DOES A 'BABY LED' APPROACH TO COMPLEMENTARY FEEDING HAVE AN IMPACT ON INTAKE OF SELECTED NUTRIENTS, FOOD PREFERENCE AND FOOD VARIETY IN 12 MONTH OLD INFANTS?

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Abstract

Background: Baby-led weaning (BLW) is a form of complementary feeding where the baby feeds themselves foods that they can pick up right from the start of complementary feeding. It appears to be gaining popularity in the United Kingdom and New Zealand. However, the published evidence available in this area is very limited. Baby-Led Introduction to SolidS (BLISS) is a modified version of BLW, and the BLISS study is the first randomised controlled trial of a baby-led approach to complementary feeding in the world. It aims to address this current gap and determine whether a baby-led approach is associated with potential health benefits or risks in infants through to 2 years of age.

Aim: This thesis will use results from the BLISS study and focus on the food intake and behaviour of infants when they are 12 months of age. The three key objectives for this research are to determine: if a baby-led approach to complementary feeding has an effect on energy, macronutrients, calcium and dietary fibre intakes; if food taste and texture preferences are established differently as a result of following a baby-led approach to complementary feeding; and if a baby-led approach to complementary feeding increases the likelihood of offering a more varied diet.

Methods: Of the 206 participants who enrolled in the BLISS study, demographic data were available for 123 parent-child pairs at 12 months of age at the time this MSc thesis was being written. Data were obtained from questionnaires administered from 2-12 months of age, and a food preference questionnaire and 3-day Weighed Diet Record (WDR) collected at 12 months of age. The infant's primary caregiver completed all questionnaires and the WDR. Weighed diet record data were entered into the 'Kai-culator' nutrient analysis program. Food preference scores for different food tastes and textures were determined using questions on how often the infant had been offered various foods ('exposure'), and the infant's 'acceptance' of foods - defined as whether the infant eats (or tastes) the food when it is offered. Food variety scores were determined using the 3-day WDR by counting the total number of different foods eaten, and counting the foods

eaten from 9 different food groups. All statistical analyses were conducted using Stata 12.1. All tests with a two-sided $p<0.05$ were considered statistically significant.

Results: Infants in the BLISS group at 12 months of age had significantly higher exposure scores for foods classified as 'savoury - vegetable' (P=0.050), 'savoury - non-meat high protein' (P=0.024), and 'lumpy' (P=0.004), and a lower exposure score for 'salty' foods (P=0.014), when compared to the control group. However, the BLISS intervention did not appear to affect the 12 month infants' overall nutrient intake, food preference, or food variety. Compared to the control group, BLISS did modify some specific eating behaviours and parent practices. Those in the BLISS group had a longer duration of exclusive breastfeeding (P=0.022), started complementary feeding later (P<0.001), and were less likely to be offered commercial baby foods (P=0.019).

Conclusion: Following a modified approach to Baby-led weaning resulted in an increased exposure to a range of tastes and textures; this could theoretically lead to positive influences on eating behaviours later in life. However, reassuringly both study groups had adequate nutrient intakes, and consumed a variety of foods at 12 months of age. However, there are still a number of unanswered questions concerning BLW and further research into the implications of BLW is needed to provide policy makers and health professionals with sound scientific evidence before any recommendations regarding BLW can be made to the general New Zealand population.

Keywords: Baby-Led Weaning, complementary feeding, infant nutrition, food preference, food acceptance, 12 months of age, energy, fat, protein, carbohydrate, calcium, dietary fibre, food variety

Preface

This MSc project is part of the Baby Led Introduction to SolidS (BLISS) study. The BLISS Study began in 2012 and was conducted through the Department of Human Nutrition and Department of Medicine (University of Otago Dunedin, New Zealand).

Dr Anne-Louise Heath and Associate Professor Rachael Taylor were responsible for the design and outline of this MSc project, and provided the supervision for this thesis. Dr Karen Lusk assisted and supervised the food preference section of this thesis. The focus of this thesis was to evaluate energy and nutrient intakes, determine food preferences and calculate food variety in a subset sample of 123 infant participants in the BLISS study when they were one year of age.

As part of this thesis, the MSc candidate was the primary researcher for the project and was responsible for the following:

- Developing protocols for questionnaire administration and WDR administration.
- Pretesting the phone questionnaire on mock participants before administration.
- Conducting breastfeeding and solids phone questionnaires for 105 participants, (each participant answered the questionnaire six times).
- Coordinating some study participants, which included the booking of appointments, following up phone-calls and reminder texts/emails.
- The training of other research assistants on WDR administration.
- Tracking and collecting the 12-month WDRs.
- Developing nutrient lines for infant foods that had been consumed but were not available within Kai-culator.
- Contributing to the analysis of BLISS study recipes to determine moisture retention factors which were used in Kai-culator.
- Entry of 80 three-day WDRs into Kai-culator.
- Co-ordinating the entry and checking of remaining WDRs and the quality control process.

- Developing, pre-testing, and refining of the food preference questionnaire.
- Entry of 112 food preference questionnaires.
- Contributing to fortnightly BLISS meetings for the two years I was part of the BLISS study.
- Conducting all statistical analysis and interpretation presented in this thesis.

This thesis was only able to include data from 123 parent-child pairs at 12 months of age from the total pool of 206 participants due to the time it took to recruit participants and the constraints of the MSc period.

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Thank you to my supervisors Dr Anne-Louise Heath, Associate Professor Rachael Taylor and Dr Karen Lusk for not only providing me with guidance, support and feedback throughout my journey of this project, but also pushing me to excel in areas in which I never knew I had the ability to.

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To my parents Toni and Stephen Morison for your loyalty throughout my university degree and understanding why I continued to study for so long. You two have both been supportive.

To Anne and Madeline, upstairs running the show. You two are not only always up for a chat, but have also kept me on my toes throughout this 'thesis journey'.

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And finally thank you to all the BLISS study families, from whom I have learnt so much. Thank you for making time in your busy lifestyle, answering all our questions and doing a fantastic job in completing the diet records.

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List of Abbreviations

AI – Adequate Intake

BLISS – Baby Led Introduction to SolidS (Study)

BLW – Baby Led Weaning

BMI – Body Mass Index

CI – Confidence Interval

cm – Centimetre

EER – Estimated Energy Requirement

EAT – Eating Assessment in Toddlers (Study)

FFQ – Food Frequency Questionnaire

FPQ – Food Preference Questionnaire

mg – Milligrams

ml – Millilitres

MDiet – Masters of Dietetics

MOH – Ministry of Health

MSc – Master of Science

NRV – Nutrient Reference Value

NZDep – New Zealand Deprivation (Index)

POI – Prevention of Overweight in Infancy (Study)

RDI – Recommended Dietary Intake

SD – Standard Deviation

WDR – Weighed Diet Record

WHO – World Health Organisation

1 Introduction

Current recommendations for complementary feeding in developed countries advise parents to spoon-feed their infant puréed foods before progressing to mashed, chopped and then family foods once the child is one year of age (Ministry of Health., 2008; World Health Organization., 2003). This method of feeding will be referred to as traditional complementary feeding throughout this thesis.

An alternative method called Baby-Led Weaning (BLW) has recently become popular (Rapley & Murkett, 2008). In BLW, infants are not spoon-fed at all. Instead, infants use their own instincts in an exploration of first foods; they are offered family foods and practice self-directed feeding right from the start of complementary feeding. Baby-led weaners then avoid the 'purée stage' completely, while continuing to breastfeed on demand throughout the feeding process (Cameron et al., 2012b; Rapley & Murkett, 2008). According to the authors, this approach to complementary feeding "promises a revolution", assuring "self-led feeders are happy eaters" who participate at family meal times and "eat with minimal stress and fuss" (Rapley & Murkett, 2008).

With the prevalence of childhood obesity climbing over the last generation (Lobstein et al., 2004; Ministry of Health, 2013), one of the potential advantages suggested by supporters of BLW is that this method of feeding helps to prevent obesity. In theory, those following BLW are less likely to overeat, as they are not persuaded to eat foods they do not want (which is thought to occur more easily when spoon-feeding). As a result baby-led weaned children are thought to have better energy self-regulation because they keep the ability to acknowledge satiety cues (Rapley & Murkett, 2008). A second proposed benefit of BLW is that infants following this practice experience a wide range of tastes and textures from a younger age (rather than the bland combination and consistent texture of blended baby-foods). In turn, this is thought to result in a greater acceptance of a variety of food when the child is older (Rapley G, 2003; Rapley & Murkett, 2008), and the development of healthier food preferences in later life (Cooke et al., 2004; Townsend & Pitchford, 2012). Lastly, if BLW places emphasis on exploring tastes and textures, this could be an excellent way of introducing a wide variety of foods

into the infant's diet to ensure they are receiving an adequate nutrient intake. Parents are therefore turning to BLW as a form of complementary feeding, which is fast gaining a reputation as a better way to establish healthy long-term eating habits. However, research to support these proposed health benefits is very sparse and therefore it is difficult to draw any firm conclusions (Reeves, 2008).

Previous studies have only looked at BLW during the early stages of complementary feeding (Brown & Lee, 2011a; 2011b; 2013; Cameron et al., 2013a; Rapley G, 2003; Rowan & Harris, 2012; Wright et al., 2011); and not in later infancy. Despite BLW being a very attractive concept, almost nothing about the diets of children following BLW is known. Only one study appeared to have examined dietary intake of those following BLW, however no comparison group following traditional complementary feeding was examined (Rowan & Harris, 2012). With traditional complementary feeding, it is recommended that caregivers start offering their child family foods once they are one year of age, assuming the family food environment provides a variety of appropriate and adequate foods (Ministry of Health., 2008). The nutrient intakes and eating behaviours of those following BLW have not been examined, nor compared to traditional complementary feeding practices at one year of age, therefore creating a gap in the literature.

Currently parents who wish to adopt BLW have to seek advice from other peers and social media, without scientific support. Without the right knowledge and guidance this could lead to risk, such as providing unhealthy or unsafe foods and not monitoring the infant's food intake (Brown & Lee, 2011a). In New Zealand the Ministry of Health does not currently recommend BLW due to concerns around choking and baby-led weaned infants not being able to get sufficient intakes of energy and iron in their diet to keep up with growth demands (Ministry of Health, 2014). Further research on the implications of BLW is needed to provide policy makers and health professionals with sound scientific evidence before any revisions of the current recommendations can be made.

Presently, the Baby-Led Introduction to SolidS (BLISS) study (University of Otago, Dunedin) is investigating whether a novel approach to infant complementary

feeding (Baby-Led Weaning), encourages self-regulation of energy intake and prevents the development of overweight without detrimental effects on iron status and growth (Daniels et al., 2015).

This thesis will use results of the BLISS study to focus on the infants' food behaviour and intake when they are 12 months of age. The three key objectives for this research are to:

1. Assess dietary intake to determine if a baby-led approach to complementary feeding has an effect on energy, macronutrient, calcium and dietary fibre intakes.
2. Determine if food taste and texture preferences are established differently as a result of following a baby-led approach to complementary feeding.
3. Establish if a baby-led approach to complementary feeding increases the likelihood of a more varied diet.

2 Literature review

2.1 Literature search methods

Literature searches were conducted between March 2014 and June 2014 using electronic databases Medline (OvidSP) (Ovid MEDLINE® 1946 to Present update), Web of Science (1900 – 2014), PEN Practice-based Evidence in Nutrition, and Google Scholar for articles published in English, and in human subjects. Search strategies and key terms used are outlined in **Table 2.1.1** Additionally, the World Wide Web was used to access information on current perceptions of Baby-Led Weaning. Searches focused primarily on outcomes in infants and toddlers, however, where there were insufficient studies published, the search was expanded to include 3-6 year old children.

This review aims to evaluate current approaches to BLW worldwide and approaches to complementary feeding within New Zealand, and investigate methods for measuring and evaluating nutrient intake, food preference and food variety among infants and toddlers.

Table 2.1.1 Search strategies and terms used to identify studies in this review.

Search terms used to identify approaches to complementary feeding
1. weaning
2. self feed*
3. finger food*
4. baby led
5. family food*
6. complementary feeding
7. New Zealand
8. current recommendations
9. feeding method
10. maternal feeding
11. infant/
12. toddler/
13. 12 month$
14. (11) OR (12) OR (13)
15. (1) OR (2) OR (3) OR (4) OR (5) OR (6) OR (9) OR (10)
16. (14) AND (15)
17. (6) AND (7) AND (8)
18. (14) AND (17)
19. (7) AND (18)
20. (7) AND (15)
Search terms used to identify nutrient intakes in infants/toddlers
1. nutrition requirement
2. New Zealand

3. complementary feeding
4. calcium
5. protein OR dietary protein
6. fat OR dietary fat
7. energy intake
8. fibre OR dietary fibre
9. infant/
10. toddler/
11. 12 month$
12. (9) OR (10) OR (11)
13. (12) AND (1) AND (3) OR (4) OR (5) OR (6) OR (7) OR (8)
14. (12) AND (1) AND (2)
15. nutrient recommend*
16. diet
17. measurement
18. nutrition* assess*
19. dirt record*
20. (1) OR (15) OR (16) OR (17) OR (18) OR (19)
21. (12) AND (20)

Search terms used to identify food preference in infants/toddlers

1. infant/
2. toddler/
3. preschool/
4. 12 month$
5. (1) OR (2) OR (3) OR (4)
6. food preference*
7. eating behav*
8. food acceptance
9. (6) OR (7) OR (8)
10. parent practice
11. maternal feeding
12. diet
13. maternal behav*
14. food habit
15. style
16. (10) OR (11) OR (12) OR (13) OR (14) OR (15)
17. assess*
18. questionnaire
19. scale
20. experiment
21. measuring
22. (17) OR (18) OR (19) OR (20) OR (21)
23. taste
24. flavour
25. texture
26. food variety
27. food diversity
28. (23) OR (24) OR (25) OR (26) OR (27)
29. (5) AND (9)
30. (29) AND (16)
31. (29) AND (22)
32. (28) AND (29)
33. (5) AND (16)
34. (9) AND (22)

Search terms used to identify food variety in infants/toddlers

1. infant/

2. toddler/
3. preschool/
4. 12 month$
5. (1) OR (2) OR (3) OR (4)
6. diet variety
7. diet diversity
8. (6) OR (7)
9. assess*
10. questionnaire
11. scale
12. experiment
13. measuring
14. (9) OR (10) OR (11) OR (12) OR (13)
15. New Zealand
16. recommendation
17. (15) OR (16)
18. complementary feeding
19. weaning
20. parent practice
21. maternal feeding
22. diet
23. maternal behave*
24. style
25. (18) OR (19) OR (20) OR (21) OR (22) OR (23) OR (24)
26. (5) AND (8)
27. (26) AND (14)
28. (8) AND (14)
29. (26) AND (17)
30. (26) AND (25)

2.2 Approaches to infant complementary feeding

2.2.1 Recommendations for complementary feeding

Current recommendations in developed countries advise parents to exclusively breastfeed (no other liquids or solids except breast milk from the breast or expressed milk and prescribed medicines since birth) until around 6 months of age (Agostoni et al., 2008; Ministry of Health., 2008; World Health Organisation, 2009; World Health Organization., 2003). At this time, complementary foods can be introduced while breastfeeding continues to at least 12 months of age. Thus the World Health Organisation (WHO) describes the complementary feeding period as 'the period during which other foods or liquids are provided along with breast milk' and states that 'any nutrient-containing foods and liquids other than breast milk given to the young child during the period of complementary feeding are defined as complementary foods'. Thus human milk substitutes, infant formula, and follow-on formulas are included in the definition of 'complementary foods'. Parents are also advised to practice responsive feeding, by being sensitive to hunger and satiety cues, and feeding slowly and patiently while minimising distractions during meal times. Parents should encourage their children to eat (but not force them), experimenting with different food combinations, tastes, textures, and methods of encouragement, and remember that feeding times are about learning and love (Ministry of Health., 2008; Pelto et al., 2003; World Health Organisation, 2009; World Health Organization., 2003).

The timely introduction of complementary foods during infancy is necessary for both developmental and nutritional reasons. The ability of breast milk to meet requirements for macronutrients and micronutrients becomes reduced with the increasing age of the infant. At six-months of age, small amounts of puréed and semi-mashed foods are typically spoon-fed to the child, gradually increasing the amount, consistency and variety of food as the infant gets older. By 8 months most infants can eat 'finger foods', but these generally do not represent a large portion of the diet until the child is older. These changes continue until by 12 months of age, most children are eating the types of foods consumed by the rest of the family

(Dewey & Brown, 2003). It has been suggested that there is a 'critical window' for introducing 'lumpy' solid foods and if these are delayed beyond 10 months of age, it may increase the risk of feeding difficulties (Agostoni et al., 2008; Northstone et al., 2001; World Health Organization., 2003). For the average healthy breastfed infant, meals and complementary foods should be provided 3-4 times a day from 9-24 months of age. It is important that a variety of foods are offered to ensure that nutrient needs are met. Foods should be low in salt, and have little or no added sugar. Iron and zinc-rich foods, meat, poultry, fish or eggs should be eaten daily, alongside vitamin-A rich fruits and vegetables, and a diet with adequate fat content. Cows milk is not recommended before 12 months of age, and caffeinated beverages should be avoided (Agostoni et al., 2008; Ministry of Health., 2013; National Health and Medical Research Council, 2012; World Health Organisation, 2009; World Health Organization., 2003).

2.2.2 Complementary feeding in New Zealand

Breastfeeding: In 2013, 42% of New Zealand women with children aged 3 months exclusively or fully breastfeed (no other liquids or solids except breast milk from the breast or expressed milk and prescribed medicines since birth), which decreased to 17% of women breastfeeding when the child was 6 months of age (data representing 90% of all births in New Zealand)(Royal NZ Plunket Society, 2013). In New Zealand, breastfeeding rates have not changed significantly in the past six-year period between 2008 and 2013. Other research has demonstrated that exclusive breastfeeding duration in New Zealand falls short of the recommended 6 months (Cameron et al., 2013b; Heath et al., 2002a; Heath et al., 2002b; Schluter et al., 2006), similarly many do not continue to breastfeed on demand until 12 months of age, after non milk foods have been introduced into the child's diet (Cameron et al., 2013b; Heath et al., 2002a; Heath et al., 2002b; Schluter et al., 2006; Simons, 1999).

Food and Milk drinks: The findings of published studies (**Table 2.2.1**) suggest that many infants in New Zealand are: not being breastfed long enough, are inappropriately introduced to complementary foods before four months of age, are introduced to cows' milk as a drink before one year of age, and are consuming

foods that are considered inappropriate before one year of age (Cameron et al., 2013a; Ford et al., 1995; Heath et al., 2002a; Heath et al., 2002b; Schluter et al., 2006; Wham, 1996).

Table 2.2.1 Studies examining complementary feeding among New Zealand infants and toddlers (0-3 years of age).

Author, year	Participants	Study Type and Methods	Findings
(Cameron et al., 2013a)	n=199 Mother/infant pairs 6-12 months of age	Population-based cross sectional survey	58% of the sample surveyed exclusively breastfed their infant until 5 months of age. 4% reported never exclusively breastfeeding. 63% of infants received complementary food before 6 months of age.
(Ford et al., 1995)	n=1592 Parents/caregivers of infants 1-12 months of age	Comprehensive questionnaire	20% of infants were receiving solids by 12 weeks of age. 50% of infants were receiving solids at 16 weeks of age. 90% of infants were receiving solids at 6 months of age.
(Heath et al., 2002a; Heath et al., 2002b)	n=74 Mother/infant pairs 9 months to 2 years age Dunedin	Longitudinal study, Estimated diet records collected at 9, 12, 18 and 24 months of age.	42% of the infants were exclusively breastfed to 3 months of age. 88% of mothers initiated breastfeeding. 34% of infants were receiving some breast milk at 12 months of age. 39% of infants were given 'follow on' formula at 9 months of age45% of infants were given non-milk foods before 4 months of age. 69% were given unmodified cows milk as a beverage before 12 months of age.

Author, year	Participants	Study Type and Methods	Findings
(Schluter et al., 2006)	n=1124 Pacific Island mother/infant pairs 6 weeks - 24 months of age Auckland	Longitudinal study Maternal interviews	37% of infants were exclusively breastfeeding and 95% were receiving some form of breast milk at 3 months of age. 9 % of infants were exclusively breastfeeding at 6 month of age. No infants were exclusively breastfeeding and 31% were receiving some form of breast milk at 12 months of age.
(Wham, 1996)	n=53 Mother/toddler pairs 9-24 months of age	Nutrient intake assessed by 24-hour recall and dietary history questionnaire.	94% of the sample initiated breastfeeding. 77% of infants were receiving breast milk at 9 weeks of age. 22% of infants were receiving breast milk at one year of age . Cows milk was introduced at a mean age of 11 months.

2.2.3 Baby Led Weaning

BLW is described as a novel approach to complementary feeding in which the infant controls the weaning process. The first foods are offered as 'graspable' finger foods as the infant learns self-feeding skills, while continuing breastfeeding on demand (Cameron et al., 2012b; 2013a; Rapley & Murkett, 2008). In theory, the infant remains in control of how much food is eaten; hence they may maintain better energy self-regulation, which is thought to lower the risk of obesity (Rapley & Murkett, 2008). Additionally Rapley recommends those following BLW should make sure their child experiences a wide range of flavours and textures, suggesting the more variety they experience at an early age, the more willing they will be to try new things when they are older (Rapley & Murkett, 2008).

Further published findings suggest that those following a BLW approach believe it to be more nutritional, less stressful (Brown & Lee, 2011b; Cameron et al., 2012a), more convenient, cheaper and enjoyable (Brown & Lee, 2013; 2011b; Rapley & Murkett, 2008). In contrast, interview data from health professionals has raised concerns regarding the increased risks associated with BLW, such as choking, iron deficiency and inadequate energy intake (Cameron et al., 2012a).

In 2003, Gill Rapley conducted the first investigation into whether babies could initiate the self-weaning practices of BLW. This was a very small observational study assessing 5 six-month-old infants' response to being offered 'graspable' whole foods that allowed self-feeding at family meal times. Findings suggested that infants have the necessary motor skills to self-feed whole foods, and therefore Rapley concluded parents should allow infants to 'lead the way' by feeding themselves, as opposed to spoon-feeding (Rapley G, 2003). Publication of Gill Rapley's book followed, which encourages the general population to carry out BLW as an alternate form of complementary feeding (Rapley & Murkett, 2008). BLW has since become a very popular approach of complementary feeding (991,000 'hits' on Google (19/2/2015)).

Despite the popularity of BLW, and the reported frequent requests for advice regarding its use from health professionals (Cameron et al., 2012a), very little

research has examined BLW. However, published research in this area generally concludes that parents who follow BLW were more likely to adhere to the recommended complementary feeding guidelines, while mothers are also more likely to follow breastfeeding recommendations, have more years of education, and are less likely to return to work before 12 months postpartum (Brown & Lee, 2013; Cameron et al., 2012a). This suggests that parents following a BLW approach are a highly motivated group, who are actively searching for information, and therefore the perceived benefits may vary in a more representative population sample. To achieve more reliable, consistent and comprehensive evidence on the effects of BLW, research conducted with the broader general population is needed.

Several limitations are present in the existing literature concerning BLW, including an inconsistent definition of BLW. For instance, most studies have included self-reported BLW followers, and their inclusion was regardless of the extent to which they adhered to BLW guidelines (Cameron et al., 2012a; Rowan & Harris, 2012; Townsend & Pitchford, 2012). Surprisingly, the extent of self-feeding in comparison to parental-feeding has rarely been measured, despite this remaining the defining characteristic of BLW (Brown & Lee, 2011a; Rapley G, 2003). However, other measures of adherence including the frequency and duration of breastfeeding (Brown & Lee, 2013; Townsend & Pitchford, 2012), the age of complementary food introduction (Brown & Lee, 2013; Townsend & Pitchford, 2012; Wright et al., 2011), the extent to which breastfeeding is on demand (Brown & Lee, 2013), the frequency with which baby sits in on family meals (Brown & Lee, 2013; Rowan & Harris, 2012), and whether they eat the same foods as the family (Brown & Lee, 2011b; Rowan & Harris, 2012) has been measured. An additional problem arising within existing research is the possibility of recall bias, as the inquiries into participants' adherence were generally performed retrospectively. Only one very small (n = 10) cross-sectional study appears to have examined dietary intake of those following BLW, with no comparison group (Rowan & Harris, 2012).

Although the baby-led approach to complementary feeding appears to be a growing trend, there is very little data on nutrient intakes, food preferences or food variety.

2.3 Nutrient intake in toddlers

2.3.1 Methods of dietary assessment in toddlers

By 12 months of age, an infant should have started the transition to solid foods. Complementary food intake can be measured using traditional dietary assessment techniques (Gibson, 2005). There are five conventional methods used for estimating dietary intake: 24-hour recalls, estimated food records, food frequency questionnaires (FFQ), a diet history and weighed diet records (WDR) (Gibson, 2005). Each has it own advantages and disadvantages.

Measuring dietary intake in an infant population depends on the main caregiver to provide the information. This can be difficult with an infant's varied diet during the weaning period. Many variables can influence an infant's food preference and overall food intake; such as mood, tiredness, growth and sickness, all of which can create difficulties when trying to assess usual intake (Gondolf et al., 2012). Therefore, more measurement days are required to capture an accurate representation of usual intake (Briefel et al., 2010; Livingstone & Robson, 2000). However, difficulties may arise when children are attending day-care and adequate food descriptions are not recorded. Although the dietary pattern of the infant is not going to be influenced by the presence of a diet record, parents may be more mindful of the foods they are offering and may modify the diet to present one that is more favourable (i.e., more healthy foods being offered and missing 'treat' foods) (Lanigan et al., 2001).

Burrows et al. (2010) review of validation studies looking at the most accurate way to measure dietary intake in children (0-18 years), found participants involved in a 24hour food recall, food frequency questionnaire and diet history were significantly more likely to over-report energy intake, while participants using weighed and estimated diet records were more likely to under report. The

review concluded that WDRs provided the best estimate for younger children (0.5-4 years) (Burrows et al., 2010). However an added complication is the measurement of breast milk intake at this age (Briefel et al., 2010; Dewey et al., 1991; Marriott et al., 2008). This is usually done by using algorithms or a standard estimated intake to estimate breast milk intake (Briefel et al., 2010; Conn et al., 2009; Marriott et al., 2008), although this has led to an overestimation of breast milk intake in some studies (Briefel et al., 2010; Marriott et al., 2008).

Multiple WDRs are known to be the most precise dietary assessment method for assessing usual dietary intake (Gibson, 2005). However, in order to capture accurate food consumption, the participant is required to be highly motivated, numerate and literate. WDRs are time consuming and can be difficult, with a high respondent burden possibly resulting in changes of eating behaviour to make recording easier (Burrows et al., 2010). However, this method does not involve the participant attempting to remember food that has been eaten as is required for other methods (Bingham, 2007).

2.3.2 New Zealand dietary recommendations at 12 months of age (Energy, Fats, Protein, Carbohydrate, Calcium and Dietary fibre)

Complementary foods should be safe and nutrient dense and prepared with little or no added sugar or salt. Complementary feeding should provide a variety of foods while reflecting specific family foods, meals and eating patterns. By 12 months of age young children should be eating a wide variety of family foods. However, texture progression from puréed to mashed to chopped should be offered based on developmental stage, with breast milk used to achieve the desired consistency until one year of age (Ministry of Health., 2008).

Regular growth monitoring throughout the first two years of life is recommended to ensure that the child is growing along their normal growth curve. Frequency of feeding should be based on cues of hunger and satiety. The amount of food should be gradually increased with age and caregivers should avoid over or underfeeding their child (Ministry of Health., 2008).

Energy: During the first two years of life the child has high-energy demands for growth, metabolism and development. High energy density foods should be offered, as toddlers have a relatively high energy requirement and limited stomach capacity. For example, reduced-fat milk should not be given to toddlers under two years of age because of the low energy content (Ministry of Health., 2008). The Nutrient Reference Values (NRVs) for Australia and New Zealand state the estimated energy requirement for toddlers aged 12 months is 3500kJ for boys and 3200kJ for girls. These energy requirements are estimated from total energy expenditure and the additional need for growth of 90kJ per day (National Health and Medical Research Council of Australia, 2006). However at the individual level, a child's appetite and growth is the best guide to adequacy of energy intake and substantial variation in requirements exist, as energy needs reflect the varying levels of physical activity (Ministry of Health., 2008).

Fat: Dietary fat is an essential component of the diet as an important source of energy and essential fatty acids that aid and promote the absorption of fat-soluble vitamins A, D, E and K (Ministry of Health., 2008). During the transition to complementary foods the infant's diet changes from one that provides half the energy from fat (breast milk composition) to one where less than 40% of the energy is from fat. It is recommended that whole cows' milk is offered, as it is a good source of dietary fat for toddlers from 12 months of age. The NRVs for infants aged seven to 12 months state the Adequate Intake (AI) for fat as 30 grams per day. However there is no AI set for toddlers aged one to two years (National Health and Medical Research Council of Australia, 2006).

Protein: Protein is an essential component of the diet and is required to supply essential amino acids required for the growth of the infant. Animal sources such as meat, fish, chicken, eggs and dairy products tend to be higher in protein and also supply all nine indispensable amino acids. Similarly plant based proteins such as legumes and nuts are also good sources of protein in the diet (Ministry of Health., 2008). The Recommended Dietary Intake (RDI) of protein for toddlers aged one to two years is 14 grams (1.08g/ kg body weight) per day (National Health and Medical Research Council of Australia, 2006).

Carbohydrate: Carbohydrates provide energy to the body, in particular to the brain. Carbohydrate-rich foods include vegetables, fruits, cereals, bread, pasta, rice and legumes. The AI for carbohydrates for infants aged seven to 12 months is 95 grams per day. No AI has been set for toddlers aged one to two years (National Health and Medical Research Council of Australia, 2006).

Calcium: Calcium is required for normal development and maintenance of the skeleton. Calcium is essential for the bone, muscle contraction, transmission of nerve impulses and blood clotting and is present in the bones and teeth to provide structure and strength (Ministry of Health., 2008). The average concentration of calcium present in breast milk is around 260-300mg/L, and absorption of calcium from breast milk is estimated to be 55-60% (Ministry of Health., 2008). Milk and milk products are the major food sources of calcium and products such as cheese, yoghurt, custard and milk puddings are suitable once the infant is around 7-8 months of age. Once the toddler is in the second year of their life, cows' milk can be introduced into the diet. Toddlers should not consume more than 500mL of whole cows' milk a day, and breastfed toddlers will need less cows' milk, depending on breast milk consumption (Ministry of Health., 2008). The RDI for calcium in toddlers aged one to two years is 500mg per day (National Health and Medical Research Council of Australia, 2006).

Dietary fibre: Dietary fibre is found in all plant materials, with the main sources found in cereals, legumes, fruits and vegetables. Dietary fibre is essential for gut function and regular bowel movements, as it is generally not digested by normal digestive processes but rather broken down (fermented) by bacteria in the large intestine (Ministry of Health., 2008). Although concern has been expressed that infants and toddlers given large amounts of fibre containing foods may have their appetite satisfied before meeting their energy requirements (Ministry of Health., 2008), research does not support that this is common (Edwards & Parrett, 2003; Kranz et al., 2005; Williams & Bollella, 1995). The AI for dietary fibre is 14 grams per day for one to two year olds (National Health and Medical Research Council of Australia, 2006).

