 Sources of energy in the diet

Breast milk provides energy mainly from fat (around 50 percent) and carbohydrate (around 43 percent) with protein providing around 7 percent. Most of the protein is used for growth and not as fuel for energy (see section 10.1: Protein).

Infant formula is designed as a breast milk substitute and have a similar distribution of energy sources as has the average composition of breast milk.

In an infant's first year of life, the energy contribution of complementary foods is initially small, and breast milk or infant formula remains the predominant energy source. Although infants aged seven to 12 months of age will obtain increasing amounts of energy from complementary foods, in the first year of life, most infants and toddlers still obtain the majority of their energy from breast milk or infant formula.

Reduced-fat milks should not be used for infants and toddlers under two years of age because of the low energy content of these milks at a time when children have high energy requirements (American Academy of Pediatrics 1992).

The energy density of a food is the amount of energy it contains per unit mass. Because infants and toddlers have relatively high energy requirements and limited stomach capacity, it is appropriate for them to eat foods that have higher energy density and lower dietary fibre than adults eat (see section 10.2.3: Recommended carbohydrate, dietary fibre and prebiotic intakes).

9.3 Key points for growth and energy

- Use the WHO growth standards (2006) to monitor growth.
- The child's appetite and growth and development are the best guides to adequacy of energy intake. However, care is needed when interpreting the growth pattern of individual infants and toddlers using the WHO standards. Individual circumstances need to be considered in the assessment.
- After an infant is six months of age, the contribution of energy from complementary food increases. However, in the first year of life, most infants and toddlers still obtain most of their energy from breast milk (or infant formula if breast milk is unavailable).
- Toddlers aged one and two years have a great variation in energy needs due to their varying levels of physical activity.
- Maintain healthy growth and development of the infant or toddler by providing them with appropriate food and physical activity opportunities every day.

10 Nutrients

10.1 Protein

10.1.1 Background

Protein is an essential component of the diet required for infant growth. Unlike fat and carbohydrates, most protein is used for growth rather than to generate energy. However, adequate energy intake is required along with adequate dietary protein intake for amino acids to be used for the specific functions of protein replacement and body growth.

Protein is made of amino acids. The body can synthesise some amino acids, but the indispensable (essential) amino acids must be obtained from food (Institute of Medicine 2000; NHMRC 2006). Protein is necessary to build and repair tissue, to synthesise hormones, enzymes and antibodies, and for many other bodily functions.

10.1.2 Recommended protein intakes

The AI of protein for infants from birth to six months of age is 10 g (1.43 g/kg bodyweight) per day, and for infants aged seven to 12 months is 14 g (1.60 g/kg bodyweight) per day.

The RDI for toddlers aged one to two years is 14 g (1.08 g/kg bodyweight) per day (NHMRC 2006).

10.1.3 Sources of protein in the diet

Breast milk and infant formula are the only sources of protein for an infant aged up to six months, and continue to be the main sources of protein until the infant is one year of age. Once an infant is six months of age, complementary foods are introduced to the infant's diet, which provide some protein (see Table 4 in section 4.4.). Such foods may include cooked and puréed meat, poultry, fish, legumes (including lentils and beans). Once the infant is aged seven to eight months, such foods include mashed eggs, seafood and milk products, including yoghurt, cottage cheese, custard and milk in cooking. The heat treatment or fermentation process that occurs to produce these milk products denatures the protein, making them more easily digested. Cows' milk should not be given as a drink before an infant is one year of age (see 'Factors associated with iron deficiency' in section 10.4.1: Iron).

Sources of protein vary in their nutritional value, digestibility, efficiency of use and ratio of indispensable amino acids. Protein from animal sources such as meat, poultry, seafood, eggs, milk, and milk products tend to be of higher protein quality because they provide all nine indispensable amino acids. Proteins from plant-based sources may be limited in at least one indispensable amino acid. However, plant protein can meet requirements when a variety of plant foods is consumed and energy needs are met (American Dietetic Association 2003).

Vegan and vegetarian diets in New Zealand usually contain adequate protein. Care should be taken with infants over the age of six months and toddlers in families consuming vegan diets to ensure they eat a range of texture-appropriate legumes (including lentils and beans), nuts (not whole), grains, cereals and bread, and milk substitutes daily to receive adequate protein. (See section 12.1: Considerations for vegetarian and vegan infant and toddlers and their families.)

10.1.4 Protein in breast milk and cows' milk-based formula

Protein in breast milk and cows' milk-based formula has two types: casein and whey. Their levels in the protein are expressed as the casein to whey ratio. After feeding, whey protein is quickly digested from the stomach, whereas casein protein forms curds that are more slowly digested, resulting in slower gastric emptying (Billeaud et al 1990; Fried et al 1992; Tolia et al 1992).

Breast milk is described as whey-dominant, with an average casein to whey ratio of 40:60. This ratio varies according to the stage of lactation: 10:90 in early lactation and 50:50 in late lactation.

Infant formula can be casein-dominant (a casein to whey ratio of 80:20) or whey-dominant (a casein to whey ratio of 40:60). Full-term infants readily digest casein-dominant or whey-dominant formula. Both types of formula appear to ensure normal growth (Raiha et al 2002; Turck et al 2006). However, a study of the influence of components of infant formula on iron, zinc and calcium availability indicated that minerals may be more available in whey-dominant formulae (Drago and Valencia 2004). The casein to whey ratio in infant formula may influence the types of fat in the blood plasma lipid profile, with casein raising cholesterol levels in the blood (Weizman et al 1997). Two specialised formulae are available in New Zealand that are 100 percent whey. These both contain partially hydrolysed proteins (see 'Formula feeding' in section 12.5.2: Prevention of food allergies).

The dominant whey protein in breast milk is alpha-lactalbumin, and this protein is found in relatively low levels in formula. The dominant whey protein in formula is beta-lactoglobulin, and this protein is not found in breast milk (Lien 2003).

Improvements to the protein component of cows' milk-based infant formula are being investigated. These include reducing the protein content, increasing the proportion of whey protein, reducing the allergenic component and improving the amino acid profile (see section 5.2: Types of formula).

10.1.5 Key points for protein

- Protein is essential for growth.
- Breast milk and infant formula are the only sources of protein until complementary feeding begins.
- Meat, fish, chicken, eggs, dairy products, legumes and nuts* are all sources of protein in the diet.

10.2 Carbohydrate and dietary fibre

10.2.1 Carbohydrates

The main role of dietary carbohydrate is to provide energy to the body, in particular to the brain, which needs glucose to function (NHMRC 2006). Carbohydrates can be classified as sugars, oligosaccharides and polysaccharides (FAO and WHO 1998) (see Table 9).

* Do not give small hard foods like whole nuts and large seeds until children are at least five years old.

Table 9: Classification of the major dietary carbohydrates

Class	Subgroup	Examples
Sugars	Monosaccharides	Glucose, galactose, fructose
	Disaccharides	Sucrose, lactose, trehalose
	Polyols	Sorbitol, mannitol
Oligosaccharides	Malto-oligosaccharides	Maltodextrins
	Other oligosaccharides	Raffinose, stachyose, fructo-oligosaccharides, galacto-oligosaccharides
Polysaccharides	Starch	Resistant starch, amylose, amylopectin, modified starches
	Non-starch polysaccharides	Cellulose, hemicellulose, pectins, hydrocolloids

Source:FAO/WHO 1998

The classification in Table 9 is based on the number of single sugar units linked together (that is, the degree of polymerisation), the type of linkages and the specific single sugars present. These factors in turn determine the specific properties of each grouping (Mann and Truswell 2007).

10.2.2 Dietary fibre

Dietary fibre is found in all plant materials. The main sources of dietary fibre are cereals, legumes, vegetables and fruit.

Dietary fibre is generally not digested by normal digestive processes but is partially or fully broken down (fermented) by bacteria in the large intestine.

Dietary fibre is essential for proper gut function and regular bowel motions and may be related to reducing risk for several diseases, including heart disease, certain cancers and diabetes.

Foods containing dietary fibre often have a low energy content relative to their volume. Infants and toddlers given large amounts of dietary fibre-containing foods may have their appetite satisfied before their energy requirements have been met (Lifshitz and Moses 1989). However, adverse effects from the over-consumption of dietary fibre appears unlikely in infant and young children unless their intake has been extreme (ESPGHAN 2003). There are very few data looking at the effects of dietary fibre intakes on the growth of children less than two years of age. Studies identified in a review by Edwards and Parrett (2003) that have shown a slowing of growth in young children have failed to show a causative relationship with dietary fibre intake.

Phytic acid or phytate (the salt form of phytic acid), is found in the hulls of nuts, seeds and grains. Phytates and, albeit to a lesser extent, dietary fibre can bind with and prevent the effective absorption of some minerals, including calcium, copper, iron, magnesium, phosphorus and zinc (Francis 1986) (see section 10.4: Minerals and trace elements). The nutritional significance of this effect depends on the amount of phytate and the minerals it influences that are consumed in the diet. Most Western diets do not contain sufficiently high amounts of phytates for infants and toddlers to be at risk of mineral deficiencies. Concerns that a high-fibre diet in children under five years of age will lead to growth faltering and mineral imbalance are not well supported by evidence, especially for children in the developed world (Edwards and Parrett 2003). Nutritious diets with adequate intakes of nutrients and moderate levels of fibre are considered to have minimal effect on energy and nutrient utilisation (Williams and Bollella 1995). Nutritious diets can be achieved by including a variety of different foods (that is, foods from the four food groups) as tolerated (see Tables 4 and 5). Research shows diets

adequate in fibre-containing foods are also usually rich in micronutrients and non-nutritive ingredients that have health benefits (American Dietetic Association 2002). Specifically, in more than 5000 preschool children aged two to five years, dietary fibre intake was positively associated with more nutrient-dense diets (Kranz et al 2005).

However, infants and toddlers, whose diets are reliant on grains and cereals, may consume intakes of phytate and dietary fibre that may contribute to suboptimal mineral levels. One New Zealand study showed a negative association between dietary fibre intake and iron stores in six- to 24-month-old New Zealand children (Soh et al 2002).

There are very few data on normal intakes of dietary fibre for New Zealand infants and toddlers. A small study looking at the nutritional intakes of 53 healthy Auckland children aged nine to 24 months found their mean daily intake of dietary fibre was 8 g, with a range of 1–22 g (Wham 1994). Girls and boys aged one to four years in the CNS pilot study were shown to have a fibre intake of 10 g, which was lower than the AI of 14 g (NHMRC 2006). The CNS pilot study also suggested many toddlers were not eating enough vegetables and fruit (see section 2.3 for more on these New Zealand-based studies).

10.2.3 Recommended carbohydrate and dietary fibre intakes

The AI for carbohydrate for infants from birth to six months of age is 60 g per day and for infants aged seven to 12 months is 95 g per day. No AI has been set for toddlers aged one to two years (NHMRC 2006).

The definition of dietary fibre is expanding and now includes a range of non-digestible carbohydrates. This has created problems in determining exactly what substances are being discussed in regard to dietary fibre in various studies (ESPGHAN 2003; Edwards and Parrett 2003). The definition used for the AI is that dietary fibre includes non-starch polysaccharides, resistant starch (endogenous plant material resistant to digestion) and lignin (a non-carbohydrate) (NHMRC 2006). There is no dietary fibre intake recommendation for infants aged between birth and 12 months.

An AI of 14 g per day of dietary fibre intake has been set for one- to two-year-olds (NHMRC 2006). The AI for one- to two-year-olds is based on the mean actual intakes of New Zealand and Australian children with the addition of 2–4 g/ per day of resistant starch. It is recognised that resistant starch is underestimated when approved methods of assessment are used (NHMRC 2006). Before the AI was set no national figure had been given for an acceptable fibre intake in one- to two-year-olds. Some clinicians used the American Academy of Pediatrics' 'age + 5' rule (child's age plus 5 g fibre) as a guide for fibre intake by toddlers two years and older (Williams et al 1995). An AI of 14 g per day is significantly higher than the amount achieved using the 'age + 5' rule. The 'age + 5' rule has been criticised as being pragmatic but without a firm physiological basis (ESPGHAN 2003). In addition, the 'age + 5' rule is at the lower end of what is now considered a 'safe range' of fibre for small children. The upper end of the range is 'age +10' (Williams et al 1995), which brings the recommendation closer to that of the current AI (NHMRC 2006).

The DONALD study evaluated the dietary fibre intake of more than 7000 infants, children and adolescents (Alexy et al 2006). It recommended that a reference value based on dietary fibre intakes with a reasonable diet that achieves all other nutrient requirements is the most appropriate guide to fibre intake given the absence of specific research in the area.

10.2.4 Sources of carbohydrate and dietary fibre in the diet

Breast milk contains around 75 g of carbohydrate per litre. About 70 g per litre of this is lactose, which is digested in the small intestine, and the remainder is oligosaccharides. Infants who are fed exclusively on breast milk or infant formula do not receive any dietary fibre. Normal bowel function in infancy is maintained by undigested compounds, including oligosaccharides from breast milk, that together with gut bacteria provide the bulk for normal motions (see section 12.9: Prebiotics in infant formula).

Complementary foods are the initial sources of fibre in the infant diet. Cereals, vegetables, fruit and legumes should be introduced following the order suggested in Table 4 in section 4.4.

Age-appropriate iron-fortified infant cereals are recommended as initial sources of carbohydrate (for example, baby cereal). Iron-fortified wheat breakfast biscuits contain a moderate level of fibre and can be given once the infant is eight months of age. They should be served up to once a day with only breast milk or infant formula, then with cows' milk (or suitable alternatives) after one year of age. Bran-based cereals should not be given to infants and toddlers because they are generally too high in dietary fibre. Chunky cereals containing whole nuts, large seeds or small pieces of hard dried fruit are not suitable because of the risk of choking.

In the case of breads and cereals, start with white or wholemeal bread. Continue to use wholemeal bread. Wholegrain bread can be added into the diet as tolerated (that is, as it can be chewed and swallowed safely without choking) during the child's second year.

10.2.5 Key points for carbohydrates and dietary fibre

- Carbohydrates are an important source of energy.
- Dietary fibre is essential for proper gut function and regular bowel motions.
- Foods high in carbohydrate are vegetables, fruit, cereals, bread, pasta, rice. Legumes and dairy products also contain significant amounts of carbohydrate.
- In case of breads and cereals, start the infant with white or wholemeal bread.

10.3 Fat

10.3.1 Background

Importance of fat in the diet

Fat is an essential component of the diet. Dietary fat provides essential substrates for cell structures and a wide variety of biologically active components of the endocrine, coagulation and immune systems. Fat is a concentrated source of energy especially important for the rapid growth in a child's first two years of life. It provides essential fatty acids and contains the fat-soluble vitamins A, D, E and K.

Forms of fat in the diet

Dietary fat predominantly takes the form of triglycerides, which consist of three fatty acids and one glycerol unit. Fatty acids can be classified into saturated, monounsaturated and polyunsaturated fatty acids. The polyunsaturated fatty acids can be classified as omega-3 (n-3) and omega-6 (n-6) fatty acids. The differences in classification of fat are based on differences in the molecular structure and the presence and placement of bonds between atoms within the fatty acids. These structural differences have a profound influence on the health effects and nutritional properties of the fatty acids (Mann and Truswell 2007). Saturated fats are found mainly in animal-based foods, while monounsaturated and polyunsaturated fats are mostly found in plant-based foods (NHMRC 2006).

Of the many biochemical and immunological differences between breast milk, cows' milk and infant formula, the differences in the composition of the fat are of particular importance. The differences are in the proportion of polyunsaturated, monounsaturated and saturated fats, and the differences in the amount of omega-3 and omega-6 polyunsaturated fatty acids. Breast milk contains varying amounts of essential fatty acids, which are related to maternal intake (Lawrence and Lawrence 2005). Any infant formula sold in New Zealand, in compliance with the Australia New Zealand Food Standards Code (FSANZ 2002) must contain linoleic and alpha-linolenic acid (within a specific range that meets a designated ratio).

The ratio of polyunsaturated to saturated fat in milk affects its digestibility and is significant in facilitating the absorption of calcium and fat from the gut (Lawrence and Lawrence 2005).

Two polyunsaturated fatty acids are essential in the diet because they cannot be synthesised by the body. These are linoleic acid, an omega-6 fatty acid, and alpha-linolenic acid, an omega-3 fatty acid. These two fatty acids form the starting point for the creation of longer and more unsaturated fatty acids, referred to as long chain polyunsaturated fatty acids (LCPUFAs). Individuals can use linoleic acid to make omega-6 LCPUFAs arachidonic acid (AA) and gamma-linolenic acid. Alpha-linolenic acid can be used to make omega-3 LCPUFAs eicosapentanoic acid (EPA), docosahexaenoic acid (DHA) and docosapentanoic acid (DPA). Breast milk contains LCPUFAs. The DHA content of breast milk is thought to be closely linked to the maternal diet although the AA content seems less so (Brenna et al 2007). In contrast, infant formula has historically contained only the precursor essential fatty acids not the LCPUFAs.

Long chain polyunsaturated fatty acids in infant formula

Since the mid 1990s, LCPUFAs, DHA and AA have been the focus of much research. DHA and AA are important components of the phospholipids present in the retina and the brain (Makrides et al 1995). They are also integral structural components of all cells in the body. Almost half the high lipid content of the brain is LCPUFAs.

Full-term infants fed formula containing no LCPUFAs have lower levels of AA and DHA in their plasma and erythrocyte phospholipids and lower levels of DHA in their brain cortical phospholipids compared with breastfed infants. Early research suggested that infants fed a continuous supply of DHA, from either breast milk or supplemented formula, may have improved visual functioning (Makrides et al 1995; Carlson et al 1996). However, less evidence supports the role of AA in improved visual functioning (Makrides et al 1995).

Because of the possible benefits attributed to the LCPUFA content of breast milk, LCPUFAs are now added to some infant formula. Although LCPUFA-supplemented infant formula seems safe, the 2008 Cochrane Collaboration Review found that feeding full-term infants with milk formula enriched with LCPUFAs had no proven benefits to vision, cognition or physical growth (Simmer et al 2008).

10.3.2 Recommended fat intakes

During the first two years of life, a child's high energy demands for growth and metabolism have to be met by a diet of greater energy density than that required in adulthood. Recommendations for dietary modifications, which aim to reduce total fat and control the energy intake of the general population, are inappropriate for infants and toddlers because of the potential adverse effect on their energy balance (Magarey et al 1993). Children on low-fat diets (that is, diets with less than 30 percent energy from fat) are at greater risk of unsatisfactory intakes of fat-soluble vitamins and inadequate energy (Lifshitz 1992).

For infants from birth to six months of age, the AI for total fat is 31 g per day, omega-6 polyunsaturated fats is 4.4 g per day, and omega-3 polyunsaturated fats is 0.5 g per day.

For infants aged seven to 12 months, the AI for total fat is 30 g per day, omega-6 polyunsaturated fats is 4.6 g per day, and omega-3 polyunsaturated fats is 0.5 g per day.

For toddlers aged one to two years, the AI for linoleic acid is 5 g per day, alpha-linolenic acid is 0.5 g per day, and LCPUFAs (DHA plus EPA plus DPA) is 0.4 g per day (NMHRC 2006).

10.3.3 Sources of fat in the diet

Both breast milk and infant formula provide around 50 percent of energy from fat (Riordan 2005). The fat content of breast milk is related to maternal weight, pregnancy weight gain and diet. Very low maternal fat intakes have been associated with lower breast milk fat content, with fat concentration reaching a plateau at a maternal intake of around 35 g per day, or about 20 percent of energy (Lonnerdal 1986). Although milk with a lower fat concentration has a lower energy concentration, this does not appear to limit infant energy intake because infants consume more milk if allowed to breastfeed in response to their hunger cues (Lonnerdal 1986).

From one to two years of age, a toddler gradually increases the variety of foods in their diet as they explore differences in taste and texture. The diet changes from one in which half the energy is derived from fat (particularly milk) to a mixture in which less than 40 percent of energy is derived from fat. The implication of this change is that a wider range of types of fat is in the diet, so the family's selection of food becomes of great importance in determining the biochemical influences of fat on serum lipoproteins and cholesterol. It is recommended that margarine derived from polyunsaturated plant oils be used as a spread and in baking to provide a source of polyunsaturated fat. Toddlers up to two years of age should be given whole, homogenised (dark blue) cows' milk or suitable alternatives to drink, but reduced fat milk can be used for cooking (for example, in custard).

Linoleic acid and alpha-linolenic acid are both found in breast milk and added to all infant formula. Linoleic acid is also found in soybean, safflower, sunflower and corn oils, green leafy vegetables, nuts and seeds.* Alpha-linolenic acid is found in soybean, canola, flaxseed and walnut oils, nuts and seeds.* The omega-3 LCPUFAs DHA, EPA and DPA naturally occur in breast milk. They are also found in fish oils and oily fish (for example, canned tuna, sardines, salmon, mackerel, eel, warehou and kahawai) (Ministry of Health 2006b).

10.3.4 Key points for fat

- Fat is an important nutrient for infants and toddlers.
- Breast milk contains both linoleic and alpha-linolenic acids along with preformed LCPUFAs.
- Whole cows' milk or a suitable alternative is recommended for toddlers.
- Use margarine derived from polyunsaturated plant oils as a spread, and margarine and reduced fat milk in baking.

10.4 Minerals and trace elements

10.4.1 Iron

Background

More than 60 percent of iron in the body is found as the haemoglobin in the blood, another 25 percent is stored in the liver, 8 percent as myoglobin in muscles, 5 percent as enzymes, and a small amount is in transit in the circulation (Mann and Truswell 2007).

* Do not give small hard foods like whole nuts and large seeds until children are at least five years old.

Two types of iron are in the diet: haem iron and non-haem iron. Haem iron is more bio-available than is non-haem iron. Haem iron from meat, poultry and fish is conservatively estimated to be 25 percent absorbed, and absorption is not significantly affected by other components of the diet. Non-haem iron from non-animal sources such as plant foods (vegetables, fruit and cereals), eggs, iron medication and iron fortificants in food is less bio-available, with absorption around 17 percent (Institute of Medicine 2001). The absorption of non-haem iron from foods is improved in the presence of beef, lamb, pork, chicken, liver and fish (Lynch 1997). Non-haem iron absorption is also enhanced by the presence of vitamin C. Thus, eating vegetables and fruit that contain vitamin C and products containing non-haem iron at the same meal will enhance the absorption of non-haem iron.

Other promoters of non-haem iron absorption include citric acid, malic acid and tartaric acid, which are found in fruit.

Absorption of iron varies with physiological requirements, the iron status of the individual and dietary composition. Iron status is a powerful predictor of iron absorption. More iron is absorbed when iron stores are low, and iron absorption is reduced when iron stores are high. Healthy full-term infants have adequate iron stores for around the first six months of life, so absorb far less iron in the first six months than they do in later infancy when their stores are depleted.

Iron is present in breast milk in a low concentration (an average 0.35 mg/L (Institute of Medicine 2001), but it is highly bio-available. About 50 percent of the iron in breast milk is absorbed, compared with 10 percent from cows' milk-based infant formula (Saarinen et al 1977; Department of Health (UK) 1994). In breast milk, the lower calcium, phosphorus and protein content and the high concentration of lactose, iron-binding protein and lactoferrin aid absorption.

Because of the lower bio-availability of iron in infant formula, the formulae used in New Zealand have a higher iron content (7–12 mg/L) than breast milk has. Iron-fortified formulae also have added vitamin C, which enhances iron absorption (Steel et al 1986).

The depletion of iron stores from birth and increased demands of growth indicate that after six months of age infants are critically dependent on dietary iron supplied from complementary foods even with continued breastfeeding (Faldella et al 2003; Male et al 2001).

Evidence is inconsistent regarding the adequacy of iron stores of exclusively breastfed infants aged four to six months (Faldella et al 2003; Thorsdottir et al 2003; Male et al 2001; Kazal 2002). This is a consequence of variability within and between the populations studied and a lack of evidence of sufficient quality. However, it is considered that for the full-term infant whose mother had good iron status, breast milk provides sufficient iron until the infant is six months of age (Dewey 2003).

Iron deficiency

Iron deficiency is the most common nutritional deficiency in the world, and one of the few nutritional deficiency conditions that remains common in the developed world. This is particularly true for infants aged between six months and two years for whom the consequences of iron-deficiency anaemia (IDA) are more serious than those of IDA in adults. Infant feeding practices can play a major role in preventing this condition.

Anaemia is the primary sign of severe iron deficiency. The spectrum of iron deficiency can be characterised in terms of three stages: iron depletion, iron-deficient erythropoiesis and IDA. As each iron compartment in the body is depleted, different measurements of iron status become abnormal (Mann and Trusswell 2007) (see Table 10).

Table 10: Measurement of iron status and the spectrum of iron deficiency

Stage	Definition	Characteristics
	Normal iron status	Normal iron in tissue, serum ferritin, serum iron, transferrin saturation percentage and haemoglobin
1	Iron depletion	Low iron in tissue based on a fall in serum ferritin; normal serum iron, transferrin saturation percentage and haemoglobin
2	Iron-deficient erythropoiesis	Depleted iron stores based on low serum ferritin; low serum iron and transferrin saturation percent; normal haemoglobin
3	Iron-deficiency anaemia	Depleted iron stores based on low serum ferritin; low serum iron and transferrin saturation percentage and low haemoglobin

Source: Mann and Truswell (2007).

Abnormalities attributed to iron deficiency include decreased immunity, altered intestinal function, abnormal thermogenesis (body heat production) and decreased red blood cell formation (Gallagher and Ehrenkranz 1995). Sustained IDA during infancy may be associated with irreversible and detrimental effects on intellectual and motor performance, including basic learning skills (Holst 1998; Walter et al 1983; Lozoff et al 1987, 1991; Grantham-McGregor and Ani 2001; Heath et al 2002b). Children with IDA in infancy are at risk of long-lasting developmental impairment (Lozoff et al 1991). Iron deficiency may also restrict linear growth (Chwang et al 1988).

Prevalence of iron deficiency

There are concerns about the prevalence of the spectrum of iron deficiency in New Zealand. Studies show 18–51 percent of children with iron depletion and 5–34 percent of children with IDA (Moyes et al 1990; Dickson and Morison 1992; Poppe 1993; Crampton et al 1994; Rive et al 1996; Wham 1996; Adams et al 1997; Wilson et al 1999).

Two studies of iron status enrolled urban children aged six to 23 months from the South Island (Soh et al 2004) and Auckland (Grant et al 2007). While 10 percent (243 children) of the South Island sample were iron deficient, those children of mothers who were European or had a university education were overrepresented, suggesting the prevalence of iron deficiency may not generalise to children of mothers with low education. In the Auckland study, 24 percent (416 children) of the sample were iron deficient and 11 percent had IDA. Iron deficiency prevalence varied with ethnicity (Other, 27 percent; Māori, 20 percent; Pacific, 17 percent; and New Zealand European, 7 percent). After controlling for ethnicity, the prevalence of iron deficiency was 14 percent.

Factors associated with iron deficiency

Infants and toddlers are at risk of becoming iron deficient because of their increased needs for growth and/or limited food choices (Dallman et al 1980). They may also be at risk if born to mothers with certain conditions: low iron status during pregnancy, multiple births, low haemoglobin concentration at birth, and perinatal bleeding. Rates of IDA prevalence in hospitalised children are likely to appear to be higher than those for healthy children because infection and inflammation result in a transitory reduction in iron indices such as haemoglobin concentration and transferrin saturation (Gibson 2005). IDA can be caused by infection, inflammation and factors affecting health (for example, malabsorption).

Infants who are iron deficient are clearly at increased risk of IDA, possibly following even short periods of stress.

The dietary factors that increase the risk of iron deficiency in infants and toddlers include:

- having a lower than usual iron intake, which can occur during common infectious or contagious illnesses when children are likely to eat poorly, or during an episode of financial need or family disruption when children may not be adequately fed
- receiving complementary foods earlier or later than recommended
- being fed tea frequently
- having a low vitamin C or meat intake once complementary foods are started
- receiving cows' milk earlier than recommended
- drinking too much cows' milk (more than 500 mL per day)
- being exclusively breastfed for too long (that is, beyond six to seven months).

Blood loss from the gut is rare in breastfed infants compared with infants fed cows' milk (Ziegler et al 1990). Cows' milk has a low concentration of iron, and the iron absorption is poor. Feeding infants cows' milk may cause gastrointestinal blood loss and subsequent iron deficiency during infancy (Ziegler et al 1990). The calcium, protein and high phosphate levels in cows' milk inhibit iron absorption. Whole cows' milk is not recommended as a drink until the infant is one year of age.

Cows' milk and cheese may decrease iron availability if they are taken in large amounts. Inhibition is possibly due to the presence of high levels of calcium and phosphorus (Bothwell et al 1989).