2.3.3 New Zealand nutrient intakes (Energy, Carbohydrate, Fats, Protein, Calcium and Dietary fibre)

There are limited national data on the dietary practices and nutrient intakes of children in New Zealand from birth to one year of age. Findings discussed in this thesis have been drawn from studies that were conducted on regional or selected population groups, often in small sample sizes, a larger age range (6 months to three years of age), or when different methods of collecting dietary data have been used. Therefore, the information may have limited generalizability to the whole population. However, some continuity in findings is apparent. Daily intakes of energy, carbohydrate, protein, fat and calcium have all been identified to be above Ministry of Health recommendations (Ministry of Health., 2008), (Heath et al., 2002b; McLachlan et al., 2004; Metcalf et al., 2007; Morgan et al., 2010; Soh et al., 2002; Szymlek-Gay et al., 2007; Thomson et al., 2008; Wham, 1996), whereas intakes of dietary fibre are below the recommended AI of 14g per day (Morgan et al., 2010; Simons, 1999; Soh et al., 2002; Wham, 1994; Wham, 1996). However, it is important to acknowledge these findings have been based on mean and median intakes and therefore cannot be used as a judgment of nutrient adequacy.

Table 2.3.1 Nutrient intakes (Energy, Carbohydrate, Fats, Protein, Dietary fibre and Calcium) among New Zealand infants and toddlers (0-3 years of age).

Author, year	Participants	Study Type and Methods	Nutrient	Findings	
Heath et al. (2002b)	n=72 Mothers of infants 12 months of age	Longitudinal study 3-Day WDR	Energy, calcium	Median (25^{th}, 75^{th} percentile) Energy (kJ): 3986 (3317, 4603) Calcium (mg): 636 (439, 874)	
Morgan et al. (2010)	n=225 Mother/toddler pairs 12-20 months of age	20 week randomized intervention trial 3-Day WDR	Energy, calcium, dietary fibre	At baseline: Geometric mean (95% CI) **Placebo group (n=90)** Energy (kJ/d): 4119 (3921, 4316) Calcium (mg/d): 844(771, 916) Dietary fibre (g/d): 8.1 (7.3, 8.9) **FTMD group (n=45)** Energy (kJ/d): 4077 (3861, 4338) Calcium (mg/d): 834 (737, 930) Dietary fibre (g/d): 8.3 (7.3, 9.3)	**Meat group (n=90)** Energy (kJ/d): 4126 (3917, 4334) Calcium (mg/d): 898 (821, 975) Dietary fibre (g/d):7.8 (7.0, 8.6)
Soh et al. (2002)	n=184 Non-breastfeeding toddlers 12-24 months of age	Cross-sectional survey 3-Day WDR	Energy, protein, iron, dietary fibre, calcium	**Boys n=106** Median (quartiles) intakes/day Energy (kJ): 4143 (3654,4679) Protein (g): 38 (30,43) Calcium (mg): 687 (544, 883) Dietary fibre (g): 8 (6,10)	**Girls n=78** Median (quartiles) intakes/day Energy (kJ): 3956 (3380,4386) Protein (g): 34 (29,38) Calcium (mg): 644 (509, 855) Dietary fibre (g): 7 (5,9)
Szymlek-Gay et al. (2010)	n=188 Mother/toddlers pairs 12-24 months of age	Community base cross-sectional survey 3-day WDR	Energy	Mean (SD) Energy (kj/d): 4162 (1099)	

Author, year	Participants	Study Type and Methods	Nutrient	Findings
Thomson et al. (2008)	n=968 New Zealand population	Mean dietary exposure New Zealand Total Diet Survey	Energy	**6-12 month old infant group:** Mean energy: 3800 kJ/day **1-3 year old age group** Mean energy: 5200 kJ/day
Wham (1994)	n=53 Mother/toddler pairs 9-24 months	Cross-sectional survey 24 hour food recall and diet history questionnaire	Energy, protein, fat, carbohydrate, and dietary fibre	**9-12 months (n=13)** **(Daily intake (Mean))** Energy: 4179kJ Protein: 35g Fat: 38g Carbohydrate: 136g Calcium: 756mg Dietary fibre: 8g
McLachlan et al. (2004)	n=188 Mother/toddler pairs 12-24 months of age	Cross-sectional survey South Island 3-Day WDR	Energy, protein	Daily intakes (Mean (SD)) Energy (kJ): 4162 (1099) Protein (g): 36 (11)
Metcalf et al. (2007)	n=125 (50 clusters) children aged 1-12 years	Intra-cluster dietary nutrients obtained from 24 hour recalls	All nutrients of interest	**Pre-school (1-4 years age) (mean (SD) daily intakes)** Energy (kJ): 5766 (2266) Protein (g): 49.7 (23) Fat (g): 47.6 (23.5) Carbohydrate (g): 195 (71.8) Calcium (mg): 627.2 (326.4) Dietary fibre: 11.6 (5.33)

2.4 Food preference in toddlers

When solids are introduced and the transition to an adult diet begins, food preferences start to influence food intake (Birch, 1999). The effect of exposure on the development of food flavour and texture preferences is thought to be the greatest at the start of the complementary feeding period, due to all foods being new and novel to the infant (Mennella et al., 2008).

By 12 months of age the infant's development is advanced enough to cope with foods that have a soft to moderate texture and flavour. They are able to feed themselves and even bite through a number of different textures (Blossfeld et al., 2007). There is considerable evidence that sensory experiences early in life can influence later preferences and food acceptance (Birch, 1999; de Lauzon-Guillain et al., 2012). Rapley claims that babies following BLW may have preference for a wider range of flavours and textures due to the increased exposure to family foods (Rapley & Murkett, 2008), supported by Townsend and Pitchford (2012), who suggested BLW promotes healthy food preferences in early childhood. Infants following BLW had a significantly increased liking for carbohydrates. Additionally, the BLW group also had an increased liking for proteins and whole meals, when compared to the spoon fed group. However, participants in this study were self-identified baby-led-weaners.

2.4.1 Methods for measuring food preference in toddlers

Food preference in adult populations is generally measured either by conducting actual taste tests (participants taste a range of different foods and rank them from most to least preferred), or via questionnaires. More specifically, four techniques are commonly used (rank order preference assessment, video recording, food behaviour questionnaires, and food exposure questionnaires) (de Lauzon-Guillain et al., 2012), each with their own advantages and limitations. Assessing food preference is of course more complicated in infants, as they are unable to verbalize which foods they prefer over others. Because caregivers are therefore required to assess food preference on behalf of their child, it cannot be assumed

that designs developed for an adult population will be appropriate for collecting data in young children.

Rank order preference assessment: Ranking is an effective way of measuring food preference in a group or population (Bell & Tepper, 2006; Birch & Marlin, 1982; Finistrella et al., 2012; Fisher & Birch, 1999b). Participants are asked to taste a range of foods and rank them from most preferred to least preferred. Fisher and Birch (1999b) adapted this technique to examine the eating patterns of children (3-5 years of age) during a 5-week period, in which they had restricted access to snack foods. Children were interviewed individually and asked to sample small amounts of foods and assign them to 1 of 3 categories illustrated with cartoon faces depicting 'yummy', 'yucky', and 'just okay' (Birch & Sullivan, 1991; Fisher & Birch, 1999b). This is an effective technique because the foods which are preferred are clearly identified in a ranked order, however it is more suited to an older population that are able to verbalize and rank their own food preferences.

Video recording analysis: Video recoding analysis is a common method used to measure infant food preference and eating behaviour (Blissett et al., 2012; Forestell & Mennella, 2007; Hausner et al., 2009; Mennella et al., 2001; Young & Drewett, 2000). Meals are observed either in the laboratory or in the child's home, and the infant's eating behaviour is video recorded. Mothers are asked to feed their children as usual until the infant refuses the spoon consecutively (more than three times). Eating behaviour, such as turning the head away, pushing the spoon away, crying, or becoming playful with the food is evaluated and coded. The videotape is then analysed, focusing on the frequency of negative responses (nose wrinkling, brow lowering, upper lip raising, gaping, and head turning) with each spoonful of food. The food can also be weighed before and after the feeding period to calculate the actual amount of food consumed (Hausner et al., 2009; Young & Drewett, 2000). This is a great technique for determining preference in a young infant age group as facial and body cues are all assessed, as opposed to determining preference based solely on the caregivers assumptions, which could induce bias in the results. However video recording is a costly and time-consuming technique, and this is not practical in a large population setting.

Food preference questionnaire: A food preference questionnaire lists a range of foods representing major food groups, where subjects are asked to indicate how much they like or dislike each food item on a standard anchored (Likert-type, or hedonic) scale (Bell & Tepper, 2006; Blossfeld et al., 2007; Caporale et al., 2009; Finistrella et al., 2012; Forestell & Mennella, 2007; Hausner et al., 2009; Jacobi et al., 2003; Jones et al., 1955; Mennella et al., 2001; Peryam & Pilgrim, 1957; Skinner et al., 1998; Skinner et al., 2002b). Phrases can be used to describe the answers (e.g. never eats, rarely eats, sometimes eats, often eats, and always eats) (Jacobi et al., 2003) or numeric scales where only the anchor points have a written description (e.g. 1 = did not like at all to 9 = liked very much) (Mennella et al., 2001; Peryam & Pilgrim, 1957). The hedonic scale has been widely used for measuring food acceptability in adult populations. However, the hedonic scale has also been used to measure infant and preschool food acceptance (Bell & Tepper, 2006; Blossfeld et al., 2007; Caporale et al., 2009; Forestell & Mennella, 2007; Skinner et al., 1998; Skinner et al., 2002b). Skinner et al. (1998) developed a food preference questionnaire to describe the preferences of commonly consumed foods in 70 children, completed by their mothers in a longitudinal study from when the children were 2-3 years through to 8 years of age. Mothers were asked to choose one of six options: (1) 'likes and eats', (2) 'likes but does not eat', (3) 'dislikes but eats', (4) 'dislikes and does not eat', (5) 'never offered', and (6) 'never tasted' (Skinner et al., 1998; Skinner et al., 2002b). This questionnaire has been subsequently simplified to (1) 'eats often', (2) 'eats sometimes', and (3) 'rarely eats/does not like', (Blossfeld et al., 2007). Pliner and Pelchat (1986) is one of the only studies to test their food preference questionnaire for reliability and validity of the mother's opinion of their child's preference, which resulted in a 71% agreement between the mother's opinion and the children's food preferences. Pliner and Pelchat's questionnaire has since been modified and used as a tool to measure children's food preferences (Gibson et al., 1998; Nicklaus et al., 2005; Wardle et al., 2001).

While each variant has its advantages and disadvantages for measuring food preference in toddlers, all are limited by the fact that the caregiver has to answer on behalf of the infant. Therefore, it is hard to capture true preference without the

caregiver's opinion becoming biased by leading words (i.e.,'likes' and 'dislikes'), as the child is unable to verbalise if they like or dislike a particular food. However, determining food preference in the form of a questionnaire is easy, cost effective, with little respondent burden and it can be carried out over a large population group.

Food consumption and exposure questionnaires: Food exposure is an important element in determining preferences in an infant population as exposure and familiarity can influence acceptance of new foods. Food frequency questionnaires (FFQ) are useful for assessing the frequency with which food items or groups are consumed during a specific time period and are useful for providing qualitative information about usual food-consumption patterns (Gibson, 2005). The questionnaire is composed of a list of foods and an associated set of frequency of use response categories. A FFQ is an effective way of capturing how much exposure preschool children have had to different foods (Finistrella et al., 2012; Forestell & Mennella, 2007; Fox et al., 2004; Hammond et al., 1993; Magarey et al., 2009; Mennella et al., 2006; Wardle et al., 2001). Wardle and colleagues (2001) used this technique to ask the mothers of 214 twin pairs about their exposure to commonly consumed foods. Information on food "preference" using the terms (1) 'dislikes a lot', (2) 'dislikes a little', (3) 'neither dislikes nor likes', (4) 'likes a little', (5) 'likes a lot', and (6) 'hasn't tried' was also provided by this FFQ. Matching frequency of consumption with overall liking of the food is a good way of determining which foods are offered and preferred by the child. However this may have been a simpler process in Wardle et al's research as it was undertaken in an older age group (4-5 years), presumably making it easier for the mother to determine their child's liking for the foods (Wardle et al., 2001).

Townsend and Pitchford (2012) looked at the impact of different weaning methods (BLW and 'Traditional Weaning') on food preferences in infants and preschool children (n=155) (20-78 months of age). The infant's food preference was measured using a preference questionnaire completed by the caregiver. Child preference was rated on a scale ranging from: (1) 'loves it' to (5) 'hates it'. Exposure (frequency of consumption) was rated from: (1) 'eats more than once a day' to (7) 'eats less than once per month'. Although, Townsend and Pitchford's

questionnaire captured the infant's exposure alongside the preference of the foods, overall preference may have been biased by the caregiver determining what is 'loved' and 'hated' given these are emotive terms and therefore could be biased by the caregiver's own food preferences and opinion.

Ideally video recording analysis would result in the best measure of food preference, however this is not feasible in a large population setting, due to the extensive laboratory procedure each participant would have to carry out for each food being assessed, and the time and cost of the research team required for the analysis of the data. A modified food preference questionnaire, which is inclusive of exposure questions, and excludes prompting words (likes, loves, dislikes, hates) that might be biased by the caregiver's opinion, may therefore be the most appropriate measure of food preference in this age group while still having a reasonably low respondent burden.

2.4.2 Foods commonly accepted and refused by toddlers

At birth, humans have a predisposition to prefer or reject the basic tastes. These predispositions include the unlearned positive responses to sweet, salty, and umami tastes, and the rejection of bitter and sour tastes (Beauchamp & Mennella, 2009; Birch, 1999; Birch & Doub, 2014; Blossfeld et al., 2007; Drewnowski, 1997; Havermans & Jansen, 2007; Mennella & Trabulsi, 2012; Schwartz et al., 2009; Stein et al., 2012; Young & Drewett, 2000). However, postnatal experiences can alter or modulate the expression of these innate preferences (Beauchamp & Cowart, 1985). Unfortunately, our current food environment is full of our unlearned predispositions and is characterised by the ready availability of energy-dense, inexpensive foods that are high in sugar and salt. These foods and beverages tend to be accepted by infants and young children the first time they are offered (Beauchamp & Mennella, 2009; Birch & Doub, 2014; Fisher & Birch, 1999b; Havermans & Jansen, 2007; Skinner et al., 1998; Wardle et al., 2001).

The acceptance of a variety of foods is important for optimal growth and health. When solids are first introduced, all foods other than milk are unfamiliar as milk is the first food all infants are exposed to. When complementary feeding begins, milk

provides a standard against which all the new flavours and textures are evaluated, resulting in a stronger acceptance for similar sensory properties (flavoured and textured foods) (Birch & Doub, 2014; Blossfeld et al., 2007; Wardle et al., 2001).

Texture is a sensory and functional manifestation, which is derived from the structure of the food, detected by several senses (touch, smell, vision, hearing and kinaesthetics) (Szczesniak, 2002). Texture and other sensory properties play a large role in the acceptance and refusal of foods, as babies and young children tend to reject textures that are difficult to manipulate in the mouth (Blossfeld et al., 2007; Szczesniak, 2002; Wardle et al., 2001). Therefore, overall liking is a key determinant of intake for infants and young children who tend to eat only preferred foods (Birch, 1999). It has been reported that children around the age of 12 months start to favour finger food as they learn to handle food themselves, look at it, put it in their mouth and discover the different textures, tastes and flavours (Blossfeld et al., 2007). BLW emphasises infant self-feeding with solid finger foods from the outset rather than parental spoon-feeding with purées. Thus it is quite feasible that this alternative complementary feeding method could have an impact on the infants' food preferences, especially texture preferences.

2.4.3 Factors that influence food preferences in toddlers

What, when, and how an infant is fed depends on their caregivers' feeding practices, all of which play a critical role in the formation of food preferences and eating behaviours (Birch, 1999). Parents are the ones to teach eating behaviours, determine which foods and portions are offered, select the timing and social context of meals, and may even pressure or force their children to eat foods (Blissett et al., 2012; Blossfeld et al., 2007; Brown & Lee, 2013; Fisher & Birch, 1999a; Fisher & Birch, 1999b; Galloway et al., 2006; Young & Drewett, 2000).

During the first two years of life infants and toddlers achieve many developmental milestones including learning to sit, crawl, stand, walk, and talk. Birch and Doub (2014) reviewed the factors influencing the diets of children under the age of 24 months. Eating behaviour also develops during this time, as the child makes the transition from breast milk and/or formula to solid foods. During these first years,

development is rapid and eating behaviour dramatically changes. Individual patterns of food preferences and eating behaviours emerge depending on the foods offered and the context of feeding during this early period of dietary transition (Birch & Doub, 2014). Sensory flavour and texture properties (discussed in section 2.4.2) have a major influence on food preference (Russell & Worsley, 2013; Wardle et al., 2001), although parental feeding practices and environmental factors also play a large role in influencing food preference.

Genetics: Parents impart the genes that can influence which tastes are preferred and which are disliked (i.e., bitter is generally rejected and sweet is accepted) (Birch, 1999; Blossfeld et al., 2007; Finistrella et al., 2012; Russell & Worsley, 2013). An example of genetic variation is the possible sensitivity to the bitterness of 6-n-propylthiouracil (PROP), which is thought to affect the acceptance or rejection of bitter-tasting vegetables by young children (Anliker et al., 1991; Bell & Tepper, 2006).

Breast milk and amniotic fluid: A variety of flavours from the mother's diet are introduced to the infant through breast milk and amniotic fluid. Therefore, breastfed infants have already become familiar with a variety of flavours before they start consuming solid foods (Hausner et al., 2009; Maier et al., 2007; Mennella, 2009; Schulze et al., 2001). Research by Mennella and Trabulsi (2012) suggested these familiar flavours provided a 'flavour bridge', easing the transition to foods of the adult diet consumed by the mother. For example, a longitudinal study showed that breastfeeding infants were more accepting of new foods during weaning compared to bottle-fed infants, indicating that breastfeeding may facilitate the acceptance of new foods (Sullivan & Birch, 1994). There may be some exceptions however; infants that had drunk hydrolysed infant formula for several months early in life were more acceptant of acid tasting drinks at 4-5 years of age (Liem & Mennella, 2002; Mennella & Beauchamp, 2002).

Introduction to solid foods: Research indicates that a delayed introduction to lumpier 'choking risk' textures can lead to the infant rejecting certain textures, which in turn can lead to the rejection of certain types of foods with harder textures (i.e., chopped carrots) (Blossfeld et al., 2007). Similarly, Northstone et al.

(2001) observed a significant increase in the variety of foods consumed by infants according to the age at which they were presented with lumps in their food, concluding that feeding difficulties were more likely to occur when lumps were introduced at or after 10 months of age (Northstone et al., 2001). Thus, the age of introduction of solids may also influence the first experiences with these foods. Delaying more textured solids could be a result of a diet based on a limited number of foods, which can alter behaviour around these foods (Blissett et al., 2012; Northstone et al., 2001).

Exposure and familiarization: There is evidence to support exposing your infant to solid foods contributes to different forms of learning (i.e., familiarization, associative learning and observational learning) (Havermans & Jansen, 2007; Maier et al., 2007; Mennella et al., 2001). A review by Birch (1999) stated it took 2-year-old children 5-10 exposures to a new food to see an increased preference for that food, while repeated opportunities to smell and look at food resulted in an increased likelihood of acceptance (Birch et al., 1987). Other research suggests that a new food may need to be offered 8-15 times before it is accepted (Briefel et al., 2004). The distinction between the familiar and unfamiliar is important, as familiarity has a strong evaluative component: what becomes familiar tends to become more preferred, and the unfamiliar tends to be avoided and disliked (Birch & Anzman, 2010).

Parent feeding style and family eating environment: Parental feeding practice and style has been found to affect both children's eating behaviour and their weight status (de Lauzon-Guillain et al., 2012; Fisher & Birch, 1999a; Fisher & Birch, 1999b; Galloway et al., 2006; Russell & Worsley, 2013). Certain feeding behaviours can promote a liking (e.g. repeated exposure and food as a reward), and a disliking (e.g. pressure and rewards for eating disliked foods) for foods (Russell & Worsley, 2013). Harper and Sanders (1975) also reported that children show a tendency to taste unfamiliar foods more readily when they observe adults consuming the foods.

Experimental studies have provided evidence that pressuring preschool children to eat 'healthy' foods such as vegetables can promote a dislike for these foods

(Fisher & Birch, 1999a; Galloway et al., 2006). This pressure to eat healthy foods has also been linked to a greater consumption of more energy-dense sweet and salty snacks in preschool children (Fisher & Birch, 1999b). The nature of the parents' attributions towards the eating environment will influence the child's response (feeding behaviour) and thus shape the developmental outcome of the child's food preference.

Baby led weaning emphasises the infant self-feeding solid finger foods from the outset, as they sit in on family meals and are encouraged to explore foods that are a size and shape the baby can handle easily. Therefore these children are being exposed to lumpier foods and textures at an earlier age, compared to infants being spoon-fed with purées. The food form, maternal interaction and family feeding environment are quite different between these complementary feeding styles and the impact of BLW on food preferences and health related outcomes are not known. Understanding the factors that outline food preference is important when developing evidence-based strategies to improve eating habits.

2.5 Food variety in toddlers

A variety of foods and flavours can be introduced gradually as the infant accepts the taste of different foods. The introduction of complementary foods involves the infant learning to recognise and enjoy the tastes as well as textures. A more varied diet ensures the infant has the opportunity to obtain an adequate intake of all nutrients, as well as offering opportunities to develop personal preferences and accept variation in textures and tastes (Mennella & Beauchamp, 1998). There is a large body of evidence that encourages parents and caregivers to expose young children to a wide variety of fruits and vegetables, wholegrain products, dairy products, and healthier fats, and to limit the consumption of low-nutrient, energy dense foods and beverages (Kant, 1996; Ministry of Health., 2008; Schwartz & Benuck, 2013; Skinner et al., 2002a; Steyn et al., 2006). It is hypothesized that babies following BLW are offered and consume a greater variety of food, as they start eating whole family foods from an earlier age (Rapley & Murkett, 2008). However, there is no evidence to either support or refute this and it does not appear to have been directly measured.

2.5.1 Methods of food variety measurement in toddlers

Dietary variety is universally recognised as a key component of healthy diets. However, there is still a lack of consensus on how to measure diet diversity (Ruel, 2003). Diet variety is usually measured using a simple count of foods or food groups over a given reference period (McNaughton et al., 2008; Ruel, 2003). Dietary data can be collected in a number of different ways including FFQs, diet records and 24-hour diet recalls. Generally, the number of individual foods consumed over a 3-day period has served as a reference (Drewnowski et al., 1997; Kennedy et al., 1995; Krebs-Smith et al., 1987).

Although most diet variety measures consist of a simple count of foods, scales have been established in developed countries, which take into consideration the number of servings of different food groups in conformity with dietary guidelines. An example of this approach is the 'Dietary Score'; scores are calculated from the number of food servings into 5 established food groups (2 servings of each dairy, meat, fruit and vegetables and 4 servings of the grain group). Diet quality is then determined from the scores of the classified food groups. However this method has its disadvantages, as observed variety is the result of different 'healthier' core foods, omitting unhealthy food items and therefore not a result of overall food variety (Kant, 1996). Another example is The Healthy Eating Index (HEI), developed from food-based dietary guidelines and data from the USDA 1989-1990 Counting Survey of Food Intake by Individuals. This survey consisted of 2-day diet records and 24-hour diet recalls from 7500 individuals (Kennedy et al., 1995). The HEI helps provide a picture of the type and quantity of foods consumed by an individual and their compliance to the dietary guidelines, by combining information on nutrients and food groups of interest (Gibson, 2005). The index consists of 10 components, each reflecting aspects of a healthy diet. Within each component 1-5 scores are allocated for the consumption of the suggested number of servings as recommended by the dietary guidelines. The HEI tool has been used to evaluate the diet quality in US children (Carlson et al., 2001), and has been validated by plasma biomarkers (Hann et al., 2001). However, Hann et al. (2001) modified the HEI in their validation study to a 10 point score (0 points = < 9

different items, and 10 points = > 24 items over the three days), determined by a count of the total number of different foods and food groups consumed over the 3-day WDR. Foods that were similar (i.e., different cultivars of apples) were only counted once in the variety category, and mixtures were broken down into their component parts, lasagna contributed to the meat group and the grain group for example.

Cox and colleagues (1997) developed a variety index based on the adjusted US Food Guide Pyramid specific for toddlers. A group consisting of 123 toddlers aged 2-3 years whose parents completed three days of 24-hour diet recalls. A list of the foods eaten over the three days was produced to calculate the total amount of each food consumed. Foods were then classified into Food Guide Pyramid groups of bread, fruits, vegetables, dairy and meat. The fats, sweets, and oils group was omitted from the count because no specific recommendations around these foods existed. Serving sizes were adapted to suit toddlers (i.e., ½ an apple is equivalent to one serving of fruit). Therefore for each child, the number of toddler-sized servings consumed within each food group over the 3-day period was added together to determine the total for each food group. The total was compared with the minimum recommended serving for that group, which resulted in a ratio food group score. However it should be noted that this method of omitting 'unhealthy' food groups might have caused the results to look healthier than the diets actually were.

Scott et al. (2012) explored food variety in 2601 two-year-old infants whose parents had completed 24-hour dietary recalls. Two food variety scores where calculated: (1) core food variety score and (2) fruit and vegetable variety score. Core foods are described as foods that are essential for good health and wellbeing ((a) breads, cereals, rice, pasta, noodles; (b) vegetables, legumes; (c) fruit; (d) milk, yoghurt, cheese, and (e) meat, fish, poultry, eggs, nuts, legumes), and foods that were high-energy dense/low nutrient dense (generally high in fat, salt or sugar) were classified as non-core or 'extra' foods. Variety scores for each group were categorized into a binary variable, where '0' equaled no intake and '1' equaled one or more foods from the food group were consumed. Total scores were then calculated by summing the individual food groups. However, variety scores

were derived from a single 24-hour recall completed by the infant's mother. Therefore, 1 day of collection cannot represent usual intake so is probably not very good for indicating food variety.

Skinner et al. (2002a) measured fruit and vegetable variety in 2-year-old toddlers by counting the total number of different vegetables and fruit, collected in repeated 24-hour diet recalls. Total counts were then divided by the number of diet recalls for each child to provide an average per day.

Thus it is apparent that several methods exist for calculating food variety scores. However, direct comparisons are difficult because of the myriad of ways in which variety has been defined and calculated in the literature. Even with broad guidelines, there are still many unanswered questions regarding the classification of foods into meaningful groups. For example, the level of aggregation of groups with similar nutrient content (i.e., should fish, poultry and meat be treated as separate categories? Should dairy products and eggs be combined?). There are no clear answers to these questions. Because dietary patterns vary substantially between cultures, clear rules around food group classifications and portion size (more specifically the minimum quantity of intake that justifies including them), which are appropriate to the research age group, need to be established before variety scores can be calculated and compared.

2.5.2 Factors that influence food variety

Research by Robinson et al. (2007) described the dietary patterns of 1434 infants aged 6 and 12 months. Results showed that the key influence on the infant diet was the quality of the maternal diet, especially at 12 months of age when the infant's diet is increasingly based on family foods. Scott et al. (2012) also demonstrated that a number of maternal and family characteristics are associated with child diet variety score. Maternal education is a strong predictor of children having high variety scores (Golley et al., 2011; Robinson et al., 2007; Skinner et al., 2002a). This finding has been attributed to more educated mothers tending to follow adult healthy guidelines and eating more healthily than less educated mothers, which is then reflected in the child's diet. Higher variety scores have also

been observed in the absence of older siblings (Golley et al., 2011; Robinson et al., 2007; Scott et al., 2012).

Many social factors affect children's eating patterns. Influences on the diet have been shown to vary by socioeconomic status, ethnicity, and urban-rural status (Golley et al., 2011; Kirby et al., 1995; North & Emmett, 2000; Royo-Bordonada et al., 2003). Unfortunately high-energy western foods such as condiments (butter, sauces, mayonnaise, margarine, etc.), carbonated beverages and baked foods have become widely available and may also influence food variety. It is not surprising that dietary variety comes from the consumption of more diverse foods of all types, including processed and high-energy foods (North & Emmett, 2000; Royo-Bordonada et al., 2003).

Many factors play a role in influencing infant food variety; these particularly include the influence of their caregivers, the social surroundings and duration of breastfeeding. Longitudinal research in infants demonstrated a direct association between breastfeeding duration and increase in food variety (Scott et al., 2012). This observation supports the hypothesis that flavours transferred in breast milk provide repeated early exposure to different tastes, which can positively shape children's food preferences and food variety (Robinson et al., 2007; Scott et al., 2012; Skinner et al., 2002a).

2.5.3 Benefits and potential limitations of food variety

During the introduction of complementary foods, all foods are new, and the acceptance of a variety of solids is essential to consuming a diet that supports growth and health (Birch & Doub, 2014). Diet variety is universally recognised as an important principle underlying a healthy diet, and has been recommended as part of many national dietary guidelines due to its role in increasing exposure to a wide range of nutrients, thereby enhancing nutrient adequacy (FAO/WHO Consultation, 1998; Kant, 1996; Ministry of Health., 2008; Royo-Bordonada et al., 2003; Schwartz et al., 2011; Schwartz & Benuck, 2013; Steyn et al., 2006; Wong et al., 2013).

Krebs-Smith et al. (1987) suggested that the consumption of a varied diet should result in the achievement of an adequate diet, reduced risk of developing a deficiency or excess of one nutrient, and achievement of an appropriate ratio of micronutrient intakes. This proposition has been supported by prospective work looking at food variety in two to three-year-old children, who were followed into young adulthood (Nicklaus et al., 2005). Nicklaus et al. (2005) findings suggested "variety seeking" at follow up increased with early "variety seeking", and those with high variety scores had greater consumption of dairy and vegetables at both young and older ages.

At the beginning of complementary feeding, exposure to a variety of textured and flavoured foods has been shown to enhance a later acceptance of new foods (Carlson et al., 2001; Krebs-Smith et al., 1995), and day-to-day variation is important (Maier et al., 2008; Mennella et al., 2008). It can be concluded that exposure to early variety is not only useful to enhance the acceptance of healthy foods but also helps to ensure the child is being offered a variety of nutrients, which are essential for the growth of the child (Kant, 1996).

However, the possible influence of diet variety on the development and persistence of obesity raises some doubts about its possible health benefits (Raynor & Epstein, 2001). Several studies argue that variety can be harmful to health as it leads to the over consumption of all foods (McCrory et al., 1999; Rolls et al., 1981; Rolls et al., 1984; Stubbs et al., 2001). When exposed to a wide range of foods that are high in sugar, salt, and energy, it can become relatively easy to establish unhealthy dietary patterns early in life. An important limitation in the research on the association between eating behaviour and dietary diversity is the lack of clarity about whether diet diversity reflects energy intake (i.e., quantity of food) or dietary quality (i.e., nutrient density), or a combination of both. As noted by Kennedy et al. (1995), varied diets are not necessarily lower in energy, fat, saturated fat or salt. Consequently, it could be that infants with a dietary pattern similar to an adult diet are being 'fast tracked' through the weaning process with a diet characterised by the high consumption of those foods that make up a poor adult diet (i.e., chips, savory snacks and biscuits) (Robinson et al., 2007; Royo-Bordonada et al., 2003). This may be a particular concern of BLW as the child

could have a greater exposure to a variety of 'unhealthy adult foods' (foods that are high in energy, but have a low nutrient density) from the early stages of complementary feeding, which may have implications for overall nutrient intake and create an early onset of unfavourable eating habits.