The tannins present in tea are the major inhibitors of food iron absorption (Bothwell et al 1989). In infants, there is an association between tea drinking and anaemia. Two early New Zealand studies found tea drinking to be common among iron-deficient children, especially those from Māori and Pacific families (Quested et al 1980; Poppe 1993). Furthermore, tea drinking was associated with an increased risk of iron deficiency in one hospital-based study from Auckland (Grant et al 2003).

Dietary iron bioavailability is also inhibited by phytates, which are present in cereals (grains and rice) and vegetable proteins such as soy beans, legumes, nuts and wheat bran (for more information on phytates, see section 10.2.2: Dietary fibre). Note that legumes, wholemeal (for infants over six months), and whole grains (for toddlers) are still useful sources of iron, particularly for vegetarians and vegans.

In a study of urban children from the South Island, the consumption of iron-fortified formula was associated with higher serum ferritin (a measure of iron stores), and consumption of more than 500 mL per day of cows' milk was associated with lower serum ferritin concentrations (Soh et al 2004). In a study of children living in an urban community (Auckland), an increased risk of iron deficiency was associated with low serum vitamin A, an increased body mass index, being breastfed after six months of age, and not receiving any infant or follow-on formula (Grant et al 2007).

Overall, the literature suggests that many infants in New Zealand are introduced to complementary foods before they are four months of age and introduced to cows' milk as a drink before they are one year of age. These practices put infants and toddlers at risk of iron deficiency.

Recommended iron intakes

The AI for iron for infants from birth to six months of age is 0.2 mg per day. The AI is based on the average iron concentration and intake of breast milk. The iron in infant formula is much less bioavailable, so intakes in formula-fed infants need to be significantly higher. No AI for formula-fed infants has been set (NHMRC 2006).

The RDI for iron for an infant aged seven to 12 months is 11 mg per day.

The RDI for iron for toddlers aged one to two years is 9 mg per day. Absorption is about 18 percent from a mixed Western diet that includes animal foods and about 10 percent from a vegetarian diet, so vegetarian infants may need higher intakes (NHMRC 2006) (for more information on vegetarian eating, see 12.1: Considerations for vegetarian and vegan infants and toddlers and their families).

Sources of iron in the diet

Infants should be exclusively breastfed until around six months of age. Breast milk should be given until the infant is at least one year of age because it provides iron in a highly bioavailable form (Filer 1990). If the infant is not breastfed, then they should receive infant formula until they are one year of age. The contribution made by milk (breast milk or infant formula) in the first year of life is unquestionably a key factor in iron status in infants (Stevens and Nelson 1995).

Once an infant reaches six months of age, complementary feeding with solid foods that provide a source of iron is essential. Iron-fortified infant cereals are suitable starter foods. Most infant cereals are fortified with iron to a level of 10–38 mg per 100 g of dry cereal. The iron absorption from infant cereal products varies greatly but has been estimated at 3 percent (Truswell et al 1990). Also, once the infant is about six months of age, meat or chicken purées can be introduced and, as swallowing develops, finely chopped meats. Meat provides iron in an easily absorbed form. Liver is a good source of iron. However, because it is high in vitamin A, it should be limited to 10 g per week. Dark-green leafy vegetables, sieved lentils, chickpeas and peas are suitable alternatives for vegetarian infants, although the iron is less well absorbed.

Breast milk remains a good source of dietary iron for toddlers, providing a variety of foods from all the four food groups are included in the diet as well.

Infants who are still exclusively breastfed after six months of age, perhaps because they are not developmentally ready for solids (see Table 4 in section 4.4), may need supplemental iron, which should be discussed with a health practitioner (Pizzaro et al 1991).

Key points for iron

- The iron in breast milk is highly bio-available. Therefore, infants should be fed exclusively on breast milk to around six months of age, then introduced to complementary foods containing iron at around six months, with breastfeeding continuing until the infant is at least one year of age, or beyond.
- The variety of complementary foods should be increased to ensure an additional intake of nutrients, especially iron. Iron-fortified infant cereals are suitable starter foods and absorption can be enhanced if the infant is also given foods containing vitamin C. Once the infant is around six months of age, meat or chicken purées can be added to their feeds, and as they develop chewing skills finely chopped meats can be introduced. Infants should be eating some family foods by around one year of age.
- Dark-green leafy vegetables, puréed or mashed lentils, chickpeas and peas are suitable alternatives for vegetarian infants, although the iron is less well absorbed and should be eaten with a source of vitamin C.
- Whole cows' milk should not be introduced as a drink until the infant is one year of age. Limit milk consumption to no more than 500mL per day. More than this can displace solid foods containing the other nutrients that children need.
- Whole cows' milk or a suitable alternative is recommended for toddlers. Fortified cows' milk, such as toddler milk, is generally not necessary.

10.4.2 Zinc

Zinc is essential for many functions, including growth and neurobehavioral development, immune and sensory function, reproduction, antioxidant protection, and membrane stabilisation (Institute of Medicine 2001). Since protein synthesis depends on several essential zinc-containing enzymes, the effects of zinc deficiency include impaired growth. Infants and toddlers are known to be vulnerable to nutritional deficiencies in both iron and zinc. The prevalence of zinc deficiency both in New Zealand and worldwide is unknown because of the difficulty in assessing zinc status. The prevalence of zinc deficiency is likely to be comparable to that of iron deficiency in children because dietary patterns associated with iron deficiency also induce zinc deficiency.

Factors associated with mild zinc deficiency (and iron deficiency) include low birthweight and prematurity, prolonged exclusive breastfeeding, the early introduction and prolonged excessive use of cows' milk, poor appetite, high physiological requirements induced by rapid growth, and low intakes of meat combined with high intakes of cereals unfortified with iron and zinc (Gibson 1997).

Recommended zinc intakes

The AI for zinc for infants from birth to six months of age is 2 mg per day.

The RDI for zinc for infants aged seven to 12 months and for toddlers aged one to two years is 3 mg per day (NHMRC 2006).

Sources of zinc in the diet

Infants should be exclusively breastfed until around six months of age. As with iron, the absorption of zinc from breast milk is high (Mann and Truswell, 2007). If the infant is not breastfed, then they should be given an infant formula until they are one year of age.

Once the infant is six months of age, complementary feeding with solid foods from which zinc is easily absorbed should be encouraged, such as red meat, fish or chicken purée. As the infant develops chewing skills, finely chopped meats can be introduced to their diet.

Key points for zinc

- The variety of complementary foods should be increased to ensure an additional intake of nutrients, especially zinc. At around six months of age, meat or chicken purées can be added. As chewing skills develop, finely chopped meats can be introduced. Infants should be eating family foods by around one year of age.
- Dark-green leafy vegetables, sieved lentils, chickpeas and peas are suitable alternatives to increase zinc intake for vegetarian infants

10.4.3 Calcium

Background

Calcium is required for the normal development and maintenance of the skeleton. It is present in the bones and teeth to provide structure and strength. Calcium is essential for the development of bone, muscle contraction, the transmission of nerve impulses and blood clotting. It is also an activator for several enzymes.

Calcium homeostasis, or the level of calcium in the body, is regulated by the parathyroid hormone, calcitonin, and metabolically active vitamin D. Vitamin D aids the absorption of calcium from the digestive tract (see section 10.5.2: Vitamin D). Fibre, phytates (see section 10.2.2: Dietary fibre) and oxalates present in some cereals and vegetables may decrease the absorption of calcium by forming insoluble salts (Allen 1982). Although, in nutritious diets with adequate intakes of nutrients and moderate levels of fibre, phytates and oxalates, there is no good evidence that there is any detrimental effect on mineral balance (Williams and Bollella 1995; Mann and Truswell 2007) (see also section 12.1: Considerations for vegetarian and vegan infants and toddlers and their families). Phosphorus also influences calcium uptake and combines with calcium to form the rigid structure of bone (Truswell et al 1990).

In children, while insufficient calcium affects calcium homeostasis and bone metabolism, vitamin D deficiency is the main cause of rickets, not low calcium intake (see section 10.5.2: Vitamin D).

The average concentration of calcium in breast milk is around 260–300 mg/L during the first six months of lactation, with no pronounced changes during the lactation period. The absorption of calcium from breast milk has been estimated at 55–60 percent (National Institute of Health 1994b; Lonnerdal 1997; Fomon 1993). The ratio of calcium to phosphorus in breast milk is around 2:1 compared with around 1.2:1 in cows' milk. The relatively low phosphorus content of breast milk may be a factor in the higher absorption of calcium from breast milk than from cows' milk (and cows' milk formula). Calcium concentrations in the breast milk of well-nourished women is unaffected by their calcium intake (National Institute of Health 1994a).

The Australia New Zealand Food Standards Code requires that infant formula sold in New Zealand contains a minimum of 12 mg of calcium and a maximum of 33 mg of calcium per 100 kJ of formula (FSANZ 2002). The higher concentrations of calcium in infant formula compared with those in breast milk are because of the lower bioavailability of calcium in the formula (Lonnerdal 1997). The calcium to phosphorus ratio in cows' milk-based infant formula ranges from 1.2:1 to 1.9:1. The concentration of calcium in soy-based formula is greater than that in milk-based formula to compensate for the presence of phytates in the soy protein isolate, which may inhibit calcium absorption.

Recommended calcium intakes

The AI for calcium for infants from birth to six months of age is 210 mg per day and from seven to 12 months is 270 mg per day.

The RDI for calcium for toddlers aged one to two years is 500 mg per day (NHMRC 2006).

Sources of calcium in the diet

Breast milk is the optimal source of calcium during the first year of life. No evidence suggests that calcium intakes greater than those provided by breast milk in the first six months of life, or breast milk plus complementary foods from six to 12 months, are of any long-term benefit to an infant (Greer et al 2006).

Milk and milk products are the major food sources of calcium and provide many other essential nutrients such as zinc, riboflavin and vitamin B12. Milk products such as cheese, yoghurt, custard and milk puddings are suitable foods to be introduced once the infant is around seven to eight months of age. The heat treatment or fermentation process that occurs to produce these foods denatures the protein, making them easier to digest.

Once the toddler is in the second year of life, breast milk, cows' milk, milk products and alternative sources can provide calcium in the diet. Whole cows' milk or a suitable alternative can be introduced to toddlers over one year of age. Toddlers are encouraged to consume no more than 500 mL of whole

cows' milk or suitable alternatives a day. Cheese, yoghurt, custard and milk puddings can be used as part of the recommended amount of milk. Once an infant is one year of age, it is important they receive food from all the food groups to meet their nutritional requirements, so an excessive consumption of cows' milk (that is, more than 500 mL a day) should be avoided. Breastfed toddlers will need less cows' milk, depending on their breast milk consumption.

Toddlers who do not consume milk or milk products should be encouraged to drink a calcium-fortified milk alternative (see section 12.1.3: Nutrition issues).

Alternative sources of calcium include mashed canned fish with bones (for example, sardines and salmon), tofu, nut pastes, green vegetables (for example, broccoli, leeks, cabbage and spinach) and cooked, dried beans. The use of a calcium supplement should be considered after consultation with a dietitian and a doctor if there is concern that dietary calcium requirements are not being met.

Key points for calcium

- Breast milk is the optimal source of calcium during the first year of life.
- If an infant is not breastfed, they should be fed infant formula until they are one year of age.
- For toddlers, breast milk, cows' milk and milk products are the major food sources of calcium. However, limit milk consumption to no more than 500 mL per day, because more than this can displace solid foods containing the other nutrients children need.
- For toddlers who do not have cows' milk or milk products, calcium fortified milk alternatives can provide calcium. Foods that can be used include mashed canned fish with bones (for example, sardines and salmon), tofu, nut pastes, green vegetables (for example, broccoli, leeks, cabbage and spinach) and cooked dried beans.

10.4.4 Iodine

Background

Iodine is a component of the thyroid hormones thyroxine (T_4) and its active form 3,5,3'-tri-iodothyronine (T_3). The thyroid hormones play an important role in growth and development, and in energy production. Therefore, iodine deficiency can result in goitre, hypothyroidism, and impaired mental and physical development (Hetzl et al 1990). Internationally iodine deficiency is considered the leading cause of preventable mental impairment in children (United Nations 1990).

Iodine levels in soil, irrigation and fertilisers affect the iodine content of food. In New Zealand most soils are low in iodine, resulting in low iodine concentrations in locally grown foods. Iodine is efficiently absorbed from the intestine, but dietary goitrogens (present in vegetables such as cabbage, cauliflower, broccoli and sweet potatoes) and nitrates may interfere with the utilisation of absorbed iodine.

The Ministry of Health identified in the 1987/88 and 1990/1 Total Diet Surveys that iodine available in the food supply, excluding discretionary salt, was at or below the Australian Recommended Dietary Intakes and was a possible public health issue. Subsequent studies of nutritional status within New Zealand (nationally and regionally) have confirmed that iodine intakes have fallen and are below the recommended intake levels for many New Zealanders (Thomson et al 1997; Thomson et al 2001; Skeaff et al 2002; Ministry of Health 2003b; Skeaff 2005a; Skeaff 2005b; Thomson 2001 and Pettigrew 2006).

The decrease in iodine intake in the New Zealand diet is thought to result from:

- the dairy industry having changed its cleaning compounds from iodophors, which increase the amount of iodine in milk and milk products, to non-iodine containing cleaning products

- the increased consumption of ready-to-eat and pre-prepared foods, which usually contain non-iodised salt
- the public health recommendation to use less discretionary salt
- consumers choosing to use sea salt and rock salt, which do not provide iodine.

The iodine status of infants is related to the iodine status of the mother during pregnancy, and the iodine content of breast milk correlates with maternal dietary iodine intake. In countries with iodine deficiency disorders, breast milk iodine concentrations are typically less than 50 µg/L but if iodine intakes are adequate, breast milk iodine concentrations range between 60 µg/L and 150 µg/L (Dorea 2002).

From May 1998 to March 1999, a cross-sectional survey of six- to 24-month old children was conducted in three cities in the South Island (Christchurch, Dunedin, and Invercargill) to assess and explore factors which influence iodine status (Skeaff et al 2005). Urine samples (from which iodine status was determined) and three-day dietary records were collected for each child. A breast milk sample was also obtained from mothers still breast-feeding to determine the iodine concentration of their breast milk. The median urinary iodine concentration of the children was 67 µg/L with thirty-seven percent having a urinary iodine concentration lower than 50 µg/L. Children who were formula-fed had a significantly higher median urinary iodine concentration (99 µg/L) than the children who were currently breast-fed (44 µg/L).

The researchers concluded the group of children were mildly iodine deficient, and that the better iodine status of the formula-fed children than the breast-fed children in this sample was attributed to low iodine content of the mothers' breast milk. Since iodine concentrations of breast milk are easily increased, the researchers recommended breast-feeding women increase their intake of iodine by using iodised salt (for those who use salt) and regularly consume iodine-rich foods such as fish and seafood. For women who do not use iodised salt and consume little or no seafood, a supplement containing 50 µg to 100 µg of iodine was recommended. Furthermore, over the long term, mandatory iodine fortification of staple foods, such as bread, may be a more appropriate strategy to increase iodine intake as it would also benefit low-iodine status infants and toddlers with low iodine status.

The suboptimal iodine status of New Zealanders will be addressed by the recent decision to require the addition of iodised salt to bread (excluding organic and unleavened bread) in New Zealand by September 2009 (Food Standards Australia New Zealand 2008). However, pregnant and breastfeeding mothers may also require additional iodine supplementation if their diets are low in iodine containing foods.

Recommended iodine intakes

The AI for iodine for infants from birth to six months of age is 90 µg per day and from seven to 12 months is 110 µg per day.

The RDI for iodine for toddlers aged one to two years is 90 µg per day (NHMRC 2006).

Sources of iodine in the diet

Infant formula produced in Australia and New Zealand is permitted to have an iodine content of 1.2–10 µg per 100 kJ (FSANZ 2002).

As discussed above, the level of iodine in breast milk reflects the mother's iodine intake. In New Zealand, where dietary iodine intakes are known to be suboptimal, it is likely that in many women the concentration of iodine in breast milk will be suboptimal.

Seafood is a rich source of iodine because marine animals and plants concentrate iodine from seawater. Milk and milk products (from cows) continue to be useful sources of iodine, because iodine is secreted into milk, and milk and milk products are significant components of the population's total diet. However, as a result of different dairy-sanitising processes, milk and milk products provide less iodine today than they did in the 1960s–1980s. Other sources of iodine include eggs, some meat and cereals, and seameal custard. Iodised salt is also readily available (Thomson 2004).

Kelp tablets are rich sources of iodine, but the iodine content in these tablets is extremely variable and can be high enough to be toxic. Therefore, the Ministry of Health does not recommend them for infants and toddlers.

Key points for iodine

- Introduce foods containing iodine, such as fish and seafood, meat and poultry, eggs, milk and milk products, seameal custard, and bread gradually into infants' and toddlers' diets. Prioritise these foods for infants who are exclusively breastfed.
- If salt is added when family food is cooked use small amounts of iodised salt. Rock salt and sea salt have negligible levels of iodine, so unless iodised they are not recommended.
- If required, iodine supplementation for infants and toddlers should be managed by a medical practitioner. Kelp tablets are not recommended.
- The mandatory iodine fortification of bread will help to address the suboptimal iodine status of the New Zealand population, including breastfeeding mothers.

See the Ministry's companion document *Food and Nutrition Guidelines for Healthy Pregnant and Breastfeeding Women: A background paper* (Ministry of Health 2006a, section 3.4.6).

10.4.5 Selenium

Background

Selenium has several roles in the body, including antioxidant functions and thyroid hormone metabolism (Thomson and Paterson 2003). Selenium is a component of the enzyme glutathione peroxidase, which is an essential part of the body's antioxidant defence mechanism. An adequate selenium intake is required to maintain the body's complex mechanism for scavenging the free radicals that are products of oxidative reactions.

The amount of selenium in food reflects the soil in which the food was grown and New Zealand soils are low in selenium.

There is some concern about the selenium status of New Zealand infants and toddlers. A New Zealand study found that South Island breastfed and formula-fed infants, aged between six and 12 months and toddlers had suboptimal selenium status (McLachlan et al 2004).

Recommended selenium intakes

The AI of selenium for infants from birth to six months of age is 12 µg per day and for infants from seven to 12 months is 15 µg per day.

The RDI for selenium for toddlers aged one to two years is 25 µg per day (NHMRC 2006).

Sources of selenium in the diet

Breast milk produced by a well nourished mother provides around 12 ug of selenium (in 0.78 L of breast milk) daily.

The concentration of selenium in food correlates closely with the food's protein content. Organ meats, seafood, imported legumes and baked products made from imported flour are rich sources of selenium. Meat, chicken, seafood and eggs are good sources of selenium. Cereals are usually moderately good sources, but New Zealand-grown vegetables and fruits contain relatively low levels of selenium, so are not good sources.

Selenium intakes from the diet in New Zealand tend to vary regionally, and the variation is correlated to the selenium concentration in bread and other wheat products. Imported wheat, especially Australian wheat, is higher in selenium than New Zealand wheat and is used for all bread-making in the northern parts of the North Island, so that region has higher selenium intakes. In the south of the North Island, about 30–35 percent of wheat used is Australian. In the South Island, usually all wheat is grown locally, accounting for lower selenium intakes there (Thomson and Paterson 2003).

The Total Diet Survey, completed every five years, measures pesticide residues, contaminants, and the selected nutrient content of food available to New Zealanders. The two most recent surveys in 1997/98 (Vannoort et al 2000) and 2003/04 (Vannoort and Thomson 2005) showed increased levels of selenium in wheat products and animal products. Livestock are given selenium supplements to maintain fertility and prevent disease, so the estimated selenium intakes of New Zealanders increased over the past decade. The next Total Diet Survey is being commenced in 2008.

Key points for selenium

- Good food sources of selenium include fish and other seafood, meat, poultry, eggs, milk and milk products, and bread.
- Selenium supplements are recommended only under specialised nutritional and medical advice.

10.4.6 Fluoride

Background

Fluoride combines with calcium in the body to produce healthy bones and teeth. The fluoridation of drinking water is the most effective measure for preventing dental caries, and it has a proven beneficial effect on dental health. Recent New Zealand studies have confirmed the continued beneficial effect of water fluoridation on the prevalence and severity of dental caries in children (Lee and Dennison 2004; Mackay and Thomson 2005). Children who have been drinking fluoridated water since infancy show the greatest benefits.

The concentration of fluoride in breast milk is low irrespective of whether the mother consumes fluoridated or non-fluoridated water (Chowdhury et al 1990). Fluoride supplementation of the maternal diet during pregnancy and lactation is not necessary for proper infant dental development.

The New Zealand Drinking Water Standards recommend that water supplies contain 0.7–1.0 mg/L of fluoride, which is the optimal level in New Zealand to maximise the prevention of dental caries and minimise the risk of dental fluorosis (PHC 1995).

Excessive fluoride intake can result in dental fluorosis, which causes mottling of the teeth. Infants and toddlers are most at risk of fluorosis if they swallow fluoride toothpaste (Pendry and Stamm 1990).

Two Hawke's Bay studies investigated the prevalence of fluorosis or diffuse opacity (de Liefde and Herbison 1985, 1989). Diffuse opacity is the translucency of the enamel, variable in degree and white in colour. The structural integrity of the tooth enamel is not affected. A diffuse opacities prevalence estimate of 51 percent was reported in 1989, which was higher than the 37 percent reported in 1985. This appeared to indicate that the prevalence of diffuse opacities had been increasing.

A 2002 study in New Zealand examined the prevalence, severity and associations of enamel defects and dental caries in a probability-based sample of nine- and 10-year-old children living in fluoridated Invercargill City and the non-fluoridated towns of Southland (Gore, Winton and Queenstown) (Mackay and Thomson 2005). The estimates obtained suggest no change in the prevalence of diffuse enamel opacities within that age group in New Zealand (in contradiction to the Hawke's Bay study (Liefde and Herbison 1989)).

Children who had lived all their lives in a fluoridated area had the highest odds of having a diffuse opacity. These children also enjoyed the lowest prevalence and severity of dental caries in their permanent teeth.

Powdered infant formula available in New Zealand contains negligible amounts of fluoride. The major source of fluoride in infant formula is from the water used to reconstitute the powdered formula (provided it is fluoridated water). There is no evidence that the fluoride derived from water used to reconstitute the formula has any harmful effects in areas where the fluoride concentration is no more than 1.0 mg/L (PHC 1995).

Infant formula is regulated under Standard 2.9.1 of the Australia New Zealand Food Standards Code (FSANZ 2002). Under this standard, fluoride is not permitted to be added to infant formula in New Zealand. If a powdered infant formula product contains more than 17 µg of fluoride per 100 kJ formula before reconstitution, the product label must indicate that consumption of the formula has the potential to cause dental fluorosis and must recommend that the risk of dental fluorosis be discussed with a medical or dental or other health practitioner.

Recommended fluoride intakes

The AI for fluoride for infants from birth to six months of age is 0.01 mg per day, for infants aged seven to 12 months is 0.5 mg per day, and for toddlers aged one to two years is 0.7 mg per day.

Sources of fluoride in the diet

For infants, the main source of fluoride is breast milk or water used to reconstitute infant formula.

For toddlers, the main source of fluoride is fluoridated water. For those who live in areas without fluoridated water, fluoride toothpaste is the main source of fluoride.

Dietary sources of fluoride include fish and chicken. Although tea contains significant amounts of fluoride, it is not recommended for infants and toddlers because it inhibits the absorption of iron from the diet.

Additional information for fluoride

- Use fluoride toothpaste to clean children's teeth twice a day from the time their first tooth erupts.
- Use a smear of children's toothpaste on each teeth-cleaning occasion and ensure an adult is supervising to make sure the child does not ingest toothpaste.

- Children’s toothpaste⁷, which contains approximately half the concentration of fluoride as regular toothpaste, is recommended for infants and toddlers.

See also section 12: Other issues.

10.4.7 Sodium

Sodium is an important component of extracellular fluid. The physiological roles of sodium include maintaining the acid base balance, energy transfer mechanisms, and uptake of nutrients and fluid balance within and outside cells (Department of Health (UK) 1991).

A high sodium intake (principally from salt, which is sodium chloride) is associated with high blood pressure, an important risk factor for cardiovascular disease, particularly stroke. There is strong evidence of a dose-response relationship between sodium intake and blood pressure (Ministry of Health 2003a).

Salt should not be added to food for infants, and they should be given limited amounts of salty food. This is because the infant’s organs are immature and cannot cope with salt, especially the kidneys, which have limited capacity to conserve fluids and excrete sodium. Excess sodium in the diet can also increase calcium excretion. Studies suggest that high sodium intake in infancy may be related to high blood pressure in later life (Geleijnse et al 1997).

In a Dunedin study, infants aged six to 12 months had dietary sodium intakes that were higher than the AI of 170 mg per day (Simons 1999). Non-breastfed infants had higher sodium intakes than breastfed infants. Toddlers aged one to four years had dietary sodium intakes of around 1400 mg per day, which is higher than the UL of 1000 mg per day.

In an Auckland study, some infants were consuming foods that are considered inappropriate before one year of age, such as salted and sweetened snacks (Grant et al 2003).

Many toddlers have been found to be not eating enough vegetables and fruit (Simons 1999). Offering more vegetables (unsalted) and fruit could improve the nutritional quality of a toddler’s diet and reduce their sodium intake.

Recommended sodium intakes

The AI for sodium for infants from birth to six months of age is 120 mg per day (5.2 mmol), for infants aged seven to 12 months is 170 mg per day (7.4 mmol), and for toddlers aged one to two years is 200–400 mg per day (9–17 mmol).

Sources of sodium in the diet

The practice of adding salt to infant and toddler food is not recommended.

Sodium is often added during food processing, with up to 85 percent of the average daily sodium intake for adults coming from processed and manufactured foods (Godlee 1996; Engstrom et al 1997; Young and Swinburn 2002). The amount of sodium in commercially prepared infant foods is controlled by the Food Standards Code (FSANZ 2004).

The two three-day sample meal plans in Appendix 7 use low-salt margarine to ensure the UL for sodium is not exceeded.

⁷ Regular toothpaste contains 1000 ppm fluoride whereas, children’s toothpaste has 400-500 ppm fluoride and is recommended for children up to six years of age.

Key points for sodium

- The practice of adding salt to infant and toddler food is not recommended.
- For toddlers limit the intake of foods, pre-prepared foods, drinks and snacks which contain salt.
- When using salt, choose iodised salt.

10.5 Vitamins

10.5.1 Vitamin A

Background

Vitamin A is important for vision, reproduction, gene expression, embryonic development, growth, immune function, the integrity of the epithelium and bone remodelling.

Vitamin A includes retinol (preformed vitamin A) from animal sources and pro-vitamin A carotenoids (precursors of retinol) in oils, vegetables and fruit. Carotenoids are pigments in plants. There are more than 600 carotenoids, but only a small number have vitamin A activity, and beta-carotene is the most active. Dietary vitamin A is expressed as retinol equivalents, where one retinol equivalent is equivalent to:

- 1 µg of all-trans retinol
- 6 µg of all-trans beta-carotene
- 12 µg of alpha-carotene, beta-cryptoxanthin and other provitamin A carotenoids.

Infants and toddlers absorb beta-carotene better if food is chopped, puréed and cooked with a small amount of fat (American Dietetic Association 2003).

Vitamin A deficiency is not common in New Zealand infants and toddlers but is well recognised in developing countries. An Auckland study on iron deficiency of a random sample of 416 children aged six to 23 months found low vitamin A status in 9 percent of the children (Grant et al 2007).

Excess vitamin A intake as retinol can cause hypervitaminosis in infants, which may cause anorexia and vomiting, and dry itchy skin. Vitamin A intake as beta-carotene, and other pro-vitamin A carotenoids, is of low toxicity for infants and toddlers and does not cause adverse effects, although high intakes may cause a yellowing of the skin (NHMRC 2006).

Recommended intakes of vitamin A

The AI for vitamin A for infants from birth to six months of age is 250 µg per day of retinol (as retinyl esters) and for infants seven to 12 months of age is 430 µg per day of retinol equivalents. The RDI for vitamin A for toddlers aged one to two years is 300 µg/day as retinol equivalents (NHMRC 2006).

Sources of vitamin A

Sources of vitamin A as retinol include butter and margarine, whole milk and milk products, oily fish, liver and egg yolk.

Sources of pro-vitamin A carotenoids include dark-green leafy vegetables, and yellow, red and orange vegetables and fruit.

Key points for vitamin A

- Infants and toddlers should be offered a wide variety of vegetables and fruit, including dark-green leafy vegetables (spinach, silverbeet or pūhā) and yellow, red and orange-coloured vegetables and fruit (carrots, pumpkin, kūmara, tomatoes, apricots, tamarillos).
- Liver and pâté are excellent sources of vitamin A. However, infants should not be offered liver or pâté more than once a week, and no more than 10 g per serving.

10.5.2 Vitamin D

Background

Vitamin D is a group of fat-soluble pro-hormones produced in the skin or obtained from the diet that play an important role in the maintenance of organ systems. Some of the key functions of vitamin D are (DeLuca 2004):

- regulating the calcium and phosphorus levels in the blood by promoting their absorption from the diet in the intestines and the reabsorption of calcium in the kidneys
- promoting the bone formation and mineralisation essential to the development of an intact and strong skeleton
- maintaining normal parathyroid gland status, by inhibiting parathyroid hormone secretion
- promoting cell growth
- affecting the immune system by promoting immunosuppression, the removal of pathogens, and anti-tumour activity.

Vitamin D is produced in the skin or consumed in the diet. Vitamin D circulates in the blood in the form of 25-hydroxyvitamin D and gets converted by the kidneys into 1,25-dihydroxyvitamin D, its biologically active form. Biologically active 1,25-dihydroxyvitamin D is released into the blood and binds to vitamin D receptors that are located in various target organs throughout the body (for example, brain, heart, skin, gonads, and breast).

Regarding bone metabolism, vitamin D activates vitamin D receptors in the intestines, bones, kidneys, and parathyroid gland cells, which leads to the regulation of calcium and phosphorus levels and maintenance of bone content. In infants and toddlers, low blood levels of vitamin D result in rickets, a condition characterised by soft and weakened bones, caused by the poor mineralisation of newly formed bone tissue.

Recommended vitamin D intakes

The AI for vitamin D for infants from birth through to age two years is 5 µg per day (NHMRC 2006).

Sources of vitamin D

In New Zealand, the main source of vitamin D (more than 80 percent) is skin exposure to sunlight, specifically to ultraviolet B radiation. Infants and children who are regularly exposed to sunlight are less dependent on dietary sources of vitamin D. The amount of sun exposure required to achieve adequate vitamin D levels depends on the season, time of day, geographical location (that is, latitude) and skin type (Working Group of the Australian and New Zealand Bone and Mineral Society 2005).

From October to March (including the summer months), when total ultraviolet radiation (UVR) levels are high, most infants and toddlers should be able to achieve adequate vitamin D levels through incidental outdoor UVR exposure outside peak UVR times (that is, before 11 am and after 4 pm). Deliberate

exposure during peak UVR times is not recommended because this increases the risk of skin cancer (See ‘Vitamin D and skin cancer’ below.)

During winter and spring, when UVR levels are dramatically lower and vitamin D stores are diminished, vitamin D status may fall below adequate levels, particularly among people living at lower latitudes in southern New Zealand.

Dark pigmented skin reduces UVR absorption. Therefore, for adequate vitamin D synthesis, individuals with darker skin or who tan easily and burn less easily need more sun exposure (for example, 20 minutes) than individuals with fairer skin or who burn more easily (for example, 5 minutes) (Table 11). The relationship between skin pigmentation and sun exposure for vitamin D synthesis may have implications for the lowered vitamin D status of Māori, Asian and Pacific peoples, even for those living in northern New Zealand (for example, Auckland), and especially for those living further south. Additional measures to achieve adequate vitamin D status may be required for these communities.

Table 11: Fitzpatrick scale of skin types

Type	Description
1	Always burning, never tan; sensitive to exposure; redheaded, freckles, Celtic background
2	Burns easily, tans minimally; fair-skinned, blue, green or grey eyes, Caucasians
3	Burns moderately, tans gradually to light brown; average Caucasian skin
4	Burns minimally, always tans well to moderately brown; olive skin
5	Rarely burns, tans profusely to dark; brown skin
6	Rarely burns, least sensitive; deeply pigmented skin

Source: SunSmart Partnership (2005).

Adequate vitamin D status is unlikely to be achieved through dietary intake alone, as very few foods contain significant amounts of vitamin D. The main dietary sources of vitamin D include oily fish (such as canned tuna, sardines, herrings, mackerel, eel, warehou and salmon), eggs, oils and liver. In New Zealand, the fortification of margarine and milk products with vitamin D is not mandated. However, since 1996 the voluntary fortification of margarine, fat spreads, dried and skim milk, non-fat milk solids, reduced fat cows’ milk, legume beverages and ‘food’ drinks with vitamin D has been permitted.

Infants and toddlers at risk for vitamin D deficiency may require a vitamin D supplement to be taken with supervision of a health practitioner (see ‘Risk factors for vitamin D deficiency’ below).

Risk factors for vitamin D deficiency

For infants and toddlers, the main risk factors for vitamin D deficiency are those which reduce vitamin D production or intake. In New Zealand, vitamin D deficiency is not usually dietary in origin, but is due to insufficient sunlight exposure.

Infants and toddlers at risk for vitamin D deficiency (SunSmart Partnership 2005):

- are born to vitamin D deficient mothers
- are not regularly exposed to sunlight before 11 am or after 4 pm (Cancer Society 2007)
- have darker pigmented skin (skin types 5 and 6)
- have their skin covered by clothing (for example, veiling)

- have a low dietary intake of vitamin D
- have prolonged breastfeeding (for example recent migrants with refugee status from Africa and the Middle East (Munns et al 2006).

Other notable risk factors for vitamin D deficiency are malabsorption, liver or renal disease, and drugs that are contraindicative to vitamin D metabolism. Also, low socioeconomic status and low educational levels are demographic characteristics associated with vitamin D deficiency (Hollis and Wagner 2004).

Children and pregnant or breastfeeding women at risk of vitamin D deficiency may require a vitamin D supplement to be taken with supervision of a health practitioner. It is recommended that children at risk for vitamin D deficiency receive a 10 ug (400 IU) vitamin D supplement daily (Munns et al 2006).

Vitamin D status in New Zealand

There is increasing evidence that New Zealanders have less than optimal vitamin D status (Grant et al 2007; Livesey et al 2007; Judkins and Eagleton 2006; Rockell et al 2005; NHMRC 2006), and there is concern about the vitamin D status of New Zealand infants and toddlers. Vitamin D status is defined by quantifying the concentration of the vitamin D metabolite, 25-hydroxyvitamin D (25-OHD), in blood.

While there are no data on the vitamin D status of exclusively breastfed infants in New Zealand, in a study of 356 six- to 24-month-olds living in Auckland, moderate vitamin D deficiency (25-OHD less than 27 nmol/L) was present in 46 (10 percent) of the children (Grant et al 2007).

In the 2002 Children's Nutrition Survey, an analysis of vitamin D levels showed that 4 percent of New Zealand children aged five to 14 years were vitamin D deficient (25-OHD less than 17.5 nmol/L) and around one-third (31 percent) were vitamin D insufficient (25-OHD less than 37 nmol/L) (Rockell et al 2005). In this context, vitamin D insufficiency is a lesser degree of vitamin D deficiency that is associated with lower bone mineral density and bone growth rates in children, and higher serum parathyroid hormone levels. Pacific children had the highest levels of vitamin D insufficiency followed by Māori, then New Zealand European children.

Vitamin D and skin cancer

Sun exposure causes 95 percent of all skin cancer cases (Australian and New Zealand Bone and Mineral Society et al 2007), so a balance needs to be struck between sufficient sun exposure to maintain adequate vitamin D levels and minimising the risk of skin cancer.

The Ultraviolet Index (UVI) is a measure of the intensity of UVR in our environment. The higher the index, the greater the risk of skin- and eye-damaging exposure to UVR. When the UVI is low (1 or 2), no sun protection is required. When the UVI is 3 or higher, sensible sun protection behaviour is warranted. The UVI can reach levels as high as 15 during the New Zealand summer. It is important to encourage parents and caregivers to provide sun protection for infants and toddlers, including full shade for an infant's pram or play area, a broad-brimmed legionnaire-style or bucket hat (with a brim of at least 5 cm), sun protective clothing (for example, loose-fitting clothes and wraps made from closely woven fabrics), and a broad spectrum sunscreen with a sun protection factor of at least 30 (Cancer Society 2007).

Key points for vitamin D

- Infants and toddlers require appropriate exposure to sunlight to ensure adequate vitamin D status.
- From October to March (including the summer months), before 11 am and after 4 pm, expose an infant's or toddler's face and arms to 5–20 minutes of direct sunlight per day. During winter and spring, infants and toddlers should spend time outside in the sun to prevent a reduction in vitamin D levels.

- From October to March (including the summer months), between 11 am and 4 pm, infants and toddlers should be provided sun protection, including full shade for the infant's pram or play area, a broad-brimmed hat, sun protective clothing, and a broad spectrum sunscreen with a sun protection factor of at least 30.
- Oily fish, eggs and vitamin D-fortified milks, yoghurt, margarines and spreads are minimal to moderate dietary sources of vitamin D.
- Health practitioners should identify infants and toddlers at risk of vitamin D deficiency and consider giving them a vitamin D supplement.

Infants and toddlers mainly at risk are those who:

- are borne to vitamin D deficient mothers
 - are not regularly exposed to sunlight before 11 am or after 4 pm
 - have darker pigmented skin
 - have their skin covered by clothing such as veiling
 - have a low dietary intake of vitamin D
 - have prolonged breastfeeding.
- Evidence does not support the routine use of vitamin D supplements for breastfed infants in New Zealand. However, pregnant or breastfeeding women, and infants and toddlers at risk for vitamin D deficiency may need a vitamin D supplement taken with the supervision of a health practitioner.

10.5.3 Folate and vitamin C

Background

Folate and vitamin C are present in substantial amounts in various fresh vegetables and fruit.

Folate is a B group vitamin needed for healthy growth and development. Folate refers to the various forms of the vitamin that can occur naturally and synthetically. Naturally occurring folate is present in green leafy vegetables (such as spinach and broccoli), cereals and fruits. Folic acid is a synthetic form of folate used in food fortification and dietary supplements.

Recently, Food Standards Australia New Zealand proposed that all bread (excluding organic and unleavened bread) be fortified with folic acid to reduce the number of pregnancies affected by neural tube defects. This proposal was adopted in 2007, so from September 2009, bread (except organic and unleavened bread) must contain added folic acid. Fortified bread will contain 80–180 µg of folic acid per 100 g.

Toddlers aged one to four years in the CNS pilot study had an average intake of folate of 130 µg, which is within the range of EAR of 120 µg per day (Ministry of Health 2001; NHMRC 2006). This suggests that folate intake may be sufficient for infants and toddlers in New Zealand. However, insufficient intake tends to occur when the range of vegetables and fruit is severely restricted, as may be the case for families on low incomes. Folate intakes will increase from September 2009 as a result of mandatory fortification of bread with folic acid.

Both vitamin C and folate are heat-labile vitamins, which are easily destroyed during cooking (Moser and Bendich 1991).

Folate or vitamin C supplements should be taken only after a full assessment by a dietitian, and after it has been established that dietary modification is insufficient to address inadequate intakes.

Recommended folate intakes

The AI for folate, as dietary folate equivalents, from birth to six months of age is 65 µg per day, and for infants aged from seven to 12 months is 85 µg per day. The RDI for folate, as dietary folate equivalents, for toddlers aged from one to two years is 150 µg per day (NHMRC 2006).

Recommended vitamin C intakes

The AI for vitamin C for infants from birth to six months of age is 25 mg/day, and for infants aged from seven to 12 months is 30 mg/day. The RDI for toddlers aged from one to two years is 35 mg/day (NHMRC 2006).

10.6 Key points for nutrients

- Each day toddlers should be offered a variety of nutritious foods from each of the major food groups, which are:
 - vegetables and fruit
 - breads and cereals, including some wholemeal
 - milk and milk products or suitable alternatives
 - lean meat, poultry, seafood, eggs, legumes, nuts and seeds.*
- After one year, whole cows' milk can be gradually introduced into an infant's diet.
- Provide toddlers with plenty of liquids each day such as water, breast milk, or cows' milk (but limit cows' milk to about 500 mL per day).
- As sources of carbohydrate and dietary fibre, start infant with white or wholemeal bread.
- Do not give infants or toddlers alcohol, coffee, cordial, juice, soft drinks, tea (including herbal teas), and other drinks containing caffeine.
- Use margarine derived from polyunsaturated plant oils as a spread, and margarine and reduced fat milk in baking.
- The variety of complementary foods should be increased to ensure an additional intake of nutrients, especially iron. The infant should be eating family foods by around one year of age.
- Gradually introduce foods containing iodine. In September 2009 mandatory iodine fortification of bread, will over time, help to address the sub-optimal iodine status of New Zealanders, including pregnant and breastfeeding mothers.
- Good food sources of selenium include fish and other seafood, meat, poultry, eggs, milk and milk products, and bread.
- Infants and toddlers require regular appropriate exposure to sunlight (outside of peak UVR times) to ensure adequate vitamin D status.

* Do not give small hard foods like whole nuts and large seeds until children are at least five years old.

11 Physical Activity

11.1 Active Movement/Koringa Hihiko

Physical activity is just as important for infants and toddlers as it is for older children. SPARC has developed the Active Movement/Koringa Hihiko programme, which provides a guide for activity for under-fives. The resources for Active Movement/Koringa Hihiko suggest how to encourage physical activity in infants and toddlers to help their bodies to develop, encourage them to learn, and develop confidence.

Ideas for physical activities include tummy time (the infant spends time lying on their tummy), to rolling and crawling to walking, running and jumping activities, balance, upper-body muscle development, catching, throwing and kicking.

More information and resources from Active Movement/Koringa Hihiko are available from SPARC's website (<http://www.sparc.org.nz>).

11.2 Benefits of physical activity

The health benefits of being regularly physically active, as well as eating well, are recognised as important to improving health and preventing illness.

The health benefits include:

- developing fundamental movement skills (SPARC 2004)
- improving fundamental physical skills (eg, balance) (SPARC 2004)
- promoting brain development and cognitive development (SPARC 2004)
- strengthening muscles and developing good posture (SPARC 2004)
- building strong hearts and bones (Carr 2001)
- enhancing self-esteem and confidence (Street et al 2007)
- providing social opportunities for children to interact, learn, lead and follow (SPARC 2004)
- promoting positive mental health (Street et al 2007)
- improving sleep (SPARC 2004)
- maintaining a healthy weight (Campbell and Hesketh 2007)
- reducing the risk of cardiovascular disease (Carr 2001)
- reducing the risk of Type 2 diabetes and controlling Type 1 and Type 2 diabetes (Booth et al 2000)
- reducing the risk of some cancers (Marrett et al 2000; Carr 2001).

Research indicates that children who develop fundamental movement skills and experience the joy of moving, gain physical confidence. They are more likely to lead physically active lifestyles throughout their life.

11.3 Key point for physical activity

- Maintain healthy growth and development of the infant and toddler by providing appropriate food and a wide variety of physical activity opportunities every day.

See SPARC's website (<http://www.sparc.org.nz>) for more information and resources from SPARC's Active Movement/Korīnga Hihiko programme for under-fives.

12 Other Issues

12.1 Considerations for vegetarian and vegan infants and toddlers and their families

12.1.1 Vegetarian and vegan eating patterns

Appropriately planned vegetarian and vegan diets can be healthy, nutritionally adequate and provide health benefits by preventing and managing certain diseases (American Dietetic Association 2003).

It is helpful to establish what parents mean when they describe themselves as vegetarian because there are different types of vegetarianism. Vegetarians may exclude from their diet red meat (semi-vegetarians); all meat, including fish (lacto-ovo vegetarians); eggs and meat (lacto-vegetarians); or all animal products (total vegetarians or vegans).

Parents and caregivers raising vegetarian or vegan infants and toddlers are often established vegetarian or vegans themselves. A common reason for being vegetarian or vegan is ethical (to lessen animal suffering and the environmental impact of meat production). Some vegetarians and vegans also cite health or religious reasons.

12.1.2 Relationship between vegetarian or vegan parent and health practitioner

The decision for a person to be vegetarian or vegan is usually deeply held and should be respected by the health practitioner in order to foster a positive relationship with the person and their family.

It is the experience of many vegetarian and vegan parents that health practitioners who are not well informed about vegetarian and vegan diets can be negative in their approach. This attitude will affect the health practitioner's relationship with the family and the quality of the advice and support they give. Vegetarian and vegan parents who feel judged or as if they have been 'told off' by their health practitioner for raising their children as vegetarian or vegan are likely to be wary of future admonishment from them and may question the ability of the health practitioner to advise them.

12.1.3 Nutrition issues

Nutrients requiring consideration in vegetarian and vegan diets

Key nutrients requiring consideration in vegetarian and vegan diets include protein, iron, zinc, calcium, vitamin D, riboflavin, vitamin B12, vitamin A, omega-3 fatty acids and iodine.

Evidence shows that well-planned vegetarian and vegan diets adequately meet nutritional needs and are appropriate for all stages of the life cycle, including infancy and early childhood (American Dietetic Association 2003).

Including acceptable alternatives to meat and milk products in the vegetarian or vegan diet is fundamental to ensuring the diet contains all the required nutrients. Suitable meat alternatives include vegetarian protein foods such as legumes (peas, beans, lentils, soy), grains (wheat, oats, rice, barley, buckwheat, millet, pasta, bread), nuts (not whole), meat substitutes, eggs, nut butters and spreads.

Fortified foods and in some cases supplements can be helpful in meeting the recommended intakes of some individual nutrients.

Legumes provide protein, iron, zinc and soluble fibre. Cereals help to supply protein, iron and some B vitamins. Green leafy vegetables contain iron and some B vitamins. Red and orange vegetables and fruit and green leafy vegetables provide energy, fibre and vitamins. Vitamin B12– and calcium-fortified milk alternatives and soy products (for example, soy yoghurt, soy custard and tofu) provide protein, calcium and vitamin B12.

Increased levels of fibre, phytate and oxalate in food may inhibit nutrient absorption, but with adequate intakes of nutrients and moderate levels of fibre, there is no evidence of a detrimental effect on mineral balance (Williams and Bollella 1995; Mann and Truswell 2007) (see section 10.2.2: Dietary fibre).

It is possible to improve nutrient absorption with thoughtful food choices and specific food-preparation techniques. For example, eating a wide variety of foods, including foods rich in vitamin C in meals to improve the absorption of the less-available haem iron found in plant sources, and including lower oxalate greens in the range of green leafy vegetables eaten. Food preparation techniques such as soaking and sprouting beans, grains and seeds and raising breads can breakdown phytate (American Dietetic Association 2003).

Plant-based milks

An increasing number of plant-based alternatives to cows' milk are available in New Zealand. These include soy, rice, almond and oat milk. For the non-vegetarian toddler who is no longer breastfed, cows' milk provides a significant proportion of energy, protein, calcium and riboflavin in their diet. Soy milk contains similar energy and slightly less protein than does standard cows' milk (Athar 2006). Soy milk is commonly supplemented with calcium and vitamin B12. Rice, almond and other nut and oat milks contain significantly lower amounts of protein, energy and other nutrients found in cows' milk. Under the Food Standards Code (FZANZ 2002), both soy milk and 'beverages derived from cereals' (for example, rice and oat milk) may be fortified with several vitamins and minerals, including calcium, riboflavin and vitamin B12. Plant-based milks, although not nutritionally equivalent to cows' milk, can be useful alternatives to cow and soy milk if supplemented at manufacture with vitamins B12 and D, riboflavin and calcium. They are unlikely to be supplemented with protein and energy but can still be used if the diet contains good quantities of protein and energy from other sources.

12.1.4 First food for the vegetarian or vegan infant

Infants should be fed exclusively on breast milk to around six months of age with continued breastfeeding up to at least one year, or beyond. If the infant is not breastfed, then a non-animal infant formula is recommended (if dairy products are avoided). The only non-animal infant formula available in New Zealand is soy infant formula. Cows' milk, goats' milk, soy milk, nut milk, rice milk, oat milk, pea milk and home-prepared 'formula' should not be used in the infant's first year of life.

12.1.5 Complementary foods for the vegetarian or vegan infant

Iron-fortified infant cereals, vegetables and fruit are appropriate complementary foods for the vegetarian or vegan infant. Appropriate vegetarian complementary foods for the different development stage are listed in Table 4 in section 4.4.

Consideration should be given to foods that provide concentrated sources of energy and nutrients. These include mashed tofu, bean spreads, nut and seed butters, mashed avocado and cooked dried fruit. The fat intake of healthy infants should not be restricted, and sources such as vegetable oils or soft vegan margarine should be included in an older infant's diet (Mangels and Messina 2001).

12.1.6 Specific advice for vegan infants and toddlers and their families

Vegans eat a plant-based diet, which means no products from animals, including meat, fish, chicken, milk, honey and eggs. There are vegan foods in all the main food groups and a well-planned vegan diet can be varied as the typical New Zealand omnivorous diet. A 'well planned vegan diet and other types of vegetarian diets are appropriate for all stages of the life cycle, including during pregnancy, lactation, infancy, childhood, and adolescence' (American Dietetic Association 2003).

Vitamin B12

Vitamin B12 is an essential nutrient in the diet. It is needed for growth and lipid metabolism (Mann and Truswell 2007) and is important for developing the nervous system (Mangles and Messina 2001).

A reliable source of dietary vitamin B12 is crucial, but this can be problematic for vegans because vitamin B12 is available in the diet only from animal proteins. Some bacteria in the large intestine can make vitamin B12, but this occurs below the ileal receptor site, so it is unlikely to be absorbed (Mann and Truswell 2007). Spirulina, a type of algae, has been promoted as a good source of vitamin B12. However, it is considered to have very low 'B12 activity' (Mann and Truswell 2007).

Vegans need to have adequate daily intakes of vitamin B12-fortified foods from plant-based milks, protein foods and yeast spreads, or take a supplement. It is important that vegan mothers consume vitamin B12 in their diets during pregnancy and breastfeeding. This ensures the baby is born with a body store of vitamin B12 and access to a regular supply during breastfeeding. Some vegan women take a vitamin B12 supplement while others rely on vitamin B12-fortified foods such as some breakfast cereals, fortified yeast extracts, plant-based milks and fermented soy products in order to meet their and their baby's needs for vitamin B12. If the breastfeeding mother's diet does not contain a reliable daily source of vitamin B12, the child should receive a daily source of vitamin B12 (Mangles and Messina 2001).

Encourage parents and other caregivers to ensure a balanced diet for their vegan child, including a daily intake of vitamin B12-fortified plant-based milks, meat replacements and/or yeast spreads. Use a vitamin B12 supplement if these foods are not eaten regularly.

Vitamin D

Only a small number of foods naturally contain vitamin D (D3, cholecalciferol), and only in modest amounts, and all are animal products. This can be a problem for pregnant or breastfeeding vegan women and vegan infants and toddlers, especially if the individual has other risk factors for vitamin D deficiency (see section 10.5.2: Vitamin D).

Foods fortified with a vegan source of vitamin D (D2, ergocalciferol) include some brands of margarine and some fortified milk alternatives. If none or low levels of these foods are included in the diet, supplementation with vitamin D may be necessary.

See section 10.5.2: Vitamin D.

Long chain polyunsaturated fatty acids

See also section 10.3: Fat.

The omega-3 LCPUFA DHA is thought to be of particular benefit to infants and toddlers because it is an important component of the retina and the brain (Makrides et al 1995). There is no AI for omega-3 LCPUFAs for infants, but for toddlers aged one to three years the AI is 40 mg per day (NMHRC 2006).

Breast milk contains omega-3 LCPUFAs so intake is generally not difficult for breastfed infants and toddlers. For vegan infants and toddlers who are not breastfed, achieving an adequate intake is difficult

as LCPUFAs are found primarily in animal foods. The body can make DHA from another fatty acid called alpha-linolenic acid, which is found in flaxseed, soybean, canola and walnut oils. Still, vegan toddlers who are not breastfed may require supplementation with LCPUFAs.

12.1.7 Support for vegetarian and vegan families

All parents want to ensure an optimum diet for their growing baby by ensuring good intakes of vitamins, minerals and trace elements. If the parents are not knowledgeable about the nutritional needs of their vegetarian or vegan child, encourage them to see a dietitian for specialist advice. Ensure that the parents are aware of the resources, information and support available from the New Zealand Vegetarian Society (<http://www.vegetarian.org.nz>).

12.1.8 Key points for vegetarian and vegan infants and toddlers and their families

- Infants should be fed exclusively on breast milk to around six months of age with continued breastfeeding up to at least one year, or beyond.
- Vegan mothers need to ensure an adequate vitamin B12 intake through suitable foods, fortified foods or supplements.
- If the infant is not breastfed, then an infant formula should be used until the infant is one year of age. For vegan infants who are not breastfed or are partially breastfed, the use of a commercial soy-based infant formula during the first two years of life is recommended.
- Once an infant has started complementary foods, the variety should be increased to ensure an additional intake of nutrients, especially energy, protein, iron, calcium, and vitamin B12.
- The infant should be eating some family foods by around the age of one year.
- Toddlers should be offered a variety of nutritious foods from each of the major food groups each day. The food groups are:
 - vegetables and fruit
 - breads and cereals, preferably wholemeal
 - milk and milk products or suitable alternatives
 - vegetarian protein foods, such as pulses (peas, beans, lentils, soy), grains (wheat, oats, rice, barley, buckwheat, millet, pasta, bread), nuts (not whole), meat substitutes, eggs and nut butters.
- For toddlers, prepare foods or choose pre-prepared foods, drinks and snacks that:
 - are low in salt, but if using salt, use iodised salt
 - have little added sugar (and limit the toddler's intake of high-sugar foods).
- There are some pre-prepared products suitable for vegetarian and vegan infants, but read the labels carefully. The selection of commercial products for the older vegetarian or vegan infant is limited, so many parents opt to prepare their own baby foods. Foods should be washed well, cooked thoroughly, and blended or mashed to an appropriate consistency. Home-prepared foods may be kept in the refrigerator for up to two days or frozen in small quantities for later use.
- For vegetarian and vegan toddlers, provide plenty of liquids each day, as water, breast milk, cows' milk or plant-based milks only (and no more than 500 mL of milk per day).

See section 10.4.4 Iodine and section 10.5.2 Vitamin D for additional information for vegetarians and vegans.

12.2 Pacifiers

12.2.1 Implications of pacifier use

There is evidence that pacifier use (also known as dummies or soothers) by infants can reduce the risk of sudden infant death syndrome (SIDS) also known as sudden unexpected death in infancy (SUDI) (Mitchell et al 1993, Hauck et al 2005, Li and Willinger 2006). Furthermore, the American Academy of Pediatric Task Force recommends their use to reduce SUDI/SIDS risk throughout the first year of life (American Academy of Pediatrics 2005).

The prevalence of pacifier use by New Zealand infants is unknown. However, a survey of SIDS-protective infant care practices among 200 Auckland New Zealand mothers found nearly one-third of their infants (31%) used pacifiers (Hutchison et al 2006). Similar rates of pacifier use were found in other Auckland-based studies (Mitchell et al 1992; Vogel et al 1999, 2001). The main reason parents and caregivers gave for using pacifiers was to settle their infant (Hutchinson et al 2006).

Concern has been raised about the potential negative effects of pacifier use on breastfeeding and infant nutrition and health. A number of studies has shown an association between pacifier use and decreased duration of breastfeeding (Howard et al 1999, 2003, Victoria et al 1997, Mitchell et al 2006). Although, one study suggests that pacifier use may be an indicator rather than a cause of early breastfeeding problems (Kramer 2001). Generally, since it is strongly recommended to breastfeed exclusively to around six months of age, any practice that has been shown to interfere with breastfeeding is discouraged. Pacifier use in infants has also been linked to a higher risk of infective symptoms, including otitis media (Mitchell 2006).

The possible benefits of pacifier use in infants for reducing the incidence of SIDS/SUDI need to be balanced against the possible risks of pacifier use for shortening breastfeeding duration and the negative impact on infant nutrition and health. Currently, the Ministry of Health does not recommend pacifier use for breastfed infants (see Appendix 2), although it seems appropriate to stop actively discouraging pacifier use until more research is done to clarify our understanding of the factors that influence pacifier use or non-use.

12.2.2 Key points for pacifiers

- The possible benefits of pacifier use in infants for reducing the incidence of SIDS/SUDI need to be balanced against the possible risks of pacifier use for shortening breastfeeding duration and the negative impact on infant nutrition and health.
- If an infant is already being bottle fed, it is reasonable to consider the use of pacifiers, especially if risk factors for sudden infant death syndrome are present.
- If breastfeeding mothers wish to use pacifiers, it is best to wait until breastfeeding is well established.

Additional information for pacifier use

Pacifiers should be:

- kept clean
- checked regularly for cracks or loose parts
- sterilised frequently
- not sweetened with honey or other sweeteners
- not shared.

12.3 Bottles and teats

12.3.1 Recommended types of bottle and teat

Infant feeding bottles can be made from glass, plastic (polyethylene) or polycarbonate. Plastic and polycarbonate bottles are more difficult to clean but are more robust than glass bottles. Bottles where the teat can be easily stored inside are recommended.

Teats are available in latex, which is soft and needs to be replaced often, and silicone, which is firmer and longer lasting. Teats come with varying numbers of holes: the more holes the faster the milk flows. One-hole teats encourage vigorous sucking and should be used with newborns. Milk should drip out of teats rapidly but not flow out. Children with cleft lips or palates or co-ordination problems may need special teats if they are bottle fed.