Experimental studies have shown a positive relationship between an increased variety of foods offered during a meal and an increase in overall food intake (Hetherington et al., 2006; Rolls et al., 1981), and vice versa (Raynor & Wing, 2006). However speculative data refuting this hypothesis exists. A direct observation of food choices in 2-3-year-old children showed no relationship between food variety and body mass index, whereas energy intake was positively related to body mass index (Nicklaus et al., 2005). It is therefore important to determine the degree to which diet variety in children relates to a healthy nutritional profile, and to distinguish nutrient dense foods like fruits and vegetables from variety in intake of energy-dense foods (Nicklaus, 2009).

2.6 Conclusion

Although the baby-led approach to complementary feeding appears to be a growing trend all over the world, very limited research exists, which has examined the advantages or disadvantages of this approach to feeding. There is a need for more high-quality research in this area, particularly to investigate the proposed positive eating behaviours BLW promises. Therefore the aims of this thesis were to determine if by 12 months of age a baby-led approach to complementary feeding influences nutrient sufficiency in regards to MOH guidelines (Ministry of Health., 2008), but potentially leads to lower energy intakes (due to self regulation) when compared to traditional methods of complementary feeding (objective 1); if a baby-led approach to complementary feeding increases the acceptance of different food preferences, due to the increased exposure to family foods from a younger age (objective 2); and lastly if the variety of different foods offered increases when following a baby-led approach to complementary feeding, due to the offering finger of foods from the start of complementary feeding (objective 3).

3 Methods

3.1 Study design – The BLISS Study

The aim of the Baby-Led Introduction to SolidS (BLISS) study (University of Otago, Dunedin) is to investigating whether a novel approach to infant complementary feeding (BLW), encourages self-regulation of energy intake and prevents the development of overweight without detrimental effects on iron status and growth.

The BLISS study is a 2-arm randomised control trial (RCT) that consists of a one-year intervention (birth until 12 of months age) with a one-year follow up (24 months of age). Participants were randomised into either the intervention group ('BLISS group'), these participants received BLISS and standard advice, or into the control group, these participants received only standard advice on the introduction of complementary foods. The standard advice received by all families was 'Well Child' infant care (a national health care program for under 5s; http://www.kidshealth.org.nz/well-child-tamariki-ora-programme) from the agency of their choice.

The BLISS intervention is very similar to BLW but has been modified to address concerns as described below. The BLISS approach encourages on-demand breast or formula feeds; advises starting complementary feeding by offering a variety of adult finger-shaped foods from the start of complementary feeding; expresses the importance of including the baby at meal times, allowing them to explore foods with the family; and reminds caregivers not to hurry the baby, allowing them to decide the pace of eating (Rapley & Murkett, 2008). However, the BLISS intervention differs from BLW as it was modified to account for concerns about possible choking risks and uncertainties around optimal intakes of iron and energy. BLISS advises not to start solids until the child is 180 days old (6 months) rather than when the child is considered by the parent to be ready to start solids. Caregivers are advised to check that foods are soft enough before offering them to the child, gives specific age appropriate advice around foods that have high choking risk, and advises parents to offer a high energy and an iron rich food with every meal (Appendix A), while intervention participants are educated and

supported throughout the complementary feeding process. All food advice was developed in conjunction with a paediatric speech language therapist, to address concerns about choking.

The study timeline (**Table 3.1.1**) identifies the intervention phases and measurement points made for both the BLISS and control groups, highlighting the measurements this thesis will focus on. Ethical approval was obtained from the Lower South Regional Ethics Committee (Project key: LRS 11/09/037), and all participants provided informed written consent.

This thesis focuses on the infants' nutrient and food intake and behaviour at 12 months of age, using data obtained from questionnaires administered from 2-12 months of age, and a 3-day WDRs collected when the infants were 12 months of age. The infant's primary caregiver completed all questionnaires and WDRs.

Table 3.1.1 Study timeline for BLISS and control groups

BLISS	Time point (age of infant)	Control
Antenatal session	**30-40 weeks pregnant**	
Baseline questionnaire		Baseline questionnaire
	BIRTH	
Home visit: Lactation consultant	**Week 1**	
Lactation consultant support phone call (and visit if required)	**Week 3-4**	
Breastfeeding and Solids questionnaire	**Month 2**	Breastfeeding and Solids questionnaire
Lactation consultant support phone call (and visit if required)	**Month 3.5**	
Breastfeeding and Solids questionnaire	**Month 4**	Breastfeeding and Solids questionnaire
Lactation consultant support phone call (and visit if required)	**Month 5**	
BLISS advice visit	**Month 5.5**	
6 month main measurement visit (length, weight and questionnaire)	**Month 6**	6 month main measurement visit (length, weight and questionnaire)
Breastfeeding and Solids questionnaire		Breastfeeding and Solids questionnaire
BLISS advice visit 7 month measurement (weight, questionnaire and microbiota sample) 3day-WDR	**Month 7**	7 month measurement (weight, questionnaire and microbiota sample) 3day-WDR
Breastfeeding and Solids questionnaire		Breastfeeding and Solids questionnaire
8 month measurement (weight and questionnaire)	**Month 8**	8 month measurement (weight and questionnaire)
Breastfeeding and Solids questionnaire		Breastfeeding and Solids questionnaire
9 month measurement (weight and questionnaire)	**Month 9**	9 month measurement (weight and questionnaire)
Breastfeeding and Solids questionnaire		Breastfeeding and Solids questionnaire
12 month main measurement visit (weight, length, microbiota sample, questionnaire and food preference questionnaire)	**Month 12**	12 month main measurement visit (length, weight, microbiota sample and questionnaire and food preference questionnaire)
Blood test		Blood test
3-day WDR Breastfeeding and Solids questionnaire		3-day WDR Breastfeeding and Solids questionnaire
24 month main measurement visit (length, weight, microbiota sample and questionnaire) 3-day WDR	**Month 24**	24 month main measurement visit (length, weight, microbiota sample and questionnaire) 3-day WDR

3.2 Participants

3.2.1 Recruitment

All participants were recruited in the third trimester of pregnancy, following methods similar to the Prevention of Overweight in Infancy (POI) study (Taylor et al., 2011), by using an opt-out system for recruitment. All pregnant women registered to give birth at the Queen Mary Maternity Centre at Dunedin Public Hospital (>97% of Dunedin births), were invited to participate in the BLISS study (Appendix B). When the mother reached 28 weeks gestation she was sent an information pamphlet and a letter inviting her to participate in the BLISS study (Appendix C). The letter included an opt-out option, allowing mothers to call and leave a message if they did not want to participate. Should the mothers not opt-out after two weeks, a research assistant contacted them by phone to further discuss the study, at which point they could choose to decline to participate (Appendix D).

Women were eligible to participate if they were booked into the study before 34 weeks gestation, their home address was within the greater Dunedin area, they were not expecting to shift outside the Dunedin area within the next two years and were able to communicate in English or Te Reo M ori. Participants were excluded if their child was born before full term (37 weeks gestation) or a congenital abnormality was identified which was likely to affect the feeding or growth of the child. Once eligibility was established and consent was given (Appendix E), the mother was randomised into one of the two study groups. Randomisation was stratified for parity (first child compared with subsequent child) and education (secondary school only education compared with post-secondary education), to ensure primary outcomes were not affected by these variables. Recruitment took place from December 2012 until April 2014, with the first babies born in January 2013.

3.2.2 Sample size

A required sample size for the BLISS study of 200 participants (100 each arm) was estimated, based on reference data for sample size calculations obtained from the

ongoing POI study (Taylor et al., 2011), and the 'Toddler Food Study' (Szymlek-Gay et al., 2009). This sample size was calculated based on detecting differences in the two main outcomes: 1) body mass index (BMI), using a mean (standard deviation) of 17.3 $kg.m^2$ (1.4) and a correlation between repeated measures (BMI at 6 and 12 months) of 0.78, to detect a difference in BMI of 0.40 $kg.m^2$; and 2) iron status (plasma ferritin difference of 5μg/L) at two years of age, with a 10% drop out rate. This was set at a power of 80% using a two-sided alpha of 0.05. The final BLISS study numbers consisted of 206 participants.

This thesis focuses on a subset of dietary data collected when the participants were 12 months of age. Recruitment was estimated to take one year, therefore to fit in with the time restraints of a master's degree (i.e. 8 months for data collection), a subset of data was analysed. Data were collected for 10 months from January through to October 2014, giving a sample size for this master's study of 110 infants. Allowing for a 20% drop out rate (incomplete diet records and actual drop out rates in the study) of the estimated 110 participants, data were expected to be available for 88 participants (44 each arm) by the end of October 2014. A sample size of 80 participants (40 each arm) is able to detect differences in energy, carbohydrate, fat, protein, calcium and dietary fibre as shown in **Table 3.2.1**, at 80% power using a two-sided alpha of 0.05.

Table 3.2.1 Difference in nutrients that could be detected by a sample size of approximately n=80

Nutrients	NRV[1]	Expected Mean ± sd	Group difference able to detect	Total N required	Ref
Energy (kJ)	Boys: 3500[2] Girls: 3200[2]	3308.8 ± 424.8	300kJ	64	(Conn et al., 2009)
Fat (total) (g)	30[3]	34 ± 7.5	5g	72	(Conn et al., 2009; de Bruin et al., 1998)
Protein (g)	14[4]	26.7 ± 5.4	3.5g	76	(Conn et al., 2009; Soh et al., 2002)
Carbohydrate (g)	95[3]	119.5 ± 20.3	13g	78	(Conn et al., 2009; de Bruin et al., 1998)
Calcium (mg)	500[4]	571.8 ± 181.1	125mg	68	(Conn et al., 2009; Soh et al., 2002)
Dietary fibre (g)	14[3]	7.2 ± 2.3	3.75g	70	(Conn et al., 2009; Soh et al., 2002)

[1] NRVs are from food and breast milk (or formula) from the Ministry of Health Nutrient Reference Values for Australia and New Zealand (National Health and Medical Research Council of Australia, 2006)
[2] Estimated Energy Requirement (EER)
[3] Adequate Intake (AI)
[4] Recommended Daily Intake (RDI)

3.3 Data Collection

3.3.1 Baseline Questionnaire

The baseline questionnaire was modified and developed using templates from the POI study (Taylor et al., 2011) by the BLISS research team (Appendix F). Participants completed the questionnaire at their first appointment, when the mother was approximately 30 weeks gestation. The questionnaire was split into two sections: (1) demographic information for both parents, and (2) intended infant feeding practice and methods used before with previous children (if relevant). Data obtained from the baseline questionnaires were entered into the BLISS database. Further baseline demographic information for the infant and mother was obtained from the Otago District Health Board including, infant sex, weight and date of birth, maternal NZDep2013 score, and maternal parity. The NZDep2013 Index of Deprivation was used to indicate the level of household deprivation. NZDep2013 provides a deprivation score for each meshblock (geographical units defined by Statistics New Zealand containing a median of approximately 90 people)(Ministry of Health., 2014).

3.3.2 Breastfeeding and Solids Questionnaire

The Breastfeeding and Solids Questionnaire was developed using templates from the POI study (Taylor et al., 2011), and using questions developed in the BLISS online pilot study (Cameron et al., 2012a)(Appendix G). The questionnaire was then tested for overall understanding in focus groups of mothers who were currently introducing complementary solids with their child(ren), and subsequent minor modifications were made by a MDiet student (Schramm, 2013). The Breastfeeding and Solids Questionnaire was designed to assess infant feeding behaviours, to provide information on the age solids were introduced and the extent of exclusive and on demand breastfeeding.

The questionnaire consisted of 35 questions with appropriate skips in place to ensure that previously answered questions were not re-asked in subsequent questionnaires. This made the questionnaire more efficient and avoided the repetition of sensitive questions (i.e., 'Have you stopped breastfeeding?'). An example question is shown in **Figure 1**. The order and appropriate skips were tested on 42 mock participant scenarios developed by the candidate (e.g. 'A mother who is currently breastfeeding and using formula, had breastfed but had not used formula in the last 48 hours, and also had introduced other liquids when the infant was 2.5 months old'), to ensure no questions were skipped inappropriately. This was then re-tested by the candidate once the questionnaire had been uploaded onto the BLISS database and retested regularly to ensure data were complete without errors.

The Breastfeeding and Solids Questionnaire was administered when the infants were 2, 4, 6, 7, 8, 9, and 12 months of age, to minimize recall bias associated with estimating changes in infant feeding. Interviews took place over the phone and the candidate entered the data into the database during the interview (Appendix H).

12. Does (child's name) feed **themselves** solids?

Note: 'Baby fed themselves' means that the baby picks up the food and puts it in their mouth and appears to swallow at least some.

- *Yes*
- *No*

If Q12 = no, skip to Q20 [BB doesn't feed themselves solids => Q20]

Figure 1 Breastfeeding and Solids Questionnaire, example question with corresponding skip

3.3.3 Three-day Weighed Diet Record

The 3-day WDR was modified from the "Toddler Food Study" WDR (Szymlek-Gay et al., 2009), to allow for the measurement of important BLW components: (1) level of self-feeding, and (2) form of food offered. The BLISS WDR was comprised of four resources: (1) 'At home' WDR (the main food diary), (2) 'Away from home' WDR, (3) 'Early childhood education food record', and (4) a laminated example sheet for the fridge (Appendices I-L). All resources were developed and pilot tested by Claire Schramm (MDiet student) (Schramm, 2013). The main WDR contained four sections: (1) the diet and recipe record, (2) End of day questionnaire (which collected information on specific BLW components (i.e., the frequency with which the infant sits in on family meals, and frequency of family foods offered)), (3) Supplement consumption questionnaire, and (4) a supplementary section with written instructions and examples of how to complete each section, including guidelines for how to estimate foods, a ruler and a set of circles for measuring any food items that could not be weighed. The "Away from home" WDR also supplied a supplementary page containing photographs of commonly eaten takeaway foods (e.g., McDonald's foods). Each photograph showed a food item and the corresponding food weight, allowing participants to estimate the approximate weight of food their child was offered.

The candidate administered the 3-day WDR when the infants were 12 months old (Appendix M). All participants received detailed oral and written instructions

during the measurement session on how to complete the records. They were provided with the WDR resources, a set of electronic scales (Salter Electronic Model 1017., Kent, United Kingdom) and two spare batteries. Scales were accurate to within ± one gram. The primary caregiver completed three days of WDR entry over a three-week period. Participants were assigned 3 random days, comprising 1 weekend day and 2 weekdays. The days were assigned using a Microsoft excel spreadsheet in which each day of the week was represented an equal number of times across both the control group and the BLISS group. The first day of recording was the day immediately following the administration session. A telephone call was made by the candidate the day after the first recording day to remind the caregivers to complete the record and answer any questions.

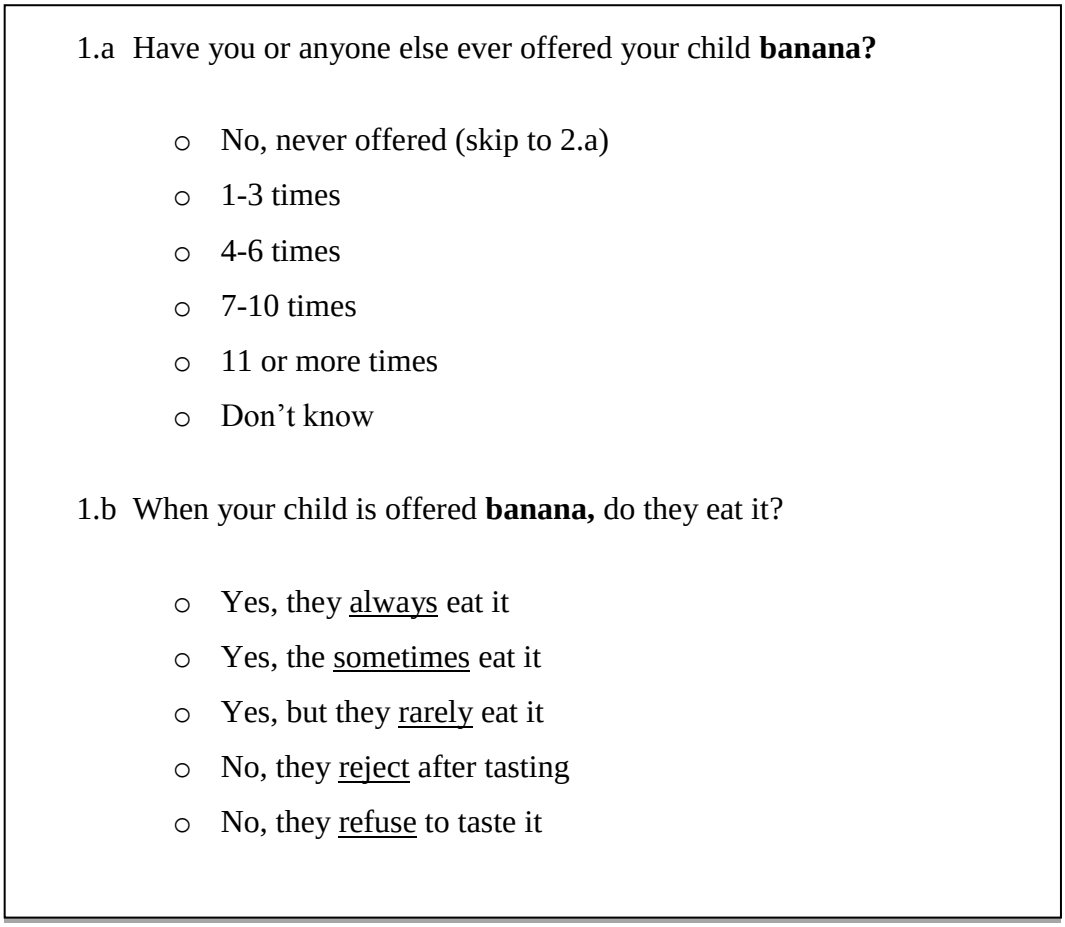
For each completion day of the WDR, participants were asked to weigh and record foods they had offered to their child before and after consumption (i.e., leftovers were weighed) for a 24-hour period. Ingredients were recorded when possible for homemade recipes, and either the proportion of the total recipe offered to the child, or the gram amount offered was reported. The candidate checked all WDRs on return, and any misunderstandings were clarified with the caregiver within a few days of record completion.

The 3-day WDR was used to determine mean energy and nutrient intake (objective 1) and variety of foods offered (objective 3).

3.3.4 Food Preference Questionnaire

Food preference is usually determined by asking overall liking of food groups. In our study the caregiver answered questions on the child's behalf, requiring caregivers' interpretation of the child's preference. Therefore, the Food Preference Questionnaire (FPQ) (Appendix N) was adapted from the Food Consumption and Acceptance questionnaire used by Maier et al (2007). Maier's acceptance questionnaire was designed as a follow up questionnaire assessing the acceptance of the exposure to previously disliked vegetables in infants aged 12 months old. Mothers noted for each vegetable if the infant: (1) ate and liked it, (2) ate it but did not particularly like it, (3) had been offered it at least once but did not like it, (4)

had been offered but refused to taste it, or (5) had never been offered it (Maier et al., 2007). The candidate made modifications to Maier's questionnaire to avoid using the word 'like', instead the words 'ate', 'rejected' and 'refused' were used as they did not require the caregiver to interpret whether or not the infant likes or dislikes the food. Frequency of food offering was also examined; due to research showing that a new food may need to be offered between 8-15 times before it is accepted (Briefel et al., 2004) (an example question is shown in **Figure 2**).



1.a Have you or anyone else ever offered your child **banana?**

- o No, never offered (skip to 2.a)
- o 1-3 times
- o 4-6 times
- o 7-10 times
- o 11 or more times
- o Don't know

1.b When your child is offered **banana,** do they eat it?

- o Yes, they <u>always</u> eat it
- o Yes, the <u>sometimes</u> eat it
- o Yes, but they <u>rarely</u> eat it
- o No, they <u>reject</u> after tasting
- o No, they <u>refuse</u> to taste it

Figure 2 Example question from the Food Preference Questionnaire

The FPQ consists of foods commonly consumed by toddlers in New Zealand. The food types in the FPQ were determined using data from an earlier study that reported the food types commonly consumed (i.e., by at least 10% of toddlers) by toddlers from the South Island of New Zealand (Szymlek-Gay et al., 2010). The Eating Assessment in Toddlers (EAT) study data (a study looking at feeding practices of 12-24 month old toddlers in New Zealand) (Mills, 2013; Watson, 2013) was used to determine specific foods that toddlers eat. Only 21 foods were

carefully selected to reduce respondent burden, given the additional measurements required at the 12-month measurement. Of these, the foods were assigned to a particular taste and texture to differentiate between food preferences.

The FPQ (objective 2) was administered during the 12-month measurement session by a researcher blinded to the participants' assigned study group.

3.4 Data Coding and Entry

The Baseline Questionnaire, Breastfeeding and Solids Questionnaire, and Food Preference Questionnaire were all uploaded onto the BLISS database after they were administered.

A WDR calculation sheet (Appendix O) was developed to help establish amount consumed (i.e., weight offered – weight left over). The dietary data from the 3-day WDR data was then entered into 'Kai-culator' (University of Otago, Dunedin, New Zealand) nutrient analysis program, which uses the New Zealand Food Composition Database (FOODfiles 2010, Plant Food Research, Palmerton North, New Zealand) to calculate intakes of energy and nutrients. Because, this database was limited in a number of commercial infant products, research staff and the candidate created an additional database of nutrient lines for these products. Nutrient information was sourced from websites, manufacturers or nutrient information panels of the foods. A BLISS study food codebook was established to ensure all food and weight substitutions were recorded and coded for consistency across all records throughout the study. Breast milk volumes were estimated based on previous research (Dewey et al. 1991), which used a combination of test weighing and expression of breast contents during a 24-hour period to estimate breast milk intake at 12 months of age as 448ml of breast milk per day. For those receiving other milk substitutes, the total volume of these was subtracted from total breast milk volume (for example, 448ml – total infant formula, cows milk or other milk substitute volume = breast milk volume).

The most appropriate way to determine adequacy of energy intake is to use BMI to determine whether energy intake is sufficient to meet energy expenditure (Institute of Medicine, 2000). Anthropometric data are not reported here because they are a primary outcome of the BLISS study. The Estimated Average Requirement (EAR) cut-point method was used to assess adequacy of protein and calcium intake among participants. The population prevalence of inadequate intake is calculated as the proportion of the population with intakes below the median requirement (EAR). However, the Adequate Intake (AI) cannot be used in this way, therefore the prevalence of inadequate nutrient intake cannot be calculated for fat, carbohydrate or dietary fibre. (Institute of Medicine, 2000).

Food preference was established by the frequency of the food being offered and the acceptance of that food by the infant. Each of the 21 foods in the Food Preference Questionnaire were assigned to a taste and/or texture category. Original tastes and textures of interest were 'sweet', 'salty', 'bitter', 'savoury', 'smooth', 'lumpy', 'crunchy' and 'chewy' (i.e., sweet=banana, salty=marmite/vegemite, bitter=broccoli, chewy=cooked meat, and crunchy=biscuits). To ensure that each of the 21 foods were classified correctly to the taste and texture categories, 14 participants with age appropriate infants were picked at random and asked to complete an additional questionnaire (Appendix P). The questionnaire asked the participants what their opinion was for the taste and texture properties of each food (in the form they would present it to their child). Taste and/or texture classifications were established if there was more than 50% agreement among the participants, and if the food had been offered by at least 20% of the study population. The final food classifications can be seen in Table 3.4.1. Due to more than 60% of the foods being classified as having a savoury taste, sub-groups were made for savoury (i.e., savoury vegetable and savoury meat).

Table 3.4.1Food preference classification by taste and texture

Food	Taste (%)		Texture (%)		Offered (%)	Classification
Banana	**Sweet**	**100**	Smooth	29	100	Sweet and
	Savoury	0	**Lumpy**	**71**		Lumpy
	Bitter	0	Chewy	0		
	Salty	0	Crunchy	0		
Sweet biscuits [1]	**Sweet**	**93**	Smooth	0	74.5	Sweet and
	Savoury	7	Lumpy	7		Crunchy
	Bitter	0	Chewy	14		
	Salty	0	**Crunchy**	**79**		
Flavoured yoghurt	**Sweet**	**100**	**Smooth**	**86**	84.7	Sweet and
	Savoury	0	Lumpy	14		Smooth
	Bitter	0	Chewy	0		
	Salty	0	Crunchy	0		
Breakfast cereal [2]	**Sweet**	**57**	Smooth	7	30.6	Sweet and
	Savoury	43	Lumpy	36		Crunchy
	Bitter	0	Chewy	7		
	Salty	0	**Crunchy**	**50**		
Raisins	**Sweet**	**100**	Smooth	0	56.1	Sweet and
	Savoury	0	Lumpy	0		Chewy
	Bitter	0	**Chewy**	**100**		
	Salty	0	Crunchy	0		
Olives	Sweet	0	Smooth	0	21.4	Salty
	Savoury	7	Lumpy	29		
	Bitter	14	Chewy	43		
	Salty	**71**	Crunchy	0		
Broccoli	Sweet	0	Smooth	0	95.9	Savoury and
	Savoury	**86**	**Lumpy**	**50**		Lumpy
	Bitter	14	Chewy	21		
	Salty	0	Crunchy	21		
Cauliflower	Sweet	0	Smooth	0	81.6	Savoury and
	Savoury	**93**	**Lumpy**	**57**		Lumpy
	Bitter	7	Chewy	21		
	Salty	0	Crunchy	21		
Cabbage	Sweet	7	Smooth	0	45.9	Savoury and
	Savoury	**79**	**Lumpy**	**86**		Lumpy
	Bitter	14	Chewy	14		
	Salty	0	Crunchy	0		
Spinach	Sweet	0	Smooth	21	64.3	Savoury and
	Savoury	**86**	Lumpy	14		Chewy
	Bitter	14	**Chewy**	**57**		
	Salty	0	Crunchy	7		
Tomato	Sweet	36	Smooth	14	85.7	Savoury
	Savoury	**57**	Lumpy	43		

Food	Taste (%)		Texture (%)		Offered (%)	Classification
	Bitter	7	Chewy	36		
	Salty	0	Crunchy	0		
Egg	Sweet	0	Smooth	14	92.9	Savoury and
	Savoury	**93**	**Lumpy**	**57**		Lumpy
	Bitter	0	Chewy	21		
	Salty	7	Crunchy	0		
Luncheon sausage	Sweet	0	Smooth	8	53.1	Savoury
	Savoury	**85**	Lumpy	38		
	Bitter	0	Chewy	46		
	Salty	15	Crunchy	0		
Baked beans	Sweet	7	Smooth	0	70.4	Savoury and
	Savoury	**86**	**Lumpy**	**86**		Lumpy
	Bitter	0	Chewy	14		
	Salty	7	Crunchy	0		
Mince	Sweet	0	Smooth	0	99	Savoury and
	Savoury	**100**	**Lumpy**	**77**		Lumpy
	Bitter	0	Chewy	23		
	Salty	0	Crunchy	0		
Cooked meat [3]	Sweet	0	Smooth	0	99	Savoury and
	Savoury	**100**	Lumpy	15		Chewy
	Bitter	0	**Chewy**	**77**		
	Salty	0	Crunchy	0		
Marmite/Vegemite	Sweet	0	**Smooth**	**86**	89.8	Salty and
	Savoury	29	Lumpy	14		Smooth
	Bitter	0	Chewy	0		
	Salty	**71**	Crunchy	0		
Crunchy peanut-butter	Sweet	21	Smooth	0	33.7	Crunchy
	Savoury	43	Lumpy	36		
	Bitter	0	Chewy	7		
	Salty	36	**Crunchy**	**57**		
Cheese	Sweet	0	Smooth	43	98	Savoury
	Savoury	**93**	Lumpy	29		
	Bitter	0	Chewy	21		
	Salty	7	Crunchy	0		
Sausage	Sweet	0	Smooth	0	82.7	Savoury and
	Savoury	**100**	Lumpy	23		Chewy
	Bitter	0	Chewy	77		
	Salty	0	Crunchy	0		
Hot potato chips [4]	Sweet	0	Smooth	14	89.8	Savoury
	Savoury	**60**	Lumpy	36		
	Bitter	0	Chewy	36		
	Salty	40	Crunchy	14		

[1] Afghans, chocolate chip – not semisweet biscuits (wine, malt etc.)
[2] Sweetened breakfast cereal, not including weetbix, cornflakes, porridge, rice bubbles unless sugar/honey had been added
[3] Any form of cooked meet (i.e., chicken, beef, pork – but not including mince or sausages)
[4] home cooked or takeaway

Food variety scores were calculated using a method similar to Scott et al. (2012), who identified food variety in 2-year-old toddlers. In the current study, variety was calculated by a simple count of the number of different foods that had been offered over the 3 days of the WDR. Therefore, records were only counted if all three days had been completed. Counts were grouped into 9 food categories which contained multiple food subgroups (with the exception of fruit, vegetables, breakfast cereals and other desserts which were separated into specific types (e.g., weetbix and porridge would result in two counts for breakfast cereal) (**Table 3.4.2**)). Each individual food was only counted once over the three recording days, regardless of how many times that particular food had been offered. Condiments were not included in the food variety count. Foods that were similar (i.e., different cultivars of apples) were only counted once in the variety category. However, different forms of the food were all counted as individual items (i.e., dried apple, raw apple and stewed apple would equal three counts). Mixed food dishes (including other desserts) were broken down into their component parts, therefore all vegetables, dairy, fruit, grain products, or protein they contained would be counted, however, the mixed dish would only equal one point for the total variety score. Therefore, total variety was the number of different foods offered, whereas food group variety scores were a count of all foods offered as a whole food and within recipes. Commercial baby foods were treated the same as mixed dishes (i.e., broken down into all food components listed on the ingredient list).

The candidate counted food variety from the WDR hard copy to ensure all ingredient items were included. Counts were then entered into an excel spreadsheet.

Table 3.4.2 Food categories used to calculate food variety score based on texture and nutrients

Food categories	**Food subgroups**
Dairy products	Milk alternative[1]
	Any cheese
	Yoghurt Sweetened [2]
	Greek/unsweetened yoghurt [2]
	Custard
	Low fat dairy [3]
	High fat dairy [4]
	Ice cream/frozen yoghurt
	Milk not as a drink (any type) [5]
Grain products	Individual Breakfast cereals counted separately
	Baby rice
	Breads white
	Breads wholemeal/wholegrain
	Novelty bread [6]
	Rice
	Pasta
	Crackers
	Cereal bars
	Rusks
	Other grain products
Vegetables	Individual vegetables, counted separately[7]
Fruit	Individual fruits, counted separately [8]
Meat or other non dairy protein	Egg
	Peanut butter
	Nuts/seeds
	Baked-beans
	Hummus
	Legumes
	Vegetarian meat substitutes
	Beef
	Lamb
	Pork
	Venison
	Chicken/turkey
	Fish/shellfish
	Sausages
	Processed meats/cold cuts [9]
	Offal and other unspecified meats
	Pâté
Desserts, sweet snacks (Non core foods)	Cakes/slices
	Muffins/fruit loafs
	Sweet scones/pikelets
	Sweet pastries
	Cookies/biscuits [10]
	Individual 'other desserts' counted separately
	Candy/lollies
	Chocolate
	Popsicles [11]
Savoury, salty snacks (Non core foods)	Pies
	Burgers
	Battered fish
	Pizza

Food categories	**Food subgroups**
	Fried chicken
	Fried potatoes [12]
	Pastries [13]
	Dips [14]
	Savoury muffins/scones
	Croissants
	Potato crisps
	Popcorn
	Corn chips
	Other salty snacks
	Other takeaway foods
Milk and water drinks	Breast milk
	Infant formula
	Water
	Cows milk as a drink
Other drinks	Carbonated soft drink
	Fruit flavoured drink
	Flavoured milk drink
	Fruit juice
	Tea
	Milo
	Coffee
Total variety	

[1] soy, almond, rice, bran, oat milks
[2] includes soy dairy
[3] cottage cheese, low fat cheeses
[4] cream, sour cream, cream cheese
[5] milk/milk substitutes counted as dairy product if added to cooking or cereals
[6] fruit, nut, seed, vegetable bread
[7] incudes mushrooms, excludes potato hot chips/fries
[8] includes avocado
[9] includes bacon and ham
[10] includes semi sweet biscuits
[11] includes sorbet
[12] hot chips/fries, hash browns, fritters
[13] sausage rolls, savouries
[14] excludes hummus

3.4.1 Quality Control

A dietitian checked 1 in every 5 entered WDRs to ensure they had been entered into Kai-culator correctly. Checking ensured all calculations and data entry was correct and followed the coding rules outlined in the entry protocol (Appendix Q) and BLISS study codebooks. During the analysis, the candidate checked each participant for unusual nutrient values (abnormally high or low amounts, in comparison to other participants), any outliers were followed up and checked against the original WDR hardcopy, and any errors were amended.

The Food Preference Questionnaire data were exported from the database and the candidate checked 15 randomly selected questionnaires against the hardcopy questionnaire for errors.

3.5 Statistical Analysis

All statistical analyses were conducted using Stata 12.1 (Stata Corp, Collage Station, Tex, USA). All tests were performed with two-sided $p<0.05$ considered statistically significant. Descriptive variables were tested for normality. Continuous variables were compared using unpaired, two-tailed t-tests, and means and standard deviations reported. Categorical variables were compared with a chi-squared test. Geometric mean (95% confidence interval) were presented for nutrient intakes because the data were mostly right-skewed. All distributions from all models were examined to confirm adherence to regression assumptions. Analysis complied with the CONSORT statement following intention to treat principles.

4 Results

4.1 Participant Demographics

Table 4.1.1 Response rate and description of available data

	All	Control Group	BLISS Group
Demographic data available	123	57	66
Withdrawn[1]	7	3	4
Still enrolled at 12 months	116	54	62
Returned WDR data	83	38	44
Provided WDR data [2]	79	36	43
Completed the food preference questionnaire	105	46	59
WDR data eligible for food variety analysis [3]	77	36	41

[1]Participants who withdrew signed the consent form and provided demographic data at baseline, then withdrew from the study.
[2] At least 1 day of complete dietary data available
[3] Three days of complete dietary data available

Of the 206 participants who enrolled in the BLISS study, demographic data were available for 123 parent-child pairs at 12 months of age, at the time this MSc thesis was being written. This included 7 (5.7%) participants who withdrew (all within the first 6 months). Of the remaining 116 participants, 79 (68.1%) provided at least 1 day of WDR data, 105 (90.5%) completed the food preference questionnaire, and 77 (66.4%) had WDR data eligible to be included in the analysis of food variety (i.e. 3 days of WDR data). Incomplete data (the difference between the number still enrolled at 12 months and the number who provided WDR data) were due to the participant not being able to be contacted at the 12-month measurement point (n=4), having moved out of Dunedin (n=2), refusing to complete the WDR (n=6), losing the WDR or returning a WDR that had less that one day of diet recorded (n=16), or being in the process of completing the WDR (n=9) at the time of analysis.

Table 4.1.2 Demographic characteristics of infants and mothers[1]

	All n=123	Control Group n=57	BLISS Group n=66
Infant			
Sex			
Male	58 (47.2)	31 (54.4)	27 (40.9)
Female	65 (52.9)	26 (45.6)	39 (59.1)
Ethnicity			
New Zealand European	88 (74)	42 (75)	46 (73)
Māori	5 (4.2)	1 (1.8)	4 (6.4)
Pacific	2 (1.7)	1 (1.8)	1 (1.6)
Other [2]	24 (20.2)	12 (21.4)	12 (19.1)
Missing	4	1	3
Birth weight (grams) [3]	3523 (420)	3532 (435)	3514 (408)
Missing	5	2	3
Weeks gestation [3]	39.6 (1.1)	39.5 (1.2)	39.7 (1.2)
Missing	3	2	1
Mother			
Age at baseline (years) [3]	31.4 (5.6)	32 (6.2)	30.8 (5.0)
Missing	3	*2*	*1*
Parity			
Primiparous	48 (39.3)	21 (36.8)	27 (40.9)
Multiparous	74 (60.2)	36 (63.2)	38 (57.6)
Missing	1	0	1
Ethnicity			
New Zealand European	96 (78)	48 (84.2)	48 (72.7)
Māori	3 (2.4)	0	3 (4.6)
Pacific	3 (2.4)	1 (1.8)	2 (3)
Other [2]	20 (16.2)	8 (14)	12 (18.2)
Missing	1	0	1
Highest maternal qualification			
Primary and secondary	46 (37.4)	21 (36.8)	25 (37.9)
Non University tertiary qualification	18 (14.6)	7 (12.3)	11 (16.7)
University degree or higher	58 (47.2)	29 (50.9)	29 (43.9)
Uncategorised	1	0	1
NZ Deprivation Index [4]			
Least deprived: 1-3	40 (32.5)	17 (29.8)	23 (34.8)
4-7	55 (44.7)	29 (50.9)	26 (39.3)
Most deprived: 8-10	28 (22.8)	11 (19.3)	17 (25.8)

[1] Data are presented as number (%) unless stated otherwise

[2] Other ethnicity included: American, Australian, Brazilian, British West Indian, Canadian, Chinese, European, Fiji Indian, Fijian, Filipino, German, Indian, Irish, Japanese, Malay, Maltese, Scottish, South African, Swiss, Syrian, and US European

[3] Mean (SD)

[4] NZ deprivation index score is a measure of relative socio-economic deprivation with a scale from 1-10 where 10 is the most deprived (Ministry of Health., 2014). For descriptive purposes, NZDep quintiles were collapsed to three categories.

The characteristics of the infants and mothers are shown in **Table 4.1.2.** Infants had a mean birth weight of 3.51kg. This was similar across both groups, and similar to the average birth weight of infants in New Zealand (3.41kg) (Ministry of Health., 2006). The mean weeks of gestation was 39.6 weeks. This was consistent across both groups as a full term (37 weeks) pregnancy was an inclusion criterion for the study. Mothers had a mean age at baseline of 31.4 years (range: 17.4 – 43.9 years), which is slightly higher than the median age of 30.0 years for New Zealand women who are giving birth (Statistics., 2012). The majority of infants and mothers were New Zealand European (74% of infants, 78.7% of mothers), followed by Other (20.2% of infants, 16.4% of mothers), Māori (2.5% of mothers, 4.2% of infants) and Pacific (2.5% of mothers, 1.7% of infants). Compared to the wider New Zealand population, the study population had lower proportions of individuals who identified as Māori or Pacific (Māori (15%), Pacific (7%)) (Statistics., 2013). However, the ethnic distribution of the study sample was generally comparable to data for the Otago region where 80% of the population are New Zealand Europeans, 7% Māori, 3% Pacific and 8% Asian (Statistics., 2006a).

The current pregnancy was the second or subsequent pregnancy for more than half (60.2%) of the mothers, which was similar across both groups. The NZ deprivation index score is a measure of relative socio-economic deprivation with higher values indicating greater deprivation. The majority of families (46.7%) had an index between 4 and 7 (40% would be expected), with more families being in the lowest deprivation category (32.5%; 30% expected) than in the highest deprivation category (22.8%; 30% expected). Overall, the study population was less highly educated than the New Zealand population in general: 37.1% of mothers had no post-secondary qualification, while just under half of the study population (48.3%) had gained a University degree or higher. This was lower than the wider New Zealand population where 75% of women had obtained a post secondary qualification in the 2006 Census (Statistics., 2006b)

Table 4.1.3 Demographic characteristics of mothers who provided dietary data compared with those who did not (n=107) [1,2]

		Dietary data [3] n=79	No Dietary data [4] n= 28	P – value[5]
Mother				
Group	Control	36 (45.6)	15 (53.6)	0.347
	BLISS	43 (54.4)	13 (46.4)	
Age at baseline (years) [6]		32.5 (5.0)	28.6 (5.8)	**<0.001**
Parity				
	Primiparous	32 (40.5)	11 (39.3)	0.873
	Multiparous	46 (58.2)	17 (60.7)	
	Missing	1	0	
Ethnicity				
	New Zealand European	64 (81)	18 (64.3)	0.098
	Māori	1 (1.3)	1 (3.6)	
	Pacific	1 (1.3)	2 (7.1)	
	Other	12 (15.2)	7 (25.9)	
	Missing	1	0	
Maternal education				
	Primary and secondary	25 (31.6)	15 (53.6)	0.059
	Non University tertiary qualification	12 (15.2)	3 (10.7)	
	University degree or higher	41 (51.9)	10 (35.7)	
	Uncategorised	1	0	
NZ Deprivation Index				
	Least deprived: 1-3	27 (34.2)	8 (28.6)	0.147
	4-7	39 (48.1)	10 (35.7)	
	Most deprived: 8-10	14 (17.7)	10 (35.7)	

[1] This table does not include data from 9 participants who had received their WDR, but were still in the process of completing it at the time this MSc thesis was being written
[2] Data are presented as number (%) unless stated otherwise
[3] Completed at least one day of the WDR
[4] Did not complete any days of the WDR
[5] Differences between groups were tested using unpaired t-test for continuous variables and chi-squared test for categorical variables
[6] Mean(SD)

The only difference that was apparent between participants who provided dietary data and those who did not was that those who did not provide WDR data were younger (P<0.001) than the completers.

4.2 Breastfeeding and complementary feeding

Table 4.2.1 Breastfeeding and complementary feeding characteristics of infants [1]

	All n=123	Control Group n=57	BLISS Group n=66	P-value [2]
Infant feeding at 12 months of age				
				0.022
Receiving breast milk, not infant formula	40 (32.5)	16 (28.1)	24 (36.4)	
Receiving infant formula, not breast milk	40 (32.5)	18 (31.6)	22 (33.3)	
Receiving breast milk and infant formula	13 (10.6)	7 (12.3)	6 (9.1)	
Missing	19	10	9	
Duration of exclusive breastfeeding (weeks) [3]	20.9 (4, 26)	17.3 (3.5, 23.8)	23.8 (5.5, 26)	**0.022**
Missing	13	7	6	
Age introduced to complementary foods (weeks) [4]	23.7 (3.0)	22.6 (2.7)	24.7 (2.8)	**<0.001**
Missing	13	7	6	

[1] Data are presented as number (%) unless stated otherwise
[2] Difference between groups were tested using chi-squared test for proportions and Wilcoxon-rank sum test for medians
[3] Median (25^{th}, 75^{th} percentile)
[4] Mean (SD)

At 12 months of age 43.1% of study infants were still breastfed. The intervention group had significantly (P=0.022) higher rates of breastfeeding at 12 months (45.5%) in comparison to the control group (40.4%). The duration of exclusive breastfeeding was also significantly longer (P=0.022) for the BLISS group: 17.3 weeks in the control group, and 23.8 weeks in the BLISS intervention group. The age when complementary foods were introduced was also significantly later for those in the BLISS group (P<0.001) (**Table 4.2.1)**.

4.3 Intake of energy and selected nutrients

Table 4.3.1 Nutrient intakes according to study group [1]

Nutrients	NRV [2]	All n= 79	Control Group n=36	BLISS Group n=43	P-value [3]
Energy (kJ)	Boys: 3500 [4] Girls: 3200 [4]	3512 (3328, 3710)	3499 (3233, 3787)	3526 (3262, 3812)	0.882
Fat (total) (g)	30 [5]	34 (32, 36)	34 (32, 37)	33 (31, 36)	0.601
Protein (g)	12 [6]	30 (28, 32)	31 (28, 34)	29 (26, 32)	0.477
Carbohydrate (g)	95 [5]	103 (97, 110)	100 (91, 110)	106 (96, 116)	0.429
Calcium (mg)	360 [6]	576 (519, 640)	601 (515, 701)	556 (479, 645)	0.464
Dietary fibre (g)	14 [5]	7.3 (6.6, 8.1)	7.3 (6.2, 8.5)	7.3 (6.4, 8.3)	0.966

[1] Mean intake has been expressed as geometric mean (95% confidence interval), calculated as the daily mean intake from 3 days of WDR
[2] NRVs are from food and breast milk (or formula) from the Ministry of Health Nutrient Reference Values for Australia and New Zealand (National Health and Medical Research Council of Australia, 2006)
[3] Difference between groups tested using Wilcoxon-Mann-Whitney test
[4] Estimated Energy Requirement (EER)
[5] Adequate Intake (AI)
[6] Estimated Average Requirement (EAR)

Of the 116 eligible participants with infants aged 12 months, 79 parents provided at least one full day of dietary data. Caregivers described their child as being sick on a total of 23% of the diet record days. On 81.5% of these days parents thought that appetite was decreased. On the remaining 18.5% of days there was no change in appetite. However, adjustment for sick days made no group difference to energy and nutrient intakes overall. **Table 4.3.1** shows that there were no significant differences in the energy and nutrient intakes between the two groups.

The most appropriate way to determine adequacy of energy intake is to use BMI to determine whether energy intake is sufficient to meet energy expenditure (Institute of Medicine, 2000). Anthropometric data are not presented here because they are a primary outcome of the BLISS study as a whole. Overall, 20.3% of participants had inadequate intakes of calcium (9 from the BLISS group and 7 from the control group had a mean intake of calcium less than the EAR of 360mg per day) and no participants had inadequate intakes of protein (mean intake of protein less than the EAR of 12g per day)(National Health and Medical Research Council of Australia, 2006). The AI cannot be used to calculate the prevalence of inadequate nutrient intake in a group population, however when groups have a mean intake at or above the AI it can generally be assumed that there is a low prevalence of inadequate nutrient intake for that population group (Institute of Medicine, 2000). It therefore is assumed that study participants are likely to have adequate intakes of fat and carbohydrates because the mean intake is higher than the AI. However, the dietary fibre adequacy cannot be determined because the mean intake is below the AI, so the adequacy of the group cannot be determined (Institute of Medicine, 2000).

4.4 Food taste and texture preferences

Table 4.4.1 Food exposure and preference scores (mean (SD)) for different tastes according to study group

Food taste category	All n= 105	Control Group n= 46	BLISS Group n= 59	P – value [1]
Exposure Score: Offered to the infant [1]				
Sweet [3]	2.2 (0.81)	2.3 (0.71)	2.2 (0.92)	0.415
Savoury vegetable [4]	2.4 (0.88)	2.2 (1.03)	2.5 (0.72)	**0.050**
Savoury meat [5]	2.8 (0.81)	2.7 (0.80)	2.9 (0.81)	0.311
Savoury non meat high protein [6]	2.8 (0.84)	2.6 (0.88)	3.0 (0.78)	**0.024**
Salty [7]	1.9 (0.77)	2.1 (0.76)	1.7 (0.75)	**0.014**
Savoury - Hot chips	2.7 (1.33)	2.7 (1.22)	2.6 (1.42)	0.781
Preference Score: Consumed by the infant [2]				
Sweet [3]	4.5 (0.44)	4.5 (0.49)	4.6 (0.39)	0.209
Savoury vegetable [4]	4.3 (0.56)	4.2 (0.64)	4.3 (0.48)	0.589
Savoury meat [5]	4.6 (048)	4.5 (0.47)	4.6 (0.48)	0.384
Savoury non meat high protein [6]	4.5 (0.54)	4.4 (0.62)	4.5 (0.47)	0.232
Salty [7]	4.5 (0.71)	4.5 (0.78)	4.5 (0.65)	0.985
Savoury - Hot chips	4.7 (0.54)	4.7 (0.45)	4.7 (0.61)	0.887

[1] Difference between groups were tested using a paired two-sample t-test, Pearson's chi-squared test for proportions
Exposure score is a mean score of offering over lifetime, on a scale from 0-4 where 0 = never offered and 4 = offered more than 11 times
[2] Data on consumption were only available for the foods that had been offered, therefore preference score is a mean consumption score on a scale from 1-5 where 1 = no, refuses to taste and 5 = always eats when offered
[3] Sweet foods = banana, sweet biscuits, yoghurt, raisins, breakfast cereal
[4] Savoury vegetable foods = broccoli, cabbage, spinach, cauliflower, tomato
[5] Savoury meat foods = luncheon sausage, mince, cooked meat, sausage
[6] Savoury non meat high protein foods = cheese, baked beans, egg
[7] Salty foods = marmite/vegemite, olives

Tables 4.4.1 and **4.4.2** show the mean exposure and preference scores for the six taste and texture groups used in this study. Based on food taste (**Table 4.4.1**), infants in the BLISS intervention group were offered significantly more savoury non-meat high protein (P=0.024) and savoury vegetables foods (P=0.050) than infants in the control group while salty foods were offered significantly (P=0.014) less often. Each of these taste groups included single food with a significantly different exposure score between groups: broccoli (P=0.002) (savoury vegetable) and baked beans (P=0.014) (savoury non-meat high protein) were offered more by the BLISS group and marmite/vegemite (P=0.034) (salty) was offered more by the control group (Appendix O). By contrast there were no differences in the frequency with which sweet, savoury meat and savoury hot chip foods had been offered. No differences were observed in the infants' preference for any food category between the two groups (**Table 4.4.1**) or for any individual foods

(Appendix O). No difference was observed for the number of infants who always consumed the food when offered (Appendix P).

Table 4.4.2 Food exposure and preference scores (mean (SD)) for different textures according to study group

Food texture category	All n= 105	Control Group n= 46	BLISS Group n= 59	P – value [1]
Exposure Score: Offered to the infant [1]				
Smooth [3]	3.0 (1.13)	3.1 (1.07)	2.9 (1.17)	0.431
Lumpy [4]	3.0 (0.73)	2.8 (0.87)	3.2 (0.53)	**0.004**
Chewy [5]	2.2 (0.80)	2.1 (0.84)	2.2 (0.76)	0.364
Crunchy [6]	1.4 (0.93)	1.5 (0.99)	1.4 (1.13)	0.499
Preference Score: Consumed by the infant [2]				
Smooth [3]	4.7 (0.41)	4.7 (0.48)	4.7 (0.41)	0.619
Lumpy [4]	4.4 (0.46)	4.3 (0.51)	4.5 (0.40)	0.051
Chewy [5]	4.4 (0.48)	4.3 (0.51)	4.5 (0.45)	0.106
Crunchy [6]	4.6 (0.52)	4.6 (0.56)	4.6 (0.50)	0.925

[1] Difference between groups were tested using a paired two-sample t-test; Pearson's chi-squared test for proportions
Exposure score is a mean score of offering over lifetime, on a scale from 0-4 where 0 = never offered and 4 = offered more than 11 times
[2] Data on consumption were only available for the foods that had been offered, therefore preference score is a mean consumption score on a scale from 1-5 where 1 = no, refuses to taste and 5 = always eats when offered
[3] Smooth foods = yoghurt, marmite/vegemite
[4] Lumpy foods = mince, baked beans, egg, cauliflower, banana, broccoli
[5] Chewy foods = raisins, cabbage, spinach, cooked meat, sausage
[6] Crunchy foods = crunchy peanut butter, breakfast cereal, sweet biscuits
NB: Hot potato chips, cheese, luncheon sausage, tomato have not been classified under any texture, as there was less than 50% agreement for any of the four textures

Overall, smooth and lumpy foods were offered more than chewy and crunchy foods by both of the groups (P<0.001). However those in the intervention group were offered lumpy foods significantly (P=0.004) more frequently than the control group. No differences were observed for smooth, chewy and crunchy foods. The 'lumpy foods' category contained two individual foods; broccoli and baked beans (Appendix O) that had significantly higher exposure scores for the BLISS group than the control group. Those in the BLISS group tended to prefer lumpy foods, but this did not quite reach statistical significance (P=0.051). As stated above, no differences were observed in the infants' preference for any individual foods (Appendix O), nor in the number of infants who always consumed the food when it was offered (Appendix P).

4.5 Food variety

Table 4.5.1 Total variety score and food group variety scores (mean (SD) number of foods per day) at 12 months of age according to study group[1]

Food Groups	Total n=77	Control Group n=36	BLISS Group n=41	P-value [2]
Dairy products [3]	0.87 (0.38)	0.84 (0.35)	0.89 (0.40)	0.485
Grains and grain products [4]	1.59 (0.65)	1.64 (0.70)	1.55 (0.61)	0.414
Vegetables [5]	2.60 (1.19)	2.75 (1.29)	2.58 (1.11)	0.357
Fruit [5]	1.52 (0.93)	1.58 (0.95)	1.47 (0.92)	0.622
Meat and other non dairy protein [6]	1.20 (0.50)	1.15 (0.46)	1.26 (0.52)	0.472
Non core food, sweet snacks [7]	0.40 (0.33)	0.41 (0.33)	0.39 (0.33)	0.740
Non core food, savoury snacks [8]	0.31 (0.35)	0.35 (0.40)	0.27 (0.30)	0.452
Milk and water drinks [9]	0.70 (0.26)	0.66 (0.28)	0.74 (0.24)	0.154
Other drinks [10]	0.05 (0.13)	0.06 (0.15)	0.04 (0.11)	0.810
Total Variety	6.81 (2.01)	6.73 (1.99)	6.87 (2.06)	0.906
Offered Baby food [11]	34 (44.2)	21 (58.3)	13 (31.7)	**0.019**

[1] Data presented as mean (SD) unless stated otherwise
[2] Differences between groups were tested using Wilcoxon rank-sum test
[3] **Dairy products**: milk alternative, any cheese, sweetened yoghurt, unsweetened/greek yoghurt, custard, low fat dairy, high fat dairy, ice cream/frozen yoghurt, milk not as a drink ***(0-9 count)***
[4] **Grain products:** breakfast cereal (individually counted), baby rice, white-bread, grain-bread, novelty bread, rice, pasta, crackers, cereal bars, rusks, other grain products ***(no maximum count)***
[5] **Fruit and vegetables**: all fruit and vegetables counted, offered on own or within recipes ***(no maximum count)***
[6] **Meat and other non dairy protein:** eggs, peanut butter, nuts and seeds, baked beans, hummus, legumes, vegetarian substitutes, beef, lamb, pork, venison, chicken/turkey, fish/shellfish, sausages, processed meats/cold cuts, offal and other unspecified meats, pate ***(0-17 count)***
[7] **Non core food, sweet snacks:** cakes/slices, muffins/fruit loaf, sweet scones/pikelets, other desserts (individually counted), cookies/biscuits, lollies, chocolate, popsicles/sorbet (no maximum count)
[8] **Non core food, savoury snacks**: pies, burgers, battered fish, pizza, fried chicken, fried potatoes, pastries, dips, savoury muffins/scones, croissants, potato crisps, popcorn, corn chips, other salty snacks, other takeaway foods ***(0-14 count)***
[9] Milk and water drinks = breast milk, infant formula, water, cow's milk offered as a drink (0-4 count)
[10] Other drinks = carbonated soft drink, fruit flavoured drink, flavoured milk, fruit juice, tea, milo, coffee ***(0-7 count)***
[11] Data presented as number (%)

Food variety scores were calculated for the nine food groups of interest as well as overall (**Table 4.5.1**). Because commercial baby foods often include a range of different fruit and vegetables, a post-hoc analysis was carried out to determine whether differences in the use of commercial baby foods between the groups might impact on fruit and variety scores. Although there was a significant difference (P=0.019) in the percentage of infants using commercial baby food in the control group (58.3%) compared to the BLISS group (31.7%), after adjustment for baby foods there was still no significant difference in the variety of fruit and vegetables offered between the two groups.

5 Discussion

5.1 Key findings

Research findings demonstrate that infants in the BLISS group had significantly higher exposure scores for savoury vegetables (P=0.050), savoury non-meat high protein foods (P=0.024), and lumpy foods (P=0.004) and a lower exposure score for salty foods (P=0.014), when compared to the control group. While this intervention did not appear to have an effect on overall nutrient intake, food variety or food preferences of these 12 month old infants, it did modify some specific eating behaviours and parent practices. Those in the BLISS group had a longer duration of exclusive breastfeeding, started complementary feeding later and were less likely to offer commercial baby foods, when compared to the control group.

5.2 Impact on intake of energy and selected nutrients

During the first two years of life infants have a high demand for energy for growth, development, and metabolism. Healthcare professionals surveyed by Cameron et al. (2012a) in a content analysis study of Baby-led weaning were particularly concerned about the safety and nutrient sufficiency of BLW. One of the main concerns raised was that at the beginning of complementary feeding, the infant would not be able to self-feed enough to keep up with their growth demands. However, our research findings demonstrate that infants in the BLISS group had similar intakes of energy, macronutrients, calcium and dietary fibre at 12 months of age to those in the control group. This suggests that energy intakes were no worse for those in the BLISS intervention group than for those in the control group who were being fed a more traditional diet. The anthropometric data will need to be used to determine whether these energy intakes were adequate, or excessive, for the two groups. All mean nutrient intakes met New Zealand Ministry of Health NRV recommendations (National Health and Medical Research Council of Australia, 2006) for this age group. The exception was dietary fibre, which has consistently been shown to be lower than MOH recommendations for this age group (Morgan et al., 2010; Simons, 1999; Soh et al., 2002; Wham, 1994). It is

surprising that 20.3% of participants had inadequate intakes of calcium (21% of BLISS participants and 19% of control participants) because an infant's diet at this age largely consists of dairy foods (e.g., breast milk or infant formula). It is reassuring to see similar rates of inadequacy in both the groups (i.e. the inadequacy was not a result of the BLISS intervention). It is possible that it was a result of underestimating breast milk intake. However, mean energy and nutrient intakes were similar to those of toddlers of similar age from New Zealand (Simons, 1999; Soh et al., 2002; Wham, 1994), Australia (Conn et al., 2009) and the Netherlands (de Bruin et al., 1998). However, whether the energy intake of those following BLW differs from that reported by the BLISS group is not known. It is possible that the energy similarities between the two groups in this study were a result of the BLISS intervention group being advised to offer a high-energy food with every meal. This advice was given in order to address concerns that BLW may result in lower energy intakes (Cameron et al., 2012a).

The current prevalence of breastfeeding at one year of age in New Zealand is hard to determine as most data available only report breastfeeding up to 7 months of age (Royal NZ Plunket Society, 2013). Nevertheless, the breastfeeding prevalence reported in the current study (43.1%) was similar to the 39% observed by another study conducted recently in Dunedin (Somerville, 2013). Although the mean duration of exclusive breastfeeding (19.8 weeks) was shorter than the Ministry of Health recommendation of 26 weeks (6 months) (Ministry of Health., 2008), the frequency of breastfeeding was higher than national breastfeeding data (2004-2009), which reported only 16% of mothers to still be breastfeeding at 16 weeks – 7 months of age (Royal New Zealand Plunket Society, 2010). The BLISS group exclusively breastfed for considerably longer than the control group (5.4 months for the BLISS group compared to 3.9 months in the control group) and began complementary foods at a later age (5.7 months for the BLISS group compared to 5.2 months in the control group). Thus we would assume that the BLISS group were more likely to meet the WHO recommendations to exclusively breastfeed to 6 months before introducing complementary foods (World Health Organisation, 2009), although our small numbers did not enable us to carry out such an analysis. The BLISS group also had significantly (P=0.022) higher rates of

breastfeeding at 12 months (45.5%) in comparison to the control group (40.4%). It is likely that the increased prevalence of breastfeeding seen in the BLISS group is due to the lactation support the group received in the first 6 months of life.

One limitation in the measurement of dietary energy and macronutrient intake in the current study was that breast milk intake was estimated using a standard intake from the literature (Dewey et al., 1991). This is a fairly crude approach that does not take into account variation in breast milk supply in individual mother-infant pairs. For example, nutrient intake may have been underestimated for those receiving more frequent breastfeeds especially on days when the child was unwell, when the infant may have more milk feeds (Mohrbacher & Stock, 2005). The use of stable isotopes would have given a more accurate measure of breast milk volume (Gibson, 2005). This method is however, costly, time consuming and would have been an additional burden for the participants, so was not feasible in our study. It is reassuring that the standard volume of breast milk used was similar to the infant formula intake of the formula fed toddlers in our study (data not shown). The collection of three non-consecutive days of weighed dietary data, and the randomisation of study participants to the BLISS and control groups ensured the observed nutrient intakes are likely to reflect the impact of the BLISS intervention on nutrient intakes in toddlers.

5.3 Taste and texture exposure and acceptance

According to the New Zealand Ministry of Health, by 12 months of age infants should be eating a wide variety of family foods, with texture progressing from puréed, to mashed, to chopped foods, based on the developmental stage of the child (Ministry of Health., 2008). One of the supposed benefits of BLW is an increased acceptance of a wide range of tastes and textures (Rapley & Murkett, 2008). The increase in acceptance is thought to be due to the greater exposure to family foods from an earlier age. Rapley's early research (2003) found that babies who completed the BLW programme demonstrated a wide range of food preferences, with few dislikes by nine months of age. However, Rapley's early research only included five babies and did not compare the observations to a control group.

5.3.1 Taste exposure and acceptance

In the present study, those in the BLISS intervention had significantly higher exposure scores for savoury vegetables (P=0.050) and savoury non-meat high protein foods (P=0.024), and a lower exposure score for salty foods (P=0.014), when compared to the control group. Whether this increase in exposure scores seen in the BLISS group would result in an increased acceptance of these tastes later in life is unknown, and would have to be examined longitudinally. Although the BLISS group were offered savoury vegetables and savoury non-meat high protein foods more often and salty foods less often, this did not seem to translate into an increase in preference for these foods. The taste preference scores were similar for all six of the taste categories and it appeared that the study infants accepted all tastes, though savoury vegetable preference scores were slightly lower compared with the other categories. This is comparable to recent research that has reported that infants and toddlers have a greater acceptance of sweet, salty and umami tastes because of an innate liking for these foods (Beauchamp & Mennella, 2009; Birch & Doub, 2014; Young & Drewett, 2000). Green vegetables, or foods that have a bitter or sour taste, are generally rejected (Beauchamp & Mennella, 2009; Birch & Doub, 2014; Stein et al., 2012).

Although there was no difference in the acceptance of tastes between the two groups at 12 months of age, perhaps the increased exposure to savoury vegetables and savoury non-meat high protein foods, and decreased exposure to salty foods, seen in the BLISS group could possibly lead to different taste preferences at a later age. Townsend and Pitchford (2012) carried out case-control research among self identified baby-led weaners and spoon-fed infants. They presented findings of an increased liking of carbohydrates in those following BLW, which was interpreted as being a building block of healthy nutrition, leading to healthy food choices in later life. However, Townsend used the word 'carbohydrates' very broadly and did not report carbohydrate intake per se. The definition of a carbohydrate could range from fresh fruit and vegetables to chocolate cake and Coca-Cola, therefore the description of a carbohydrate being a building block of healthy nutrition is problematic from a nutrition perspective. Townsend and Pitchford are also the

only ones to compare the food preferences of Baby-led weaners and traditional complementary feeders; therefore this limits any further confirmation of their findings.