Research suggests that non-ventilated and under-ventilated bottles lead to pressure changes in the infant's oral cavity, which may lead to pressure changes in the middle ear and potentially a predisposition to middle ear infections (Brown and Magnuson 2000). Fully ventilated bottles which eliminate air vacuums are the best option.

For information on cleaning and sterilising bottles and teats, see section 5: Formula feeding.

12.3.2 Discouraged feeding position

Infants should not be placed lying down with a bottle propped up so that they can continue to feed without an adult being present. An infant left alone might choke if the fluid goes down their airway rather than oesophagus. Fluid can also enter the middle ear of infants fed with a bottle propped up, causing inflammation.

If the infant has teeth and falls asleep before the contents of the bottle are finished, their teeth continue to be bathed in carbohydrate-containing fluid. This can lead to 'nursing bottle caries', in which the teeth decay and may require extraction (Swartz et al 1993; Ripa 1988).

12.3.3 Key points for bottles and teats

- Fully-ventilated bottles should be used when bottle feeding.
- Never leave an infant unattended and feeding from a bottle.

Additional information for drinks

Bottle feeding of any drinks containing sugar, for example, soft drinks, cordials and fruit juice is not recommended because such beverages are highly likely to cause tooth decay (cariogenic) because of the sugar content. Fruit juices with and without added sugar are high in natural sugars, which are also cariogenic (see section 6: Fluids).

12.4 Supplements

Most infants and toddlers in New Zealand do not need vitamin or mineral supplements with a healthy well-balanced diet. However, specific groups of infants and toddlers in New Zealand may need to be considered for vitamin or mineral supplementation (see section 12.4.1: Special indications for supplements).

Obtaining nutrients directly from food is preferable to relying on supplements. Along with specific vitamins and minerals many foods contain other components, some still unidentified, which seem to benefit health in ways manufactured vitamins and minerals do not. A healthy well-balanced diet is summarised in section 1.1: New Zealand Food and Nutrition Guideline Statements for Healthy Infants and Toddlers.

Dietary supplements are regulated in New Zealand by the Dietary Supplements Regulations 1985. However, there is no mandatory requirement for these products to meet good-manufacturing practice standards. In contrast, food available in New Zealand must meet several standards (FSANZ 2002). Certain foods are also monitored for safety with regard to their content of industrial and agricultural products.

Full-term infants fed breast milk or infant formula should not require supplements of vitamins, minerals or other nutrients. A mother with a very poor diet can have relatively low levels of iodine, some B vitamins and vitamin C in her breast milk (Fomon and McCormick 1993), but even in extreme cases, it would usually be better to give the vitamin supplements to the mother rather than to the infant.

In New Zealand, there is no evidence of benefit from giving nutritional supplements to infants and toddlers who are adequately fed. Those who do develop a vitamin deficiency have usually had a diet inadequate in quality or quantity. In these cases, a change in diet is the correct course of action.

Parents may be encouraged by advertising or acquaintances to provide vitamin supplements to infants and toddlers in the belief that this may help to prevent infections or strengthen the immune system. There is no evidence that their use offers any benefits when the child is receiving an adequate diet.

Dietary supplements for infants, including herbal supplements, should be used only on the recommendation and with directions of a medical practitioner or dietitian.

12.4.1 Special indications for supplements

In some situations it may be necessary to give specialised feeding advice, for example, a pre-term birth; a breastfed pre-term infant; an infant born to a growing and/or malnourished mother; the delayed or inappropriate introduction of complementary foods; a nutritionally uninformed caregiver; an infant diagnosed with iron deficiency; or concerns with the infant's vitamin D status (Cockburn 1998).

For iron deficiency, iron supplements must be used with caution because of the danger of poisoning should a child consume a large quantity. If swallowed in excess, iron can cause life-threatening acute poisoning. An excessive iron intake overwhelms the iron control systems in the body leading to high free-iron levels. These act as pro-oxidants and greatly enhance the risk of infection. Liquid iron preparations have a tendency to stain teeth, and all chemical forms of iron can irritate the gut.

For infants and toddlers, the main risk factors for vitamin D deficiency are those that reduce vitamin D production or intake. In New Zealand, vitamin D deficiency is not usually dietary in origin, but is due to insufficient exposure to sunlight. Infants and toddlers at risk for vitamin D deficiency (SunSmart Partnership 2005):

- are born to vitamin D-deficient mothers
- are not regularly exposed to sunlight before 11am or after 4pm
- have darker pigmented skin
- have their skin covered by clothing (for example, veiling)

- have a low dietary intake of vitamin D
- have prolonged breastfeeding (particularly among recent migrants with refugee status from Africa and the Middle East).

(See section 10.5.2: Vitamin D.)

Vitamin B12 is available naturally only in foods from animal sources, which can cause a problem for breastfed infants and toddlers. Some vegan women opt to use a vitamin B12 supplement while others rely on vitamin B12–fortified foods such as fortified yeast extracts, non-dairy milks and fermented soy products to meet their and their baby’s needs for vitamin B12.

If supplements are recommended, they should be given in liquid form and not in tablet or capsule form, which the infant or toddler may inhale and choke. Only preparations specifically designated for use with infants and toddlers should be taken, and they must be given in the correct dosage.

Supplements should not contain sugar.

Supplements should be securely stored in containers with child-resistant closures. Great care must be taken to ensure that infants and toddlers do not have access to supplements (or medicines) because they may mistake tablets for sweets.

12.4.2 Key points for supplements

- Infants and toddlers generally do not require supplements. A healthy well-balanced diet is the best way to provide nutrients for the body.
- Seek recommendations and directions of a medical practitioner or dietitian if there are concerns about an infant’s or a toddler’s nutrition intake, status or health.
- Infants and toddlers may need iron supplements under certain circumstances, for example, if an infant is diagnosed with iron deficiency or has been exclusively breastfed for a prolonged period.
- Vitamin D supplements may be required by infants of vitamin D–deficient mothers, and toddlers at risk of vitamin D deficiency.
- Breastfeeding mothers following a vegan diet may require supplements if they do not have a reliable supply of vitamin B12 in their diet from fortified foods and fluids. Infants and toddlers of vegan mothers may also require vitamin B12 supplements.

See section 10.4.4 Iodine, for implications of mandatory iodine fortification.

12.5 Food allergies and food intolerances

12.5.1 Food allergies

Definition of food allergy

A food allergy is an abnormal response of a person’s immune system to a food allergen, which is always a protein. The immune system recognises the food allergen as ‘foreign’ or ‘dangerous’ and reacts with subsequent effects in one or more areas of the body. The reaction to the allergen is reproducible (that is, it will occur each time the person is exposed to the allergen).

Signs and symptoms of an allergic reaction

Common signs and symptoms of an allergic reaction are:

- respiratory effects: nasal congestion and a runny nose, sneezing, asthma, coughing or wheezing
- skin effects: swelling of the lips, mouth, tongue, face and/or throat; itching; redness or rashes (for example, hives or eczema) or allergic conjunctivitis
- gastrointestinal effects: intestinal cramps, diarrhoea, nausea, vomiting or colic
- cardiovascular effects: tachycardia, hypotension, feeling faint, dizziness, or collapse.

Symptoms can be mild to very severe. Anaphylactic shock or anaphylaxis is life threatening. It is a ‘rapidly evolving, generalised multi-system allergic reaction characterized by one or more symptoms or signs of respiratory and/or cardiovascular involvement and involvement of other systems such as the skin and/or the gastrointestinal tract. Common triggers include food, stinging insects and medication (ASCIA 2007).

Following emergency treatment all patients with suspected anaphylaxis should be referred to an allergy specialist or paediatrician for investigation and the provision of a comprehensive anaphylaxis management plan, including an emergency action plan (ASCIA 2007).

Types of food allergy reaction

Food allergy reactions are classified into three groups: immunoglobulin E (IgE) mediated; non-IgE mediated and mixed (IgE and non-IgE mediated).

- IgE-mediated food allergy reactions generally occur rapidly (that is, within four hours, with most severe reactions having rapid onset), after contact with the allergen. Immunoglobulin antibodies are involved, and these reactions can affect skin and the gastrointestinal, respiratory and cardiovascular systems. Diagnostic tests are available to identify these types of allergic reaction.
- Non-IgE-mediated food allergy reactions do not involve IgE antibodies. The symptoms of these reactions are generally delayed from hours to days following contact with the allergen, and tend to involve the gastrointestinal system. Diagnosis is made difficult by this delay following contact with the allergen and the lack of diagnostic tests.
- Mixed food allergy reactions involve IgE- and non-IgE-mediated responses but tend to be delayed rather than rapid responses to allergens (ASCIA 2007, Sampson 2004).

Prevalence of food allergies

Food allergies occur in around 6 percent of children under three years of age and decrease in prevalence over the first decade of life (Wang and Sampson 2006). It is estimated that 80–90 percent of children outgrow their allergies, although this may take many years. There is little, if any, data on prevalence of food allergy in New Zealand. All the prevalence data quoted is from overseas.

Eczema and food allergy

An association exists between eczema and food allergies. Up to one-third of infants with eczema also have a food allergy. There is also a correlation between the severity of eczema and the likelihood of a food allergy, particularly in early infancy, and research has demonstrated a pathway between the IgE antibody response and the development of eczema lesions (Burks 2003).

Food is only one of the many possible triggers of eczema. Other triggers include exposure to allergens in the air (for example, animal hair and dust, dust mites and moulds), irritants (for example, fabrics such as wool can trigger itching) and infection.

It is estimated that 2–8 percent of respiratory reactions are food induced (James 2003), which is probably much lower than the proportion the public perceives.

Common food allergens

A food allergen is always a protein. Around 160 foods have been reported as causing food allergies but only eight of these are responsible for 90 percent of all allergic reactions to food: cows' milk, eggs, peanuts, tree nuts, soy, fish, shellfish, and wheat (NZFSA 2004). Tree nuts include almonds, Brazil nuts, cashews, chestnuts, hazelnuts, hickory nuts, macadamia nuts, pecans, pine nuts, pistachios and walnuts. Coconut is classed as a tree nut, but allergy to coconut is relatively uncommon.

Cows' milk and milk products

Cows' milk is the most common food allergen for infants and toddlers. It is estimated that around 3 percent of young children have cows' milk allergy (CMA) (Sampson 2004). Over 70 percent of infants with CMA will outgrow their allergy (Zeiger 2003).

If CMA is present, milk and milk products must be avoided. Breast milk is the ideal food for infants with CMA. If the mother does not breastfeed, a suitable infant formula must be suggested by a specialist physician. Between 17 percent and 47 percent of children with CMA also have adverse reactions to soy (ASCI 2007). This is particularly a problem for children with CMA aged under six months. Research shows a strong cross-reactivity between cows' and goats' milks (Restani et al 1999; Pessler and Nejat 2004), with one study showing around 92 percent of children with IgE-mediated CMA also having a reaction to goats' milk (Bellioni-Businco et al 1999). Therefore, individuals with IgE-mediated CMA should also avoid soy and goats' milks.

Eggs

Egg allergy is another common allergy in infants and young children. It affects approximately 3 percent of this group (Chapman 2006).

In cases of diagnosed egg allergy, egg should be avoided. The extent of egg avoidance needs to be reviewed with the specialist caring for the child. The egg white particularly contains proteins known to cause allergic reactions. Practically, avoidance of both white and yolk is always recommended because of the high risk of cross-contamination between the two.

Peanuts

The prevalence of peanut allergy in children under three years old is 0.8 percent (Sampson 2004).

Peanuts can cause especially severe allergic reactions and may be the most immediate and life-threatening allergy (Wood 2003).

Only around 20 percent of young children with peanut allergy will outgrow the allergy (Sampson 2004).

Peanuts are legumes, so there is a small risk (around 5 percent) that a peanut-allergic individual may also react to other legumes (for example, peas, lentils and beans). Of more concern is that 35–50 percent of peanut-allergic people also react to at least one type of tree nut (Sampson 2003a, b). Many people with peanut allergy are advised to avoid all tree nuts.

Tree nuts

Tree nuts (that is, almonds, Brazil nuts, cashews, chestnuts, hazelnuts, hickory nuts, macadamia nuts, pecans, pine nuts, pistachios and walnuts) are also relatively common allergens. In the United States it is estimated that 0.2 percent of the population is allergic to tree nuts (Sampson 2004).

Around 9 percent of children with a tree nut allergy will outgrow it (Fleischer et al 2005).

See also the section ‘Peanuts’ above.

Soy

The prevalence of soy allergy among children is around 2 percent. Of those children, 10–15 percent will have an IgE-mediated allergy, and the remainder will have non-IgE-mediated gastrointestinal symptoms (Zeiger et al 1999).

(See also section 5.2: Types of formula.)

Wheat

Wheat is a common allergen, although wheat allergies generally resolve in early childhood. Severe reactions can occur but are relatively uncommon.

Note that a wheat allergy is not the same as coeliac disease (see ‘Coeliac disease’ below).

Coeliac disease

Coeliac disease is caused by hypersensitivity to gluten, which is a protein found in wheat, oats, rye and barley. The hypersensitivity causes damage to the mucosa of the small intestine. It is an example of a non-IgE-mediated food allergy.

Coeliac disease is characterised by a failure to gain weight and chronic diarrhoea, although symptoms may be less obvious too.

Coeliac disease is managed with a gluten-free diet. A gluten-free diet is very restrictive and should not be started unless a diagnosis of coeliac disease has been confirmed by intestinal biopsy.

12.5.2 Prevention of food allergies

Any infant and toddler may have an allergic reaction to food. However, children born into families with allergies are more likely to have an allergy (50–80 percent) than are children with no family history of allergy (20 percent). The risk appears to be higher if both parents have an allergy (60–80 percent) and if the mother rather than the father has an allergy (Kjellman 1998).

In this part of the document the expression ‘high-risk infants’ refers to infants with at least one parent or sibling with allergic disease. Allergic disease typically refers to atopic dermatitis (eczema), asthma, allergic rhinitis (hay fever) and food allergy (American Academy of Pediatrics 2008).

It is not possible to alter an inherited predisposition to a food allergy. However, it is uncertain whether you can reduce the likelihood of the predisposition developing into a food allergy (primary prevention) or reduce the severity of allergic reaction if an allergy becomes established (secondary prevention).

Maternal avoidance of common food allergens during pregnancy and breastfeeding

Maternal avoidance of common food allergens during pregnancy and breastfeeding is not proven to reduce the risk of gastrointestinal and respiratory manifestations of allergic disease. However, some evidence suggests that excluding common food allergens during breastfeeding may prevent atopic eczema, but more data are needed to confirm this.

Maternal avoidance of common food allergens during pregnancy and breastfeeding could compromise the nutrition of the mother and the baby. Such avoidance is not recommended by the Australasian Society of Clinical Immunology and Allergy (Prescott and Tang 2004). The American Academy of Pediatrics (2008) found a lack of evidence that maternal dietary restrictions during pregnancy and breastfeeding played a significant role in preventing atopic disease with the possible exception of atopic eczema.

Even though it is not recommended, if the pregnant or breastfeeding mother wants to avoid common allergens in an attempt to decrease the risk of her infant developing an allergy, a dietitian should be involved to help ensure she maintains a nutritious diet.

Breastfeeding

Breast milk offers the ideal nourishment for all newborns in terms of nutritional, immunological and physiological factors (Zeiger 2003). In addition, breastfeeding is thought to have a role in the primary prevention of allergic disease. Evidence is conflicting (Zeiger 2003), but on balance breastfeeding probably reduces the risk of developing a food allergy (see Appendix 11).

The American Academy of Pediatrics (2008) recently concluded that exclusive breastfeeding for at least four months compared with feeding intact cow milk protein formula decreased the cumulative incidence of atopic dermatitis and cow milk allergy in the first two years of life for high-risk infants.

Exclusive breastfeeding also protects against wheezing in early life but the evidence that it protects against allergic asthma occurring beyond six years is not convincing.

Formula feeding

Exclusive breastfeeding to around six months is recommended to reduce the risk of allergic disease for all infants, and especially high-risk infants. For all infants not breastfed, the recommendation is to begin with a standard cows' milk formula.

Recent recommendations have been made that high-risk infants who are not breastfed should be fed a protein-hydrolysed formula to lower their risk of developing allergic disease (Prescott and Tang 2004; Bjorksten 2007). Protein-hydrolysed formula is cows' milk-based formula that has been treated with enzymes to break down some or most of the proteins that cause CMA. The American Academy of Pediatrics (2008) acknowledges there is modest evidence that atopic dermatitis may be delayed or prevented by the use of extensively or partially hydrolysed formulas compared with cows' milk formula, in early childhood. More research is required to assess whether these benefits extend into late childhood and beyond.

Protein-hydrolysed formula is available in New Zealand in both partially and extensively hydrolysed forms. The appropriate formula for high-risk infants who are not breastfed continues to be investigated. For parents or caregivers with concerns about the most appropriate formula for their high-risk infant, the Ministry of Health advises they consult a paediatrician or an allergy specialist.

Delayed introduction of complementary foods to around six months of age

Delaying the introduction of complementary foods until around six months of age may delay the onset of the symptoms or consequences of a food allergy. Infants should be fed exclusively on breast milk until developmentally ready to begin solids (see Table 4 in section 4.4). This usually occurs at around six months of age.

Delayed introduction of common food allergens

Delayed introduction of common food allergens as an intervention to prevent food allergy is controversial. Until recently, national and international recommendations to delay some common food allergens had been common (Ministry of Health 2000; NHMRC 2003; American Academy of Pediatrics 2000). However, more recent guidelines state there is no convincing evidence to support delaying the introduction of highly allergic foods (Prescott, Tang and Bjorksten 2007; American Academy of Pediatrics 2008; ESPGHAN 2008). The European Society for Paediatric Gastroenterology Hepatology and Nutrition Committee for Nutrition specifically states that this applies to high-risk infants as well as those not considered at risk (ESPGHAN 2008).

There is some evidence that delaying the introduction of some foods until the infant has reached six months of age may increase the risk of allergic disease in infants and toddlers (Poole et al 2006).

For all infants new foods should be introduced one at a time to allow the detection of reactions to individual food components (ESPGHAN 2008). At first, a new food should be added only every two to four days. If an infant develops symptoms of an allergy, refer them to their general practitioner (see section 12.5.1: Food allergies). In the case of suspected anaphylaxis, emergency medical treatment is required immediately.

12.5.3 Diagnosis and management of food allergies

Infants with food allergies have a greater risk of developing not only further food allergies but also inhalant allergies (that is, allergies to airborne allergens such as dust mites and grass). Therefore, the early diagnosis of infants with food allergies and the implementation of a management plan may be of benefit in reducing the possible development of further food allergies (Wood 2003).

Diagnosis of food allergy

Misdiagnosis of a food allergy is common. After the introduction of complementary foods, normal changes, such as the character or frequency of an infant's bowel motions, may be incorrectly identified as abnormal and due to a food allergy. Common childhood complaints such as colic and skin rashes may also be wrongly attributed to a food allergy.

A formal diagnosis of a food allergy by an allergy specialist or paediatrician is needed. Specialists generally use a mix of approaches to build a picture of what is happening to a patient. A patient's medical history is considered the mainstay in the diagnostic process, which involves establishing whether a food-induced allergic reaction has occurred, which food was involved and what allergic mechanism occurred (Sampson 2004). A physical examination and certain laboratory test may be done.

For IgE-mediated reactions skin prick tests and radio allergosorbent tests (usually the CAP RAST test) can be helpful. However, studies looking at skin prick tests have shown that while a negative result is 95 percent reliable, a positive test correlates with a true IgE-mediated reaction in less than half of cases. This means there are a number of false positive results that indicate hypersensitivity inappropriately. False positives have also been found in studies looking at radio allergosorbent tests.

An elimination test followed by a food challenge may be done. This is considered the gold standard in the diagnosis of allergies (Sampson 2004), but risks causing acute food allergic reactions so is not commonly done in children. It is also often not needed if there is a good history of acute allergic reaction. In addition, food challenges for diagnosis should be done only with specialist back up in case the child has a severe allergic reaction. Elimination diets should be done in co-operation with a dietitian to ensure all the suspected food is removed from the diet and that the infant or toddler is still receiving a nutritionally adequate diet.

Ongoing medical review of the child is essential to monitor for new allergies or symptoms or the possible resolution of the food allergy.

Management of food allergy

A food allergy is managed by ensuring the child avoids the food allergen while still receiving a nutritionally adequate diet. This can be achieved jointly by a dietitian, an allergy specialist or a paediatrician, a general practitioner and the family.

Dietitians have a key role in assessing nutritional requirements and regularly reviewing the child's diet and checking compliance with the diet (Wham et al 1989). The doctor and dietitian should monitor the child's diet to avoid unnecessary food restrictions and to monitor the child's growth. Children may outgrow food allergies or intolerances, so should be tested regularly to ensure that dietary modifications are not prolonged unnecessarily.

The dietitian will teach carers how to identify sources of food allergens in the diet and to read and understand food labels. The Australia New Zealand Food Standards Code contains provisions relating to the labelling of foods with warning statements (FSANZ 2002). These provisions require all common food allergens to be clearly highlighted on the label if they are present in that product as an ingredient, food additive or a processing aid. Consumers can then make informed decisions about food purchases for infants and toddlers who are in their care and have food allergies.

The allergens that must be declared on food labels in Australia and New Zealand are:

- milk and milk products
- egg and egg products
- peanuts and soybeans and their products
- cereals containing gluten and gluten products (wheat, oats, barley and rye)
- fish and fish products (including shellfish)
- crustacean and crustacean products (crab, prawn and crayfish)
- tree nuts and sesame seeds and their products.

Labels must also declare the presence of sulphites above a certain level (see section 12.5.4: Food intolerance).

The Manufactured Food Database (at <http://www.mfd.co.nz>) provides information on manufactured foods that are free of common food allergens. Specific allergen (or multiple allergen) manufactured food lists can be obtained directly from the Manufactured Food Database website and are useful when purchasing commercially produced food.

Allergy New Zealand provides comprehensive information on all aspects of living with allergies that can be accessed from its website (<http://www.allergy.org.nz>).

The New Zealand Food Safety Authority has information on food allergies that can be accessed on website (<http://www.nzfsa.govt.nz>). It also produces the booklet *Eating Safely When You Have Food Allergies* (NZFSA 2007). To request a free copy of the booklet, call the authority on 0800 693 721 (0800 NZFSA1).

12.5.4 Food intolerance

Food intolerance is a reproducible reaction to a food that is not mediated by the immune system. The most common causes include an enzyme deficiency (for example, lactose intolerance caused by lactase deficiency), a histamine-releasing effect (for example, sensitivity to shellfish), or the release of substances produced by the fermentation of food residues in the bowel (Royal College of Physicians and British Nutrition Foundation 1984).

Most lactose intolerance in children is secondary, usually due to an intestinal infection. During such an infection breastfeeding should be encouraged to continue because breastfed infants can usually continue to tolerate breast milk despite its high lactose content. However, formula containing lactose may pose a temporary problem. In some severe cases, a temporary change to a lactose-free formula may be required, but only under medical supervision (Chandra and Haemmed 1992).

12.5.5 Key points for food allergies and food intolerances

- Maternal avoidance of common food allergens during pregnancy and breastfeeding is not recommended.
- Infants should be fed exclusively on breast milk until they are around six months of age.
- There is insufficient evidence that delaying the introduction of common food allergens prevents food allergies.
- Introduce infants to new foods one at a time to allow the detection of reactions to individual components of foods. At first, a new food should be added only every two to four days.
- Children with severe food allergy may be at risk of anaphylaxis, and should be assessed by an allergy specialist or a paediatrician.
- If any infant develops symptoms of an allergy a referral to their general practitioner is required. In the case of suspected anaphylaxis, emergency medical treatment is required immediately.
- Following emergency treatment, all patients with suspected anaphylaxis should be referred to an allergy specialist or a paediatrician for investigation and the provision of a comprehensive management plan that includes an emergency instructions.
- Food allergies should be managed jointly by a dietitian, the referring doctor/specialist, and the family.

12.6 Colic

12.6.1 Definition of colic

Colic is episodic inconsolable crying in an otherwise healthy infant. The crying often begins with the infant going red in the face, pulling up their knees or arching their back, and having a tight stomach, wind and explosive bowel motions.

Colic will usually begin in the infant's first three weeks of life and can continue for 12–16 weeks.

Parents may misdiagnose an unsettled or crying infant as having colic when the behaviour is common for an infant in their first two to three months of life. The first step to take if colic is suspected is to seek a health practitioner's advice.

It is not known what causes colic.

12.6.2 Recommended treatments for colic

Treatments for colic will work for some infants but not others. Cuddling, rocking and massaging are common ways of soothing infants with colic.

Other treatments include changing infant feeding practices, such as eliminating cows' milk protein, although breastfed infants are also known to get colic. It is recommended that changes to infant feeding practices are made only under a doctor's or dietitian's direction (Lucassen et al 1998) to ensure that any dietary modification or pharmacological intervention is safe and does not result in nutritional deficiencies. (See also *Food and Nutrition Guidelines for Healthy Pregnant and Breastfeeding Women: A background paper* (Ministry of Health 2006b).)

Parental counselling is an effective intervention for managing the stress associated with colic (Taubman 1988).

12.6.3 Key points for colic

- Colic is episodic inconsolable crying in an otherwise healthy infant. Its cause is unknown. The first step to take with colic is to seek a health practitioner's advice.
- Colic will usually begin in the infant's first three weeks of life and can continue for 12–16 weeks.
- Recommended treatments include cuddling, rocking and massaging the infant. Other methods include changing infant feeding practices. However, changes to infant feeding practices should be made only under a doctor's or dietitian's direction.

12.7 Constipation and diarrhoea

Constipation and diarrhoea are common causes of concern for parents and other caregivers. However, defining constipation and diarrhoea depends on what is normal or usual for the infant and what is considered a change in their bowel habits. Normality in infants' bowel habits varies greatly, and straining to pass a stool is not uncommon or necessarily abnormal. Therefore, it is important to educate parents about the wide variation in normal bowel function.

Constipation and diarrhoea can be symptoms of food allergy or intolerance (see section 12.5: Food allergies and food intolerances).

12.7.1 Constipation

Definition of constipation in children

Stool frequency reduces progressively in early childhood, from more than four stools a day to one to two a day by four years of age, by which age 98 percent of children are toilet trained. Constipation is typically characterised by infrequent bowel motions, large hard stools, and difficult or painful defecation (Rubin and Dale 2006).

Constipation is considered a change in bowel habits to harder, less frequent stools, and diarrhoea is a change to looser, more frequent stools. Infants who are exclusively breastfed in response to their hunger cues commonly have soft motions whereas infants who are formula fed often have firmer motions.

Causes of constipation

For 90–95 percent of children with constipation, the problem is functional (for example, a diet low in fibre, dehydration, changing from breast milk to infant formula or changing infant formula), and a family history of constipation may be present. Case-control studies have shown an association between constipation and low dietary fibre and a lower energy and nutrient intake (Rubin and Dale 2006).

Most children with constipation are developmentally normal. Psychosocial factors are often suspected, and some studies have reported higher levels of behavioural disorders in children with constipation, with or without incontinence, although it is unclear whether these precede the problem or are a maintaining factor (Rubin and Dale 2006).

Chronic constipation can lead to progressive faecal retention, distension of the rectum, and a loss of sensory and motor function (Rubin and Dale 2006).

An infant or toddler who is not getting sufficient fluids will become dehydrated. Their urine will become darker and stronger smelling as it becomes more concentrated. More fluid will be extracted from the intestine, resulting in hard, pellet-like motions.

Constipation may occur in infants when they move from breast milk to infant formula or change infant formula. If a formula-fed infant becomes constipated, it is worth checking that the formula is made up correctly and is being offered in response to hunger cues. If the formula is too concentrated (that is, if more powder is used than is recommended), the infant may be getting insufficient fluids for adequate kidney excretory function.

For infants eating complementary foods, increasing their fruit intake may help, as well as increasing their intake of water.

Medical advice should be sought if constipation persists for more than a week.

12.7.2 Diarrhoea

Definition of diarrhoea in children

Diarrhoea is considered a change to looser, more frequent stools.

Dangers from diarrhoea

The main danger from diarrhoea is dehydration, especially in infants under six months of age.

Breastfed infants with diarrhoea should continue to receive breast milk and be offered extra feeds. Formula-fed infants with diarrhoea should continue to receive formula. Any changes to the feeding of an infant should be under the direction of a doctor or dietitian. Offering a toddler small drinks of cool fluids or breast milk every 10 minutes will help to ensure the toddler remains hydrated.

Treatment for diarrhoea

The optimal treatment for diarrhoea is rehydration through the use of breast milk, oral rehydration, electrolyte solutions, and the early reintroduction of feeding.

Medical advice should be sought if diarrhoea continues for more than 24–48 hours.