5.3.2 Texture exposure and acceptance

It has been suggested that infants following BLW maybe more accepting of different textures, because they are exposed to them at the start of the complementary feeding period, rather than having to make the transition from puréed baby foods, to lumpy meals, and then family foods, a process which can be challenging for infants (Rapley & Murkett, 2008). In this present study, crunchy and chewy foods that have to be worked in the mouth, rather than sucked off the spoon tended to be offered less among caregivers overall, presumably due to concerns around safety and choking. 'Safe' textured foods (i.e., smooth or lumpy) had higher exposure scores than foods with more difficult textures (i.e., crunchy or chewy) in both the control group and the intervention group ($P<0.001$). Interestingly, in spite of this difference in exposure, preference scores were similar for all infants who were offered the food regardless of the texture. Perhaps by 12 months of age children start to favour finger foods (which are more likely to be crunchy or chewy) as they can handle the food themselves and have more independence (Blossfeld et al., 2007). It would be interesting to see whether differences are apparent earlier in the complementary feeding period.

Those in the BLISS group were offered lumpy foods significantly ($P=0.004$) more often than those in the control group, and subsequently tended ($P=0.051$) to have a higher acceptance for these lumpy foods than those in the control group. This is consistent with previous research that repeated exposure results in an increased acceptance of foods in infants (Briefel et al., 2004).

Looking at the acceptance for all 21 foods individually (Appendix O) there were no differences between the two groups, nor was there a group difference in the percentage of infants who always consumed the food when offered (Appendix P). Though there was not a pronounced difference between individual food preference scores, sweet biscuits, yoghurt, mince and hot potato chips appeared to

be somewhat more accepted among study infants (preference score = 4.7), while cauliflower, cabbage and olives were less accepted (preference score = 3.9-4.1). This supports the innately determined sensory preferences that cause a child to accept or reject particular foods based on their sensory determinates and to have a greater acceptance of sweet, salty and umami tastes. Green vegetables, or foods that have a bitter or sour taste, are generally rejected (Beauchamp & Mennella, 2009; Birch & Doub, 2014; Havermans & Jansen, 2007; Mennella & Trabulsi, 2012; Wardle et al., 2001).

Although research suggests that a new food may need to be offered 8-15 times before it is accepted (Briefel et al., 2004), this was not the case in this present study. Foods were offered a mean score of 0.8-3.8 times, yet this made no difference to the preference scores. In fact, no particular flavours, textures or types of foods were favoured. Preference scores across all taste and texture categories were surprisingly high with scores all above 4.2 (5 being the highest score and representing that the child always consumes the food when offered). Perhaps this may be a study group that is very accepting of a range of foods. This could be related to age and stronger preferences or rejection may present when the child is aged 2-3 years as they learn more independence. However, the high scores could also be a result of the questionnaire design and administration. When participants were asked 'does your child always eat the food when offered?' it is possible that their affirmative response included those instances where the infant tried at least some of the food, rather than consuming the whole food item, resulting in the over-reporting of food acceptance. However, the advantage of this is that their responses were not affected as much by infant satiety, or the size of the portions offered as they would be if we had required that the whole food item was consumed before a food could be classified as preferred.

Further work on the design of the BLISS preference questionnaire could be undertaken to improve its validity and reproducibility in order to fully explore food preferences in this age group. The approach used was novel in that the questionnaire did not use prompting words (i.e., likes and dislikes) that may have biased the caregivers' opinion of what they thought their child liked. Instead the questionnaire focused on the infants' consumption of particular foods when

offered. The questionnaire only established a broad classification of textures and tastes for foods. For example, spinach could be offered to the child raw, boiled, fried, or puréed, which changes the texture and taste profile, which made it difficult to classify foods. Our method was able to identify the infants' acceptance of individual foods and the candidate collected data from parents on how they would categorise these foods in terms of tastes and textures. However, preference for an individual food is likely to account for more dimensions than just the food's taste and texture. Creating separate texture questions (i.e., have you ever offered boiled spinach?) would establish a more precise taste and texture preference profile. However, this would also require a much larger sample size to ensure that a sufficient amount of participants had offered these specific foods, as well as increasing the respondent burden.

Longitudinal research has shown that food preferences that are formed in early infancy could follow into childhood, thus predicting later food consumption patterns (Skinner et al., 2002b). Therefore, an early intervention like BLISS may encourage healthy food preferences, which could result in an enhancement of healthy eating behaviours later in childhood. Using the methods reported here we were not able to determine any difference in food preference at 12 months, but differences in acceptance between the two groups may be apparent at earlier or later ages.

5.4 Variety of foods offered

Parents of the infants in the BLISS intervention were encouraged to involve their infant in family meal times and to offer them a range of finger foods from six months of age. It was hypothesised that those in the BLISS group would offer a wider variety of foods as a result. Although this could be expected to lead to a 'healthier diet' there were concerns that the increased variety of easy to hold finger foods offered would not only include healthy choices but also 'unhealthier' easy food choices (Cameron et al., 2012a), such as: fish fingers, hot chips, biscuits and chicken nuggets. These foods are high in sugar, saturated fats, and salt and therefore consumption of these may have a negative impact on health. However, our research found no difference in the number of foods offered across nine food

groups, or in overall variety, between the control and BLISS groups at 12 months of age.

Higher maternal age and education are associated with high dietary variety scores in children (Robinson et al., 2007; Scott et al., 2012; Smithers et al., 2012). However, as there was no difference in maternal age and education between our two groups, this should not have influenced the group findings. It is possible that measuring dietary variety at 7 months of age, i.e. earlier in the complementary feeding period, may have shown differences in food variety between the two groups. This may have resulted in a greater exposure to a range of different foods from a younger age being seen in the BLISS group. However, if there was no difference detected between the groups by 12 months of age, perhaps the increased variety from an earlier age does not make any difference in the later complementary feeding progression.

Parents are encouraged to expose their children to a wide variety of fruits, vegetables, cereals, dairy products and healthy fats, and to limit the consumption of energy-dense, nutrient-poor foods and beverages (Ministry of Health., 2008; Skinner et al., 2002a; Steyn et al., 2006). Reassuringly, both groups had higher variety scores for these recommended foods and lower scores for non-core sweet and savoury foods, and other drinks, suggesting a healthy diet among participants. Consumption of a variety of fruits and vegetables daily is a widely publicised public health message and our research suggests families are aware of these guidelines and have the ability to adhere to them. However, it is important to remember that variety scores do not take into account serving size, and do not acknowledge repeated offerings of the same food.

Those in the control group offered significantly more commercial baby foods than the BLISS intervention group. Originally it was thought that commercial baby products might bias the variety count (due to the large list of different ingredients in some baby foods), yet after adjusting for commercial baby foods, there were no differences in variety scores for fruits and vegetables between the BLISS and control groups.

The WDR is known to be the most precise method available for estimating usual food and nutrient takes among individuals (Gibson, 2005). However, perhaps for the measurement of dietary variety it was not the most appropriate assessment tool. One mother mentioned that she did not offer foods from her own or other siblings' plates on recording days, as she normally would have, because of the difficulty of weighing foods individually. Another parent noted the use of commercial baby food pouches on recording days, as it was much easier to weigh these before and after feeding. Conducting a 24-hour food recall could have eliminated these examples of altered eating behaviour as a result of dietary measurement, which would have produced a more accurate snapshot of these infants' diets. However a single 24-hour diet recall would not be able to collect enough dietary data to determine usual intakes among study infants, and measuring 3 days of 24-hour diet recalls would be a large time burden for both the measurer and the participant and therefore likely to result in incomplete data collection. Assuming that the infants had good energy self-regulation, these behaviour modifications should not have impacted on analysis of energy intake, but may have impacted on the nutrient intake and variety score.

Previous research recognises that greater variety at the beginning of the complementary feeding period can influence later acceptance of new foods (Forestell & Mennella, 2007; Kant et al., 1993; Maier et al., 2007; Nicklaus et al., 2005; Skinner et al., 2002a). Though this was not seen in our research at 12 months of age, the early exposure to family foods recommended to the BLISS group may encourage healthier long-term eating patterns (Hammons & Fiese, 2011; Harris, 2008; Skinner et al., 2002a). Furthermore, it is possible that assessing food variety at the beginning of complementary feeding may have identified differences between the two groups that were no longer apparent by 12 months.

5.5 Baby-Led Weaning compared to the BLISS intervention

It is important to acknowledge that the BLISS intervention is a modified form of BLW. The BLISS intervention differs from BLW as it was modified to account for uncertainties around optimal intakes of iron and energy. BLISS advises parents to

offer a high energy and an iron rich food with every meal and intervention participants were educated and supported throughout the complementary feeding process. This may have resulted in us not seeing any differences in the energy intakes between the two groups, as the BLISS group were prompted to include high-energy foods with every meal.

Therefore the results of the BLISS intervention group may differ from those of the general public who choose to follow BLW, as they are not being monitored and do not have the support and safety advice regarding this novel way of complementary feeding. Therefore, our results cannot be used to support BLW per se, as it might be undertaken by the general population, but they do tell us about this baby-led approach to complementary feeding that is a modified version of BLW.

5.6 Research strengths and limitations

A major strength of this study was the randomised controlled trial design and recruitment of 206 participants. All mothers registered to give birth at Queen Mary Maternity Centre were invited to participate, and those who were planning home births were included where possible, by contact through their midwife. Also ethical approval was obtained to use an 'opt-out' recruitment system, which ensured a study sample that was reasonably representative of the Dunedin public.

Several steps were taken during the study to ensure the accuracy of findings. To prevent bias, all research assistants were blinded during data collection. Protocols were developed for each measurement session to ensure consistency during data collection, and the Principal Investigators assessed adherence to protocols twice yearly. Research assistants administered the questionnaires so the participant could ask for clarification if needed.

Dietary assessment in toddlers can be challenging because it can be particularly difficult to weigh and measure leftover foods due to the 'mess factor' of infant feeding and because of the difficulty of measuring breast milk volumes. To ensure high quality dietary data, three collection days were randomly assigned over a

three-week timeframe (including one weekend and two week days), diet records were modified to capture behaviours associated with BLW, and additional supplementary resources were developed to capture feeding away from home and in Early Childhood Education. The diet record modifications (Cameron, 2014) and the study resources (Schramm, 2013) were pilot tested before administering in the BLISS study. Participants were familiar with the process of completing the WDR, which had been previously completed at 7 months and any misunderstandings apparent in the first record were explained in the refreshment session at 12 months. Participants also received an additional phone call following their first day of WDR completion to answer any queries they may have had.

While the study demographics were similar to those of the Otago region, the extent to which research findings can be generalised to the wider New Zealand population is not clear. The study population had a greater portion of New Zealand Europeans (74%) and the number of participants who identified themselves as Māori (4.2%) and Pacific peoples (1.7%) were small. Overall, participants were less educated than the general population (37.1% of mothers had no post-secondary qualification, which was higher than the 25% reported in the 2006 censes (Statistics., 2006)), although they were more likely to have completed University education (47.2%).

Due to the time constraints of a master's degree, it was not possible to collect dietary data from all 206 participants. Also, the larger than predicted non-completion rate (33.6%) resulted in a smaller data set (77 participants with complete data) than had been hoped. With the full data set there may be enough power to detect differences between the two groups that did not reach statistical significance in the current analysis.

One final limitation is that there was potential for a crossover of intervention information between groups, particularly amongst those in the control group wanting to follow a BLW method of complementary feeding. It is likely that participants in the two different groups would attend public antenatal classes together and therefore could easily share information. To minimise contamination, all BLISS participants at each intervention visit were reminded not

to share their resources and knowledge with others in the study. However we have no way of knowing if this was adhered to.

5.7 Application of findings and future research

There is a very limited amount of research on BLW, and to date no other known randomised control trials on a baby-led approach to complementary feeding have been undertaken. It is acknowledged that the BLISS study is an adapted form of BLW therefore it is probable that our findings (especially for energy and nutrients) are not a true representation of those following BLW as they might do unassisted out in the community. It is therefore still possible that those following BLW may have low nutrient intakes. A separate observational study would be required to determine this. The advantage of our randomised BLISS study was that we could see how practical this approach was for a wider range of people in the population – not just those who would normally choose to follow a baby-led approach.

The growing popularity of BLW among parents, and research suggesting that health professionals had either not heard of BLW or had concerns and limited knowledge around this practice (Cameron et al., 2012a), suggests an urgency for further research. Furthermore, the Ministry of Health is not in a position to recommend BLW as a safe practice for New Zealand babies as an alternative to current weaning advice until further evidence becomes available to support this practice (Ministry of Health, 2014).

This research has opened the door for future investigation, which will advance the knowledge of health practitioners, the New Zealand Ministry of Health and parents. There are still a number of unanswered questions concerning BLW. Further research could be conducted to:

1. Expand this investigation, in order to collect a more demographically representative sample of the greater New Zealand population.

2. Identify whether the food exposures identified at 12 months of age track into food preferences in later toddlerhood, which could potentially lead to healthier eating behaviours in childhood.
3. Detect whether dietary preferences identified in toddlerhood are related to the prevention of obesity and nutrition-related health behaviours later in life.
4. Examine the long-term effects of a modified version of BLW, especially the ability to recognise hunger cues and to respond to satiety when presented with a variety of palatable foods.

6 Conclusion

This research demonstrates that at 12 months of age infants involved in the BLISS study had similar energy, macronutrient, calcium, and dietary fibre intakes, regardless of study group. Those in the BLISS group had a longer duration of exclusive breastfeeding, and introduced complementary foods at a later age, than those in the control group, which is more in line with New Zealand Ministry of Health recommendations. Food acceptance was consistent among all infants, although those in the intervention group were more likely to be exposed to a wider range of tastes and textures than the control group, which resulted in a tendency to a slightly higher acceptance for lumpy foods. Whether this has an impact on later life food choices is however still unknown. Study infants were offered a variety of foods, which did not differ between the two groups, although the control group did offer more commercial baby foods. There are still a number of unanswered questions concerning BLW and further research into the implications of BLW is needed to provide policy makers and health professionals with sound scientific evidence before any recommendations regarding BLW can be made to the general New Zealand population.

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8 Appendices

Appendix A: An example of a BLISS intervention resource 'Everyday Foods from 7-9 months'

Appendix B: Queen Mary booking letter

Appendix C: Invitation to participate in the BLISS Study letter

Appendix D: BLISS Study recruitment protocol

Appendix E: Maternal consent form

Appendix F: Baseline questionnaire

Appendix G: Breastfeeding and Solids questionnaire

Appendix H: Breastfeeding and Solids questionnaire administration protocol

Appendix I: BLISS WDR 'Main food diary'

Appendix J: BLISS WDR 'Away from home'

Appendix K: BLISS WDR 'Early childhood education'

Appendix L: BLISS WDR 'Laminated example resource'

Appendix M: WDR administration protocol

Appendix N: 12-month Food Preference Questionnaire

Appendix O: WDR calculation sheet

Appendix P: Food preference taste and texture validation questionnaire

Appendix Q: BLISS diet record Kai-culator data entry

Appendix R: Food exposure and preference scores for individual foods according to study group

Appendix S: Number (%) of infants who had been offered the food at least once and who always consumed when it was offered, according to study group

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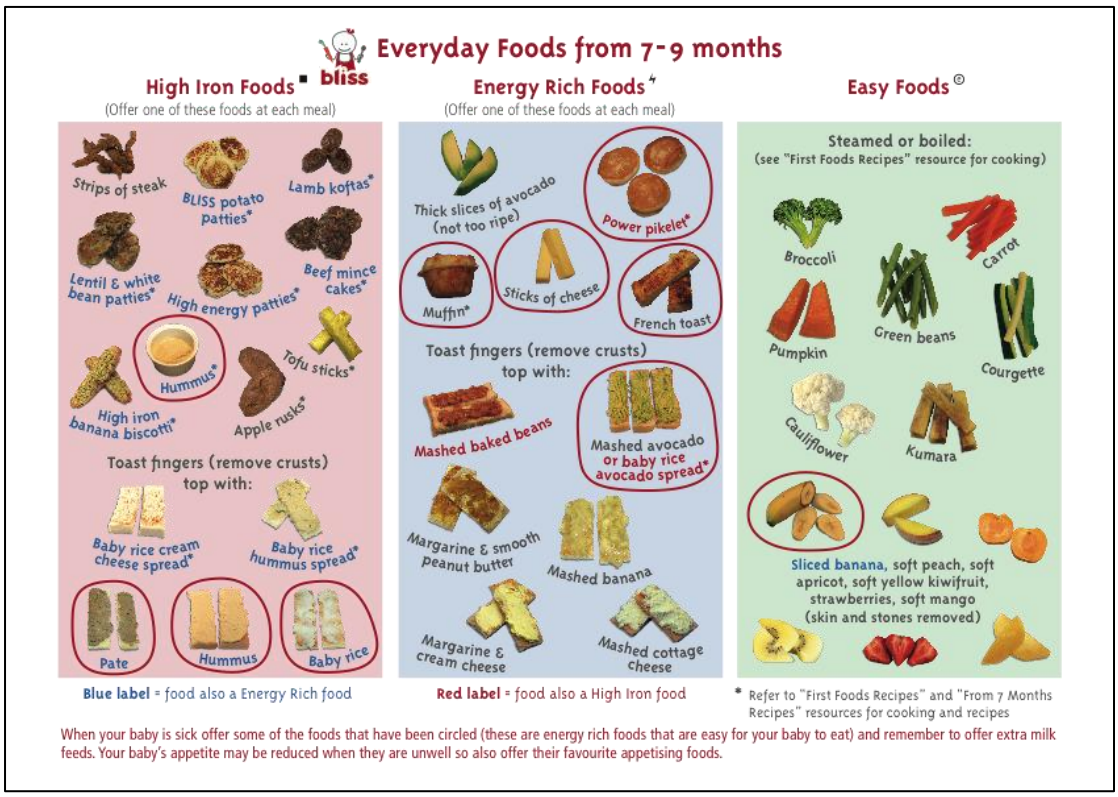
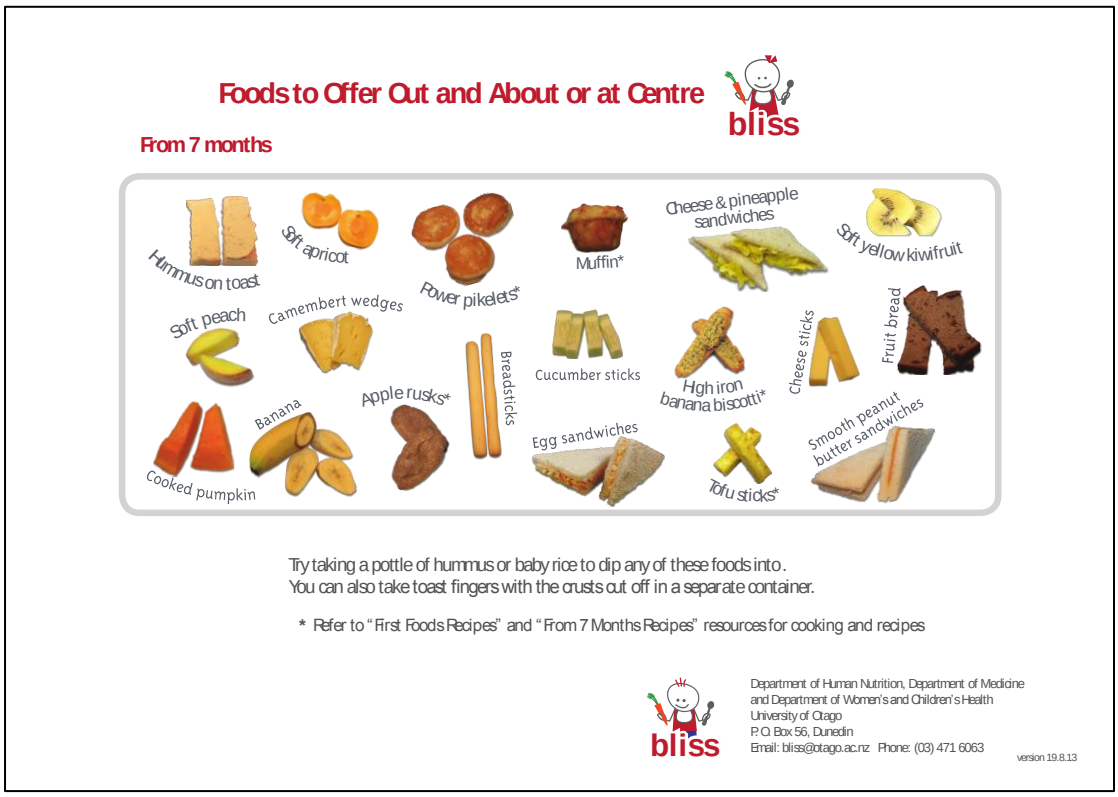
Appendix A: An example of a BLISS intervention resource 'Everyday Foods from 7-9 months'





Appendix B: Queen Mary booking letter

Dear

We are writing to confirm that we have received a pregnancy booking from your lead maternity carer midwife and to welcome you to the Queen Mary Maternity service at Dunedin Hospital.

Queen Mary Centre is available for all pregnant women from those with completely normal pregnancies to those women and babies requiring specialist medical care.

Your midwife has primary responsibility for providing your pregnancy care and this means that if you are healthy and well and your pregnancy and birth remain normal you will remain under the care of your midwife. Should you have significant health issues or develop problems during your pregnancy or birth your midwife will evaluate these and after discussion with you may recommend that you be referred to the medical team. Queen Mary has a team of core midwives and doctors available 24hrs a day. Their role is to work with your midwife to provide you with the best care possible during your stay with us and an environment that is safe, welcoming and private.

When you arrive at Queen Mary your midwife will briefly discuss your care with the Associate Charge Midwife (ACM). The ACM ensures that women in the unit have access to all the staff and resources they need and will share basic information about you with the doctors. Medical staff will not be involved in your care unless you need it. When they become involved (you develop a problem or need an epidural for pain relief) it is likely that a doctor will need to speak with you and examine you. This may include an internal examination. There may be a need for your care to be transferred to the medical team in which case your midwife may continue to provide midwifery care or in some situations, the core midwives and doctors may provide all your care. Except in an extreme emergency situation everyone involved will ensure that you are always fully involved in any decisions.

All our birthing rooms have a pool, deep bath or shower and we encourage use of these to increase relaxation and help you manage the pain of labour. You are welcome to bring personal items for your comfort such as your own pillow, music, food snacks and drinks. We have Swiss balls and kneeling pads to enable you to remain upright and active and to use a variety of positions during labour.

This is a University Hospital where teaching of students and research is conducted. If we wish to involve you in teaching or research you will always be asked if you are willing to be involved and saying "no" will not affect how you are looked after.

If you have any questions at all regarding any of this information, please discuss with your midwife or ring on 474 7948. At any time during your care or stay with us we welcome feedback or your ideas on how we could improve our service and the care you receive.

Kind regards

Queen Mary Reception
On behalf of Caroline Folland
Charge Midwife

Appendix C: Invitation to participate in the BLISS Study letter

Baby-Led Introduction to SolidS (BLISS)

Dear

We would like to invite you to take part in the BLISS study. This study will find out more about the way New Zealanders start their children on solid foods and how this affects their growth and health. You will find out about your baby's growth and whether they are getting enough nutrients as well as helping us improve the health of New Zealand babies.

If you decide to take part you will be one of the 300 families who are needed to answer these questions. We hope that most families having a baby in Dunedin from November 2012 to March 2014 will take part.

Please find enclosed an information sheet that describes the study in detail. We have been given ethical approval to send you this letter of invitation using contact details provided by the Queen Mary Maternity Unit. We will not share these details with any other party, and will destroy them if you choose not to take part in BLISS. Saying that you do not want to take part in the BLISS study will not affect the care you receive from your Lead Maternity Carer or Queen Mary in any way. If you decide after reading the information sheet that you do not wish to take part, please phone 479 4241 and leave a message to let us know. If we do not hear from you within two weeks, one of the team will contact you by phone to discuss the study further, answer any questions you may have and, if you would like to take part, arrange to visit you.

In the meantime, if you have any questions, please contact the research team:

Liz Fleming (BLISS Study Project Coordinator)
c/- Department of Human Nutrition
University of Otago
P O Box 56, Dunedin, New Zealand
Telephone (03) 471 6063
Mobile 022 192 7421
Email: bliss@otago.ac.nz

Many thanks for your time,

Kind regards

Dr Anne-Louise Heath, Associate Professor Rachael Taylor, and Professor Barry Taylor
Department of Human Nutrition, Department of Medicine, Department of Women's and Children's Health University of Otago, Dunedin.

Appendix D: BLISS Study recruitment protocol

P5-RECRUITMENT TELEPHONE CALL PROTOCOL

Study:	*BLISS*	*Version number: 2*
Prepared by:	*Rachael*	*Date prepared: 23/11/12*
		Edited: 6/12/12, 24/1/13

Objectives:

To see if a prospective mother is willing to be involved in the study
To confirm her eligibility for the study
To arrange a consent visit

Equipment required

P-5 Recruitment telephone protocol
BLISS participant tracking sheet
Online diary system for booking in consent visit

Process - overview

Make telephone call to mother
Refer to P-5 Recruitment Telephone Phone Call protocol
No → Thank you, mark as declined
Yes → Check inclusion criteria
Organise consent visit appointment as appropriate

Steps

Researcher (note date and time of call)
"Hello or good morning/afternoon/evening, this is *researcher's name* from the University of Otago BLISS study, may I speak to *prospective participant's name* please?"

Researcher
"Hi *parent's name*, this is *researcher's name* from the University of Otago BLISS study"

Researcher

"I am calling to follow up the invitation to take part in our study that we sent to you on *date letter sent*". Is now a good time to have a quick chat about it?

NO, I haven't received anything = "I'm sorry about that, could you please confirm your address and I'll arrange for our invitation to be resent" *Note in Participant tracking sheet PTS, arrange for letter to be resent*

NO = "When would be a better time to call you back please? *Make another date, end call – note in diary when to recall this person*

NO, Don't want to be called back, not interested. "No problem, but would you mind me asking why you are not interested? This is just important for statistical purposes". *Record reason on Participant tracking sheet, thank them for their time.*

YES = "have you had a chance to look through the information about the study?"

YES = "do you have any questions so far?" NO

YES = person asks questions. *Refer to FAQs at end if required*

NO, I haven't had a chance to look through information

"Would you be interested in hearing more about the study now?"

YES – *see study summary blurb*

NO, would you like more time. When could I ring you…

Researcher

"Does this sound like something you would be interested in being involved in?

YES, sounds great……. OR NO thanks….Not interested

BLISS study summary blurb
This study is looking at how babies are introduced to solid foods and how this might affect how they grow. We want to compare following the usual approach, which is to feed them purees before moving on to mashed and lumpier foods, with a baby-led approach – where spoons and purees are not used. Instead, the baby learns to feed themselves using finger foods.

There are two groups and which one you get into is just by chance. One of the groups gets more support than the other, but this other group is very important because this is how we measure the results of the study; we can't tell if our extra support is effective without being able to compare that group with this important group.

If we can show a real difference, the government might be interested in providing extra funding to support families.

Researcher
"I just need to ask you 3 questions to confirm that you are eligible to participate in the study. Is that OK with you?"

Exclusion criteria checklist
Can I please check that you are at least 16 years of age? Yes / No

Do you intend to live in Dunedin for the next two years?

YES = continue

NO = cannot continue…..Thank you very much for your time but we can only follow families who will be living in Dunedin for the next two years…..*Record on Participant tracking sheet*

Researcher
"That's great, thanks very much. You are certainly eligible to take part in the study so now we need to arrange a consent visit. This visit should take about 20-30 minutes and we can either come to your home or you can come to our clinic at the University. You are welcome to bring your other children if you have any. Free parking is available outside our BLISS house on the University grounds in two marked parks – we will send you an appointment card and map which will show the location of building and the parking available. If the car parks are full, we will reimburse your parking fee.

Does that all sound ok?"
Arrange suitable time.

"So just confirming with you……
you are meeting with …..*Name of researcher*
on …..*day and date of the appointment*
at…..*time of the appointment*
at…..*5 Leithbank at the University*

"We will send an appointment card and map, but would you like a reminder text as well"

NO = ok

YES = ask for cell phone number, *record on participant tracking sheet, make note to text them as appropriate the day before the consent visit*

Researcher
"If you have any questions or want to change the appointment, please contact us on 471 6063. Thanks again for your time and we look forward to seeing you on the …..*date*." End of call

After call process
File participant tracking sheet
Ensure consent visit appointment is entered into researcher's diary
Send appointment card and map

FREQUENTLY ASKED QUESTIONS
How long does the consent visit take?
Please allow about 30 minutes.

What will I have to do?
We can talk to you about the study more and you might like to ask questions. You then sign a consent form saying that you want to participate. We have a short questionnaire that we ask you to complete. Then we find out which group you have been assigned to. When we leave we will give you a calendar of upcoming events.

I have other children, is it okay to bring them?
Yes, no problem, we have some games and activities, including Nintendo Wii for the older children that they can have fun playing, as well as someone to supervise them while you are busy.

Can I choose what group I go into?
A computer will select what group you are in. You cannot choose which group and neither can we.

How many visits will I have to have?
This depends on which group you are in but it will range from 9 to 16 contacts over the next two years.

How long does the study go for?
We are interested in following you and your family for two years.

Will I get paid to be in the study?
No, but we can reimburse any travel expenses and we do offer small gifts to you for participating.

What's in it for me?
Knowing how to feed babies and toddlers has its challenges. We want to learn if another way of feeding young babies is a good way of making sure they get all the good nutrition they need. If you are in the BLISS group, we will give you plenty of support to help you breastfeed should you have issues (or to formula feed if that's what you choose), and then specially prepared resources to help introduce your baby to solid food.

We will be measuring all the children in the Bliss study and asking you about your child's feeding, meal times and how she/he are developing. We will be able to tell you about your child's growth and whether he/she is getting enough iron and other nutrients.

What happens if I change my mind later and want to opt out/withdraw?
You can withdraw from the study at any point and this will have no effect on your or your child's on-going healthcare.

I have been approached by other studies – why are you contacting me?
Well the different studies are looking at different things. We want to give everybody the opportunity to participate in our study, so that is why I am ringing you today. Our study doesn't really involve much until your child is around 6 months. We will also give you help with breastfeeding if you would like it.

I have volunteered for other studies – Would this affect the Bliss study?
It is OK to be in the Rotovirus study, Vitamin D study as well as ours.

The control group is a very useful group
The control group is very important because this is how we measure the results of the study; we can't tell if our extra support for baby lead introduction of solids is effective without being able to compare that group with the control group.

Ministry of Health view of Baby led weaning
Yes, the MOH has sourced its information from this study. The MOH says there isn't enough information to make population based recommendations. This study is the study the MOH is referring to when it says it is waiting for the results of further research.

I heard about Baby led weaning in the newspaper or on TV3
I'm really pleased you heard about that. That was part of this research group. We are going to be looking at baby led weaning in a safe way.

The choking thing
*Two paediatricians and a speech language therapist and our nutrition researchers have modified the BLW for this study. Cf babies chewing on raw apple is unsafe and we give advice on the safe way to introduce solid foods***.**

Appendix E: Maternal consent form

Consent form for the BLISS study

- I have read and I understand the information brochure for volunteers taking part in the BLISS study.
- I have had the opportunity to discuss the study and I am satisfied with the answers I have been given.
- I have had the opportunity to use Whānau support or a friend to help me ask questions and understand the study.
- I understand that taking part in this study is voluntary (my choice) and that I may withdraw from the study at any time and this will in no way affect my future health care or that of my child**.**
- I understand that taking part in the blood test in this study is voluntary (my choice) and that I may decline the blood test and this will in no way affect my future health care or that of my child**.**
- I consent to my baby providing a blood sample when they are 12 months.**YES / NO**
- If you consent to your baby providing a blood sample, would you like us to dispose of any blood left over in the standard manner? **YES / NO**

  Or with an appropriate karakia ? **YES / NO**
- I understand that my participation in this study is confidential and that no material which could identify me or my child will be used in any reports on this study.
- I have had time to consider whether to take part.
- I know who to contact if I have questions about the study
- I understand that when the study is completed, results of the study will be made available to me.
- I am happy to be contacted in the future to see if I might be interested in taking part in other related studies. **YES / NO**

- I agree to my GP being informed of my participation in this study and being notified about any abnormal results from my child's blood test. **YES / NO**

  Name of GP ……

  Address or Name of GP's practice ……

- I agree to my LMC being informed of my participation in this study. **YES / NO**

  Name of LMC ……

  Address or Name of LMC's practice ……

- I consent to information about my child's birth being transferred to the BLISS study researchers from my hospital and Well Child provider records. **YES / NO**

We will be contacting you via email or text - could you please give us

1. Your email address .....
2. Your mobile phone number .....

The name of your child's father (in case he comes to the visits) is ……

……

I _____hereby consent to take part in this study
(Please print your full name)

Signature_____Date_____

You have the opportunity to have an interpreter; please indicate in the table below whether you would like one and the language you would prefer:

English	I wish to have an interpreter	Yes	No
Maori	E hiahia ana ahau ki tetahi kaiwhakamaori/kaiwhaka pakeha korero.	Ae	Kao
Cook Island	Ka inangaro au i tetai tangata uri reo.	Ae	Kare
Fijian	Au gadreva me dua e vakadewa vosa vei au Io Sega Niuean Fia manako au ke fakaaoga e taha tagata fakahokohoko kupu.	E	Nakai
Samoan	Ou te mana'o ia i ai se fa'amatala upu.	Ioe	Leai
Tokelaun	Ko au e fofou ki he tino ke fakaliliu te gagana Peletania ki na gagana o na motu o te Pahefika	Ioe	Leai
Tongan	Oku ou fiema'u ha fakatonulea.	Io	Ikai

Appendix F: Baseline questionnaire

Mother's Baseline Questionnaire

Welcome and thank you for being part of the BLISS study.
This questionnaire is split into 2 sections and should take about 10 minutes to complete.
Please answer every question - *there are no right or wrong answers*.
Please ask the researchers if you have any questions - **thank you for your time**.

Section 1: Demographics

This section asks questions that will tell us how similar the people who are a part of BLISS are to other New Zealanders.

1 What is your date of birth? _____ / _____ / _____
day month year

2 What is your expected date of delivery? _____ / _____ / _____
day month year

3 How many weeks pregnant are you now? _____ weeks

4 Which ethnic group(s) do you belong to? *Please tick <u>all</u> the boxes that apply*

- ○ NZ European
- ○ Māori
- ○ Samoan
- ○ Tongan
- ○ Cook Island Māori
- ○ Niuean
- ○ Chinese
- ○ Indian
- ○ Other (such as Dutch, Japanese, Tokelauan). Please state:

_____

5 Are you descended from a Māori (that is do you have a Māori birth parent, grandparent or great-grandparent etc)?

- ○ Yes
- ○ No *Please go to question 7*
- ○ Don't know *Please go to question 7*

6 Do you know the name(s) of your Iwi (tribe)?

- ○ Yes If yes, please list your Iwi …….
- ○ No

7 Which ethnic group(s) does your baby's father belong to? *Please tick <u>all</u> the boxes that apply*

- ○ NZ European
- ○ Maori
- ○ Samoan
- ○ Tongan
- ○ Cook Island Maori
- ○ Niuean
- ○ Chinese
- ○ Indian
- ○ Other (such as Dutch, Japanese, Tokelauan). Please state: _____

7b Which ethnic group(s) does your baby's father belong to? *Please tick <u>all</u> the boxes that apply*

- ○ NZ European
- ○ Maori
- ○ Samoan
- ○ Tongan
- ○ Cook Island Maori
- ○ Niuean
- ○ Chinese
- ○ Indian
- ○ Other (such as Dutch, Japanese, Tokelauan). Please state:_____

8 What is your marital status?

- ○ Single
- ○ Married/Civil union
- ○ Separated/Divorced/Widowed
- ○ Partner/De facto
- ○ Boyfriend/Girlfriend

9 What is your <u>highest</u> qualification? *Don't count qualifications that take less than 3 months of full-time study to get*

- ○ Primary school
- ○ NZ School Certificate in one or more subjects *or* National Certificate level 1 *or* NCEA level 1
- ○ NZ Sixth Form Certificate in one or more subjects *or* National Certificate level 2 *or* NZ UE before 1986 in one or more subjects *or* NCEA level 2
- ○ NZ Higher School Certificate *or* Higher Leaving Certificate *or* NZ University Bursary/Scholarship *or* National Certificate level 3 *or* NCEA level 3
- ○ NZ trade certificate
- ○ Polytechnic diploma or degree
- ○ University undergraduate degree
- ○ University postgraduate degree

10 How many people live in your household? *Including yourself* _____

11 In addition to yourself, who else will your baby live with? *Please tick all the boxes that apply*

- ○ Child's father
- ○ Your partner, but not child's father
- ○ Brothers or sisters (include step brothers/sisters)
- ○ Child's grandparents
- ○ Other relatives
- ○ Non-family members (eg. boarder)
- ○ No-one else besides you

12 Have you taken any of the following supplements during this pregnancy? *Please tick all that apply and state the brand name.*

- ○ Elevit
- ○ Vitamin D: *please state brand name*:
- ○ Women's pregnancy vitamin: *please state brand name*:
- ○ Other : *please state type (eg Iron supplement)*:
  please state brand name:

Questions 13 to 16 ask about your situation when **you became pregnant**

13 Were you in paid employment?

- ○ No, I was not in paid employment
- ○ I was employed part-time (include self-employed)
- ○ I was employed full-time (include self-employed)

14 Were you studying at University or Polytechnic?

- ○ No, I was not studying
- ○ I was a part-time student
- ○ I was a full-time student

15 How tall were you without shoes? *This is probably also your current height*

_____ cm *or* _____ feet and _____ inches

16 How much did you weigh?

_____ kg *or* _____ stone and _____ pounds *or* _____ pounds

Questions 17 and 18 ask about your baby's *biological father*

17 How tall is he without shoes?

_____ cm *or* _____ feet and _____ inches

18 How much does he weigh?

_____ kg *or* _____ stone and _____ pounds *or* _____ pounds

Section 2: Infant feeding

This section asks about how you plan to feed this baby, and if you have other children, how you fed them as babies.

19 Do you plan to breastfeed your child?

○ Yes
○ No *Please go to question 22*

20 At what age do you plan to stop **exclusively** breastfeeding your child? The term **exclusively breastfed** means that the infant receives **only** breast milk and nothing else except medicine. *Please give your answer as their age in days, weeks or months.*

_____ days *or* _____ weeks *or* _____ months of age *or*

○ Don't know

21 At what age do you plan to stop **all** breastfeeding? *Please give your answer as you infant's age in days, weeks or months.*

_____ days *or* _____ weeks *or* _____ months of age *or*

○ Don't know

22 At what age do you plan to introduce solid foods? *Please give your answer as your infant's age in days, weeks or months.*

_____ days *or* _____ weeks *or* _____ months of age *or*

○ Don't know

Questions 23 to 25 are about starting your baby on solids.

23 At what age is it currently recommended that a child is first given solid foods? *Please give your answer as the child's age in days, weeks or months.*

_____ days *or* _____ weeks *or* _____ months of age *or*

○ Don't know

24 How do you plan to feed your baby when <u>they first start eating</u> solid foods?

- ○ Spoon fed by adult
- ○ Mostly spoon fed by adult, some baby feeding themselves
- ○ About half spoon feeding by adult and half baby feeding themselves
- ○ Mostly baby feeding themselves, some adult spoon feeding
- ○ Baby feeding themselves
- ○ Don't know or not yet decided

25 What type of food do you plan to feed your baby when they first start eating solid foods?

- ○ All puréed or mashed foods (including cans or jars of baby food, or food you purée yourself)
- ○ Mostly puréed or mashed food, some finger foods
- ○ About half puréed or mashed food and half finger foods
- ○ Mostly finger foods and some puréed or mashed foods
- ○ All finger foods (for example carrot sticks, broccoli floret, sliced toast)

26 Do you have other biological children?

- ○ No this will be my first child (Please go to the end of the questionnaire)
- ○ Yes, 1 child
- ○ Yes, 2 children
- ○ Yes, 3 or more children

If you have more than one older child, please refer to the *youngest* child when answering questions 27 to 28.

27 How did you feed your **youngest** child when they first started eating solid foods?

- ○ Spoon fed by adult
- ○ Mostly spoon fed by adult, some baby feeding themselves
- ○ About half spoon feeding by adult and half baby feeding themselves
- ○ Mostly baby feeding themselves, some adult spoon feeding
- ○ Baby feeding themselves

28 What type of food did you feed your youngest child when they first started eating solid foods?

- ○ All puréed or mashed foods (including cans or jars of baby food, or food you purée yourself)
- ○ Mostly puréed or mashed food, some finger foods
- ○ About half puréed or mashed food and half finger foods
- ○ Mostly finger foods and some puréed or mashed foods
- ○ All finger foods (for example carrot sticks, broccoli floret, sliced toast)

Thank you for completing this questionnaire

Appendix G: Breastfeeding and Solids questionnaire

Breastfeeding and Solids - Feeding questionnaire

Welcome and thank you for being part of the BLISS study.
This questionnaire should take about 5-10 minutes to complete.

Screening questions

1 Which of the following has *[child's name]* been fed in the last **48 hours**?

		Yes	No
a.	Breast milk	○	○
b.	Infant formula	○	○
c.	Other liquids (not including minimal water)	○	○
d.	Solid foods	○	○

2 Which of the following has *[child's name]* been fed at any time **since birth**, including in the hospital?

		Yes	No
a.	Breast milk	○	○
b.	Infant formula	○	○
c.	Other liquids (not including minimal water)	○	○
d.	Solid foods	○	○

3 Consistency check (not visible on questionnaire)

Have warning alert if any of the following combinations appear:

If 1a = yes AND 2a = no *[YES BM in last 48 hours AND NO BM since birth]*
If 1b = yes AND 2b = no *[YES IF in last 48 hours AND NO IF since birth]*
If 1c = yes and 2c = no *[YES OL in last 48 hours AND NO OL since birth]*
If 1d = yes and 2d = no *[YES Solids in last 48 hours AND NO solids since birth]*

All other combinations okay

Answers to Q1 and Q2 determine skips according to following criteria:

If 2b = yes, go to Q4 *[Yes IF + any other answers=> Q4]*
If 2c = yes, skip to Q5 *[Yes OL + any other answers => Q5]*
If 2d = yes, skip to Q6a *[Yes Solids => Q6a]*
If 2a = yes and 1a = no, skip to Q7 *[Only BM BUT No BM in last 48 hours => Q7]*
If 2a = yes and 1a = yes, skip to Q11 *[Only BM ever => Q11]*

4 How old was *[child's name]* when they first had infant formula?

_____ days OR _____ weeks OR _____ months

If 2c = yes, go to Q5 *[Yes OL]*
If 2d = yes, skip to Q6a *[Yes Solids =>Q6a]*
If 2a = yes and 1a = no, skip to Q7 *[Yes BM from birth BUT NO BM last 48 hrs => Q7]*
If 2b = yes and 1b = no, skip to Q9 *[Yes IF from birth BUT No IF last 48 hrs => Q9]*
If 2a = yes and 1a = yes, skip to Q11 *[Yes BM from birth + Yes BM last 48 hrs => Q11]*
If 2b = yes and 1b = yes, skip to Q11 *[Yes IF from birth + Yes IF last 48 hrs => Q11]*

5 How old was *[child's name]* when they first had liquids other than breast milk or infant formula?

_____ days OR _____ weeks OR _____ months

If 2d=yes, go to Q6a *[Yes Solids]*
If 2a = yes and 1a = no, skip to Q7 *[Yes BM from birth BUT NO BM last 48 hours => Q7]*
If 2b = yes and 1b = no, skip to Q9 *[Yes IF from birth BUT No IF last 48 hours => Q9]*
If 2a = yes and 1a = yes, skip to Q11 *[Yes BM from birth + Yes BM last 48 hours => Q11]*
If 2b = yes and 1b = yes, skip to Q11 *[Yes IF from birth + Yes IF last 48 hours => Q11]*
If 2c = yes, skip to Q31 ***[No milk OR solids + Yes OL => Q31]***

6a How old was *[child's name]* when they first started eating solid foods?
Note: "eating solid foods" means that baby appears to swallow at least some of the food.

_____ weeks OR _____ months

6b How was *[child's name]* fed when they first started eating solid foods?
Note: "Fed by adult" means that someone other than baby put the food in their mouth.
"Baby fed themselves" means that baby picks up the food, puts it in their mouth and appears to swallow at least some.

○ Fed by adult
○ Mostly fed by adult, some baby fed themselves
○ About half fed by adult and half baby fed themselves
○ Mostly baby fed themselves, some fed by adult
○ Baby fed themselves

6c What type of foods did you give *[child's name]* when they first started eating solid food?

○ All puréed or mashed foods (including cans or jars of baby food, or food you purée yourself , and dry foods that you add water to such as "baby rice" and porridge)
○ Mostly puréed or mashed food, some finger foods
○ About half puréed or mashed food and half finger foods
○ Mostly finger foods and some puréed or mashed foods
○ All finger foods (for example carrot sticks, broccoli floret, sliced toast)

If 2a = yes and 1a = no, go to Q7 *[Yes BM since birth BUT No BM last 48 hrs => Q7]*
If 2b = yes and 1b = no, skip to Q9 *[Yes IF since birth BUT No IF last 48 hrs =>Q9]*
If 2b = yes and 1b = yes, skip to Q11 *[Yes IF since birth + yes IF last 48 hrs =>Q11]*
If 2a = yes and 1a = yes, skip to Q11 *[Yes BM since Birth + Yes BM last 48 hours => Q11]*
If 2d = yes, skip to Q12 *[Yes Solids since Birth => Q12]*
If 2c = yes, skip to Q31 *[Yes OL =>Q31]*

7 Have you stopped breastfeeding?

○ Yes
○ No

If Q7 = no and 2b = yes and 1b = no, Skip to Q9
[No Stop BF + Yes IF <u>BUT</u> No IF last 48 hours =>Q9]

ELSE If Q7 = no, Skip to Q11 *[No Stop BF =>Q11]*

8 How old was *[child's name]* when you stopped breastfeeding?

_____ days OR _____ weeks OR _____ months

If 2b = yes and 1b = no, go to Q9 *[Yes IF since Birth + No IF last 48 hrs =>Q9]*
If 2b = yes and 1b = yes, skip to Q11 *[Yes Stop BF + Yes IF + Yes IF last 48 hours => Q11]*
If 2b = no and 2d = yes, skip to Q12 *[Yes Solids =>Q12]*
If 2c = yes, skip to Q31 *[No IF + No Solids + Yes OL => Q31]*

9 Have you stopped feeding infant formula?

○ Yes
○ No

If Q9 = no, skip to Q11 *[No Stop IF => Q11]*

10 How old was *[child's name]* when you stopped feeding infant formula?

_____ days OR _____ weeks OR _____ months

If 2a = yes and 1a = yes, go to Q11 *[Yes BF since birth + Yes BF last 48 hrs =>Q11]*
If 2a = yes and 1a = no and Q7 = no, go to Q11 *[No Stop BF =>Q11]*
If 2d = yes, skip to Q12 *[Yes Solids + NO BM/IF => Q12]*
If 2c = yes, skip to Q31 *[Yes OL + No Solids + NO BM/IF =>Q31]*

11 How has *[child's name]* been fed their milk (breast milk or infant formula) in the last **48 hours**?
Note: Feeding on demand means feeding your baby as often as they want, day and night. Feeding on schedule means feeding your baby at set intervals.

○ Fed on demand
○ Mostly fed on demand, some fed on schedule
○ About half fed on demand and half fed on schedule
○ Mostly fed on schedule, some fed on demand
○ Fed on schedule
○ Not fed breast milk or infant formula in the last 48 hours

If 2d = no, skip to Q31 *[No Solids => Q31]*

12 Does *[child's name]* feed **themselves** solids?
Note: "Baby fed themselves" means that baby picks up the food, puts it in their mouth and appears to swallow at least some.

○ Yes
○ No

If Q12 = no, skip to Q20 *[BB doesn't feed themselves solids => Q20]*

13 How old was *[child's name]* when they first fed **themselves** solids?
Note: "Baby fed themselves" means that baby picks up the food, puts it in their mouth and appears to swallow at least some.

_____ days OR _____ weeks

14 How was *[child's name]* fed when they first started feeding **themselves** solids?
Note: "Fed by adult" means that someone other than baby put the food in their mouth. "Baby fed themselves" means that baby picks up the food, puts it in their mouth and appears to swallow at least some

○ Mostly fed by adult, some baby fed themselves
○ About half fed by adult and half baby fed themselves
○ Mostly baby fed themselves, some fed by adult
○ Baby fed themselves

15 Does *[child's name]* feed **themselves** solids regularly (at least once a day)?
Note: Baby fed themselves means that baby picks up the food, puts it in their mouth and swallows some.

○ Yes
○ No

If Q15 = no, skip to Q20 *[BB doesn't feed themselves solids regularly => Q20]*

16 How old was *[child's name]* when they started feeding **themselves** solids regularly (at least once a day)?
Note: "Baby fed themselves" means that baby picks up the food, puts it in their mouth and appears to swallow at least some.

_____ weeks OR _____ months

17 How was *[child's name]* fed when they first started feeding **themselves** solids regularly?
Note: "Baby fed themselves" means that baby picks up the food, puts it in their mouth and appears to swallow at least some

○ Mostly fed by adult, some baby fed themselves
○ About half fed by adult and half baby fed themselves
○ Mostly baby fed themselves, some fed by adult
○ Baby fed themselves

18 Does *[child's name]* feed themselves **all their food?** (Excluding feeding by an adult when baby is feeling unwell).
Note: "Baby fed themselves" means that baby picks up the food, puts it in their mouth and appears to swallow at least some.

○ Yes
○ No

If Q18 = no, skip to Q20 *[BB doesn't feed themselves all their solids =>18]*

19 How old was your baby when they first started feeding themselves **all their food?**

_____ weeks OR _____ months

20 How has *[child's name]* been fed their solids in the last **48 hours**?
Note: "Baby fed themselves" means that baby picks up the food, puts it in their mouth and appears to swallow at least some.

○ Fed by adult
○ Mostly fed by adult, some baby feeding themselves
○ About half spoon feeding by adult and half baby feeding themselves
○ Mostly baby feeding themselves, some adult feeding
○ Baby feeding themselves

21 How has *[child's name]* been fed their solids in the **past week**?
Note: "Baby fed themselves" means that baby picks up the food, puts it in their mouth and appears to swallow at least some.

○ Fed by adult
○ Mostly fed by adult, some baby feeding themselves
○ About half spoon feeding by adult and half baby feeding themselves
○ Mostly baby feeding themselves, some adult feeding
○ Baby feeding themselves

For questions 22-30, "eaten" means that food has been in baby's mouth and s/he appears to swallow at least some.

22a Has *[child's name]* eaten **Baby cereal**?
○ Yes
○ No

If Q22a = no, skip to Q23a

22b. How old were they when they first ate **Baby cereal**?

_____ weeks OR _____ months

23a Has *[child's name]* eaten **Beef** (includes mince, steak, sausages and roast beef)?
○ Yes
○ No

If Q23a = no, skip to Q24a

23b How old were they when they first ate **Beef**?

_____ weeks OR _____ months

24a Has *[child's name]* eaten **Lamb** (includes mince, steak, sausages and roast lamb)?
○ Yes
○ No

If Q24a = no, skip to Q25a

24b How old were they when they first ate **Lamb**?

_____ weeks OR _____ months

25a Has *[child's name]* eaten **Pork** (includes mince, ham, sausages and roast pork)?
○ Yes
○ No

If Q25a = no, skip to Q26a

25b How old were they when they first ate **Pork** (includes ham)?

_____ weeks OR _____ months

26a Has *[child's name]* eaten **Chicken** (includes chicken pieces, mince, sausages and roast chicken)?
○ Yes
○ No

If Q26a = no, skip to Q27a

26b How old were they when they first ate **Chicken**?

_____ weeks OR _____ months

27a Has *[child's name]* eaten **Fish**?
○ Yes
○ No

If Q27a = no, skip to Q28a

27b How old were they when they first ate **Fish**?

_____ weeks OR _____ months

28a Has *[child's name]* eaten **Shellfish**?
○ Yes
○ No

If Q28a = no, skip to Q29a

28b How old were they when they first ate **Shellfish**?
_____ weeks OR _____ months

29a Has *[child's name]* eaten **processed meats** (luncheon sausage or Belgium or cheerio sausages)?

○ Yes
○ No

If Q29a = no, skip to Q30a

29b How old were they when they first ate **processed meats**?

_____ weeks OR _____ months

30a Has *[child's name]* eaten **Beans, peas or lentils** (e.g. baked beans, hummus; NOT green peas or beans)?

○ Yes
○ No

If Q30a = no, skip to Q31

30b How old were they when they first ate **Beans, peas or lentils** (e.g. baked beans, hummus; NOT green peas or beans)?

_____ weeks OR _____ months

31 How much of a problem is *[child's name]* sleeping pattern or habits for you?

○ ○ ○ ○ ○ ○ ○

No problem Small problem Moderate problem Large problem

32 In the last week what is the longest time *[child's name]* has slept in the night without waking?

_____ hours OR _____ minutes

33 Have you been worried about *[child's name]* weight gain since their birth?

○ Yes, too much weight gain
○ Yes, not enough weight gain
○ No

Thank you for completing this questionnaire

Appendix H: Breastfeeding and Solids questionnaire administration protocol

R-15d: Administer 2month Bfing and Solids question Telephone Call Protocol

Study: BLISS Study *Version number:* Version 5
Prepared by: Brittany Morison (+ALH, LF) *Date prepared:* 26 March 2013

Purpose of Telephone Call

Objective: Call to each participant at 2 months from birth date (as close as possible ± 1 week OK) to ask 2 Month Feeding Questionnaire.

Equipment required

Protocols:

- Phone Call - 2 month feeding questionnaire. (This protocol)

Paperwork:

- • List of people who are due to have 2 month questionnaire
- "Participant Information" page (downloaded from BLISS database):
- Name of baby's primary carer (usually but not always mother – if Dad then it should be indicated in the Notes)
- Phone number – landline
- Phone number – mobile
- Infant name
- Infant sex
- Notes on best time to contact etc
- • 2 Month Feeding Questionnaire
- • Pen

Software:

- BLISS database

Steps - Before

Download and print Participant Information page from BLISS database. Look up website and click "participants" then "show all" then "enrolled".

[To find the Participant Information sheet you click into the participant then immediately click 'Save participant and exit' The next screen that pops up has 'Print reports' page where you can print off the mothers name and babies name and address and contact details.]

Record ID numbers on the Participant Information page. Record ID number on Questionnaire. Also have the BLISS database open to record corresponding questionnaire answers.

DO NOT look at the following screens:
Eligibility/Recruitment
Events

The Participant Information page contains confidential participant details, and their study ID number, so must be kept very securely so no non-study people have access to it, and must be destroyed (by shredding) once it has been used.

Questionnaire should be asked the week the baby turns 2 months of age.

Steps – During

- Introduce yourself
- Check it is a good time for the interview
- Administer Questionnaire
- Thank participant & tell will be in contact in 2 months [NB: if in BLISS group will hear from LC before then but you will not know whether or not they are in the BLISS group]
- Record duration of interview
- Note date of phone call on "bliss questionnaire tracking sheet"

THEY ANSWER THE PHONE:

Researcher
*Hello/Good morning/Good afternoon/Good evening, this is **[RESEARCHER'S NAME]** from the BLISS Study at the University of Otago speaking. I was wondering if I could talk to your baby's main carer – is that you?*

Participant
"Speaking …"

OR

"Just get her/him …"

Researcher
*Hi, this is **[RESEARCHER'S NAME]** from the BLISS study at the University of Otago.*

Researcher
Is now a good time to talk? I have the 2 month questionnaire to carry out - it takes about 5-10 minutes.

Participant
"Now is fine …"

Researcher
I have a short questionnaire about how things have been going with your baby's feeding. Before we start - I'm not allowed to know which group you and your baby are in so please don't tell me.

Finding out babies name and sex **if not on Participant Information page**:

NO NAME OR SEX: *Great. Congratulations on the birth of your wee baby a couple of months ago! Did you have a wee boy or a wee girl? And what name did you choose? Lovely... and could I check the spelling with that?*

SEX BUT NO NAME: *Great. Congratulations on the birth of your wee baby a couple of months ago! We have down here that you had a baby [BOY/GIRL] and what name did you choose? Can I get the spelling on that please? Lovely.....*

DOUBLE CHECK DETAILS: *Just to double check that our details are right, we have that you have had a wee baby (NAME) and (GENDER). Nice thank you.*
[RECORD DETAILS]

I will start the questionnaire now.

[ADMINISTER QUESTIONNAIRE]

[You might find a few respondents have difficulty understanding a particular question. Be patient and repeat the question, allowing the respondent time to consider the question and his or her answer. If the respondent is still not sure of what the question means, then you should explain the question BUT be very careful not to emphasis any answers or 'lead' the participant.]

Thank you for your time for completing the questionnaire – I'll be in contact in a couple of months time about the 4 month questionnaire.
[END]

NOT NOW

Participant
"Not now / No …

Researcher
When would be a better time to call you back?

[RECORD IN YOUR DIARY]

Thank you – I'll look forward to talking to you then.
[END]

REACH THE ANSWER PHONE

Researcher
Hello/Good morning/Good afternoon/Good evening, this is [RESEARCHER'S NAME] from the BLISS Study at the University of Otago speaking. I am just calling bout the 2 month questionnaire. Sorry I missed you, I'll try you again later.
Thank You and I look forward to talking to you.

ANY PROBLEMS TO DO WITH BLISS

Researcher
Thank you for letting us know / telling me that. I will get someone from the study office to contact you.

Steps – After

1. Record the date and data collected in the BLISS database.
2. If contact cannot be reached, 10 attempts must be made at different times on different days, and eventually in different weeks, to contact someone before giving up.
3. If haven't been able to contact them then record this in BLISS database.
4. Destroy (by shredding) the Participant Information page once interview completed as it has confidential participant details, and the study ID number on it.

Appendix I: BLISS WDR – 'Main food diary'

BLISS Food Diary

Please read through the instruction pages before starting your food diary

Things to record each day:

	What	When
1	Food Diary	During preparation, dishing and clean-up of the food or drink
2	Description of Recipes Used	As you are cooking the recipe
3	End of Day Questionnaire	At the end of each day
4	Supplement Use	At the end of each day

On these days:

1. .....
2. .....
3. .....

Please try not to change what you give your child just because you are keeping a diary!

Thank you very much for your help

bliss

Step 5: Turn off the scales

Press the 'OFF' button once to switch it off (scales will turn off automatically if left for 3 minutes).

Changing the batteries

It a picture of a battery appears on the display it means the battery is low and needs replacing
Remove the back cover
Take out battery box and remove inner box
Place two batteries on top of each other with the + terminal on top
Place boxes into original position and close back cover

Note

- **'Err'** means you have put too much weight on the scale – try a lighter plate. These scales can not be used with any plate, bowl or container that weighs more than approximately 2 kg.
- If a picture of a **battery** appears on the display it means the battery is low and needs replacing (see above).
- Clean scales with a slightly **damp cloth** – please DO NOT immerse in water or use chemical/abrasive cleaning agents.
- Please clean scales **immediately** after a spill.
- Don't use the scales next to your **microwave** – this will interfere with the display.
- The scales with automatically **switch-off** after 1 minute if the display has been showing '0' continuously, or after 3 minutes if one reading has been displayed continuously for that time.

If you have any questions please leave a message and we will get back to you

Instructions for using scales (SALTER Electronic)

Please weigh EVERYTHING in grams using the scales we have given you

Step 1: Turn on the scales

1. Place scales on a **stable, flat** work surface away from the microwave
2. Press the ON ZERO button once (quite firmly) in the centre
3. A '0' with a 'g' (above the zero) should appear on the display
4. If a '0' with an 'oz' appears on the display, please push the 'KG LB' button to convert to 'g'

Step 2: Weigh the empty plate or bowl

Place bowl or plate on the platform. Read the weight and record it in the column labelled **"Weight of plate or mug" (Step 4)** on your food diary

Step 3: Weigh the plate or bowl with food (before eating)

1. Add the first food to the plate or bowl. Read the weight and record it in the column labelled **"Weight of food or drink + plate or mug" (Step 4)** on your food diary
2. Add the next food to the plate or bowl. Read the weight and record it in the column labelled **"Weight of food or drink + plate or mug" (Step 4)** to your food diary
3. Repeat as needed, do not zero the scales in between weighing foods

Step 4: Weigh the plate or bowl with leftover food (after eating)

1. Place the bowl or plate with the food leftovers on the platform
2. Read the weight and record it in the column labelled **"Weight of leftover + plate or mug" (Step 6)** on your food diary
3. Estimate the proportion of each food that was leftover (e.g., ½ baked beans, ¼ slice bread)

C) How to estimate amounts of food when you can't weigh them

Please record an estimated amount in the "weight of food or drink" column.

- **HOUSEHOLD MEASURES** – Household measures like cups, tablespoons and teaspoons can be useful. Please tell us whether it was a heaped or level amount.
- **WEIGHTS MARKED ON PACKAGES** – Use the weight marked on canned or packet foods e.g., half a 220g can of baked beans, one 60g pottle of yoghurt.
- **RULER** – Foods such as cheese, cakes and meat can be measured using the ruler provided in the Away from Home booklet (page 10), e.g. slice of luncheon sausage 8cm x 4cm x 1mm (remember to give length, width and depth!).
- **CIRCLES** – Round foods such as biscuits and muffins can be measured using the circles provided in the Away from Home booklet (page 11), e.g. one muffin 6cm circle x 7cm high (height estimated using the ruler).
- **BREAD** – Tell us the number and the size of the slices e.g., sandwich, medium, or toast slice.
- **FRUIT** – Tell us whether the piece of fruit is small, medium or large. Alternatively you could use the circles for round fruit such as mandarins.

TAKEAWAY FOODS

The Away from Home booklet (page 9) has photographs of commonly eaten takeaway foods. Please write down the weight from the photograph that best describes the amount of food your child was served and write it in the "Weight of food or drink" column. Your child might not have exactly the amount in the photos so feel free to tell us if she had "two x 40g pizza".

Remember: We are NOT looking for a "healthy" diet. We need to know what children actually eat and how they eat it.

B) How to describe recipes

Example:

Step 1	Step 2	Step 3	Step 4	Step 5
Name of recipe	Amount of each ingredient including any water added (eg: 3 medium carrots, 500g lean beef mince, 1 onion, 60g water etc)	Cooking method	Proportion of recipe served to your child	Time of day served
Home-made mince	*300g standard beef mince (browned in 1 tablespoon olive oil)* *50g onion, diced* *60g carrot, diced* *1 clove garlic, minced* *60g beef stock (Campbells)* *30g tomato sauce (Watties)* *60g diced potatoes* *40g diced kumara* *40g frozen mixed vegetables (Watties)* *60g water* *5g white flour*	*Mince was stewed in a small pot with the lid on*	*One tenth (1/10)*	*6 pm*

Supplement Use — Day 2

(a) Did your child take any supplements today? Include anything you consider to be a supplement to your child's diet (e.g., multi-vitamin, etc.).