12.7.3 Key points for constipation and diarrhoea

- The definitions of constipation and diarrhoea depend on what is normal or usual for the infant and what is considered a change in bowel habits. Normality in infants' bowel habits varies greatly.
- Constipation in children is typically characterised by infrequent bowel motions, large hard stools, and difficult or painful defecation.
- In most children with constipation, the problem is functional (for example, a diet low in fibre, dehydration, changing from breast milk to infant formula or changing infant formula), and there may be a family history of constipation.
- Chronic constipation can lead to progressive faecal retention, distension of the rectum and loss of sensory and motor function.
- The main danger from diarrhoea is dehydration, especially in infants under six months of age.
- Offering small drinks of cool fluids or breast milk every 10 minutes will help to ensure a toddler remains hydrated.
- Seek medical advice if constipation persists for more than a week or diarrhoea continues for more than 24–48 hours.

12.8 Probiotics in infant formula

12.8.1 Definition and role of probiotics

Probiotics are 'live microorganisms, which when administered in adequate amounts confer a health benefit on the host' (FAO and WHO Working Group 2002, p 8).

There are many different strains of probiotics, the most common are strains of *Bifidobacterium* or *Lactobacillus* species (Broekaert and Walker 2006). Both species are lactic acid-producing bacteria that occur naturally in the gut. They produce short-chain fatty acids as well as acetate and lactate as a result of carbohydrate fermentation (see section 12.9: Prebiotics in infant formula), and are responsible for increasing the acidity of the gut, which is a desirable effect. Lactobacilli also produce compounds that inhibit growth of harmful bacteria (Broekaert and Walker 2006).

Probiotics are thought to improve gut barrier function and host immune response (Saavedra 2004).

The breast milk of healthy mothers can contain up to 10^9 microbes per litre of beneficial bacteria (Mackie et al 1999). Breast-fed infants have been shown to have more Lactobacilli and Bifidobacteria in their intestines than formula-fed infants have (ESPGHAN 2003). A bifidus-dominated flora is considered protective because it may activate the immune system and prevent harm due to pathogens (Gibson and Roberfroid 1995).

12.8.2 Regulatory status of probiotics in infant formula

The Australia New Zealand Food Standards Code allows the addition of probiotics in infant formula products and infant foods (FSANZ 2002). As a result, probiotics are added to some infant formula sold in New Zealand in an attempt to make it more like breast milk.

12.8.3 Efficacy of probiotics in infant formula

When considering research that tests the efficacy and safety of adding probiotics in infant formula it has been noted that the properties of different probiotic species can be strain-specific. Therefore, research findings can be attributed only to the strain studied and not generalised to other probiotics (Boyle et al 2007).

Recent research suggests that infant formula containing *Lactobacillus reuteri* and *Bifidobacterium lactis* (specific strains of probiotics) may reduce the severity and/or occurrence of diarrhoea (Weizman et al 2005). There has also been a suggestion that probiotics may have a role in preventing and managing allergic disease (Salminen et al 2005), but more research is needed to confirm this (Osborn and Sinn 2007).

Saavedra et al (2004) concluded that the long-term consumption of formula supplemented with *Bifidobacterium lactis* and *Streptococcus thermophilus* was well tolerated and safe. Use of the formula resulted in adequate growth, a significant reduction in colic or irritability, and a significantly lower frequency of antibiotic use compared with the results in the group using standard formula. However, questions of validity around this study have been raised, because some of the subjects were being breastfed up to two times a week as well as receiving the formula (Falk et al 2004). Boyle et al (2007) in a more recent review of the safety of probiotics found them to have an excellent overall safety record, but that they should be used with caution in immuno-compromised infants. Documented case reports of sepsis in vulnerable infants do exist.

In summary, the efficacy of probiotics in infant formula is yet to be confirmed and the Ministry of Health's position remains, exclusive breastfeeding is recommended for the first six months of life. Probiotics found in breast milk provide an immune protective benefit to their host, stimulates antibody production and improves phagocytosis by blood leukocytes (Lawrence and Lawrence 2005).

12.8.4 Key points for probiotics

- Probiotics are live microorganisms, which when administered in adequate amounts confer a health benefit on the host (FAO and WHO Working Group 2002, p 8).
- There are many different strains of probiotics, the most common are strains of *Bifidobacterium* or *Lactobacillus* species.
- Probiotics may improve gut barrier function and host immune response.
- Breast-fed infants have been shown to have more Lactobacilli and Bifidobacteria in their intestines than formula fed infants.
- When considering the cost-benefit of adding probiotics to infant formula, research findings are equivocal.

12.9 Prebiotics in infant formula

12.9.1 Definition of prebiotic

A prebiotic is a food ingredient that is resistant to digestion in the small intestine (Collins and Gibson 1999). It is fermented by one or a few beneficial bacteria (like Bifidobacteria and Lactobacilli) in the large intestine, which, in turn, stimulates the growth and activity of this bacteria. This improves the health of the host by altering the intestine toward a healthier balance of bacteria.

12.9.2 Oligosaccharides

Oligosaccharides are short chain carbohydrates (see Table 9 in section 10.2). Fructo-oligosaccharides, inulin and galacto-oligosaccharides are non-digestible oligosaccharides that can act as prebiotics in the colon. They are fermented by and promote the growth and activity of Lactobacilli and Bifidobacteria.

Fructo-oligosaccharides and inulin are naturally found in foods such as bananas, onions and chicory root. Fructo-oligosaccharides and inulin may also be extracted from plant tissues or synthesised. Galacto-oligosaccharides can be synthesised from lactose.

Breast milk contains oligosaccharides, predominantly galactose-containing, at 5–8 g/L. The oligosaccharides in breast milk have been shown to demonstrate a prebiotic effect in infants (Ward et al 2006).

Cows' milk-based formula contains only trace amounts of oligosaccharides. In some countries infant formula is supplemented with prebiotics. This modification is primarily aimed at altering the intestinal flora of formula-fed infants to more closely resemble that of breast-fed infants (Ghisolfi 2003).

12.9.3 Regulatory status of prebiotics in infant formula

For the regulatory status of prebiotics in infant formula, see standard 2.9.1 of the Australia New Zealand Food Standards Code (FSANZ 2002).

12.9.4 Key points for prebiotics

- Oligosaccharides are short chain carbohydrates, some of which are non-digestible and act as prebiotics in the colon.
- Breast milk contains oligosaccharides that have been shown to demonstrate a prebiotic effect in infants. Cows' milk-based formula contains only trace amounts of oligosaccharides.
- The supplementation of infant formula with prebiotics is aimed at altering the intestinal flora of formula-fed infants to more closely resemble that of breast-fed infants.

12.10 Gastro-oesophageal reflux

12.10.1 Definition of gastro-oesophageal reflux

Many newborn infants (in the first four weeks of life) suffer from gastro-oesophageal reflux. Gastro-oesophageal reflux is a condition in which stomach contents travel backward from the stomach to the oesophagus and can involve frequent spills of large amounts of undigested milk. Spilling after feeds in most cases is harmless, although it can worry parents and caregivers.

No treatment is required, apart from careful handling after feeds, if:

- spilling is infrequent (that is, it does not happen after every feed)
- only a small amount of undigested milk is in the spill
- the infant is growing along their centile.

If the infant is spilling frequently, or is failing to thrive, medical assistance should be sought.

Spilling may be able to be minimised by feeding the baby in a more upright position (breast or bottle feeding) and winding them frequently.

12.10.2 Treatment for gastro-oesophageal reflux

Treatment for gastric reflux, as recommended by a health practitioner, can include the thickening of feed. Thickeners are available that can be added to expressed breast milk or fed from a teaspoon before breastfeeding or between changing from one breast to another. It is not recommended that breastfed infants with gastro-oesophageal reflux change to thickened formula.

Thickeners can also be added to infant formula. Several formula companies produce special formula that is thickened to assist gastro-oesophageal reflux. These products are suitable for a full-term infant so may help formula-fed infants with gastro-oesophageal reflux. Advice on their use should be sought from a health practitioner such as a Well Child provider or general practitioner.

12.10.2 Key points for gastro-oesophageal reflux

- Infants with gastro-oesophageal reflux may have frequent and large spills of undigested milk during and after feeding.
- Gastro-oesophageal reflux is a common condition in newborn infants, and in most cases is harmless and no treatment is required
- The treatment for gastric-oesophageal reflux may include thickening the feed.
- Thickeners can be added to expressed breast milk or fed from a teaspoon before breastfeeding.
- Formula companies produce special thickened formula to assist gastro-oesophageal reflux.
- If the infant is spilling frequently, or is failing to thrive, medical assistance should be sought.

12.11 Overweight and obesity

In recent years, there have been rapid increases in the occurrence of childhood overweight and obesity. This is of public health concern because significant health problems are associated with child obesity, notwithstanding the psychological issues resulting from the social stigma of obesity. Additionally, the probability of obesity and associated diseases in adulthood is substantially greater for the obese child (American Academy of Pediatrics 2003).

The prevalence of overweight and obesity is increasing in New Zealand (Ministry of Health 2004d). There is little New Zealand data about overweight and obesity in infants and toddlers.

Compared with the 'ideal' growth of infants and toddlers seen in the WHO growth standards (see section 9.1.4: Assessment of growth) New Zealand infants, as defined by the New Zealand growth charts (1991), tend to be heavier and shorter than the WHO standard. A British-based expert group that investigated the WHO growth standards believes these 'new standards could be an effective tool for detecting both under nutrition and obesity' (SACN and RCPCH Expert Group 2007).

Even if increased levels of overweight were found among infants, any intentional restriction of weight gain, through dieting or the withholding of food, is inappropriate (NHMRC 2003). Infancy and, albeit to a less extent, early childhood are periods of rapid growth.

12.11.1 Causes of and mitigating factors in childhood overweight and obesity

There is some evidence that breastfeeding probably reduces the risk of obesity in later childhood and adulthood (see Appendix 11).

It is recognised that genetics are involved in causing obesity. However, the rapid increase in obesity in recent years cannot be attributed to genetics alone. Dominant environmental factors must be considered. The current physical, sociocultural, economic and political environments in New Zealand, as in other Western countries, are believed to be contributing significantly to the rapid increase in obesity. So much so, that our environment is known as an obesogenic (obesity-promoting) environment (Egger and Swinburn 1997).

Historically, responsibility for being overweight or obese was considered individual. With a greater understanding of the factors that influence body weight, the impact of the wider environment on the lives of individuals and families is being taken into account. Examples are the increase of and access to high-energy low-nutrient foods, decreased opportunities for physical activity in every day life, and the increased cost of high-nutrient lower-energy foods.

Until the environment changes, no significant lowering of the obesity rates is likely to be seen. As a result, new public health initiatives in New Zealand are using strategies that focus on creating healthier environments to tackle the growing rate of overweight and obesity (Minister of Health 2003; Ministry of Health 2004a).

Although considerable research has been undertaken in relation to child obesity, information on infants and toddlers is more limited. In addition to the significant influence of the wider or macro-environment, key areas in the immediate or micro-environment relating to obesity risk in children have emerged: parenting practices, fatness in parents and dieting history (Birch and Fisher 1998).

It is important to recognise the impact of the family's diet on that of the child (Greer et al 2006). Parents create their children's eating environment through their choice of infant-feeding methods, the foods they make available, their behaviour, the media exposure the child has in the home, and the way they interact with the child at mealtimes. For example, there are associations between a parent's fat intake, their child's fat intake and the child's degree of body fat (Birch and Fisher 1998).

Studies have also shown that preschool children will consume more food when served consistently with larger portions. This effect is particularly pronounced in children who have poor satiety responses. Researchers found that allowing children to self-select their own portion sizes circumvented this problem (Fisher et al 2003).

Studies show that parental directives encouraging or restricting intakes of various foods can have adverse consequences; that is, children may prefer foods that parents deem to be 'bad' and restrict, and avoid foods parents deems to be 'good' and make available.

Studies have also shown that children have an innate ability to regulate their energy intake when a range of healthy foods are provided, and attempts by parents to control the energy intake of children may have the opposite effect (Birch and Fisher 1998). Recent research has provided longitudinal evidence of this effect in five-year-old girls (Birch et al 2003). In this study, mothers' restrictive feeding practices on their five-year-old daughters were associated with increased episodes of the girls eating in the absence of hunger in later years, a behaviour prevalent in overweight adults.

A recent report from an American Academy of Pediatrics-linked multidisciplinary expert committee on childhood overweight and obesity recommended that efforts are needed from birth to prevent obesity (Barlow 2007). Obesity in childhood, especially among older children and those with more-severe obesity, is likely to persist into adulthood. Childhood represents an important opportunity to establish healthy eating and activity behaviours that can protect children from future obesity. The report recommends that clinicians advise and support families to adopt and maintain the following behaviours: limit the consumption of sugar-sweetened beverages; encourage the consumption of vegetables and fruit as part of a healthy balanced diet; do not let children under two years of age watch television; eat breakfast daily; limit high-energy low-nutrient 'fast foods'; and encourage family meals in which parents or other caregivers and children eat together.

In addition, the committee recommended that growth patterns in under-twos be monitored using weight-for-height charts, as an alternative to body mass index charts. Weight-for-height values above the 95 percentile in the under-two age group can be categorised as ‘overweight’. However, as mentioned above, any intentional restriction of weight for this age group is inappropriate. The focus needs to be on promoting a healthy lifestyle within the family.

Physical activity is important for normal growth and development, and regular fun activity should be part of an infant’s and toddler’s life. Physical activity and dietary practices set during the first two years of life form the framework of future practices, so should be modelled and encouraged by parents and other caregivers. (See section 11: Physical activity.)

12.11.2 Key points for overweight and obesity

- There is little New Zealand information about overweight and obesity in infants and toddlers.
- There is a probable association between breastfeeding and reduced risk of obesity in later childhood and adulthood.
- Strategies to create healthier food and physical activity environments for families may help to slow the development of overweight and obesity.
- An intentional restriction of weight gain in an infant or toddler is inappropriate. If there are concerns about the growth of an infant or toddler, see a health practitioner.
- The focus for families with under-twos should be on promoting a healthy lifestyle within the family.

12.12 Oral health for healthy infants and toddlers

12.12.1 Fluoridated drinking-water most effective measure for preventing dental caries

The fluoridation of drinking-water is the most effective measure for preventing dental caries. It has a proven beneficial effect on dental health. Recent New Zealand studies have confirmed the continued beneficial effect of water fluoridation on prevalence and severity of dental caries in children (Lee and Dennison 2004; Mackay and Thomson 2005). Children who have been drinking fluoridated water since infancy show the greatest benefits.

12.12.2 Children’s entitlement to free basic dental care

In New Zealand, children are entitled to free basic dental care from birth to the end of year 8 (form 2). For information on how to enrol a child for free dental care, see the Ministry of Health’s Oral Health webpage (www.health.govt.nz/oralhealth).

12.12.3 Key points for oral health for healthy infants and toddlers

- Use fluoride toothpaste to clean children’s teeth twice a day from the time their first tooth erupts.
- Use a smear of toothpaste on each teeth-brushing occasion, and make sure the child does not ingest toothpaste by making sure an adult supervises teeth-brushing.
- Full strength (also known as adult strength) toothpaste, which contains 1000 ppm of fluoride, is recommended for infants and toddlers.
- Avoid leaving a feeding bottle in the mouth of a sleeping infant or using one as a pacifier.
- Avoid night-time and long-term use of infant bottles containing liquids other than water.
- Do not dip pacifiers or bottle teats in sugar or honey.

- Dried fruit is not recommended as a snack between meals because it sticks to teeth and is cariogenic.
- For more information on oral health for infants and toddlers see: *Healthy Smile, Healthy Child: Oral Health Guide for Well Child Providers* (New Zealand Dental Association 2008). This document is available at: www.healthysmile.org.nz

See also section 10.4.6: Fluoride.

12.13 Food safety

12.13.1 General information

Food is easily contaminated by a range of micro-organisms and needs to be handled with care to prevent illness in infants and toddlers. Appropriate food handling and preparation reduces the risk of infants and toddlers contracting serious food-borne illnesses, such as salmonellosis and campylobacteriosis.

For more information on food safety, see: www.foodsmart.govt.nz

12.13.2 Infant botulism and honey

Infant botulism occurs in infants under one year of age (Midura 1996), and is caused by the toxin produced when ingested spores of *Clostridium botulinum* germinate in the intestinal tract. Unlike the gut in older children and adults, the gut flora of infants under one year of age is unable to prevent colonisation by *Clostridium botulinum*. While most bacteria responsible for food borne illness are usually destroyed by the cooking process, *Clostridium botulinum* spores survive standard cooking temperatures.

Honey has been associated with cases of infant botulism in the United States, Japan, Argentina, Italy and Denmark, but not in the six cases of infant botulism confirmed in the United Kingdom since 1978 (ACMSF 2005). In the United States, the ingestion of honey was suspected in up to 15 percent of cases (Shapiro et al 1998). *Clostridium botulinum* spores have been found in up to 20 percent of honey samples worldwide, but no formal studies on the presence of *Clostridium botulinum* in honey have been undertaken in New Zealand. The risk of contracting infant botulism from honey is extremely small.

As a general recommendation, honey should not be given to infants younger than one year of age. This is to ensure consistency with the New Zealand recommendation not to add sugar or sweeteners to food for infants and because in many countries honey is not recommended before one year of age.

12.13.3 Key points for food safety

- Wash and dry hands with soap and dry with a clean towel before preparing food.
- Wash all equipment thoroughly in hot soapy water. Rinse it well in hot water and air dry it.
- Sterilise all equipment until infants are three months old. Boil bottles and teats or use an appropriate sterilising solution, following the manufacturer's instructions.
- For infants older than three months, wash all of the infant's utensils in hot soapy water, rinse well in hot water, and dry with a clean tea towel, or wash and dry them in a dishwasher.
- Most home-prepared and commercial infant foods can be kept in a covered container in the refrigerator for up to 48 hours. Only take out of the refrigerator or freezer sufficient food to feed an infant at one feed time.

- Refrigerators should have a mid-fridge temperature of 2–4°C.
- Throw out food an infant has not eaten at the end of the meal and/or food sitting at room temperature for more than two hours.

12.14 Food security

12.14.1 Definition of food security

Food security is an internationally recognised term that encompasses the ready availability of nutritionally adequate and safe foods and a person's assured ability to acquire personally acceptable foods in a socially acceptable way (LRSO 1990).

12.14.2 Importance and effect of food security

Food security is an issue for almost half the households with children in New Zealand (Parnell et al 2005). However, Parnell et al examined households with children aged from five to 14 years, so the study cannot be extrapolated to households with infants and toddlers.

The magnitude of effect of food insecurity on the health of young children is unknown. A study by Rose-Jacobs et al (2008) found caregivers in food-insecure households were two-thirds more likely than caregivers in food-secure households to report that their children were at developmental risk. Generally, however, there is no evidence demonstrating a cause and effect relationship between food insecurity and ill health mediated by nutrition in infants and toddlers. More research is needed in this area.

12.14.3 Key points of food security

- Food security is an issue for many households with children in New Zealand.
- The magnitude of effect of food insecurity on the health of young New Zealand children is unknown. More research is needed.

12.15 Feeding infants and young children in an emergency

In New Zealand, the risks posed by natural and man-made hazards are a fact of life. The World Health Organization Global Strategy for Infant and Young Child Feeding highlights that in emergencies, infants are among the most vulnerable people (WHO 2003).

In emergencies mothers should be encouraged and supported to continue breastfeeding their infants. If breast milk is not available, it may be necessary to feed infant formula temporarily until breast milk is available again in sufficient quantity.

For infants and children you may have to rely on the following emergency survival items (Ministry of Civil Defence and Emergency Management 2008):

- at least a 3-day supply of food, formula and drink
- change of clothing and nappies
- toys or favourite activity.

See Ministry of Civil Defence and Emergency Management website (<http://www.getthru.govt.nz/Civil-Defence-Home.30.html>) for more information on emergency survival items.

Glossary

adequate intake (AI)	The average daily nutrient intake level based on observed or experimentally determined approximations or estimates of nutrient intake by a group (or groups) of apparently healthy people that are assumed to be adequate. Used when a recommended dietary intake cannot be determined.
alpha-linolenic acid	An omega-3 fatty acid with 18 carbon atoms that is found in soybean, canola, flaxseed, walnut oils, nuts and seeds.
amylase	An enzyme involved in food digestion that breaks down amylose (a form of starch).
anaemia	Having less haemoglobin than is normal for a person's age and sex. A diagnosis of iron deficiency anaemia is made when anaemia is accompanied by laboratory evidence of iron deficiency, such as low serum ferritin.
anaphylaxis	A rapidly evolving, generalised multi-system allergic reaction characterised by one or more symptoms or signs of respiratory and/or cardiovascular involvement and the involvement of other systems such as the skin and/or the gastrointestinal tract. It is the end result of major mast cell degranulation, triggered by immunoglobulin E- (IgE-) dependent or independent mechanisms. Common triggers include food, stinging insects and medication. Exercise and alcohol are important co-factors in some patients.
antigen	A substance, usually a protein, that can stimulate the production of antibodies and react specifically with those antibodies. An antigen may be a bacterium or pollen grain. Each antigen requires a different antibody to neutralise it.
antigenicity	The strength or potency of an antigen.
arachadonic acid	An omega-6 fatty acid with 20 carbon atoms that is found in egg yolk and meats (particularly organ meats).
atopy	The genetic tendency to develop the classic allergic diseases such as eczema (atopic dermatitis), hay fever (allergic rhinitis) and asthma. Atopy involves the capacity to produce immunoglobulin E (IgE) in response to common environmental proteins, such as house dust mites, grass pollen and food allergens. The diagnosis of atopy is not based on one single distinctive clinical feature or laboratory test but on results from a combination of patient and family history and clinical findings.
atua	Gods.
basal metabolic rate	The amount of energy required to sustain basic essential processes for keeping the body alive, healthy and growing, such as heart, lungs, nervous system and kidneys. It is measured when an individual is at rest in a warm environment, is in the post-absorptive state (that is, they have not eaten for at least 12 hours) and is disease free.
bioavailability	The degree to which a drug or nutrient (for example, iron) becomes available for use by the body after administration or ingestion.
cariogenic	Producing or promoting the development of tooth decay.
casein	Milk proteins are divided into two groups: casein (curd) and whey proteins. Casein is the predominant phosphoprotein in milk, precipitated by acids and rennet.
casein to whey ratio	Cows' milk has a higher casein to whey protein ratio (80:20) than human milk (40:60).
Children's Nutrition Survey (CNS)	A cross-sectional population survey of New Zealanders aged five to 14 years, undertaken by the Ministry of Health in 2002.
Codex Alimentarius Commission	The United Nations joint body, comprising the Food and Agriculture Organization and World Health Organization, developed for setting international food standards.

colostrum	The first milk secreted from the breasts after childbirth. It contains a large amount of protein and immunising factors for the newborn.
contraindication	A sign, symptom or condition suggesting that a certain line of treatment should be discontinued or avoided.
diabetes mellitus	A diagnosis when levels of glucose are abnormally elevated in the blood. It is usually caused by a lack of insulin or by the body's inability to use insulin efficiently. The two most common types of diabetes mellitus are Type 1 and Type 2.
dietary folate equivalents	Recommended folate intake is expressed as a dietary folate equivalent to account for differences in the bioavailability of food folate and synthetic folic acid. One microgram (1 µg) of dietary folate equivalents equals: <ul style="list-style-type: none"> • 1 µg of folate from food • 0.5 µg of a folic acid tablet taken on an empty stomach • 0.6 µg of folic acid from fortified food or taken as a tablet with meals.
docosahexaenoic acid (DHA)	An omega-3 fatty acid with 22 carbon atoms. Dietary sources include: fish (especially canned tuna).
eicosapentanoic acid (EPA)	An omega-3 fatty acid with 20 carbon atoms. Dietary sources include: fish (especially canned tuna).
essential amino acids	See indispensable amino acids.
estimated average requirement (EAR)	A daily nutrient level estimated to meet the requirements of half the healthy individuals in a particular life stage and gender group.
exclusive breastfeeding	The infant takes only breast milk and no additional food, water or other fluids with the exception of medicines prescribed under the Medicines Act 1981.
fatty acids	A component of fat consisting of a chain of carbon atoms with hydrogens attached, a methyl group at one end and a carboxyl group at the other. Fatty acids are classified as short (fewer than 8 carbons), medium (8–12 carbons) or long (14 or more carbons) chains, and saturated or unsaturated. Some fatty acids are essential.
folate	A generic term for the various forms of folate found in food. It is involved in the metabolism of nucleic and amino acids, and hence the synthesis of deoxyribonucleic acid (DNA), ribonucleic acid and proteins.
folic acid	A synthetic form of folate which is found in supplements and fortified foods and beverages. It is more bio-available and stable than folate in food.
fontanelle	The points on the crown and base of the head where the skull bones will join together.
food security	Access to adequate, safe, affordable and acceptable food.
full breastfeeding	The infant has taken breast milk only, and no other liquids or complementary foods except a minimal amount of water or prescribed medicines, in the past 48 hours.
galactosaemia	A rare inherited condition in which the infant is unable to metabolise galactose to glucose.
gamma linolenic acid	An omega-6 fatty acid with 18 carbon atoms. Dietary sources include: evening primrose and blackcurrant oils.
gastro-enteritis	An inflammation of the lining of the stomach and intestine, usually caused by a bacterial, viral infection, or food poisoning which may result in vomiting or diarrhoea.
glutathione peroxidase	An antioxidant enzyme that is used to assess selenium status.

goitre	An enlargement of the thyroid gland, forming a swelling on the side or front of the neck. It is often associated with iodine deficiency.
glycaemic index	Measures the rise in blood glucose after a portion of carbohydrate-containing food is eaten compared with the rise in blood glucose after a standard food (usually white bread or glucose) is eaten. The index is usually expressed as a percentage.
haem	The iron-containing part of the haemoglobin protein. Around 40 percent of the iron in meat, fish and poultry is haem iron, and the other 60 percent is non-haem iron.
haemoglobin	The protein carrying oxygen in the red blood cells.
Hapū	Subtribe.
HEAT	Health Equity Assessment Tool.
hyperthyroidism	Excessive activity of the thyroid gland, characterised by a high metabolic rate, heat intolerance and weight loss.
hypoglycaemia	Very low blood sugar levels.
hypotension	Abnormally low blood pressure.
immunoglobulins	A group of globulins capable of reacting specifically as antibodies (for example, IgA, IgG, IgM).
indispensable amino acids	The nine amino acids required for protein synthesis that cannot be synthesised by the body and must be obtained through the diet. These amino acids are histidine, isoleucine, leucine, lysine, methionine, phenylalanine, threonine, tryptophan and valine. (These used to be known as essential amino acids.)
infant	A child in the first 12 months of life.
insulin	A polypeptide hormone that regulates carbohydrate metabolism. As well being the primary effector in carbohydrate homeostasis, it takes part in the metabolism of fat, triglycerides and proteins. It has anabolic properties.
insulin resistance	The decreased sensitivity of target cells (muscle and fat cells) to insulin.
international unit (IU)	A unit of measurement for the amount of a substance such as a vitamin, hormone, or toxin, based on measured biological activity or, effect.
iron-deficiency anaemia (IDA)	Depleted iron stores based on low serum ferritin, low serum iron and transferrin saturation percentage, and low haemoglobin.
iron-deficient erythropoiesis	Depleted iron stores based on low serum ferritin, low serum iron and transferrin saturation percentage, and normal haemoglobin.
iron depletion	Low iron in tissue based on a fall in serum ferritin, normal serum iron, transferrin saturation percentage, and haemoglobin.
iwi	Tribe.
kai	Food.
kai moana	Seafood.
kamokamo	Marrow.
kina	Sea-eggs.
kōura	Crayfish.
kūmara	Sweet potato.
lactoferrin	A factor in breast milk that binds iron and prevents bacteria from metabolising iron. It helps antibodies to resist certain infectious diseases.