No ☐ (please go to page 13)

Yes ☐

(b) **If yes,** please record the following:

Type of supplement (e.g., cod liver oil): _____

Brand name (e.g., Smith's): _____

Amount (number of mls, drops, tablets, capsules, etc.) taken (e.g., 5mls): _____

(c) **If yes,** does the supplement contain iron or zinc? (check the label)

No ☐

Yes ☐

If yes, please record the type of iron (e.g., ferrous fumerate, ferrous sulphate and anything else with the words "iron", "ferric" or "ferrous" or "zinc" (e.g., zinc sulfate) and the amount of iron or zinc per tablet (e.g., 10mg, etc.).

Type of iron (e.g., ferrous sulphate): _____ Amount per dose (e.g., 7mg in 5ml): _____

Type of zinc (e.g., zinc sulfate): _____ Amount per dose (e.g., 7mg in 5ml): _____

THE INTERVIEWER WILL HELP YOU FILL IN THIS PAGE IF YOU ARE NOT SURE - please keep the bottle or packet

Day 1

Step 1	Step 2			Step 3		Step 4				Step 5		Step 6	
Time of day	Name of food or drink	Brand of food or drink	Cooking method	Weight of plate/ mug	Weight of food/drink + plate/ mug	Consistency of food/drink item				Food/drink was put in child's mouth by:		Weight of leftover + plate or mug	Estimation of what is left on plate
						Puréed	Mashed	Diced	Whole	Parent	Child		

If your child has finished eating for the day, please remember to fill out the end of day questionnaire and supplement use on pages 11 and 12.

End of Day Questionnaire - Day 3

Table 1

Step 1	Step 2	Step 3		Step 4				
Date	Day of week	Is this a typical eating day for your child?		Is your child unwell (for any reason)?		If unwell, did this influence your child's appetite?		
		Yes	No	Yes	No	No	Yes - Decreased appetite	Yes - Increased appetite

Table 2

How did your child's meals compare to the family meals today?

	Part 1			Part 2									
				Step 1	Step 2		Step 3				Step 4			
	Did not have this meal today	Was with another adult at this meal time	Breast milk or formula **only**	Breast milk/ formula and food	Child ate meal with at least one other adult: (Both were eating but food may be different.)		Meal Ingredients				Meal Preparation (Eg: texture of meal, length and method of cooking, size of food pieces)			
					Yes	No	Exactly the same	Almost the same	Similar	Mostly different	Exactly the same	Almost the same	Similar	Mostly different
Breakfast														
Lunch														
Evening meal														

Appendix J: BLISS WDR – 'Away from Home'

bliss

BLISS Food Diary

Away from Home Booklet

- Please use this booklet if you are leaving the house and will be unable to weigh foods.
- Remember we are NOT looking for a "healthy" diet. We need to know what children actually eat and how they eat.

Thank you very much for your help

Day 1 Date:
Day of week:

Step 1	Step 2		
Time of day	Name of food or drink	Brand of food or drink	Cooking method

2

Step 3		Step 4				Step 5		Step 6	
Weight of plate/ mug	Weight of food/ drink + plate/mug	Consistency of food/drink item				Food/drink was put in child's mouth by:		Weight of leftover + plate or mug	Estimation of what is left on plate
		Purred	Mashed	Diced	Whole	Parent	Child		

3

How to estimate amounts of food when you can't weigh them

Please record an estimated amount in the "weight of food or drink" column.

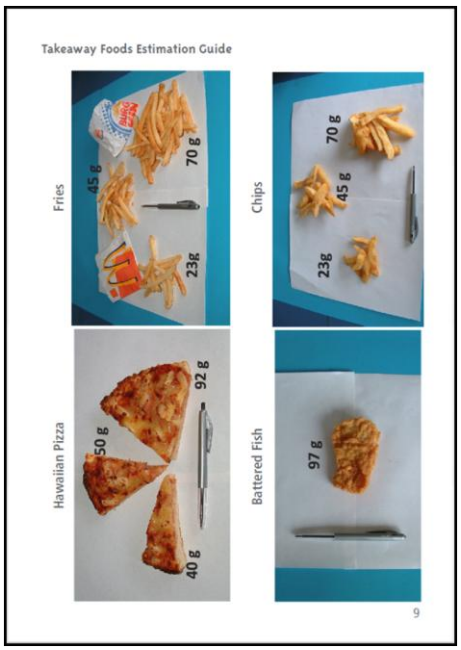
- **HOUSEHOLD MEASURES** – Household measures like cups, tablespoons and teaspoons can be useful. Please tell us whether it was a heaped or level amount.
- **WEIGHTS MARKED ON PACKAGES** – Use the weight marked on canned or packet foods e.g., half a 220g can of baked beans, one 60g pottle of yoghurt.
- **RULER** – Foods such as cheese, cakes and meat can be measured using the ruler provided on page 10, e.g., slice of luncheon sausage 8cm x 4cm x 1mm (remember to give length, width and depth!).
- **CIRCLES** – Round foods such as biscuits and muffins can be measured using the circles provided on page 11, e.g., one muffin 6cm circle x 7cm high (height estimated using the ruler).
- **BREAD** – Tell us the number and the size of the slices e.g., sandwich, medium, or toast slice.
- **FRUIT** – Tell us whether the piece of fruit is small, medium or large. Alternatively you could use the circles for round fruit such as mandarins.

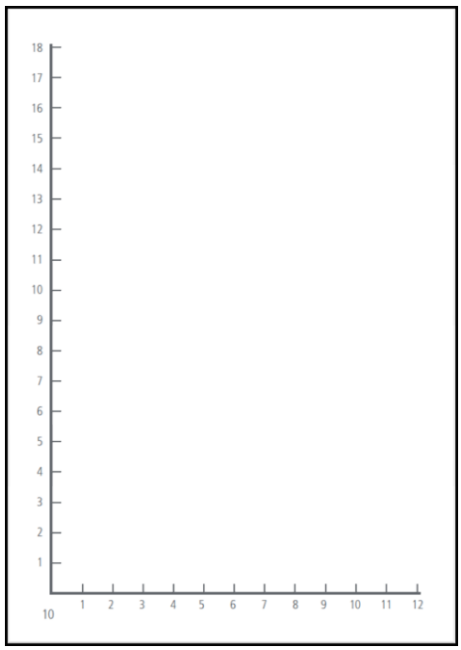
TAKEAWAY FOODS

Page 9 has photographs of commonly eaten takeaway foods. Please write down the weight from the photograph that best describes the amount of food your child was served and write it in the "Weight of food or drink" column. Your child might not have exactly the amount in the photos so feel free to tell us if she had "two x 40g pizza".

Remember: We are NOT looking for a "healthy" diet. We need to know what children actually eat and how they eat it.

8


Takeaway Foods Estimation Guide
Fries
45 g
70 g
23g
Chips
70 g
45 g
23g
Hawaiian Pizza
92 g
50 g
40 g
Battered Fish
97 g
9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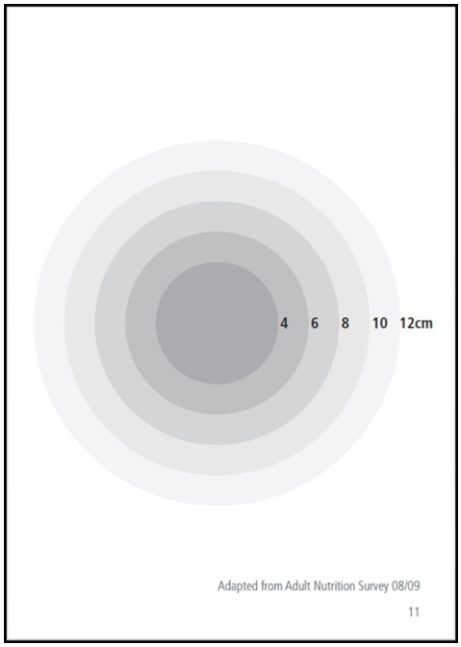
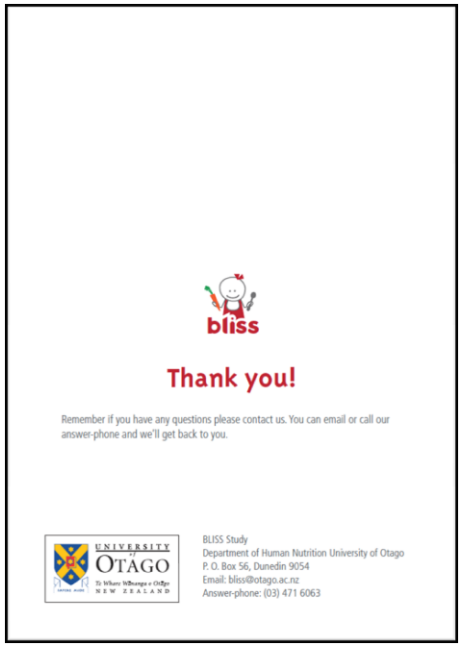

4 6 8 10 12cm
Adapted from Adult Nutrition Survey 08/09
11


bliss
Thank you!
Remember if you have any questions please contact us. You can email or call our answer-phone and we'll get back to you.
UNIVERSITY OF OTAGO
NEW ZEALAND
BLISS Study
Department of Human Nutrition University of Otago
P. O. Box 56, Dunedin 9054
Email: bliss@otago.ac.nz
Answer-phone: (03) 471 6063

Appendix K: BLISS WDR – 'Early childhood education'

Participant I.D: _____

BLISS Food Diary – Childcare

Name of staff member: _____ Date: _____

_____ is involved in a study looking at infant feeding practices. We would appreciate it if you could record a complete description of what s/he eats today while in your care, following the instructions below. Your help in completing this food record will contribute to determining the advantages and limitations of a baby-led approach to infant feeding.

We would like you to please:

- **Step 1 & 2:** Record what will be offered to the child today based on the menu or what has been put into their lunch box, and write the time of the day they are served these items. Please list each food or drink item individually (e.g., 'bread' 'cheese' instead of 'cheese on toast') and remember to include all water, breast milk and formula as well.
- **Step 3:** Tick the option that **best** describes the consistency of the food item (e.g., ***puréed*** to a smooth consistency, ***mashed*** to a lumpy consistency, ***diced*** into pieces that need to be eaten with a spoon, or served as a ***whole*** food). NB: Whole may include food that has been cut up into more manageable portion sizes such as sliced toast. Liquids, sauces and spreads are always served in their whole form.
- **Step 4:** Record an **estimate** of how much food and drink s/he has **EATEN**, rather than how much you offered. You can use household measures (e.g., cups or spoons), sizes of packets (e.g., 140g yoghurt pottle, 15g "Little Kids" bar).
- **Step 5:** Tick the option that best describes who put the food in his/her mouth. You can tick both options if it was a combined effort.
- **Step 6:** If any foods eaten are recipes made at the centre, please attach a copy of the recipe to this sheet, including the number of portions the recipe makes. Then in the "amount eaten" column, please record how many of these portions s/he ate e.g., ½ a portion or 2 portions.

Here's an example of how to fill out the food diary:

Step 1	Step 2			Step 3				Step 4	Step 5	
Time of day	Name	Brand	Cooking method	Consistency of food item				Amount eaten	Food/drink was put in child's mouth by:	
				Puréed	Mashed	Diced	Whole		Adult	Child
10 am	*Peaches, canned*	*Oak*				✓		*1/3 cup*	✓	
	Sugar-free fruit drink	*Raro*					✓	*¾ cup*		✓
12 noon	*Lasagne- See Recipe*						✓	*1 portion*		✓
	Potato		*boiled*		✓			*¼ cup*	✓	
	Frozen peas	*Watties*	*boiled*	✓				*10 peas*	✓	✓
1:30pm	*Fruit bar, Strawberry and Vanilla*	*Mother Earth*					✓	*1 bar (15g)*		✓

We know how busy ECE Centres can be - Thank you very much for filling out the information on these pages, we really appreciate your support of the parents' participation in this study.

If you would like to know more about the Baby-Led Introduction to SolidS study (BLISS), our website is: bliss.otago.ac.nz.
If you have any comments or questions, then please feel free to contact the study on (03) 471 6063 or bliss@otago.ac.nz.

Food Diary:

Step 1	Step 2			Step 3				Step 4	Step 5	
Time of day	Name	Brand	Cooking method	Consistency of food item				Amount eaten	Food/drink was put in child's mouth by:	
				Puréed	Mashed	Diced	Whole		Adult	Child

Thank you!

Appendix L: BLISS WDR 'Laminated example resource'

An example filled out by the parents of a 14 month old toddler

Step 1	Step 2			Step 3		Step 4				Step 5		Step 6	
Time of day	Name of food or drink	Brand of food or drink	Cooking method	Weight of plate/ mug	Weight of food/drink + plate/ mug	Consistency of food/drink item				Food/drink was put in child's mouth by:		Weight of leftover + plate or mug	Estimation of what is left on plate
						Puréed	Mashed	Diced	Whole	Parent	Child		
7:30am	Breastfeed 15 minutes								✓	✓	✓		
	1 slice white bread toast slice	Tip Top	toasted	115g	135g				✓		✓		almost all
	Butter, salted	Mainland			140g				✓		✓		"
	Marmite	Sanitarium			142g				✓		✓	127g	"
	Baby food, peach, apricot and semolina	Watties	microwaved	80g	200g	✓					✓	100g	
10am	Fruit cake				2 match boxes				✓		✓		
	Bobby banana				small			✓			✓		
	Water				2 sips				✓	✓			
	Breastfeed 10 minutes								✓	✓	✓		
12pm	Medium fries 45g (from Away from Home booklet pg 9)	McDonalds							✓		✓		1/8 leftover
	Small lemonade	McDonalds							✓		✓		1/3 leftover
3pm	Breastfeed 20 minutes								✓	✓	✓		
	Home-made mince (see recipe)			115g	145g				✓	✓		155g	one tsp
6pm	Potato		boiled		195g		✓			✓			1/2
	Butter				197g				✓	✓			
	Peas, frozen		boiled		211g	✓				✓			none
	Fruit juice = Orange and mango	Just Juice		42g	210g				✓		✓	44g	
	Ice cream = Vanilla	Tip Top		80g	140g				✓	✓		86g	
8pm	Infant formula = follow-on formula	Smiths		50g	250g				✓	✓		90g	
	Water	tap		90g	470g				✓	✓	✓	205g	

Write down every time your child has a breast or formula feed. For breast milk please write down the duration of the breastfeed. For formula please fill out all the columns.

Please write down if you have toast or sandwich slice bread.

If you don't have your scales with you please estimate the amount.

If you are having fruit and don't have your scales you can write down whether it is a small, medium or large piece of fruit.

If you are using a sippy cup or bottle remember to take the top off before you weigh the leftovers.

If your child drinks water out of a bottle, remember to weigh their full drink bottle when you fill it up and any leftovers before you refill it or empty it.

'Whole' can include foods that have been cut into smaller, more manageable portion sizes. E.g. Toast fingers, sliced peaches and carrot sticks.

'Diced' food has been chopped into small pieces, needing a spoon to eat it.

'Mashed' food has been mashed by hand to make a lumpy consistency.

Liquids, spreads and sauces are always served in their 'whole' form.

'Puréed' food has been blended together using a machine to make a smooth consistency.

Tick both 'parent' and 'child' for breast feeds.

Tick 'child' if you pre-load the spoon, but they put the spoon in their mouth.

Please weigh the total amount of food left over + weight of plate or mug.

'Parent' could be times when you are spoon feeding your child.

For liquids, if your child is holding the cup/bottle, tick 'child', If an adult is holding the cup/bottle, tick 'parent'.

Of the total amount that is left over please tell us how much there is of each food (for example, half the mince, half the potato, no peas).

D) How to fill out your End of Day Questionnaire

Table 1: Please answer **all steps** (Step 1 - 4).

Table 2: Please answer Part 1 **or** Part 2, depending on you child's food and drink intake today.

: If you answer Part 2, please fill in **all the steps** (Step 1 - 4).

Table 1

Step 1	Step 2	Step 3		Step 4				
Date	Day of week	Is this a typical eating day for your child?		Is your child unwell (for any reason)?		If unwell, did this influence your child's appetite?		
2 March 2013	Thursday	Yes	(No)	(Yes)	No	(No)	Yes - Decreased appetite	Yes - Increased appetite

Table 2

An example filled out by the parents of a 9 month old

How did your child's meals compare to the family meals today?

	Part 1			Part 2			
				Step 1	Step 2	Step 3	Step 4
	Did not have this meal today	Was with another adult at this meal time	Breast milk or formula only	Breast milk/ formula and food	Child ate meal with at least one other adult: (Both were eating but food may be different.) Yes or No	Meal Ingredients: Exactly the same or Almost the same or Similar or Different / Mostly different	Meal Preparation (Eg: texture of meal, length and method of cooking, size of food pieces): Exactly the same or Almost the same or Similar or Different / Mostly different
Breakfast				✓	✓	✓	✓
Lunch		✓					
Evening meal				✓	✓	✓	✓

If you tick a box in 'Part 1', you don't need to fill in 'Part 2', for that meal or snack.

Choose this option if your child has had nothing to eat or drink at this meal time.

A breastfeed or formula feed is counted as part of a meal if it is within 30 minutes of having food.

This could also be times where your child is eating with siblings, but not an adult.

'Similar' could be serving some of the same ingredients, but leaving out, or changing others.

'Almost the same' could be having the same main ingredients but leaving out some of the spices, or swapping rice for pasta.

'Almost the same' could be cooking vegetables a little longer, or cutting foods into finger sized pieces.

'Similar' could be giving your child mashed potato instead of roasted potato.

'Different' could be serving roast vegetables and chicken for the family meal, and puréed vegetables and chicken for your child.

Appendix M: WDR administration protocol

P51: Diet record instructions for participants in the BLISS study Protocol

Study: BLISS Study *Version number:* Version 3
Prepared by: *Liz Williams, Claire Schramm, ALH* *Date prepared:* 15 July 2013
Date amended: 22 Feb 2014

Purpose of visit for diet record administrator
Objective:
Visit each participant at 12 months from birth date (as close as possible ± 1 week OK) to give scales and BLISS 3 day WDR booklet and teach participants to use scales and fill out the diet record booklet.

Equipment required
Protocols: **Protocol for 12-month diet record visit**. (This protocol)
Paperwork:

- "Participant Information" page (downloaded from BLISS database):
- Name of baby's primary carer (usually but not always mother – if Dad then it should be indicated in the Notes)
- Phone number – landline
- Phone number – mobile
- Infant name
- Infant sex
- Notes on best time to contact etc

Equipment:

- Pen
- Food models
- Blank Weighed Food Diary page
- Blank End of Day Questionnaire
- Resources for participants
- BLISS food diary booklet
- Away from Home booklet
- Laminated example page
- Childcare food diary
- Scales and spare batteries

Steps - Before

1. Download and print Participant Information page from BLISS database. Look up website and click "participants" then "show all" then "enrolled".

[To find the Participant Information sheet you click into the participant then immediately click 'Exit' and 'OK' The next screen that pops up has 'Print reports' page where you can print off the mothers name and babies name and address and contact details.]

Record ID numbers on the Participant Information page. **RECORD PARTICIPANT ID NUMBER on food diary, away from home booklet and early childhood education food diary.**

DO NOT look at the following screens:
Eligibility/Recruitment
Events

The Participant Information page contains confidential participant details, and their study ID number, so must be kept very securely so no non-study people have access to it, and must be destroyed (by shredding) once it has been used.

2. (a) Find the correct pattern of diet recording days using the appropriate spreadsheet:
<3 Non-Consecutive Days C **7mos** ALH22Feb14>
<3 Non-Consecutive Days C **12mos** ALH22Feb14>
(b) Click on the tab for the day on which the weighed diet record is being handed out to the participant
(c) Find the next unused pattern for that handout day
(d) Record the participant ID, scales ID, and date of visit on the patterns spreadsheet beside that pattern
(e) Record the appropriate days and dates (one day each week) on the Food Diary.

NB: Visits should be made the week the baby turns 7 months (or 12 months) of age.

Steps – During

Introduce yourself
Convey thanks for taking the time to see us today
Remind them that we are not allowed to know which study group they and their baby are in.
Explain what is going to happen during **this** portion of the visit
Explain how to use the diet record resources (see 'Explanation of resources' below)
Show how to use the scales
Practise with food models
6 steps of food diary – show participant, do with participant, get participant to do alone.

Explanation of Resources

1. Introduction to the resources

- BLISS food diary booklet
- Laminated example page
- Away from home booklet
- Childcare food diary

2. Discuss what they will be need to complete each day

Use the checklist on the front of the BLISS food diary
Show them…

- Blank food diary
- Blank end of day questionnaire
- Supplements page
- Away from Home diary to record when out of the house
- Estimated Food Record to give to ECE Centre staff if child goes to daycare

3. Run through the BLISS food diary booklet - Short explanation

A) How to fill out your food diary (pg 2)

- Discuss steps 1-6

B) How to describe recipes (pg 4)

- Discuss steps 1-4

C) How to estimate amounts of food when you can't weigh them

- Discuss page 5
- Introduce Away from Home diary (supplementary resources) D) How to fill out your end of day questionnaire

- Table 1:

o Discuss 'typical day' etc
o What happens when child is at preschool (Estimated Food Record)

- Table 2: (Use thought bubbles as a guide)

o Discuss how to classify breastfeeds and food into meals and snacks
o Part 2, step 2: Emphasise that their child has to be eating solid food for it to count as 'parent and child eating together'
o Part 2, Step 3 and 4: Discuss options where meals can be 'exactly the same, almost the same, similar, mostly different'
o Part 2, Step 3 and 4: Discuss options where the ingredients and preparation can be different from each other (Use bubbles).

4. Provide a more in depth explanation of how to complete the Weighed Food Record using thought bubbles as discussion points (laminated example page)

Highlight key points (below).

Step 1	• "Remember that a day is 24 hours, so don't forget to include feeds that occur throughout the night" • "If you are recording water intake, you can either write down the total volume of water consumed throughout the day, or at each time it was offered to your child (eg, at meals)"
Step 2	• Remind participants to record food eaten during meal preparation and off other plates if possible, and tell them how to do this (eg,"4 mouthfuls of potato off mums plate"). Emphasise that you want the food record to be as realistic as possible therefore try to maintain normal eating patterns (eg: if child normally eats foods off mum's plate, let them). • Explain what level of detail is required in step 2 and why. Eg: "We need to be able to recreate exactly what your child has been eating over the three days. So provide me with enough detail so I could buy or prepare exactly the same food that your child is having'

Step 3	• Discuss that ideally weighing is best, but if you can't weigh it, then estimate (using resources in Away from Home diary or page 5) • Discuss running total using breakfast example • Tip: If meal times are a progression, simply have the scales and recording booklet at the table and weigh as you go
Step 4	• Clarify distinction between puréed, mashed, diced and whole, using examples.
Step 5	• Discuss different scenarios of 'parent' vs 'child' o Spoon-loading o Breastfeeding o Formula feeding (depends who is holding bottle)
Step 6	• Discuss expectations of weighing leftovers o Put animals outside o Pick up pieces off the floor and from seat of high chair o Try to collect all food from hands and tray of high chair.

ANY QUESTIONS???

Practical Demonstration

Scenario One: The researcher completes this scenario Explain what you are doing as you do it. Complete the Weighed Food Record and End of Day Questionnaire on blank pages provided

- Dinner: Family are eating together
- Baby has chicken tenderloin, puréed carrot and mashed potato
- Family has chicken tenderloin, roast carrot and roast potato
- After completing the table. Any questions? Does that make sense?

Scenario Two: Let the participant complete this by themselves (help if needed)

- Child is having an afternoon snack, no other adult is eating
- Child has an egg and cheese sandwich, and a few cookies
- Ask participant to complete the Weighed Food Record and End of Day Questionnaire by themselves.

Summary

- Any questions?
- Advise them to try and record at the time, rather than trying to complete the diary at a later stage.
- Ask them to try and keep food offered as normal as possible during recording days. Emphasise that you are not looking for a perfect diet.
- Suggest putting a few weighed snack items in the fridge, so that it can be given to their child as soon as they hungry, rather than them having to wait until they are weighed
- Show them the instructions for scales resource on pages 28-29 if they run into any difficulty
- Advise them to read all of the information once they get home, as there are things on there that have not been talked about in the session.
- Instruct them to refer to the instruction pages if things do not make sense. If they are still unclear, contact the study.
- Explain where they can get help if needed (details on back of booklet)
- Explain that they can write comments on back page if needed (pg 30)

Explain spot prize draws for completed 3-day WDR
Thank participant & tell then we will be in **contact TOMORROW to see how it is going and collect the 7 month breastfeeding and solids questionnaire**
Tell them we will see them in 1 month to collect food diary and scales

Steps – After

Record the date in the BLISS database.

Appendix N: 12-month Food Preference Questionnaire

12 month Food Questionnaire

These questions are about your baby's food preferences since they started eating solids. Please read the question and answer the first part of the question (eg. 1a) before moving onto the second part (eg. 1b).

The questionnaire asks about 21 different foods.

1a Have you or anyone else ever offered your child **banana**?

- ○ No, never offered (skip to next question)
- ○ 1-3 times
- ○ 4-6 times
- ○ 7-10 times
- ○ 11 or more times
- ○ Don't know

1b When your child is offered **banana**, do they eat it?

- ○ Yes, they always eat it
- ○ Yes, they sometimes eat it
- ○ Yes, but they rarely eat it
- ○ No, they reject it after tasting it
- ○ No, they refuse to taste it

2a Have you or anyone else ever offered your child **sweet biscuits** (afghans, fruit-fingers, gingernut, chocolate-chip etc.)?

- ○ No, never offered (skip to next question)
- ○ 1-3 times
- ○ 4-6 times
- ○ 7-10 times
- ○ 11 or more times
- ○ Don't know

2b When your child is offered **sweet biscuits** (afghans, fruit-fingers, gingernut, chocolate-chip, malt etc.), do they eat them?

- ○ Yes, they always eat it
- ○ Yes, they sometimes eat it
- ○ Yes, but they rarely eat it
- ○ No, they reject it after tasting it
- ○ No, they refuse to taste it

3a Have you or anyone else ever offered your child **flavoured sweetened yoghurt?**

- ○ No, never offered(skip to next question)
- ○ 1-3 times
- ○ 4-6 times
- ○ 7-10 times
- ○ 11 or more times
- ○ Don't know

3b When your child is offered **flavoured sweetened yoghurt**, do they eat it?

- ○ Yes, they always eat it
- ○ Yes, they sometimes eat it
- ○ Yes, but they rarely eat it
- ○ No, they reject it after tasting it
- ○ No, they refuse to taste it

4a Have you or anyone else ever offered your child **breakfast cereal** (only count weet-bix, cornflakes, porridge and rice-bubbles if sugar has been added)**?**

- ○ No, never offered(skip to next question)
- ○ 1-3 times
- ○ 4-6 times
- ○ 7-10 times
- ○ 11 or more times
- ○ Don't know

4b When your child is offered **breakfast cereal** (only count weet-bix, cornflakes, porridge and rice-bubbles if sugar has been added), do they eat it?

- ○ Yes, they always eat it
- ○ Yes, they sometimes eat it
- ○ Yes, but they rarely eat it
- ○ No, they reject it after tasting it
- ○ No, they refuse to taste it

5a Have you or anyone else ever offered your child **raisins?**

- ○ No, never offered(skip to next question)
- ○ 1-3 times
- ○ 4-6 times
- ○ 7-10 times
- ○ 11 or more times
- ○ Don't know

5b When your child is offered **raisins**, do they eat them?

- ○ Yes, they always eat it
- ○ Yes, they sometimes eat it
- ○ Yes, but they rarely eat it
- ○ No, they reject it after tasting it
- ○ No, they refuse to taste it

6a Have you or anyone else ever offered your child **broccoli?**

- ○ No, never offered(skip to next question)
- ○ 1-3 times
- ○ 4-6 times
- ○ 7-10 times
- ○ 11 or more times
- ○ Don't know

6b When your child is offered **broccoli**, do they eat it?

- ○ Yes, they always eat it
- ○ Yes, they sometimes eat it
- ○ Yes, but they rarely eat it
- ○ No, they reject it after tasting it
- ○ No, they refuse to taste it

7a Have you or anyone else ever offered your child **spinach?**

- ○ No, never offered(skip to next question)
- ○ 1-3 times
- ○ 4-6 times
- ○ 7-10 times
- ○ 11 or more times
- ○ Don't know

7b When your child is offered **spinach**, do they eat it?

- ○ Yes, they always eat it
- ○ Yes, they sometimes eat it
- ○ Yes, but they rarely eat it
- ○ No, they reject it after tasting it
- ○ No, they refuse to taste it

8a Have you or anyone else ever offered your child **cauliflower?**

- ○ No, never offered(skip to next question)
- ○ 1-3 times
- ○ 4-6 times
- ○ 7-10 times
- ○ 11 or more times
- ○ Don't know

8b When your child is offered **cauliflower**, do they eat it?

- ○ Yes, they always eat it
- ○ Yes, they sometimes eat it
- ○ Yes, but they rarely eat it
- ○ No, they reject it after tasting it
- ○ No, they refuse to taste it

9a Have you or anyone else ever offered your child **cabbage?**

- ○ No, never offered(skip to next question)
- ○ 1-3 times
- ○ 4-6 times
- ○ 7-10 times
- ○ 11 or more times
- ○ Don't know

9b When your child is offered **cabbage**, do they eat it?

- ○ Yes, they always eat it
- ○ Yes, they sometimes eat it
- ○ Yes, but they rarely eat it
- ○ No, they reject it after tasting it
- ○ No, they refuse to taste it

10a Have you or anyone else ever offered your child **olives?**

- ○ No, never offered(skip to next question)
- ○ 1-3 times
- ○ 4-6 times
- ○ 7-10 times
- ○ 11 or more times
- ○ Don't know

10b When your child is offered **olives**, do they eat it?

- ○ Yes, they always eat it
- ○ Yes, they sometimes eat it
- ○ Yes, but they rarely eat it
- ○ No, they reject it after tasting it
- ○ No, they refuse to taste it

11a Have you or anyone else ever offered your child **egg?**

- ○ No, never offered(skip to next question)
- ○ 1-3 times
- ○ 4-6 times
- ○ 7-10 times
- ○ 11 or more times
- ○ Don't know

11b When your child is offered **egg**, do they eat it?

- ○ Yes, they always eat it
- ○ Yes, they sometimes eat it
- ○ Yes, but they rarely eat it
- ○ No, they reject it after tasting it
- ○ No, they refuse to taste it

12a Have you or anyone else ever offered your child **mince (beef, lamb, pork etc.)?**

- ○ No, never offered(skip to next question)
- ○ 1-3 times
- ○ 4-6 times
- ○ 7-10 times
- ○ 11 or more times
- ○ Don't know

12b When your child is offered **mince (beef, lamb, pork etc.)**, do they eat it?

- ○ Yes, they always eat it
- ○ Yes, they sometimes eat it
- ○ Yes, but they rarely eat it
- ○ No, they reject it after tasting it
- ○ No, they refuse to taste it

13a Have you or anyone else ever offered your child **luncheon sausage or belgium?**

- ○ No, never offered(skip to next question)
- ○ 1-3 times
- ○ 4-6 times
- ○ 7-10 times
- ○ 11 or more times
- ○ Don't know

13b When your child is offered **luncheon sausage or belgium**, do they eat it?

- ○ Yes, they always eat it
- ○ Yes, they sometimes eat it
- ○ Yes, but they rarely eat it
- ○ No, they reject it after tasting it
- ○ No, they refuse to taste it

14a Have you or anyone else ever offered your child **cooked meat (any meat or chicken, except mince and luncheon sausage)?**

- ○ No, never offered(skip to next question)
- ○ 1-3 times
- ○ 4-6 times
- ○ 7-10 times
- ○ 11 or more times
- ○ Don't know

14b When your child is offered **cooked meat (any meat or chicken, except mince and luncheon sausage)**, do they eat it?

- ○ Yes, they always eat it
- ○ Yes, they sometimes eat it
- ○ Yes, but they rarely eat it
- ○ No, they reject it after tasting it
- ○ No, they refuse to taste it

15a Have you or anyone else ever offered your child **tomato (cooked, canned, puréed or raw, exclude tomato sauce)?**

- ○ No, never offered(skip to next question)
- ○ 1-3 times
- ○ 4-6 times
- ○ 7-10 times
- ○ 11 or more times
- ○ Don't know

15b When your child is offered **tomato (cooked, canned, puréed or raw, exclude tomato sauce)**, do they eat it?

- ○ Yes, they always eat it
- ○ Yes, they sometimes eat it
- ○ Yes, but they rarely eat it
- ○ No, they reject it after tasting it
- ○ No, they refuse to taste it

16a Have you or anyone else ever offered your child **baked beans?**

- ○ No, never offered(skip to next question)
- ○ 1-3 times
- ○ 4-6 times
- ○ 7-10 times
- ○ 11 or more times
- ○ Don't know

16b When your child is offered **baked beans**, do they eat them?

- ○ Yes, they always eat it
- ○ Yes, they sometimes eat it
- ○ Yes, but they rarely eat it
- ○ No, they reject it after tasting it
- ○ No, they refuse to taste it

17a Have you or anyone else ever offered your child **hot potato chips/wedges (takeaway or home cooked)?**

- ○ No, never offered(skip to next question)
- ○ 1-3 times
- ○ 4-6 times
- ○ 7-10 times
- ○ 11 or more times
- ○ Don't know

17b When your child is offered **hot potato chips/wedges (takeaway or home cooked)**, do they eat them?

- ○ Yes, they always eat it
- ○ Yes, they sometimes eat it
- ○ Yes, but they rarely eat it
- ○ No, they reject it after tasting it
- ○ No, they refuse to taste it

18a Have you or anyone else ever offered your child **Marmite or Vegemite?**

- ○ No, never offered(skip to next question)
- ○ 1-3 times
- ○ 4-6 times
- ○ 7-10 times
- ○ 11 or more times
- ○ Don't know

18b When your child is offered **Marmite or Vegemite**, do they eat it?

- ○ Yes, they always eat it
- ○ Yes, they sometimes eat it
- ○ Yes, but they rarely eat it
- ○ No, they reject it after tasting it
- ○ No, they refuse to taste it

19a Have you or anyone else ever offered your child **crunchy peanut butter?**

- ○ No, never offered(skip to next question)
- ○ 1-3 times
- ○ 4-6 times
- ○ 7-10 times
- ○ 11 or more times
- ○ Don't know

19b When your child is offered **crunchy peanut butter**, do they eat it?

- ○ Yes, they always eat it
- ○ Yes, they sometimes eat it
- ○ Yes, but they rarely eat it
- ○ No, they reject it after tasting it
- ○ No, they refuse to taste it

20a Have you or anyone else ever offered your child **cheese?**

- ○ No, never offered (skip to next question)
- ○ 1-3 times
- ○ 4-6 times
- ○ 7-10 times
- ○ 11 or more times
- ○ Don't know

20b When your child is offered **cheese**, do they eat it?

- ○ Yes, they always eat it
- ○ Yes, they sometimes eat it
- ○ Yes, but they rarely eat it
- ○ No, they reject it after tasting it
- ○ No, they refuse to taste it

21a Have you or anyone else ever offered your child **sausage?**

- ○ No, never offered(skip to next question)
- ○ 1-3 times
- ○ 4-6 times
- ○ 7-10 times
- ○ 11 or more times
- ○ Don't know

21b When your child is offered **sausage**, do they eat it?

- ○ Yes, they always eat it
- ○ Yes, they sometimes eat it
- ○ Yes, but they rarely eat it
- ○ No, they reject it after tasting it
- ○ No, they refuse to taste it

Thank you for completing this questionnaire

Appendix O: WDR calculation sheet

BLISS participant ID: _____ **Diet record day #: _____**

Food item	Weight of plate	Weight of food + plate	Weight of leftover + plate	Total weight of food offered	**Weight of individual food item OFFERED**	Total weight of leftover foods	Total weight of foods eaten	Factor to multiply individual food items	**Weight of food item CONSUMED**
	A	**B**	**C**	**D** = (B total) - A	**E1** = B – A **E2**= B – (B of food above)	**F** = C - A	**G** = D - F	**H** = G/D	**I** = H*E

Appendix P: Food preference taste and texture validation questionnaire

We would like to find what tastes and textures people think best represent each food <u>as it's presented to your child.</u>

For each food on the list please circle the ONE Taste and ONE Texture that applies.

TASTE	TEXTURE
Banana	
Sweet Savoury Bitter Salty	Smooth Lumpy Chewy Crunchy
Sweet biscuits (Afgans, chocolate chip – not wine or malt)	
Sweet Savoury Bitter Salty	Smooth Lumpy Chewy Crunchy
Flavoured yoghurt	
Sweet Savoury Bitter Salty	Smooth Lumpy Chewy Crunchy
Breakfast cereal (not weetbix, cornflakes, porridge, ricebubbles)	
Sweet Savoury Bitter Salty	Smooth Lumpy Chewy Crunchy
Raisins	
Sweet Savoury Bitter Salty	Smooth Lumpy Chewy Crunchy
Olives	
Sweet Savoury Bitter Salty	Smooth Lumpy Chewy Crunchy
Broccoli	
Sweet Savoury Bitter Salty	Smooth Lumpy Chewy Crunchy
Cauliflower	
Sweet Savoury Bitter Salty	Smooth Lumpy Chewy Crunchy

TASTE	TEXTURE
Cabbage	
Sweet Savoury Bitter Salty	Smooth Lumpy Chewy Crunchy
Spinach	
Sweet Savoury Bitter Salty	Smooth Lumpy Chewy Crunchy
Tomato (cooked or uncooked)	
Sweet Savoury Bitter Salty	Smooth Lumpy Chewy Crunchy
Egg	
Sweet Savoury Bitter Salty	Smooth Lumpy Chewy Crunchy
Luncheon sausage	
Sweet Savoury Bitter Salty	Smooth Lumpy Chewy Crunchy
Baked beans	
Sweet Savoury Bitter Salty	Smooth Lumpy Chewy Crunchy
Mince	
Sweet Savoury Bitter Salty	Smooth Lumpy Chewy Crunchy
Cooked meat (chicken, beef, pork – not mince or sausages)	
Sweet Savoury Bitter Salty	Smooth Lumpy Chewy Crunchy
Marmite/Vegemite	
Sweet Savoury Bitter Salty	Smooth Lumpy Chewy Crunchy
Crunchy Peanutbutter	
Sweet Savoury Bitter Salty	Smooth Lumpy Chewy Crunchy

TASTE	TEXTURE
Cheese	
Sweet Savoury Bitter Salty	Smooth Lumpy Chewy Crunchy
Sausage	
Sweet Savoury Bitter Salty	Smooth Lumpy Chewy Crunchy
Hot potato chips (homecooked or takeway)	
Sweet Savoury Bitter Salty	Smooth Lumpy Chewy Crunchy

Appendix Q: BLISS diet record Kai-culator data entry

Protocol for 7-month BLISS diet record Kai-culator data entry

Study: BLISS Study *Version number:* Version 3
Prepared by: Liz Williams Date prepared: 17 August 14

Purpose of diet record entry data protocol

Objective:
To ensure accurate and consistent entry of BLISS diet record data.

Equipment required

Protocols: **Protocol for 7-month BLISS diet record Kai-culator data entry**. (This protocol)

Documents:

- "BLISS CODEbook" excel file (access via BLISS google docs)
- "New foods and substitutions request" excel file (access via BLISS google docs)
- "BLISS diet record eating occasions definitions" (download from BLISS dropbox)
- "BLISS diet record calculations examples" (download from BLISS dropbox)
- "BLISS_7month-3DDR data entry tracking" (download from BLISS dropbox)
- BLISS 3 day diet record
- Away from home booklet (if used by participant)
- Early childhood education food diary (if used by participant)
- Diet record instructions (written and tested by Claire Schramm)

Equipment:

- Coloured pens
- Calculator
- **"BLISS diet record calculations"** (download from BLISS dropbox and print to staple into diet record)
- **"BLISS diet record RECIPE calculations"** (download from BLISS dropbox and print to staple into diet record if required)

ALL notes/marks added to the original diet record MUST be in a different pen colour (e.g. PINK) and the name of the person who made the notes and the date they were made MUST be recorded on the front of the diet record with the colour of the pen (or a scribbled sample of the colour)

Steps – First pass

Calculate the weight of each food item OFFERED and CONSUMED by the infant using the "BLISS diet record calculations":

- **Step 3** of the BLISS diet record (Weight of plate) AND (Weight of food + plate)

- **Step 6** of the BLISS diet record (Weight of leftover + plate) OR/AND (Estimation of what is left on plate)

NOTE:
'COMBINED foods' are food items that were weighed progressively as a group **(mark each group with brackets on the left hand side of the calculations page and on the original diet record)**

'INDIVIDUAL foods' are foods that were weighed on their own

Enter all values provided on the diet record onto the calculations page.
If a plate/cup/bottle was used enter "Weight of plate", "Weight of food + plate" and "Weight of leftover + plate" into **"BLISS diet record calculations"** columns **A**, **B** and **C** from the diet record**.**

If no plate/cup etc was used the weight from **STEP 3** (Weight of food + plate) can be entered directly into column **D** of the calculations page and the "Weight of leftover + plate" into column **F** (when no "Weight of plate" is provided the "Weight of leftover + plate" is assumed to equal the "weight of leftover foods").

If there were no leftovers (assumed if no "Weight of leftover + plate" or "Estimation of what is left on plate" is provided) enter 0 into column **F**.

When there is no weight for a food in the diet record, the weight has to be estimated.

When estimated quantities have been provided (i.e. household measures like a 1 cup or 1 TBsp or size measures like a medium apple or one piece of toast) the **"Food weight estimation DEFAULTS"** sheet from the **"BLISS CODEbook"** contains weights extracted from Kai-culator to be used to estimate the weight of food offered.

Foods that have no measures to guide estimation are (where possible) estimated using quantities of the food reported to be consumed by the infant on other occasions OR (as a last resort) by other infants of the same age in other diet records.

When a weight estimation for a food is not available in the **"Food weight estimation DEFAULTS"** sheet it should be added to the "**New foods and substitutions request**" document. Once an estimation quantity has been chosen (i.e. 2 grams of margarine on 1 piece of toast) it is entered into the **"Food weight estimation DEFAULTS"** sheet in the **"BLISS CODEbook"** google doc to ensure consistent use across all BLISS diet record diet record projects.

When a single overall weight has been given for COMBINED foods (i.e. toast with margarine and marmite) the weights for the individual food items are estimated using weights from the **"Food weight estimation DEFAULTS"** sheet.

Calculate the "Total weight of food offered" (not needed when no plate was used as this will be entered directly from the diet record):

For INDIVIDUAL foods:
B (Total weight of food + plate) – A (Weight of plate)
= **D (Total weight of food offered)**

For COMBINIED foods:
B (Total weight of food + plate) OF THE LAST FOOD ADDED – A (Weight of plate)
= **D (Total weight of ALL foods offered)**

When baby food was eaten directly from a pouch, jar or can/tin the weight of the pouch, jar or can/tin must be estimated in order to calculate the weight of the baby food OFFERED. Baby food pouch, jar and can weights can be found in the **"Food weight estimation DEFAULTS"** sheet from the **"BLISS CODEbook".**
Calculate the "Weight of individual food items offered" (for COMBINED foods only):

If there is a "Weight of plate" supplied:
B1 (Weight of (first) food + plate) – A (Weight of plate)
= E1(weight of (first) individual food item offered)

B2 (Weight of (second) food + plate) – B1 (Weight of (first) food + plate)
= E2 (weight of (second) individual food item offered)
etc.……

If there is NO "Weight of plate" supplied (i.e. the weights provided were for food only):
B1 (Weight of (first) food + plate)
= E1 (Total weight of (first) food offered)

B2 (Weight of (second) food + plate) - B1 (Weight of food + plate)
= E2 (Total weight of (second) food offered)
etc…..

Calculate the "Total weight of leftover foods" (when no plate was used this is entered directly from the diet record):

C (Weight of leftover + plate) - A (Weight of plate)
= F (Total weight of leftover foods)
If there is no (Weight of leftover + plate) supplied:
- Use (Estimation of what is left on plate) in order to calculate the (Weight of leftover food)

If a proportion was supplied (i.e. ¼) use it to calculate the proportion of the food item CONSUMED:
1 – (Proportion of food leftover) = (Proportion of the food item CONSUMED)
(Proportion of the food item CONSUMED) * (Weight of food OFFERED)
= (**Weight of food item CONSUMED**)

If there is no (Weight of leftover + plate) OR (Estimation of what is left on plate) supplied:
It is assumed that (**Weight of food item OFFERED**) = (**Weight of food item CONSUMED**)

When a rough approximation has been given for the left overs it can be converted to an estimation of the amount of the food item left over as below
"a little bit" OR " a tiny bit" = 25%
"Some" = 50%
"Most" = 75%
"Almost all" = 90%

Calculate the "Total weight of foods eaten"

If there is a "Weight of leftover + plate" supplied:
D (Total weight of food offered) – F (Total weight of leftover foods)
= G (Total weight of foods eaten)

If there is NO "weight of leftover + plate" supplied:
D (Total weight of food offered)

= G (Total weight of foods eaten)

Calculate the "Factor to multiply individual food items" (for COMBINED foods only):
G (Total weight of foods eaten) ÷ D (Total weight of food offered)
= H (Factor to multiply individual food items)

When different proportions of combined food components are left over (e.g. chicken ½, potato 1/3, carrot ¼) use the estimated left over proportions to guide calculation of leftover weights

(BUT often the estimated leftover proportions overestimate how much of the food components have been consumed in comparison to the total leftover weight)

Calculate the "Weight of food item CONSUMED":

For INDIVIDUAL foods:
G (Total weight of foods eaten) = **I (Weight of food item CONSUMED)**
For COMBINIED foods:
H (Factor to multiply individual food items) x E1 (weight of (first) individual food item offered)
= **I (Weight of (first) food item CONSUMED)**

H (Factor to multiply individual food items) x E2 (weight of (second) individual food item offered)
= **I (Weight of (second) food item CONSUMED)** etc…

Repeat for all foods from DAY 1 of the diet record.
- Mark the end of the day with a line after the last food
- Under the 'end of day line' report the:

Total number of breastfeeds for infants fed breast milk (remember that feeds with 30 minutes or less between them count as a single feed)
Total weight of formula consumed for infants fed infant formula
Calculate the weight of breast milk consumed per feed using

((750g – (weight of formula consumed if any)/number of breastfeeds)

If more than one calculations page is used per diet record day note the page number and total pages at the top of each page (e.g. page 1 of 2, page 2 of 2)

Staple calculation pages into the original diet record

Recipes

(Mark the food items which are recipes on the diet record calculations sheet for each day for ease of entry)

IF:

All recipe ingredients were weighed and uncooked weights were provided for all ingredients AND a 'proportion of recipe offered to you child' was recorded AND the weight of the recipe offered to the child was recorded.
If weights have been provided for all recipe ingredients then nothing furthur is required in preparation for entry into Kai-culator.

IF:
Some/all recipe ingredients were NOT weighed and estimated amounts were provided for all/some ingredients AND a 'proportion of recipe offered to you child' was recorded AND the weight of the recipe offered to the child was recorded.
When weights have not been provided for some or all ingerdients in a recipe, the weight for those ingredients has to be estimated using estimation rules in the "BLISS CODEbook" from the 'Food weight estimation RULES' sheet and the 'Food weight estimation DEFAULT' sheet.

If needed a recipe calculations page can be used to record the estimated weight of each ingredient.
The weight of the recipe offered (from the diet record day calculation page) and the 'proportion of recipe offered to you child' (from the recipe page e.g. 1/5th) can be used to caculate the approximate weight of the complete cooked recipe

weight of the recipe offered * proportion of recipe offered to child = Approx total cooked weight

IF:
Some/all recipe ingredients were NOT weighed and estimated amounts were provided for all/some ingredients AND a 'proportion of recipe offered to you child' was NOT recorded AND the weight of the recipe offered to the child was recorded.
When weights have not been provided for some or all ingerdients in a recipe, the weight for those ingredients has to be estimated using estimation rules in the "BLISS CODEbook" from the 'Food weight estimation RULES' sheet and the 'Food weight estimation DEFAULT' sheet.
If needed a recipe calculations page can be used to record the estimated weight of each ingredient.

IF:
Some/all recipe ingredients were NOT weighed and estimated amount were provided for all/some ingredients AND a "proportion of recipe offered to your child" was recorded AND the weight of the recipe offered to the child was NOT recorded.
When weights have not been provided for some or all ingerdients in a recipe, the weight for those ingredients has to be estimated using estimation rules in the "BLISS CODEbook" from the 'Food weight estimation RULES' sheet and the 'Food weight estimation DEFAULT' sheet.
A recipe calculations page should be used to record the estimated weight of each ingredient.
Use the "proportion of recipe offered to your child" and the calculated total cooked weight of the receipt from Kai-culator to estimate the weight of the recipe offered to the baby in the diet record day.

Repeat for days 2 and 3 of the diet record

Update the **"BLISS_7month-3DDR data entry tracking"** document (in dropbox) by recording that the calculations have been done with the name and date of research team member who completed them.

Steps – Second pass

Enter participant RECIPES from Days 1, 2 and 3 into Kai-culator

Open Kai-culator dietary assessment software
Open "BLISS study 2014 7 months" project
Under "Composition Data" on the side bar select "Recipes"
Add a new recipe using the + button at the bottom of the screen

Name the recipe using the participant ID followed by the name of the recipe (e.g. BL0623CM - homemade fruit)

Enter ingredients and amounts from the recipes page and recipe calculation page
Choose an appropriate "moisture retention" value for the whole recipe using moisture retention factors used in similar Adult Nutrition Survey recipes in the Kai-culator database. If there are no similar recipes in the Kai-culator database use the USDA Moisture Retention Factors that can be found in the Kai-culator "Main menu" under "Composition data" in "Moisture factors".

Enter the cooking method, time cooked for and temperature at the top of the recipe ingredients list.

Assign a retention definition to each individual ingredient in the recipe by clicking on the rightmost section of the ingredients entry in the recipe screen and choosing the most appropriate option from the menu. Fat's and sugar do not require retention factors and so can be left as "not applicable ()".

Once the recipe is complete use the calculate button to calculate the nutrient values per 100g for the final recipe.

Save and exit the "recipe database"

Go to the "food items" list and search for the newly entered recipe, click to select the recipe and use the "paste new item" button and "supress old recipe" option to convert the HN recipe to a ZZ recipe ready to be used when entering a diet record.

Enter participant DIET RECORD DAYS 1, 2 and 3

NOTE:

A "**substitution**" for a food item is when there is NO food item in Kai-culator that is closely related to the diary food item (e.g. chicken bacon would have to be substituted with pork bacon etc)

A "**default**" for a food item is when there is a food item in Kai-culator that is closely related to the diary food item (e.g. Pams white bread and Bread,white,sliced,prepacked or)

Open Kai-culator dietary assessment software
Open "BLISS study 2014 7 months" project
Open Records
Add a new record
"Record ID" = BLISS study participant ID - **(Make sure to double check this step as this cannot be changed!!)**
"Day No" = 1, 2, or 3
"Record date" = date that Day 1 was recorded on

Using the definitions in the "BLISS diet record eating occasions definitions" document, mark the breakfast meal (BF), lunch (L) and evening meal (EM) onto the diet record.
Enter all food items into the "Diary item" quick list, in the order that they were consumed, with the appropriate feeding occasion (refer to "**BLISS diet record eating occasions definitions**" document to determine which eating occasion should be used for each food item – NOTE: the eating occasion can be changed later if required)

Match each food item to the best food code from the Kai-culator database

If complete food item information has been supplied (Brand, flavour etc)
Match by brand and flavour/type (i.e light, reduced fat etc) to a food code in Kai-culator
If there is no exact match refer to **"BLISS CODEbook"** document to check for established

DEFAULT
rules for the food item
If there is a match in the **"BLISS CODEbook"** document use the DEFAULT food code.
Update the **"BLISS CODEbook"** document substitution entry with:
Count of times the DEFAULT has been used
BLISS study participant ID for future reference
If there is no established DEFAULT rule, enter the food item with all possible details into the **"New foods and substitutions request"** document

If the food item information supplied is incomplete
Establish **WHICH** food item data is missing (i.e. Brand missing but flavour/type supplied (e.g. edam cheese) OR Brand and flavour supplied but no type – fresh and fruity berry yogurt (? Full fat/light/etc)

Refer to **"BLISS CODEbook"** document to check for established DEFAULT rules for the food item

If there is no DEFAULT rule for the food item enter the food item with all details into the **"New foods and substitutions request"** document

If there is no food NO food item in Kai-culator that is closely related to the diary food item (e.g. chicken bacon would have to be substituted with pork bacon etc) a SUBSTITUTION will have to be established

When a SUBSTITUTION is used it has to be marked in Kai-culator by ticking in the 7th column on the diet record day.

Check "**New foods and substitutions request**" for infant foods and infant formulas that are not present in Kai-culator.

For foods that have already been requested, update the request count and add the BLISS participant ID.

For foods that have not been requested - add a new food request line to the "**New foods and substitutions request**" document

Recipes
Use the participant ID to search for previously entered recipes

COMBINED foods
Foods that are eaten as one item (e.g. toast with margarine and jam or cereal with milk) should be linked together in the "food diary reconciliation" page.

Click on the food diary number in column 1 of the second food of the group of linked foods (e.g. margarine) and select the first food (toast) from the drop down list.

Enter the (Weight/Amount of food item consumed) in the amount column using appropriate units (grams or mL)

Click on the final column of the "food diary reconciliation" page to enter the BLISS supplementary options

Who fed the child:
Breastfeeds require co-operation between the mother and infant: child + adult

Texture of the food:
"Naturally smooth" (foods that have to have to have a smooth texture to be themselves):
- yoghurt, humus, custard, butter, margarine, marmite, vegemite, jam, peanut butter, cream cheese etc

"Liquid"
- breast milk, infant formula, milk, water, oil etc

Amount offered in grams: (from column D or E of the diet record calculation page)
When amounts in the diet record were in mL (e.g. formula or expressed BM) they can be converted to grams by multiplying the amount in mL by the density (g/mL). (Found in the "Measure definitions" under food items)
Save and exit record (begin new record for each day of the food diary)

Steps - After

Update the "**Participant diet record data entry tracking**" file

Appendix R: Food exposure and preference scores for individual foods according to study group

Food category	All n= 105	Control Group n= 46	BLISS Group n= 59	P-value [1]
Exposure [2]				
Banana	3.8 (0.63)	3.8 (0.64)	3.8 (0.62)	0.574
Sweet biscuits[4]	1.9 (1.49)	2.0 (1.52)	1.9 (1.47)	0.645
Flavoured yoghurt	2.7 (1.60)	2.6 (1.65)	2.7 (1.55)	0.614
Breakfast cereal [5]	1.2 (1.71)	1.4 (1.76)	1.0 (1.67)	0.269
Raisins	1.6 (1.62)	1.7 (1.62)	1.5 (1.62)	0.523
Olives	0.4 (0.82)	0.6 (1.02)	0.3 (0.60)	0.162
Broccoli	3.5 (1.07)	3.2 (1.40)	3.8 (0.59)	0.002
Cauliflower	2.4 (1.54)	2.2 (1.60)	2.5 (1.50)	0.298
Cabbage	1.2 (1.43)	1.0(1.39)	1.4 (1.44)	0.143
Spinach	1.8 (1.62)	1.8 (1.69)	1.9 (1.58)	0.758
Tomato [6]	3.0 (1.61)	2.9 (1.61	3.1 (1.39)	0.466
Egg	3.1 (1.28)	2.8 (1.4)	3.3 (1.15)	0.089
Luncheon sausage	1.4 (1.56)	1.4 (1.47)	1.4 (1.64)	0.909
Baked beans	1.8 (1.52)	1.4 (1.39)	2.1 (1.55)	0.014
Mince	3.6 (0.90)	3.5 (1.09)	3.7 (0.75)	0.126
Cooked meat [7]	3.7 (0.80)	3.6 (0.93)	3.8 (0.67)	0.221
Marmite/Vegemite	3.3 (1.23)	3.6 (0.97)	3.1 (1.37)	0.034
Crunchy peanut-butter	1.1 (1.60)	1.1 (1.53)	1.2 (1.67)	0.663
Cheese	3.6 (0.90)	3.7 (0.87)	3.6 (0.93)	0.814
Sausage	2.4 (1.46)	2.3 (1.42)	2.5 (1.50)	0.454
Hot potato chips [8]	2.7 (1.33)	2.7 (1.22)	2.6 (1.42)	0.781

Food category	All n= 105		Control Group n= 46		BLISS Group n= 59		P-value [1]
Consumed [3]		n=105		n=46		n=59	
Banana	4.4 (0.78)	105	4.3 (1.02)	46	4.5 (0.54)	59	0.300
Sweet biscuits [4]	4.7 (0.52)	82	4.7 (0.45)	36	4.7 (0.57)	46	0.547
Flavoured yoghurt	4.7 (0.47)	89	4.7 (0.50)	38	4.7 (0.45)	51	0.911
Breakfast cereal [5]	4.4 (0.81)	39	4.4 (0.87)	21	4.3 (0.76)	18	0.721
Raisins	4.3 (0.96)	63	4.1 (1.14)	30	4.5 (0.71)	33	0.064
Olives	3.9 (1.09)	31	4.0 (1.04)	14	3.8 (1.17)	17	0.771
Broccoli	4.4 (0.76)	101	4.2 (0.87)	42	4.5 (0.65)	59	0.062
Cauliflower	4.1 (1.00)	87	4.1 (0.87)	36	4.1 (1.09)	51	0.876
Cabbage	4.1 (0.74)	55	4.1 (0.72)	20	4.1 (0.76)	35	0.946
Spinach	4.3 (0.74)	70	4.4 (0.78)	29	4.3 (0.72)	41	0.732
Tomato [6]	4.5 (0.69)	91	4.5 (0.61)	37	4.4 (0.74)	54	0.368
Egg	4.4 (0.76)	97	4.3 (0.90)	41	4.4 (0.65)	56	0.367
Luncheon sausage	4.4 (1.07)	60	4.4 (1.07)	30	4.3 (1.09)	30	0.812
Baked beans	4.3 (1.00)	79	4.2 (1.13)	32	4.4 (0.90)	47	0.367
Mince	4.7 (0.55)	104	4.7 (0.60)	45	4.7 (0.52)	59	0.717
Cooked meat [7]	4.5 (0.56)	104	4.5 (0.59)	45	4.6 (0.53)	59	0.345
Marmite/Vegemite	4.6 (0.65)	98	4.6 (0.72)	45	4.7 (0.58)	53	0.548
Crunchy peanut-butter	4.6 (0.73)	42	4.6 (0.78)	18	4.6 (0.71)	24	0.765
Cheese	4.6 (0.64)	103	4.6 (0.72)	45	4.7 (0.57)	58	0.571
Sausage	4.6 (0.75)	90	4.5 (0.85)	40	4.7 (0.62)	50	0.198
Hot potato chips [8]	4.7 (0.54)	96	4.7 (0.45)	44	4.7 (0.61)	52	0.887

[1] Difference between groups were tested using a paired two-sample t-test; Pearson;s chi-squared test for proportions

[2] Exposure score is a mean score of offering over lifetime, on a scale from 0-4 where 0 = never offered and 4 = offered more than 11 times

[3] Data on consumption were only available for the foods that had been offered, therefore preference score is a mean consumption score on a scale from 1-5 where 1 = no, refuses to taste and 5 = always eats when offered

[4] Afghans, chocolate chip, ANZAC etc., not including semi sweet biscuits (wine, malt)

[5] Only includes weetbix, cornflakes, porridge, rice bubbles if extra sugar/honey has been added

[6] Cooked and uncooked, includes when mixed into foods

[7] Any form of cooked meat (chicken, beef, pork), not including processed meats, mince, pãté and sausages

[8] Home cooked or takeaway

Appendix S: Number (%) of infants who had been offered the food at least once and who always consumed it when it was offered, according to study group

Consumed [1]	All	Control Group	BLISS Group	P-value [2]
Banana	57 (54.3)	26 (56.5)	31(52.5)	0.685
Sweet biscuits [3]	58 (70.7)	26 (72.2)	32 (69.6)	0.793
Flavoured yoghurt	66 (74.2)	29 (76.3)	37 (72.6)	0.688
Breakfast cereal [4]	21 (53.9)	13 (61.9)	8 (44.4)	0.276
Raisins	35 (55.6)	14 (46.7)	21 (63.6)	0.176
Olives	11 (35.5)	5 (35.7)	6 (32.3)	0.981
Broccoli	51 (50.5)	18 (42.9)	33 (55.9)	0.195
Cauliflower	35 (40.2)	12 (33.3)	23 (45.1)	0.270
Cabbage	17 (30.9)	6 (30)	11 (31.4)	0.912
Spinach	33 (47.1)	15 (51.7)	18 (43.9)	0.518
Tomato [5]	50 (55)	22 (59.5)	28 (51.9)	0.474
Egg	47 (48.5)	20 (48.8)	27 (48.2)	0.956
Luncheon sausage	40 (66.7)	21 (70)	19 (63.3)	0.584
Baked beans	48 (60.8)	18 (56.3)	30 (63.8)	0.498
Mince	78 (75)	33 (73.3)	45 (76.3)	0.732
Cooked meat [6]	60 (57.7)	24 (53.3)	36 (61)	0.432
Marmite/Vegemite	69 (70.4)	31 (68.9)	38 (71.7)	0.761
Crunchy peanut-butter	29 (69.1)	12 (66.7)	17 (70.8)	0.773
Cheese	74 (71.8)	32 (71.1)	42 (72.4)	0.884
Sausage	63 (70)	25 (62.5)	38 (76)	0.165
Hot potato chips [7]	72 (75)	32 (72.7)	40 (76.9)	0.636

[1] Not all participants were offered a particular food. Therefore, % shows those who always consume the food, of those who had been offered that food

[2] Difference between groups were tested using a paired two-sample t-test; Pearson's chi-squared test for proportions

[3] Afghans, chocolate chip, ANZAC etc., not including semi sweet biscuits (wine, malt)

[4] Only includes weetbix, cornflakes, porridge, rice bubbles if extra sugar/honey has been added

[5] Cooked and uncooked, includes when mixed into foods

[6] Any form of cooked meat (chicken, beef, pork), not including processed meats, mince, pãté and sausages

[7] Home cooked or takeaway