lacto and lacto-ovo vegetarians	Lacto vegetarians eat only plant foods and milk and milk products. Lacto-ovo vegetarians eat only plant foods, milk and milk products, and eggs.
long-chain polyunsaturated fatty acids (LCPUFAs)	Longer-chain fatty acids that are derived from the essential fatty acids and are precursors to hormone-like eicosanoid compounds, prostaglandins and leukotrienes. These fatty acids occur in food and can be made from the essential fatty acids.
low density lipoprotein	A class and range of lipoprotein particles, varying somewhat in size and content, that carry cholesterol in the blood and around the body for use by various cells. Low density lipoprotein is commonly referred to as ‘bad’ cholesterol because of the link between high low density lipoprotein levels and cardiovascular disease.
mahikai	The gathering of food.
mana	Prestige.
manaakitanga	The acts of caring well for guests.
manuhiri	Visitors.
metabolism	The uptake and digestion of food and the disposal of waste products in living organisms.
methionine	An essential amino acid containing sulphur.
mokopuna	Grandchildren.
monounsaturated fatty acid	A type of unsaturated fatty acid in which there is one double bond between the carbon atoms of the fatty acid chain. Dietary sources include olive, canola and peanut oils. The body also synthesises monounsaturated fatty acids.
niacin equivalents	The nicotinic acid, nicotinamide and contribution to niacin obtained by conversion from dietary l-tryptophan. The relative contribution of tryptophan is estimated as: 60 mg of l-tryptophan = 1 mg of niacin = 1 mg of niacin equivalents
non-starch polysaccharide	A form of dietary fibre than can be one of two types: insoluble and soluble. Most plant foods contain varying proportions of both types. Good sources of insoluble non-starch polysaccharides include wheat, corn, rice, vegetables and pulses. Good sources of soluble non-starch polysaccharides include peas, oats, dried beans, lentils, barley, pasta and fruit.
nucleotides	The structural units of ribonucleic acid,(RNA), deoxyribonucleic acid (DNA) and several cofactors including: flavin adenine dinucleotide (FAD), coenzyme A (CoA), flavin mononucleotide (FMN), nicotinamide adenine dinucleotide (NAD), and nicotinamide adenine dinucleotide phosphate (NADPH). In the cell, they play important roles in energy production, metabolism and signalling.
nutrient reference values (NRVs)	A set of recommendations, including recommended dietary intakes, for intakes of nutrients.
omega-3 fatty acid	A polyunsaturated fatty acid that is found in oily fish and vegetable oils, nuts and seeds. Some omega-3 fatty acids are classed as essential fatty acids. Common omega-3 fatty acids in the body are linolenic, eicosapentaenoic acid and docosahexaenoic acid.
omega-6 fatty acid	A polyunsaturated fatty acid that is found in vegetable oils, green leafy vegetables, and nuts and seeds. Some omega-6 fatty acids are classed as essential fatty acids. Common omega-6 fatty acids in the body are linoleic acid, the shortest omega-6 fatty acid, and arachidonic acid.
Papatūānuka	Earth mother.

parengo	A type of seaweed.
pathogen	An infectious agent that causes disease or illness to its host.
pathogenic	Disease-causing.
phytates	The principal storage form of phosphorus in many plant tissues, especially grains, bran, legumes, seeds and nuts. They bind with minerals such as iron, calcium and zinc and make the minerals unavailable for absorption.
phytoestrogen	A compound with oestrogen activity that occurs naturally in plants. Phytoestrogens have a similar structure to oestrogen. They can act as both oestrogens and anti-oestrogens in the body, depending on their concentration and tissue specific receptors. Phytoestrogens also have a range of nonhormonal activities such as antioxidant activity.
polyunsaturated fatty acid	A type of unsaturated fatty acid in which there are two or more double bonds between the carbon atoms of the fatty acid chain. Dietary sources include seed oils such as sunflower, safflower and corn oils, and fish. Human milk contains not only essential fatty acids (18-carbon chain) but also very long-chain polyunsaturated fatty acids (20- or more carbon chain). These nutrients are essential for normal brain and eye development.
prebiotic	A food ingredient that is resistant to digestion in the small intestine. It is fermented by one bacterium or a limited number of beneficial bacteria (like Lactobacilli and Bifidobacteria) in the large intestine, which, in turn, stimulates the growth and activity of this bacteria. This improves host health by altering the intestine toward a healthier balance of bacteria.
probiotic	A live micro-organism that, when administered in adequate amounts, confers a health benefit on the host. There are many different strains of probiotics, the most common are strains of the <i>Bifidobacterium</i> or <i>Lactobacillus</i> species.
prophylactic	A medicine that protects or defends against infection and disease.
protein-hydrolysed formula	Cows' milk-based formula that has been treated to break down (hydrolyse) some or most of the milk proteins (casein and/or whey) that cause cows' milk allergy (CMA). The resulting formula is either partially or extensively hydrolysed, and consists of free amino acids and peptides of varying length. This formula is then fortified with amino acids to compensate for those amino acids lost in the manufacturing process. In general, the more extensive the hydrolysis, the greater the reduction in allergenicity, and the higher the price of the formula.
pūpū	Periwinkle.
Rangi	Sky father.
recommended dietary intake (RDI)	The average daily dietary intake level that is sufficient to meet the nutrient requirements of nearly all (97–98 percent) healthy individuals in a particular life stage and gender group.
retinol equivalent	The recommendation for vitamin A intake is expressed as micrograms of retinol equivalents. Retinol activity equivalents account for the fact the body converts only a portion of beta-carotene to retinol. One microgram (1 µg) of retinol equivalent equals 1 µg of retinol or 6 µg of beta-carotene.
rēwena	Bread.
rickets	An abnormal bone growth or softening of bones that is the result of vitamin D deficiency or malabsorption, which occurs mainly in children.
Rūaumoko	God of volcanoes and heat.

saturated fatty acid	A fatty acid in which there are no double bonds between the carbon atoms of the fatty acid chain. Saturated fats tend to be solid at room temperature. Diets high in saturated fat correlate in some studies with an increased incidence of atherosclerosis and coronary heart disease.
socioeconomic status	Social position, measured by an ordinal scale, indicating an individual's (or a family's or household's) relative position in a social hierarchy, based on criteria such as income level, occupational class or educational attainment.
tachycardia	Excessively rapid heartbeat.
tamariki	Children.
Tane	God of the forest.
Tangaroa	God of the sea.
taonga	Treasure.
taurine	An important component of bile acids, present in human milk in relatively high levels. Infants fed on low-taurine formula tend to conjugate bile acids with glycine rather than taurine. This may result in less-efficient fat absorption.
the Code in New Zealand	Implementing and Monitoring the International Code of Marketing of Breast-milk Substitutes in New Zealand: The Code in New Zealand.
tinana	Body.
toddler	A child in the second year of life.
Total Diet Survey	A periodic survey examining contaminants and selected nutrients in some commonly eaten New Zealand foods.
total energy expenditure	A term that encompasses basal metabolic rate, thermoregulation, the synthetic cost of growth, and physical activity.
triglycerides (or triacylglycerols)	Fat molecules composed of one glycerol and three fatty acids. Most of the fat in foods is in the form of triglycerides.
Triiodothyronine (T ₃)	A hormone made by the thyroid gland. It has three iodine molecules attached to its molecular structure. It is the most powerful thyroid hormone, and affects almost every process in the body, including body temperature, growth, and heart rate.
turgor	Skin elasticity; skin with decreased turgor remains elevated after pinching and is slow returning to its normal position, instead of quickly.
Type 1 diabetes mellitus	A disease caused by the destruction of insulin-producing cells, resulting in insulin deficiency. Previously known as insulin-dependent diabetes mellitus.
Type 2 diabetes mellitus	A disease of unknown cause but associated with a combination of insulin resistance and a relative insulin deficit. The major risk factors are obesity, increasing age, physical inactivity and nutritional factors such as a high intake of saturated fatty acids. It can usually be controlled by diet and physical activity, along with oral hypoglycaemic agents and (increasingly) insulin to control blood glucose levels. Also known as non-insulin-dependent diabetes.
ū	Breast.
ūkaipō	Breast, mother.
upper level of intake (UL)	The highest average daily nutrient intake level likely to pose no adverse health effects to almost all individuals in the population. As intake increases above the UL of intake, the potential risk of adverse effects increases.
vegan	A person who eats only plant foods and nothing of animal origin (that is, no eggs, milk or gelatine).

vegetarian	A person who does not eat or does not believe in eating meat, fish, fowl, or, in some cases, any food derived from animals, as eggs or cheese, but eats vegetables, fruits, nuts and grain.
whānau	Extended family.
whey	Milk proteins are divided into two groups: casein (curd) and whey proteins. Whey is the liquid remaining after cows' milk has been coagulated with rennet and strained. It is a by-product of the manufacture of cheese or casein. Whey proteins mainly consist of alpha-lactalbumin (α -lactalbumin) and beta-lactoglobulin (β -lactoglobulin).
wholegrain	The intact grain or the dehulled, ground, cracked, milled, cracked or flaked grain where the proportion of endosperm, germ and bran are typical of the proportion of the whole cereal. It includes wholemeal.
wholemeal	A product containing milled endosperm, germ and bran in proportions typical of the whole cereal.

Abbreviations

25-OHD	25-hydroxyvitamin D
µg	microgram/s
AA	arachidonic acid
ACC	Accident Compensation Corporation
AI	adequate intake
BFCI	Baby Friendly Community Initiative
BFHI	Baby Friendly Hospital Initiative
CDC	Centers for Disease Control (United States)
cm	centimetre/s
CMA	cows' milk allergy
CNS	National Children's Nutrition Survey (2002)
DHA	docosahexaenoic acid
DHB	District Health Board
DPA	docosapentaenoic acid
EAR	estimated average requirement
EER	estimated energy requirement
EPA	eicosapentaenoic acid
g	gram/s
HEHA	Healthy Eating – Healthy Action Oranga Kai – Oranga Pumau
HIV	human immunodeficiency virus
IDA	iron-deficiency anaemia
IgE	immunoglobulin E
IU	international unit
kcal	kilocalorie/s
kg	kilogram/s
kJ	kilojoule/s
L	litre/s
LCPUFA	long-chain polyunsaturated fatty acids
m	metre/s
MGRS	Multicentre Growth Reference Study
mL	millilitre/s
mg	milligram/s
mJ	megajoule/s
nmol	nanomole/s
PHC	Public Health Commission (New Zealand)
NRV	nutrient reference values
RDI	recommended dietary intake
SPARC	Sport and Recreation New Zealand
UL	upper level of intake
UNICEF	United Nations Children's Fund
UVI	ultraviolet index
UVR	ultraviolet radiation
WHA	World Health Assembly
WHO	World Health Organization

Appendix 1: Summary of the World Health Organization's International Code of Marketing of Breast-milk Substitutes

Aim of the International Code of Marketing of Breast-milk Substitutes

The aim of the World Health Organization's (WHO) International Code of Marketing of Breast-milk Substitutes is

'to contribute to the provision of safe and adequate nutrition for infants, by protecting and promoting breastfeeding and by ensuring the proper use of breast milk substitutes when these are necessary, on the basis of adequate information and through appropriate marketing and distribution' (WHO 1981, Article 1).

Key points

The key points from the International Code of Marketing of Breast-milk Substitutes are as follows (Ministry of Health 2007).

- Products should not be advertised or otherwise promoted to the public.
- Mothers and pregnant women and their families should not be given samples of products.
- Health care providers should not be given free or subsidised supplies of products and must not promote products.
- People responsible for marketing products should not try to contact mothers or pregnant women or their families.
- The labels on products should not use words or pictures, including pictures of infants, to idealise the use of products.
- Health workers should not be given gifts.
- Health workers should not be given samples of products, except for practitioner evaluation or research at the institution level.
- Material for health workers should contain only scientific and factual information and must not imply or create a belief that bottle-feeding is equivalent or superior to breastfeeding.
- All informational and educational materials for pregnant women and mothers, including labels, should explain the benefits and superiority of breastfeeding, the social and financial implications of its use, and the health hazards of the unnecessary or improper use of formula.
- All products should be of a high quality and take account of the climate and storage conditions of the country where they are used.

Context

In 1981, the World Health Assembly (WHA) adopted the WHO International Code of Marketing of Breast-milk Substitutes that recommended as a basis for action, various requirements and restrictions in relation to the marketing and distributing breast-milk substitutes. The New Zealand Government adopted the International Code in its entirety in 1983 through consensus and discussion rather than through regulation.

New Zealand implements and monitors the International Code as updated in a single standard reference document called *Implementing and Monitoring the International Code of Marketing of Breast-milk Substitutes in New Zealand: The Code in New Zealand* (Ministry of Health 2007). This was in response to a review that recommended a single standard reference document (Ministry of Health 2004b).

The Code in New Zealand includes the Code of Practice for Health Workers in New Zealand and, as an annex and for ease of reference, the Code of Practice for the Marketing of Infant Formula (NZIFMA 2007).

The publication of the Code in New Zealand is intended to ensure the International Code's spirit and intent become the guiding principles for all parties concerned with infant nutrition and the health and wellbeing of New Zealand families.

Appendix 2: World Health Organization and United Nation's Children's Education Fund Statement on the 10 Steps to Successful Breastfeeding

Baby Friendly Hospital Initiative

The Baby Friendly Hospital Initiative was designed by the World Health Organization (WHO) and United Nation's Children's Fund in 1991 to encourage hospital facilities to follow the Ten Steps to Successful Breastfeeding. The initiative is implemented in New Zealand by the New Zealand Breastfeeding Authority, on behalf of the Ministry of Health.

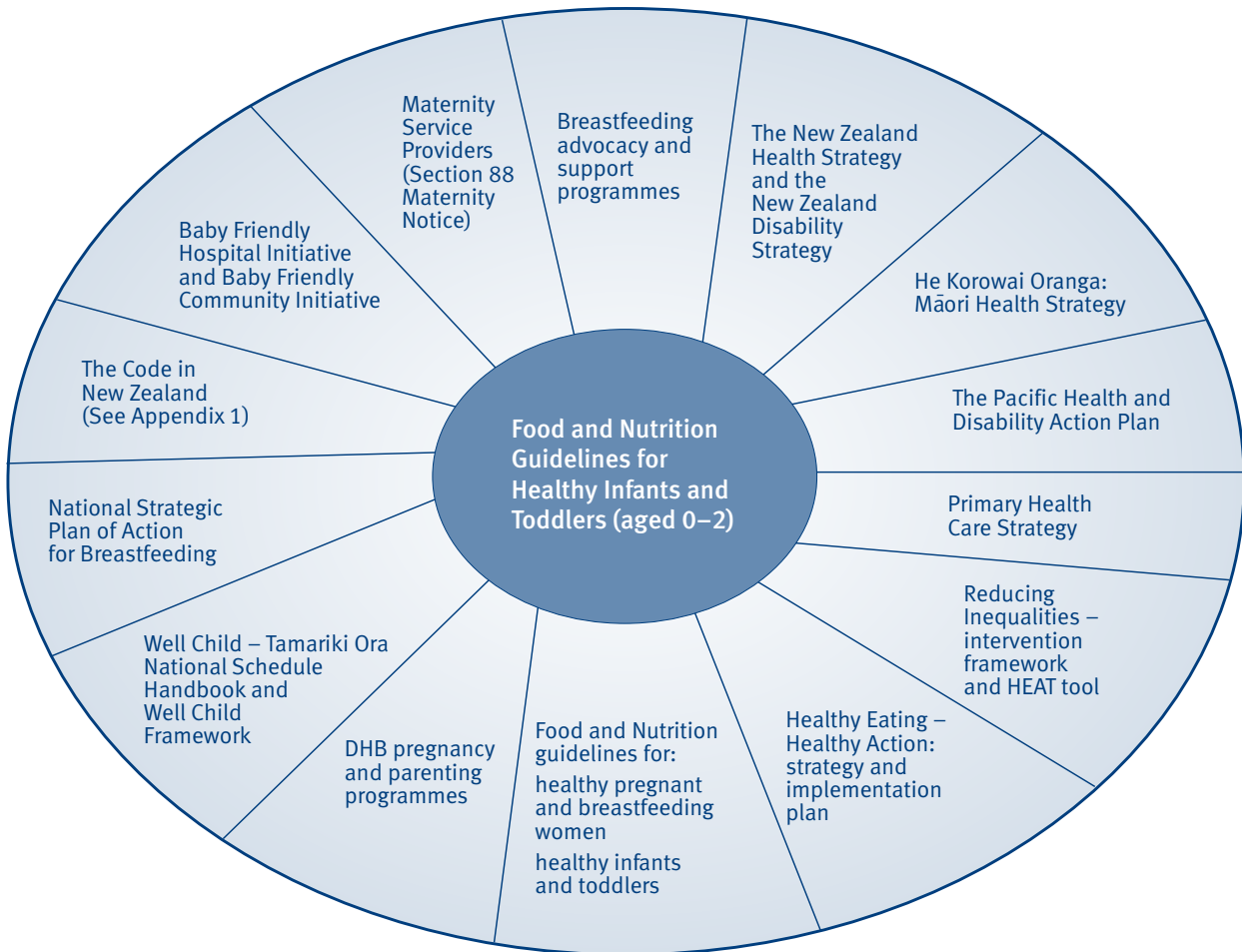
Ten Steps to Successful Breastfeeding

WHO (1989) states that every facility providing maternity services and care for newborn infants should:

- have a written breastfeeding policy that is routinely communicated to all health care staff
- train all health care staff in the skills necessary to implement this policy
- inform all pregnant women about the benefits and management of breastfeeding
- help mothers initiate breastfeeding within half an hour of birth
- show mothers how to breastfeed and how to maintain lactation even if they should be separated from their infants
- give newborn infants no food or drink other than breast milk, unless medically indicated
- practise rooming-in, so mothers and infants can remain together 24 hours a day
- encourage breastfeeding on demand
- give no artificial teats or pacifiers (also called soothers or dummies) to breastfeeding infants
- foster the establishment of breastfeeding support groups and refer mothers to such services on their discharge from the hospital or clinic.

Appendix 3: Ministry of Health’s Policy Context for *Food and Nutrition Guidelines for Healthy Infants and Toddlers (Aged 0–2): A background paper*

Figure 2: Ministry of Health’s policy context for *Food and Nutrition Guidelines for Healthy Infants and Toddlers (Aged 0–2): A background paper*



All documents associated with the areas identified in Figure 2 are available from:

Ministry of Health

Website: www.health.govt.nz

Wickliffe Limited

Postal address: PO Box 932, Dunedin,

Telephone: (03) 479 0979 or (04) 496 2277

Email: moh@wickliffe.co.nz

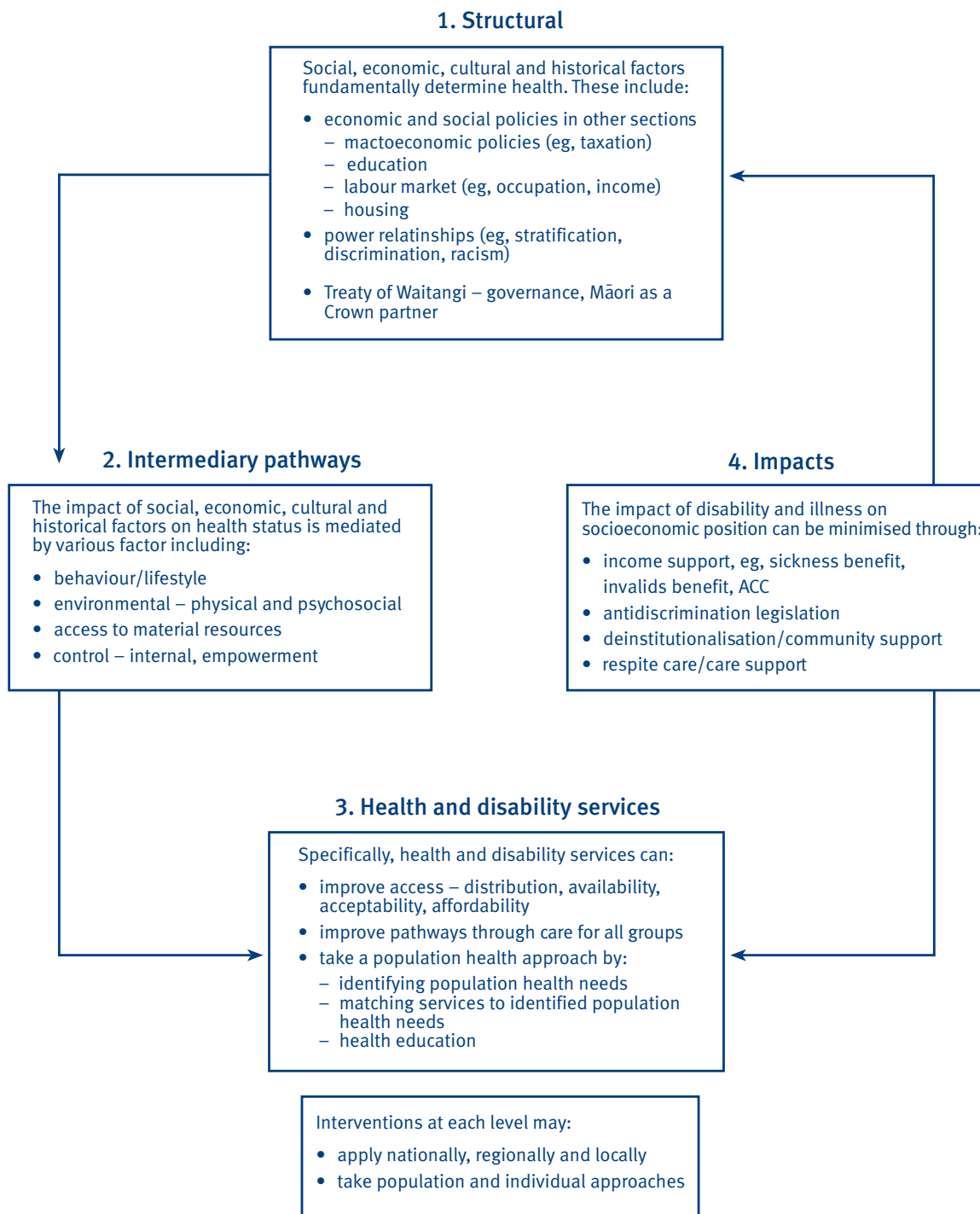
Appendix 4:

Reducing Health Inequalities: Health Equity Assessment Tool

The following questions have been developed to help you consider how particular inequalities in health have come about and where the effective intervention points are to address them. The questions should be used in conjunction with the Ministry of Health's reducing inequalities intervention framework for reducing health inequalities (Public Health Consultancy and Te Rōpu Rangahau Hauora a Eru Pōmare Wellington School of Medicine and Health Sciences 2004).

- What health issue is the policy or programme trying to address?
- What inequalities exist in this health area?
- Who is most advantaged and how?
- How did the inequality occur? (What are the mechanisms by which this inequality was created, is maintained or was increased?)
- What are the determinants of this inequality?
- How will you address the Treaty of Waitangi in the context of the New Zealand Public Health and Disability Act 2000?
- Where or how will you intervene to tackle this issue? (Use the Ministry of Health's intervention framework for reducing health inequalities (Figure 3) to guide your thinking (Ministry of Health 2002b).)
- How could this intervention affect health inequalities?
- Who will benefit most from this intervention?
- What are the possible unintended consequences of this intervention?
- What will you do to make sure the intervention does reduce or eliminate inequalities?
- How will you know if the intervention has reduced or eliminated inequalities?

Figure 3:



Source: Ministry of Health (2004c).

Appendix 5:

Priority Population Health Objectives in the New Zealand Health Strategy

The 13 priority population health objectives listed in the New Zealand Health Strategy (Minister of Health 2000) are to:

- reduce smoking
- improve nutrition
- reduce obesity
- increase the level of physical activity
- reduce the rate of suicide attempts
- minimise harm caused by alcohol and illicit and other drug use to both individuals and the community
- reduce the incidence and impact of cancer
- reduce the incidence and impact of cardiovascular disease
- reduce the incidence and impact of diabetes
- improve oral health
- reduce violence in interpersonal relationships, families, schools and communities
- improve the health status of people with severe mental illness
- ensure access to appropriate child health care services, including Well Child and family health care and immunisation.

Appendix 6:

Key Population Health Messages Underpinning the Healthy Eating – Healthy Action Strategy and Implementation Plan

The key population health messages underpinning the Healthy Eating – Healthy Action Strategy (Minister of Health 2003) and Implementation Plan (Ministry of Health 2004a) are:

- eat a variety of nutritious foods
- eat fewer fatty, salty and sugary foods
- eat more vegetables and fruits
- fully breastfeed infants for at least six months
- be active every day for at least 30 minutes in as many ways as possible
- add some vigorous exercise for extra benefit and fitness
- aim to maintain a healthy weight throughout life
- promote and foster the development of environments that support healthy lifestyles.

Appendix 7:

Sample Meal Plans for Infants and Toddlers

The meal plans in Tables 12–15 have been analysed for nutrients and to meet the nutrient reference values (NRVs) for healthy infants aged nine to 12 months and toddlers aged one to two years.

For infants aged seven to 12 months, the NRVs are based on the average intake of breast milk (600 mL per day) and 200 g of complementary food. The reference body weights are 9 kg for infants seven to 12 months of age and 13 kg for toddlers aged one to three years (NHMRC 2006).

For details on average breast milk intake at specific ages, see section 4.3: Importance of continued breastfeeding beyond period of exclusive breastfeeding.

The purpose of the meal plans is to demonstrate how the NRVs can be met, but they are not intended to be used as a dietary regimen for individuals. For more information on complementary feeding, see section 4, including Tables 4 and 5, which include examples of foods that can be given, including vegetarian options, foods for different ethnic groups, and vegetables and fruit available during different seasons.

The meal plans were analysed using Foodworks Professional Edition 2005.

Table 12: Three-day meal plan for infants aged 9 to 12 months

Day 1	Day 2	Day 3
<p>Breakfast</p> <p>Infant rice, iron fortified (5 tablespoons)</p> <p>Apple, stewed (3 tablespoons)</p> <p>Breast milk or formula to mix</p>	<p>Infant muesli, iron fortified (4 tablespoons)</p> <p>Pears, stewed or canned and mashed (3 tablespoons)</p> <p>Breast milk or formula to mix</p>	<p>Infant cereal, iron fortified (3 tablespoons)</p> <p>Fruit salad, canned and mashed (3 tablespoons)</p>
<p>Mid-morning snack</p> <p>Cheese on toast (½ slice)</p> <p>Kiwifruit (3 pieces)</p>	<p>Toasted bread, white (¼ slice)</p> <p>Margarine, low salt (½ teaspoon)</p> <p>Avocado (2 teaspoons)</p>	<p>Puffed crispbread (1)</p> <p>Cheese, Edam (2 thin slices)</p> <p>Carrot, raw, finely grated (2 tablespoons)</p>
<p>Lunch</p> <p>Soft pasta spirals (¼ cup), chopped, mixed with kumara (1 tablespoon), mashed and cottage cheese (1 tablespoon)</p> <p>Pieces of peeled, soft melon (4 tablespoons)</p>	<p>White toast (1 slice)</p> <p>Margarine, low salt (½ teaspoon)</p> <p>Vegetemite (1 teaspoon)</p> <p>Cheese, Edam, grated (1 tablespoon)</p> <p>Banana, 3 pieces</p>	<p>Chicken casserole with vegetables (2 tablespoons)</p> <p>Mashed potato (2 tablespoons)</p>
<p>Mid-afternoon snack</p> <p>Banana custard (3 tablespoons)</p> <p>Puffed crispbread (1)</p>	<p>Fruit yoghurt (¼ cup)</p> <p>Peaches, canned, mashed (3 tablespoons)</p> <p>Weetbix, crushed (3 tablespoons)</p>	<p>Puffed crispbread (1)</p> <p>Margarine, low salt (½ teaspoon)</p> <p>Soft pear pieces (¼ of a pear)</p>
<p>Dinner</p> <p>Cooked, mashed fish (¼ cup)</p> <p>Potato wedges (2)</p> <p>Cooked, mashed mixed vegetables (1 tablespoon)</p>	<p>Chicken casserole with vegetables (¼ cup)</p> <p>Carrot, mashed or soft finger food sized pieces (1 tablespoon)</p>	<p>Spaghetti noodles, chopped (2 tablespoons)</p> <p>Tomato and meat sauce (4 tablespoons)</p> <p>Mashed or chopped soft broccoli and carrot (1 tablespoon)</p>
<p>Total breast milk or formula for the day</p> <p>Breast milk or formula (2 ¼ cup)</p>	<p>Breast milk or formula (2 ¼ cup)</p>	<p>Breast milk or formula (2 ¼ cup)</p>

Metric conversion:

1 tablespoon = 15 ml 1 cup = 250 ml

Finger foods need to be in a size that can be easily picked up by infant.

Table 13: Summary of the nutritional analysis of the three-day meal plan for infants aged 9 to 12 months, average per day

	Average
Weight of food and fluid (g)	970
Fluid (mL)	788
Energy (kJ)	3265
Energy (kcal)	777
Carbohydrate (g)	91
Protein (g)	29
Total fat (g)	34
Fibre (g) (Englyst)	5
Saturated fat (g)	14
Calcium (mg)	581
Iron (mg)	10
Sodium (mg)	655
Zinc (mg)	5.1
Selenium (µ)	21
Vitamin C (mg)	96
Total vitamin A equivalents (µg)	860

Table 14: Three-day meal plan for toddlers aged one to two years

Day 1	Day 2	Day 3
Breakfast Wheat biscuits (1½ biscuits) Banana, chopped (½) Milk (¼ cup) Water (¼ cup)	Rice cereal (½ cup) Milk (½ cup) White toast (½ slice) Margarine, low salt (1 teaspoon) Jam (1 teaspoon) Water (¼ cup)	Wheat biscuits (1½ biscuits) Milk (¼ cup) Strawberries, chopped (4) Banana (½) or tinned fruit in juice
Mid-morning snack Puffed crispbread with scraping of smooth peanut butter (2) Carrot sticks, cooked (3 tablespoons) Water (½ cup)	Puffed crispbread (2) Avocado (2 tablespoons) Banana (½) Water (½ cup)	Malt biscuits (2) Apple, grated (½ cup) Water (½ cup)
Lunch Wholemeal bread (1 slice) Egg, mashed (½) Lettuce, finely chopped (2 leaves) Mayonnaise, reduced fat (1 teaspoon) Margarine, low salt (1 teaspoon) Kiwifruit pieces (½) Milk (¼ cup)	Mousetrap Wholemeal bread toast (1 slice) Vegemite (1 teaspoon) Cheese, grated (2 tablespoons) Carrot sticks, cooked (3 tablespoons) Celery sticks, cooked (3 tablespoons) Orange (½) Milk (½ cup)	Macaroni cheese (30 g) Wholemeal roll (⅓) Margarine, low salt (1 teaspoon) Milk (¼ cup)
Mid-afternoon Fruit yoghurt (⅓ cup) Water (½ cup) Banana (½)	Apricots, cut in slices (2 pieces) Cheese, thin slices (2) Milk (½ cup)	White bread toasted (¼ slice) Margarine, low salt (½ teaspoon) Vegemite (1 tablespoon) Yoghurt (¼ cup) Water (½ cup)
Dinner Pasta (⅓ cup) Tomato and meat sauce (4 tablespoons) Peas (2 tablespoons) Broccoli (3 tablespoons) Water (¼ cup)	Fish pie with mashed potato (½ cup) Green beans, cooked (3 tablespoons) Carrot, mashed or soft finger food sized pieces (1 tablespoon) Water (¼ cup)	Lamb chop, finely chopped (1 small) Parsnip and carrot mash (4 tablespoons) Broccoli (3 tablespoons) Spinach (3 tablespoons) Water (¼ cup)
Supper Apples, stewed (3 tablespoons) Wheat germ (2 tablespoons) Milk (½ cup)	Peaches, canned (⅓ cup) Milk (½ cup)	Fruit yoghurt (⅓ cup) Plums, stewed (3 tablespoons) Milk (½ cup)

Metric conversion: 1 tablespoon = 15 ml 1 cup = 250 ml

Finger foods need to be in a size that can be easily picked up by infant.

Table 15: Summary of the nutritional analysis of the three-day meal plan for toddlers aged one to two years, average per day

	Average
Weight of food and fluid (g)	1280
Fluid (mL)	1060
Energy (kJ)	3965
Energy (kcal)	944
Carbohydrate (g)	117
Protein (g)	41
Total fat (g)	35
Fibre (g) (Englyst)	12
Saturated fat (g)	15
Calcium (mg)	708
Iron (mg)	6.4
Sodium (mg)	1099
Zinc (mg)	5.6
Selenium (µ)	17
Vitamin C (mg)	70.1
Total vitamin A equivalents (µg)	1201

Appendix 8:

Nutrient Reference Values for Australia and New Zealand for Infants and Toddlers

Table 16: Daily recommendations for infants and toddlers

Nutrient	Infants aged 0–6 months AI	Infants aged 7–12 months AI	Infants aged 0–12 months UL	Toddlers aged 1–3 years RDI	Toddlers aged 1–3 years UL
Energy, macronutrients and dietary fibre					
Energy (kJ)	See Table 8 in section 9.2	See Table 8 in section 9.2		See Table 8 in section 9.2	
Protein (g)	10	14	NP	14	NP
Carbohydrate (g)	60	95	–	–	–
Dietary fibre (g)	–	–	NP	14 (AI)	NP
Total fat (g)	31	30	–	–	–
Linoleic acid (g)	4.4	4.6	NP	5 (AI)	NP
Alpha-linolenic acid (g)	0.5	0.5	NP	0.5 (AI)	NP
LCPUFA omega-3 fatty acids (mg) (DHA, EPA, DPA)	–	–	NP	40 (AI)	3000
Minerals					
Calcium (mg)	210	270	NP	500	2500
Zinc (mg)	2.0	3.0 (RDI)	0-6 mo: 4 7-12 mo: 5	3	7
Iron (mg)	0.2	11 (RDI)	20	9	20
Magnesium (mg)	30	75	NP ¹	80	65 ¹
Iodine (µg)	90	110	NP	90	200
Selenium (µg)	12	15	0-6 mo: 45 7-12 mo: 60	25	90
Copper (mg)	0.20	0.22	NP	0.7 (AI)	1
Fluoride (mg)	0.01	0.5	0-6 mo: 0.7 7-12 mo: 0.9	0.7 (AI)	1.3
Sodium (mg)	120	170	NP	200–400 (AI)	1000
Fat-soluble vitamins					
Vitamin A (µg RE)	250 ²	430	600 ³	300	600 ³
Vitamin D (µg) ⁴	5	5	25	5 (AI)	80
Vitamin E (mg α-TE)	4	5	NP	5 (AI)	70
Vitamin K (µg)	2.0	2.5	NP	25 (AI)	NP

Nutrient	Infants aged 0–6 months AI	Infants aged 7–12 months AI	Infants aged 0–12 months UL	Toddlers aged 1–3 years RDI	Toddlers aged 1–3 years UL
Water-soluble vitamins					
Thiamin (mg)	0.2	0.3	NP	0.5	NP
Riboflavin (mg)	0.3	0.4	NP	0.5	NP
Niacin (mg NE)	2	4	NP	6	10 ⁵
Vitamin B ₆ (mg)	0.1	0.3	NP	0.5	15 ⁶
Vitamin B ₁₂ (µg)	0.4	0.5	NP	0.9	NP
Folate (µg DFEs)	65	80	NP	150	300 ⁷
Pantothenic acid (mg)	1.7	2.2	NP	3.5 (AI)	NP
Biotin (µg)	5	6	NP	8 (AI)	NP
Vitamin C (mg)	25	30	NP	35	NP
Choline (mg)	125	150	NP	200 (AI)	1000
Total water (mL) (including food and fluids)	700	800	NP	1400 (AI)	NP
From fluids only (mL)	700	600	–	1000 (AI)	–

Source: NHMRC (2006).

Notes:

– = not established; α-TE = alpha-tocopherol equivalents; AI = adequate intake; UL = upper levels of intake; DHA = docosahexaenoic acid; DFE = dietary folate equivalents; DPA = docosapentaenoic acid; EPA = eicosapentaenoic acid; LCPUFA = long chain polyunsaturated fatty acids; NE = niacin equivalent; RE = retinol equivalent; NP = not possible - for infants it is generally not possible to establish an Upper Level of Intake.

¹ For magnesium, the UL is for supplements.

² As retinyl esters.

³ As retinol.

⁴ Assumes minimal sun exposure.

⁵ The UL refers to niacin as nicotinic acid. For supplemental nicotinamide, the UL is 150 mg/day.

⁶ For vitamin B₆, the UL is for pyridoxine.

⁷ For folate, the UL is for dietary folate equivalents from fortified foods and supplements.

Appendix 9: Breastfeeding Support Organisations

Table 17: Breastfeeding support organisations

Provider	Contact information
Community health worker	Telephone your local hospital.
Midwife	Look in your local <i>Yellow Pages</i> telephone directory, under 'Midwives', or in your local <i>White Pages</i> telephone directory under the front section 'Hospitals and other health service providers' or under 'M' for 'midwife'. For a list of lead maternity carers, telephone 0800-MUM 2 BE (0800 686 223). New Zealand College of Midwives website: http://www.midwife.org.nz
La Leche League New Zealand	A nationwide voluntary organisation that offers mother-to-mother information and support and breastfeeding resources for parents and health practitioners. National office: PO Box 50780, Porirua 5240 Phone/Fax: (04) 471 0690 Website: http://www.lalecheleague.org.nz e-mail: help@lalecheleague.org.nz
New Zealand Lactation Consultants Association	National office: PO Box 29-279, Christchurch Website: http://www.nzlca.org.nz
Lactation consultants	To speak to a lactation consultant, telephone your local hospital or telephone 0800 933 282
Medical practitioner	Listed at the front of the <i>White Pages</i> telephone directory under 'Registered Medical Practitioners and Medical Centres'.
New mothers support groups	See the entries in this table for Plunket nurse, practice nurse or general practitioner.
Parents Centre	A nationwide voluntary organisation that offers education in birthing and parenting and support to parents. It aims to improve community attitudes towards parenting and facilities for parents. Many centres offer breastfeeding support. New Zealand has 62 centres. For local support, see your local <i>White Pages</i> telephone directory under 'P'. Website: http://www.parentscentre.org.nz
Plunket nurse	Details for your local office are in your local <i>White Pages</i> telephone directory. PlunketLine: 0800 933 922 (7 am to midnight, seven days a week) Website: http://www.plunket.org.nz
Practice nurse	Telephone your general practitioner.
Well Child nurse	For local assistance, see your local <i>White Pages</i> telephone directory or call Healthline, 0800 611 116 (which includes the Well Child telephone advice service).
Te Kōhanga Reo National Trust	Listed in your local <i>White Pages</i> telephone directory. Website: http://www.kohanga.ac.nz

Provider	Contact information
Tipu Ora Charitable Trust	Listed in your local <i>White Pages</i> telephone directory. Website: http://www.tipuorapte.ac.nz .
Women's Health Action	National office: PO Box 9947, Newmarket, Auckland. Phone: (09) 520 5295 Website: http://www.womens-health.org.nz
Department of Labour	Website: http://www.dol.govt.nz , search for breastfeeding

Appendix 10: Health Education Resources to Support Breastfeeding and Infant Nutrition Available from the Ministry of Health

Order the health education resources to support breastfeeding and infant nutrition listed in Table 18 from your local authorised provider (using the reference number given in the table) or access them from the Ministry of Health’s Health Education website (<http://www.healthed.govt.nz>).

Table 18: Ministry of Health health education resources

Title of publication	Type of publication	Reference number
<i>Baby Teeth Are Important</i>	A5 pad of 25 leaflets with information for parents of preschool children on early dental care	9038
<i>Breast milk: Food for Life</i>	A3 breastfeeding poster for Pacific women	9059
<i>Breastfeeding: You Can Do It</i>	Brochure	9015
<i>Eating for Healthy Babies and Toddlers: From birth to two years old/Te Kai Totika mo te Hunga Kohungahunga</i>	Brochure	1521
<i>Eating for Healthy Breastfeeding Women/Nga Kai Totika ma te Ukaipo</i>	Brochure	6003
<i>Fast Free Food for Babies</i>	A2 poster	9003
<i>Fast Free Food for Babies</i>	Postcard	9011
<i>Feeding Your Baby Infant Formula</i>	Booklet for use by health practitioners in advising parents and caregivers who have decided to partially or completely formula feed a baby	1306
<i>Oranga Niho Oranga Kata</i>	A4 pad of 25 leaflets with tamariki dental health information for parents and caregivers	4934
<i>Soy-based Infant Formula</i>	A5 leaflet with information for parents about soy-based milk alternatives	9060
<i>Starting Solids</i>	A4 pad of 25 leaflets	6014
<i>Useful Information Children 0–5</i>	Key messages in Samoan – mainly for use with <i>Well Child/Tamariki Ora Health</i>	7027
<i>Useful Information Children 0–5</i>	Key messages in Tongan – mainly for use with <i>Well Child/Tamariki Ora Health</i>	7028
<i>Useful Information Children 0–5</i>	Key messages in Niuean – mainly for use with <i>Well Child/Tamariki Ora Health</i>	7029
<i>Useful Information Children 0–5</i>	Key messages in Tokelauan – mainly for use with <i>Well Child/Tamariki Ora Health</i>	7030
<i>Useful Information Children 0–5</i>	Key messages in Cook Islands Maori – mainly for use with <i>Well Child/Tamariki Ora Health</i>	7031
<i>Well Child/Tamariki Ora Health Book</i>	Parent information and health immunisation record book for infants and toddlers from birth to five years	7012
<i>Your Pregnancy/Tō Haputanga</i>	Guide to being pregnant, giving birth, the first few weeks, and the roles and responsibilities of lead maternity carers	1420

Appendix 11:

Summary of Evidence on the Importance of Breastfeeding for Infants

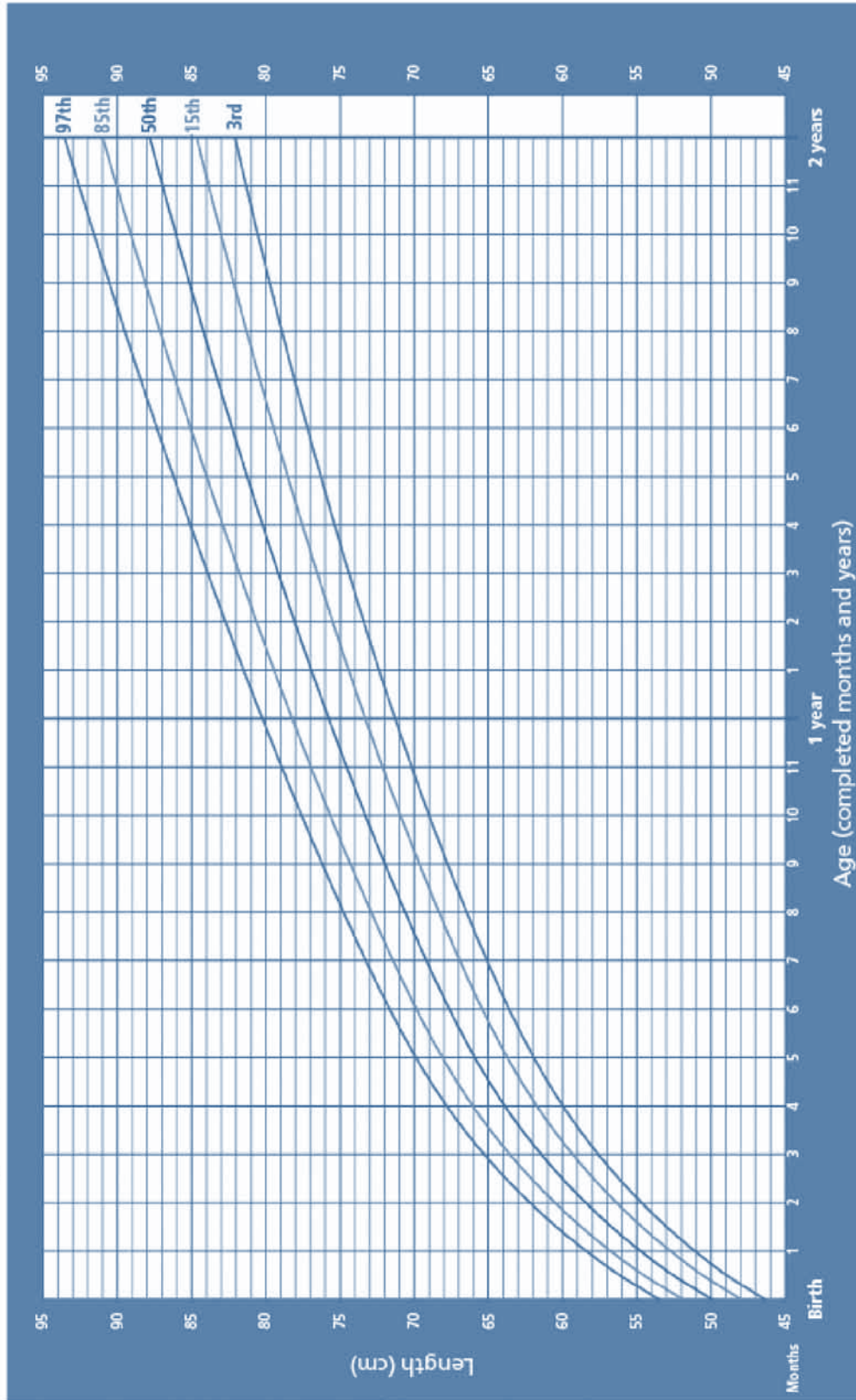
Table 19: Summary and strength of evidence of the importance of breastfeeding for infants

Strength of evidence	Protective effects
Convincing, Strong	<p>Protects against infectious diseases such as gastro-enteritis (Kramer et al 2001b; Lopez-Alarcon et al 1997; Howie et al 1990) and respiratory infections (Howie et al 1990; Wilson et al 1998; Galton et al 2003)</p> <p>Meets the full-term infant's complete nutritional and fluid needs for up to the first six months of life (Butte et al 2002; Lawrence and Lawrence 2005)</p> <p>Infant mortality (Chen and Rogan 2004)</p> <p>Hospitalisation (McVeagh 2006)</p>
Probable (probably reduces the risk), Moderate	<p>Otitis media (Duncan et al 1993; Aniansson et al 1994)</p> <p>Bacteraemia, bacterial meningitis (Hylander et al 1998), urinary tract infections (Marild et al 2004) and necrotising enterocolitis (Lucas and Cole 1990; Beeby and Jeffery 1992; American Academy of Pediatrics 2005)</p> <p>Food allergy in those with a family history of food allergy (Vanderplus 1998; Kramer and Kakuma 2003; Van Odijk et al 2003; Sears et al 2002; Kemp and Kakakios 2004), allergies and atopic disease (Zeiger 2003; Siltanen et al 2003)</p> <p>Asthma (Gdalevich et al 2001) and eczema (Dell and To 2001)</p> <p>Malocclusions or misalignment of teeth (American Dietetic Association 2005)</p> <p>Sudden infant death syndrome (Mitchell et al 1991; Ford et al 1995; McVea et al 2000)</p> <p>Obesity in later childhood and adulthood (Armstrong and Reilly 2002; Arenz et al 2004; Grummer-Strawn and Mei 2004; McMillen et al 2005; Harder et al 2005; Owen et al 2005; Dewey 2003; Burdette et al 2006), allows the infant to self-regulate their feeding (Dewey and Lonnerdal 1986)</p>
Possible (possibly reduces the risk), Limited	<p>Type 1 diabetes (Gerstein 1994; Mayer et al 1988; Vintanen et al 1991; Couper 2001)</p> <p>Type 2 diabetes (Pettit et al 1997; Owen et al 2006)</p> <p>Crohn's disease, ulcerative colitis, (Klement et al 2004) and other chronic digestive diseases (American Academy of Pediatrics 1997), coeliac disease (Nash 2003; Norris et al 2005)</p> <p>Gastro-oesophageal reflux (Heacock et al 1996)</p> <p>Cardiovascular disease (Owen et al 2002) and high blood pressure (Wilson et al 1998)</p> <p>Cognitive development (Drane and Logemann 2000; Horwood et al 2001)</p> <p>Visual development (Makrides et al 1995; Carlson et al 1996; Horwood et al 2001)</p> <p>Childhood cancer and lymphoma (Bener et al 2001)</p>

Appendix 12: World Health Organization Growth Standards – Length-for-age and Weight-for-age Percentiles for Boys and Girls from Birth to Two Years of Age

Length-for-age BOYS

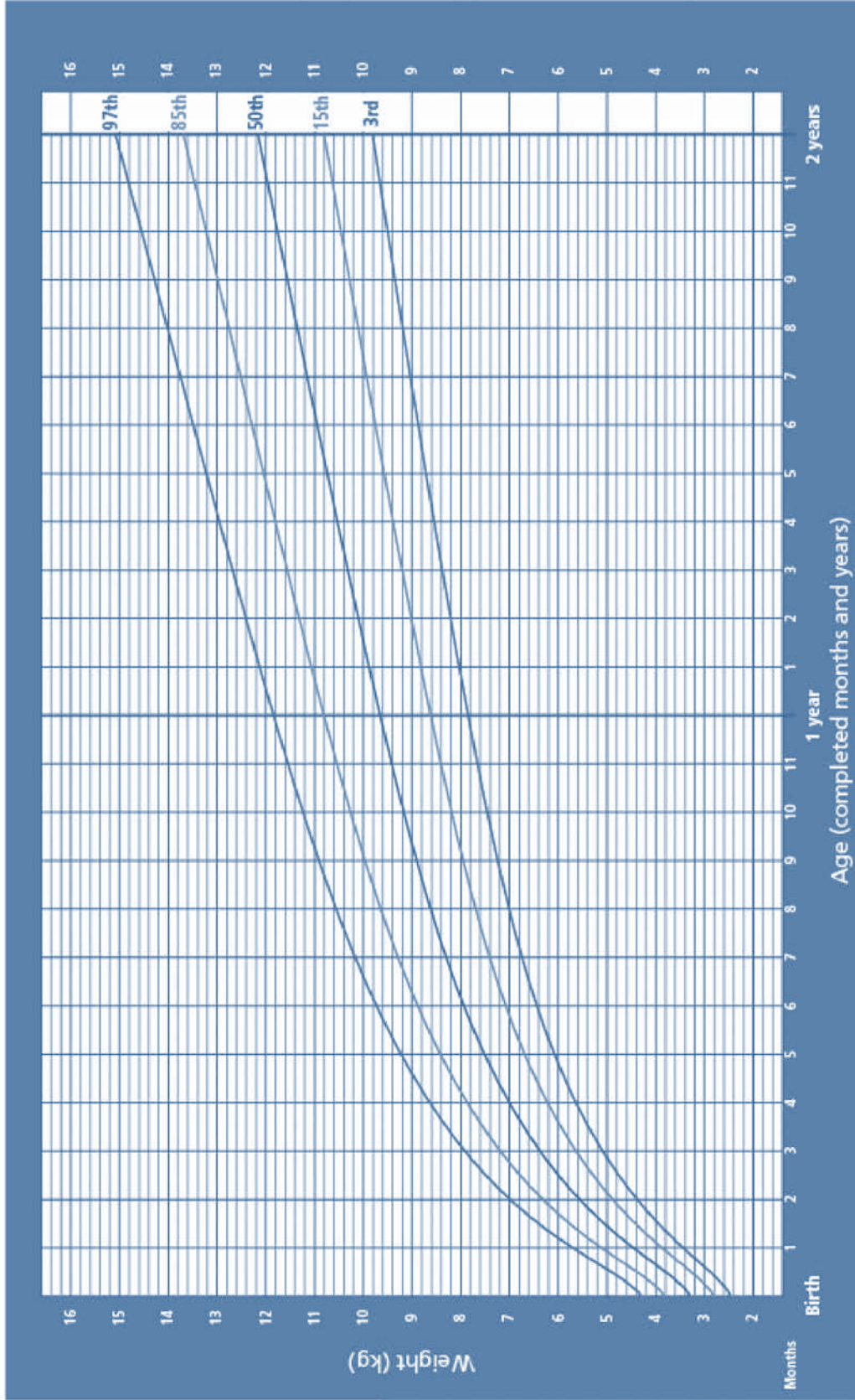
Birth to 2 years (percentiles)



WHO Child Growth Standards

Weight-for-age BOYS

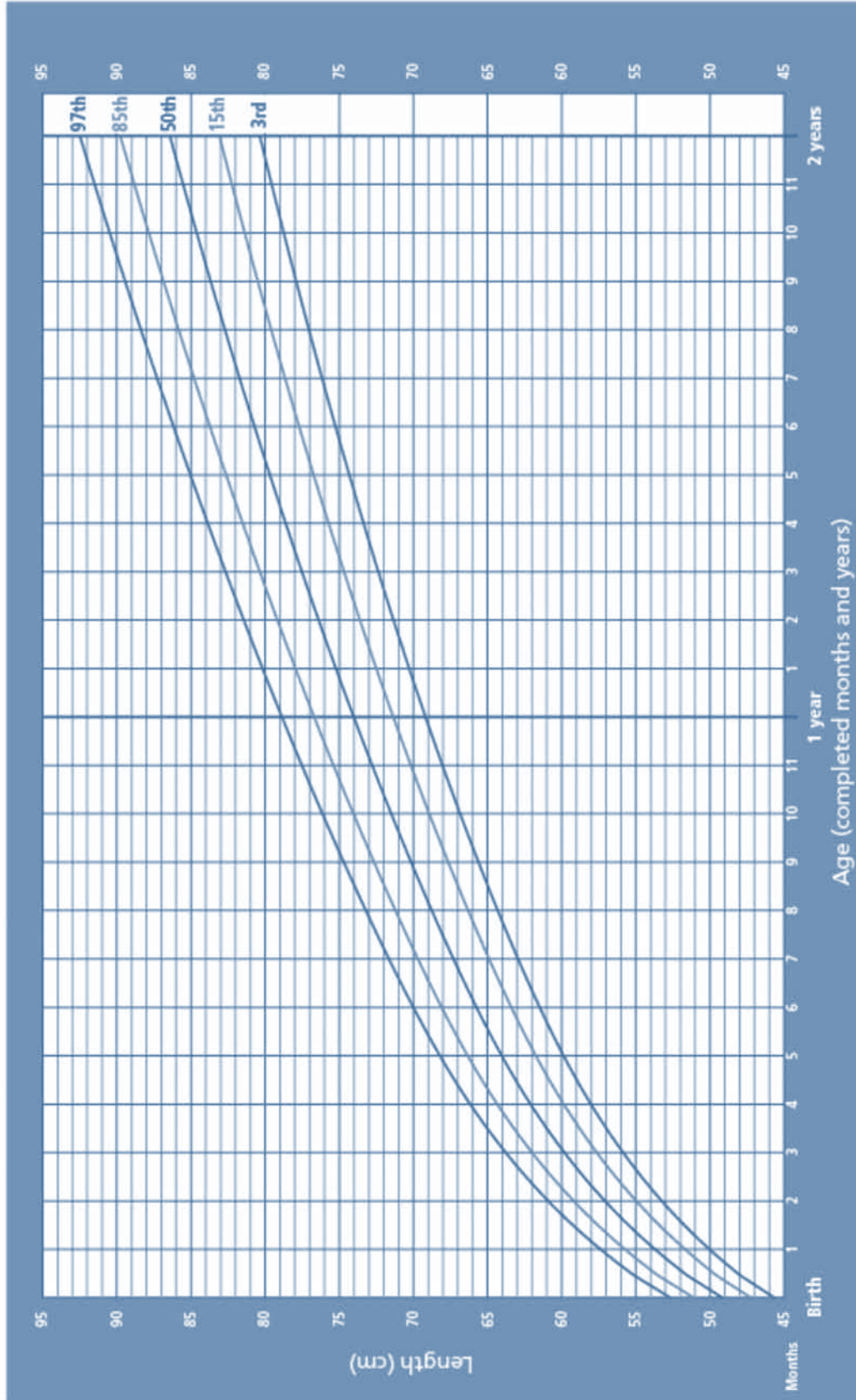
Birth to 2 years (percentiles)



WHO Child Growth Standards

Length-for-age GIRLS

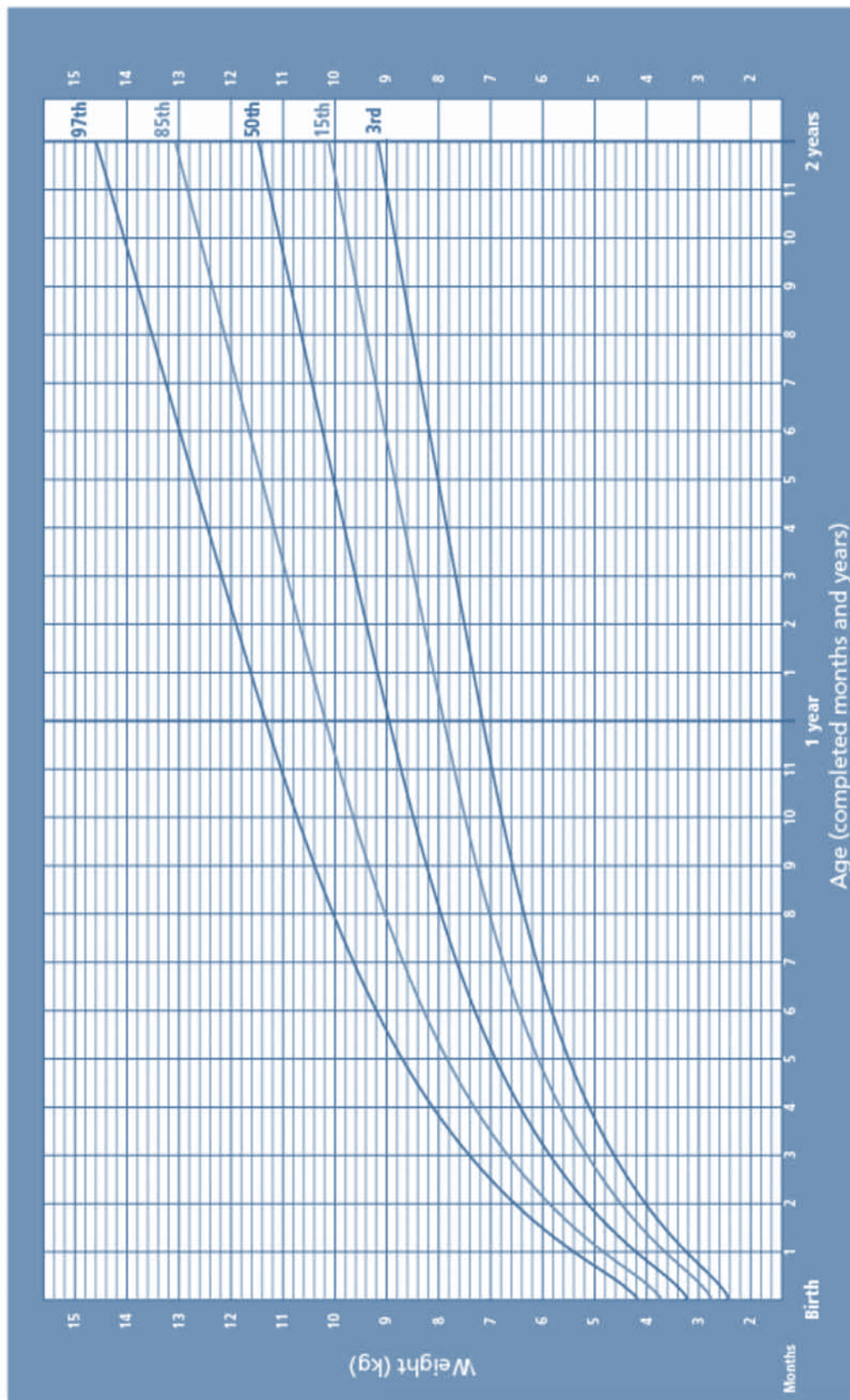
Birth to 2 years (percentiles)



WHO Child Growth Standards

Weight-for-age GIRLS

Birth to 2 years (percentiles)



WHO Child Growth Standards

Appendix 13:

Food-related choking in babies and young children

People can choke on food at any age but young children, especially those less than three years old, are at greatest risk. Approximately 70–90 percent of all choking incidents reported are in children under three years, with foods being the most common cause of choking (Altkorn et al 2008, Altmann and Ozanne-Smith 1997, Despres et al 2006 and Goren et al 2005).

Sixteen children and young people (aged 0–24 years) died from foreign body inhalation (involving choking) in New Zealand during 2002–2009 (Hayman and Dalziel 2010). Thirteen deaths were in children under six years of age and nine of the deaths involved the inhalation of food, namely meat/sausage, peanuts, apple and grapes.

European data found that for every child that dies from foreign body inhalation, another 10 are hospitalised (Zigon G et al 2006). Non-fatal choking incidents can cause severe acute and chronic health problems such as aspiration pneumonia, perforation to the airway or brain damage due to lack of oxygen.

The US Centers for Disease Control (CDC 2002) suggests that because complete removal of all choking hazards is unlikely, parents and caregivers should:

- be aware of the types of foods and objects that pose a choking risk for children
- become familiar with methods to reduce risk
- be able to treat choking in children.

Ozdemir et al (2005) also suggest parents must be educated about the importance of age and stage of development on feeding with solid food.

While people of any age can choke on food, young children choke on food more easily for a number of reasons (Byard et al 1996, Committee on Injury, Violence, and Poison Prevention 2010), including:

- the small diameter of their air and food passages (similar to the diameter of their little finger) which can be easily blocked by small objects
- their inexperience with moving food around in the mouth
- biting and chewing skills that are not fully developed
- a less effective cough mechanism to dislodge foreign bodies.

Byard et al (1996) suggest that although some young children are able to bite off food they may, due to age, lack the second molars that enable them to successfully grind the food prior to swallowing. Children don't normally have these second molars fully erupted into the mouth and functioning until they are over 30 months (two-and-a-half-years) of age. There are also significant individual, behavioural and anatomical differences among healthy children of the same age (Carruth and Skinner 2002). As a result, using age alone as a guide to judge eating competency can be problematic.

There are a number of high risk foods that are often associated with young children choking and most of these share common characteristics see Table 20. Making carers aware of them and how to make changes to reduce their risk is recommended.

Table 20: Characteristics and examples of foods that pose a high choking risk for children under five years

Food characteristics	Food examples	Choking risk	Changes to reduce risk
Small hard foods	Nuts Large seeds Hard dried fruit Pieces of raw carrot, celery or apple Food that break into hard sharp pieces eg, crisps, corn chips and rice crackers Unpopped popcorn husks	Difficult for children to bite through and break down enough to swallow safely. Pieces can become stuck in children's airways	Avoid giving whole nuts, large seeds or hard dried fruit to children under the age of five Use thinly spread smooth peanut butter instead of whole or chopped nuts Carrot, apple and celery can be either cooked until soft or finely grated
Small round or oval foods	Grapes, berries, cherry tomatoes Raisins/sultanas Fruit with stones and large seeds or pips, eg, watermelon, small stone fruits Peas Lollies/sweets	Foods with these qualities can lodge in children's airways Children do not have the ability to chew small round hard, chewy or sticky lollies/sweets	Grapes, berries and cherry tomatoes can be halved or quartered or chopped smaller Soak raisins/sultanas to soften and cut in half if large Remove stones from fruits Peas can be squashed with a fork Small round hard or chewy and sticky lollies/sweets should not be given to children under the age of three years
Foods with skins or leaves	Chicken, Sausages, saveloys, 'cherrios', frankfurters etc Stone fruits (eg, plums, peaches, nectarines) Apples and pears Tomatoes Lettuce and other raw salad leaves. Spinach, cabbage	Food skins are difficult to chew and can completely seal children's airways	Remove or peel skins before serving Chop up (to at least size of child's small finger nail and add to mashed food Remove stones from fruit Finely chop salad leaves Cook spinach and cabbage until soft and chop finely

Food characteristics	Food examples	Choking risk	Changes to reduce risk
Compressible foods	Sausages, saveloys, 'cherrios', frankfurters, hotdogs etc Pieces of cooked meat Marshmallow Popcorn Chewing or bubble gum	Can conform to the airway shape and get wedged tightly	As above, remove skins before serving Cook meat until very tender Chop finely (to at least size of child's small finger nail) and add to mashed food Marshmallows and popcorn should not be given to children under three years Do not give chewing or bubble gum
Thick pastes	Chocolate spreads Peanut butter	Can form to the shape of a child's airway and stick to its side	Use thick pastes sparingly and spread evenly onto bread
Fibrous or stringy foods	Celery Rhubarb Raw pineapple	Fibres make it difficult for children to break up the food into smaller pieces	Peel the skin/strong fibres off celery and rhubarb Slice these foods thinly across the grain of fibres

Based on information from Altkorn et al 2008, Altmann and Ozanne-Smith 1997, Byard et al 1996, Committee on Injury, Violence, and Poison Prevention 2010, Goren et al 2005, Hayman and Dalziel 2010, Karatzanis et al 2006, Morley et al 2004, Ozdemir et al 2005.

One of the most important choking prevention measures is for carers to stay with and supervise young children while they are eating. Young children should learn not to play or run around while eating (Hayman and Dalziel 2010). Establishing a routine where young children sit while eating is recommended.

Parents and caregivers should never resort to forcing children to eat and should request a feeding assessment through their general practitioner for a child who repeatedly gags or chokes on age appropriate foods. An oral health assessment via the community oral health service may be needed if there is the child has discomfort with eating.

Although all care can be taken to prevent food related choking incidents they may still occur. Due to young children's greater vulnerability to accidental injuries it is recommended people caring for children, including parents, teachers and child care providers should learn cardiopulmonary resuscitation (CPR) and choking first aid for children (Ozdemir et al 2005, Committee on Injury, Violence, and Poison Prevention 2010).

For the key messages on minimising the risk of food-related choking in young children see section 4.4.4 Creating a safe, positive feeding environment.

For more information on food related choking see the Ministry of Health website: www.health.govt.nz

For information on choking first aid and cardiopulmonary resuscitation (CPR), see your *Well Child Tamariki Ora Health Book* or the Ministry of Health website www.health.govt.nz

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Index

References in *italics* refer to tables, figures and titles.

A

Active Movement/Koranga Hihiko 93

adequate intake (AI) 8, 120

fluids 45–46

minerals and trace elements 77, 79, 80, 82, 83, 85, 86

nutrients 68, 71, 73–74

vitamins 87, 88, 92

African peoples 61, 90, 102

AI *See* adequate intake

alcohol 50

allergies *See* food allergies and intolerance

Allergy New Zealand 108

almond milk 96

alpha-linoleic acid 73, 74, 98, 120

alternatives to cows' milk 48–49, 80, 96

aluminum 39

American Academy of Pediatrics 71, 99, 106, 116

anaemia 75–77, 120, 122

anaphylactic shock or anaphylaxis 103, 107, 120

anti-reflux formula 39

appetite 49, 66

artificial feeding 9, 11

artificial sweeteners 25, 49, 118

Asian peoples 10, 11, 58–61, 89

asthma 16, 105, 106

Australasian Society of Clinical Immunology and Allergy 106

Australian New Zealand Food Standards Code (FSANZ) 12, 35, 108

formula feeding 37, 39, 73, 80, 85, 112, 114

nutrients 73, 80, 86, 91, 96

B

Baby Friendly Community Initiative (BFCl) 2

Baby Friendly Hospital Initiative (BFHI) 2, 130

behavioural disorders 111

Bifidobacterium 112–113

blood pressure 16, 86

bodyweight *See* weight

bore or tank water 42, 47

bottled water 47

bottles 100, 117

botulism 118

bowel habits 110–111

bran-based cereals 72

breads and cereals 12, 13, 26, 31, 53, 57, 59, 84
fortification 72, 78, 91

breast cancer 17, 18

breast milk 14, 30, 45, 46, 47, 66, 128–129

composition 15, 17, 24, 37–38, 97

minerals and trace elements 75, 78, 80, 82, 84

nutrients 68, 69, 72, 73, 74, 75

probiotics and prebiotics 112, 113, 114

expressed 18, 19–21, 114

See also breastfeeding

breastfeeding 3, 4, 14, 19, 66, 97, 106, 111

barriers 4–5, 99

benefits and importance 3, 14, 15–17, 24, 106, 115, 146

complementary feeding 12, 22, 24–25

conditions affecting 18–19

continued *See* continued breastfeeding

cultural differences 51–52, 55–56, 59

exclusive *See* exclusive breastfeeding

food allergies 19, 24, 106, 109

full *See* full breastfeeding

rates in New Zealand 5, 9–11, 52, 55, 59

partial breastfeeding 9, 12

supplementing *See* supplementing breastfeeding

support and resources 2, 4, 5, 130, 143–145

traditional practice 4, 14, 50

See also breast milk

C

caffeine 50

calcium 49, 69, 73, 77, 79–81, 96

cancer 16, 70

carbohydrates 69–72

cardiovascular disease 16, 24

casein-dominant formula 69, 120

Centers for Disease Control (CDC) growth charts (US) 64, 65, 151

cereals *See* breads and cereals

cerebral palsy 18

Children's Nutrition Survey 2002 (CNS) 12–13, 71, 90, 91, 120

Chinese peoples 58–60

See also Asian peoples

choking 33–34, 49, 72, 151–153

chronic disease 16, 24, 62

cleaning techniques 20, 41–42, 99

cleft lip or palate 18, 100

Clostridium botulinum 118
 CNS *See* Children's Nutrition Survey
 Cochrane Collaboration Review (2008) 73
 co-ordination problems 99
 codes of practice 5, 129
 Codex Committee on Food Hygiene 41
 Codex Alimentarius Commission 41, 120
 coeliac disease 16, 105
 coffee 50
 colic 49, 107, 109–110, 113
 colostrum 17, 46, 121
 commercial infant foods 26, 35, 86, 118
 common food allergens 104–108
 complementary feeding 22, 28–30, 35–36, 66, 96, 111
 cultural differences 52, 56, 58
 introduction 11, 12, 14, 22–34, 59, 77, 107
 nutrients 68, 72, 75, 78, 79
 constipation 45, 57, 110–112
 continued breastfeeding 14, 22, 24, 27, 56, 75, 96
 contraception 17, 24
 Cook Islands peoples 56, 57
 cordials 49–50, 100
 cows' milk 48–49
 allergy 38–40, 104
 introduction 11, 12, 26, 52
 minerals and trace elements 74, 77, 80–81
 nutrients 48, 67, 68, 73, 74
 See also milk and milk products
 cows' milk-based formula 38–39, 69, 75, 106, 114
 crying 25, 33
See also colic
 cue feeding *See* hunger cues
 culture 4, 51, 60
 cup feeding 18, 19, 46
D
 dehydration 19, 24, 45, 47, 49, 111
 dental fluorosis or caries 84–85, 100, 117
 dermatitis, atopic 105, 106
 development 15, 22, 24, 40, 62, 111, 119
 stages 25, 28–30
 diabetes 16, 63, 70, 121
 diarrhoea 16, 24, 45, 49, 104, 110–112, 113
 dietary fibre 70–72, 96
 dietary practices 9–13, 95, 116–117
 ethnic groups 52–53, 56–58, 59–60, 77
 See also nutrient intake
 dietary folate 91–92, 121
 Dietary Supplements Regulations 1985 101
 dietary supplements *see* supplements
 dieting 62, 73, 115, 116
 dietitians 19, 48, 81, 92, 98, 101, 106, 108, 110
 disabilities 18
 dishwashers, use of 41
 dislike foods 13, 26
 DONALD study 71
 dried fruit 31, 72, 118
 drinking water fluoridation 84–85, 117
 Drug Information Centres 18
 drugs 18, 90
 dummies 99, 116–117
E
 ear infections 99, 100
 eating patterns *See* dietary practices
 eating skills 23, 28
 eczema 16, 103–104, 105, 106
 eggs 32, 104
 elimination tests 108
 emergency feeding of infants and children 119
 energy 25, 38, 62, 65–67, 73–74
 energy drinks 50
Enterobacter sakazakii 40–41
 epilepsy 18
 estimated average requirement (EAR) 8, 121
 estimated energy requirement (EER) 8, 66
 European peoples 10, 11, 12, 13, 64, 76, 90
 European Society for Paediatric Gastroenterology
 Hepatology and Nutrition Committee for Nutrition
 107
 exclusive breastfeeding 9, 14, 47, 62–63, 106, 110, 113, 121
 complementary feeding 12, 22, 107
 nutrients 72, 75, 78, 79, 90
 rates 11, 52, 55, 59
 reasons for stopping or not 52, 55
 expressed breast milk 18, 19–21, 114
 extensively hydrolysed formula 40, 106
F
 failure to gain weight 49, 105
 failure to thrive 49, 62
 family meals and diet 25, 27, 33, 34, 116
 fat 13, 25, 72–74, 96
 feeding in an emergency 119
 Feeding Infants and Toddlers Study (US) 33
 feeding environment 33–34, 153
 feeding positions 100, 114

- feeding practices 33–34, 48, 52, 74, 100, 101, 110, 116, 151
- feeding skills 23, 33
- fever 24
- fibre 70–72, 80, 96
- filters (water) 47
- finger foods 26, 61
- Fitzpatrick scale of skin types 89
- flavours 13, 26, 29
- fluids 14, 45–50, 52, 100, 111
- fluoride 39, 84–86, 117
- folate and folic acid 91–92, 121
- follow-on formula 37, 38, 46
- food allergies and intolerance 16, 19, 24, 26, 62, 102–109, 110, 113
- cows' milk 38–40, 104
- Food and Agriculture Organization (FAO) 41
- Food and Nutrition Guidelines for Healthy Adults* 27
- Food and Nutrition Guidelines for Healthy Infants and Toddlers (Aged 0–2)* 1, 3–4, 7–8, 101, 131
- Food and Nutrition Guidelines for Healthy Pregnant and Breastfeeding Women* 3
- food groups 4, 8, 31–32
- food safety 14, 19–21, 37, 41, 118–119
- See also* cleaning techniques; sterilisation techniques
- food security and insecurity 4, 62, 119, 121
- Food Standards Code *See* Australia New Zealand Food Standards Code
- food supplements *See* supplements
- formula feeding 37–38, 44, 47, 111
- allergies 39–40, 106, 109
- changing formula 40, 111
- complementary feeding 12, 24–25
- composition 37–38, 66, 73, 74, 75, 80, 82, 85
- preparing formula 40–43
- quantity and frequency 44
- See also* infant formula
- foreign body inhalation *See* choking
- fortification 48, 95, 96, 101
- calcium 49, 81, 96
- folic acid 91
- iodine 82
- iron 78, 96
- vitamin B12 49, 97, 102
- vitamin D 89, 97
- fortified plant-based milk 49
- freezing breast milk 19–21
- fruit *See* vegetables and fruit
- fruit juices 49–50, 100
- full breastfeeding 9, 121
- rates 11, 52, 55, 59
- fullness cues 29, 33
- fussiness 25, 33
- ## G
- galactosaemia 18, 38, 39, 40, 121
- gastro-oesophageal reflux 16, 39, 114–115
- gastrointestinal symptoms 16, 49, 77
- Global Strategy for Infant and Child Feeding (WHO) 1–2, 22, 119
- gluten-free diet 105
- goats' milk 49, 104
- goats' milk-based infant formula 39–40
- goitre 39, 122
- growth 25, 40, 62, 66, 72
- assessment and charts 63–65, 115, 117, 147–150
- rate 25, 62–63, 70
- guarana (cola nut) 50
- ## H
- hay fever 105
- He Korowai Oranga: Māori Health Strategy 2, 52
- Health Equity Assessment Tool (HEAT) 2–3, 122, 132–133
- health practitioners 95, 110
- breastfeeding 19, 78, 114
- formula feeding 37–38, 40, 114–115
- supplements 89–90, 101
- Healthy Eating – Healthy Action Strategy and Implementation Plan 3, 5, 135
- heart disease 63, 70
- hepatitis B 18
- herbal supplements 13, 101
- See also* supplements
- herbal teas 49
- herpes simplex 17
- high-risk infants 39–40, 105, 106, 107, 113
- hip fractures 17, 24
- HIV infection 17
- home-prepared infant food 34, 118
- homemade formula 37
- honey 25, 117, 118
- hospitalisation 16, 76, 151
- hospitals 40–41, 130
- human immunodeficiency virus infection 17
- hunger cues 15, 29, 33, 44, 45, 46, 47, 74, 110–111
- hypertension 63
- hypothyroidism 39, 122

I

illness, lower rates of 63
immuno-compromised infants 40–41, 113
in-utero environment 3
Indian peoples 58–59
 See also Asian peoples
individualised feeding plan 19
inequalities, reducing 2–3, 52, 132–133
infant botulism 118
infant care practices 55–56, 99
infant feeding practices *See* feeding practices
infant foods
 commercial *See* commercial infant foods
 home-prepared 34, 118
infant formula 11, 30, 38, 40, 45, 46, 47
 composition 37, 112–115
 minerals and trace elements 75, 80, 82
 nutrients 38, 66, 68, 73, 74
 supplementing breastfeeding 14, 19, 21
types
 cows' milk-based *See* cows' milk-based formula
 follow-on 37, 38, 46
 iron-fortified 38, 75, 77
 non-animal 39–40, 96
 protein-hydrolysed 106, 124
 soy-based *See* soy-based formula
 specialised *See* specialised infant formula
 See also formula feeding
infectious disease 16, 48
Innocenti Declaration on the Protection, Promotion and Support of Breast-feeding 2
intensive care 19
International Code of Marketing of Breast-milk Substitutes 2, 5, 128–129
international policy 1–2
intolerance of food *See* food allergies and intolerance; lactose intolerance
iodine and iodine deficiency 81–83, 101
iron and iron deficiency 16, 22, 38, 48, 50, 69, 71, 74–78, 101, 122
iron-deficiency anaemia (IDA) 75–77, 120, 122
iron-fortified cereals 72, 78, 96
iron-fortified formula 38, 75, 77

K

kelp tablets 83

L

labelling of food 108
Lactobacillus 112–113
lactose intolerance 38, 39, 40, 109
Latin American peoples 61
LCPUFAs 40, 73, 74, 97–98, 123
lean meat, poultry, seafood, eggs, legumes, nuts and seeds 32, 52, 58, 78, 83
lemonade, flat 49
lesions, infectious 17
linoleic acid 73, 74
liver disease 90
long chain polyunsaturated fatty acids
 See LCPUFAs
low birth weight infants 16, 63
low-fat diets 62, 72

M

malabsorption 40, 90
malnutrition 19
maternal avoidance of common allergens 106
Manufactured Food Database 108
Māori 2, 3, 51, 54, 64
 breastfeeding 4, 10, 51–52
 dietary practices 11, 12, 52–53, 77
 nutrition 2, 53, 76, 89, 90
Māori Health Strategy 2, 52
margarine 74, 86, 89
mastitis 18
meal plans 4, 8, 86, 136–140
meat 32, 58, 78
medical conditions 19
medical practitioners *See* health practitioners
medication 18, 90
meningitis 16
metabolic conditions 18, 40
methaemoglobinaemia 47
microwaves, use of 20, 41, 43
Middle Eastern peoples 61, 90, 102
migrants 59, 61, 90, 102
milk and milk products 13, 26, 31, 35, 48–49, 68, 74
 allergies 38–40, 104
 alternatives 48–49, 80–81, 96
 minerals and trace elements 77, 80–81, 83
 reduced-fat 48, 67, 74
 See also cows' milk
mineral tablets *See* supplements
mineral and trace elements 70–71
 calcium *See* calcium
 fluoride 39, 84–86, 117

iodine 81–83, 101
 iron *See* iron and iron deficiency
 selenium 83–84
 sodium 86–87
 zinc 22, 69, 79

Ministry of Health 99, 106, 113, 117, 132
 policy 1–2, 5, 131
 publications 3, 131, 145

monounsaturated fatty acids 72–73, 123

mortality 16, 40

mothers 16–18, 24, 76, 105

Multicentre Growth Reference Study (MGRS) (WHO)
 64–65

N

National Strategic Plan for Breastfeeding 5

New Zealand Breastfeeding Authority 130

New Zealand Drinking Water Standards 84

New Zealand European *See* European peoples

New Zealand Food and Nutrition Guidelines *See Food and Nutrition Guidelines for Healthy Infants and Toddlers (Aged 0–2)*

New Zealand Food Safety Authority (NZFSA) 109

New Zealand growth charts 63–64, 65, 115

New Zealand Health Strategy 3, 134

New Zealand Infant Formula Marketers' Association (NZIFMA) 5

New Zealand policy 1–2, 5, 131

New Zealand Vegetarian Society 98

nitrate (water) 42, 47

nucleotides 40, 123

nursing bottle caries 100

nut milk 96

nutrient intake 3–4, 9–13, 38, 62, 145
 breastfeeding 15, 19
 complementary feeding 12, 22–23
 cultural differences 53, 57, 60
 vegetarians and vegans 95–96, 98
See also dietary practices

nutrient reference values (NRVs) 8, 24–25, 123, 136–142

nutrients 31–32, 48, 92, 138, 140–142
 carbohydrate and dietary fibre 69–72
 fat *See* fat
 mineral and trace elements *See* mineral and trace elements
 protein 68–69
 vitamins *See* vitamins

nutritional supplements *See* supplements

nuts 32, 72, 104–105

O

oat milk 96

obesity *See* overweight and obesity

oligosaccharides 70, 72, 113–114

omega-3 and omega-6 fatty acid 72–74, 97, 123

oral health 84–85, 117–118, 153

Other population groups 10, 11, 13, 61, 64

osteoporosis 17

otitis media 16, 99

ovarian cancer 17

overweight and obesity 16, 24, 63, 65, 115–117

oxalate 80, 96

P

Pacific Health and Disability Action Plan 2

Pacific Islands Families: First Two Years of Life Study
 55

Pacific peoples 2, 3, 55, 61, 64
 breastfeeding 10, 55–57
 dietary practices 11, 12, 56, 77
 nutrition issues 57, 76, 89, 90

pacifiers 99, 117

parental modelling 33, 116–117

partial breastfeeding 9, 12

partially hydrolysed formula 39, 40, 69, 106

peanut allergy 104

phosphorus 77, 80

physiological cues 12

physical activity 93–94, 117

physical disability 18

physical skills 28

phytates 39, 70–71, 77, 80, 96, 124

phytoestrogens 39, 124

plant-based milks 49, 96

Plunket 9, 63

polysaccharides 70

polyunsaturated fatty acids 15, 72–73, 74, 124

portion sizes 116

powdered formula 40–41, 42, 84

practitioners *See* health practitioners

prebiotics in infant formula 40, 113–114, 124

pregnancy 97, 106

premature and preterm infants 40–41, 63

primary health organisations (PHOs) 56

probiotics in infant formula 40, 112–113, 124

protein 68–69

protein-hydrolysed formula 106, 124

- R**
- rapid weight gain 63
 - RDI *See* recommended dietary intake
 - ready-to-use formula 40–41
 - recommended dietary intake (RDI) 8, 68, 71, 73–74, 124
 - fluids 45–46
 - minerals and trace elements 77–78, 79, 80, 82, 83, 85, 86
 - vitamins 87, 88, 92
 - recommended numbers or sizes of servings 4, 12–13
 - reduced-fat milks 48, 67, 74
 - reflux 39, 114–115
 - refrigeration 19–21, 43, 118–119
 - Register of Community Drinking-Water Supplies 47
 - renal disease 90
 - responsive feeding 33
 - restrictive feeding practices 116
 - rice milk 96
- S**
- Salmonella* 40–41
 - salt 25, 82, 86
 - Samoan peoples 57
 - saturated fatty acids 72–73, 125
 - seafood 32, 53, 83
 - seeds 32, 72
 - selenium 83–84
 - sepsis 16, 113
 - skin cancer 89, 90
 - skin prick tests 107
 - skin rashes 107
 - skin type scale 89
 - smart drinks 50
 - socioeconomic status 90, 125
 - sodium 86–87
 - soft drinks 49–50, 100
 - solids *See* complementary feeding
 - soothers 99, 117
 - soy milk and products 96, 104, 105
 - soy-based formula 38, 39, 80, 96
 - SPARC 93
 - specialised infant formula 40, 69, 106, 109, 115
 - spilling after feeds 114
 - spirulina 97
 - sterilisation techniques 20, 37, 40, 41–42
 - stools, loose 49
 - Streptococcus thermophilus* 113
 - stroke 63, 86
 - sudden infant death syndrome (SIDS) 16, 99
 - sugar 25, 49–50, 70, 100, 117, 118
 - sulphites 108
 - sun protection 89, 90–91
 - supplementing breastfeeding 14, 19, 21, 119
 - supplements 13, 50, 95, 96, 98, 100–102
 - calcium 81
 - fluoride 84
 - iodine 82, 101
 - iron 78, 101
 - vitamin B 101, 102
 - vitamin C 101
 - vitamin D 89–90, 101
 - sweet drinks 49–50
 - sweeteners 25, 49, 118
- T**
- takeaways 13
 - tap water 42, 47
 - taurine 15, 125
 - tea 50, 57, 77, 85
 - teats 100, 117
 - Ten Steps to Successful Breastfeeding 2, 130
 - texture 26, 29, 74
 - thickeners 39, 114–115
 - three-day meal plans *See* meal plans
 - Tongan peoples 55, 57
 - tooth decay 49, 84–85, 100
 - toothpaste 84–86, 117
 - Total Diet Surveys 81, 84, 125
 - traditional customs and practices 4, 14, 60
 - traditional foods 53, 57, 60
 - transporting feeds 43
 - tree nut allergy 104–105
 - tuberculosis 17
- U**
- Ultraviolet Index (UI) 90
 - underweight 65
 - United Nations (UN) 41
 - United Nations Children’s Fund (UNICEF) 1, 19, 130
 - United States Centers for Disease Control growth charts 64, 65
 - upper level of intake (UL) 8, 125

V

- variety of food 26, 52, 70, 74
- vegan and vegetarian infants 95–98, 123, 125, 126
 - nutrition issues 68, 77, 78, 95–96
 - specific advice for vegans 38, 39, 49, 97–98, 102
- vegetables and fruit 31, 71, 75, 78, 86
 - cultural differences , 53, 57, 59–60
- vitamins 13, 73
 - folate and folic acid 91–92, 121
 - Vitamin A 87–88
 - Vitamin B12 49, 96, 97, 101, 102
 - Vitamin C 13, 49–50, 75, 91–92, 96, 101
 - Vitamin D 80, 88–91, 97, 101–102
 - See also* supplements

W

- warming feeds 43
- water 14, 42, 45, 46, 47
- water fluoridation 84–85, 117
- weaning 22
- weight 8, 25, 49, 62–63, 105, 115–116
- Well Child providers 9, 63
- whānau ora approach 2, 52
- wheat 84, 105

- wheat breakfast biscuits 13, 26, 72
- whey-dominant formula 69, 126
- wholegrain bread 72, 126
- withholding food 62, 115, 116
- workplace support for breastfeeding 4
- World Health Organization (WHO) 1, 41
 - Global Strategy for Infant and Child Feeding 1–2, 22, 119
 - growth standards 63, 64–65, 115, 147–150
 - International Code of Marketing of Breast-milk Substitutes 2, 5, 128–129
 - Ten Steps to Successful Breastfeeding 2, 130

Y

- Yin and Yang philosophy 59–60

Z

- zinc and zinc deficiency 22, 69, 79

