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**Determining the Relative Validity and  
Reproducibility of a Complementary  
Food Frequency Questionnaire to  
Assess Nutrient Intake in New Zealand  
Infants aged 9 to 12 months**

**A thesis presented in partial fulfilment of the requirements for the  
degree of**

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in  
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## Abstract

**Background:** Obtaining information on dietary intake in infants is challenging but necessary to help understand the relationship between diet and growth and development. Food frequency questionnaires (FFQ) are commonly used to investigate dietary intake as they are suited for use in large population groups, can determine intake over multiple days and minimise participant and researcher burden, and associated costs. FFQs need to be specific to the population they are to be used in and validated so that their results can be interpreted with greater confidence. There are currently no simple, validated dietary assessment methods that are available to assess nutrient intake for New Zealand infants.

**Objective:** To validate a complementary food frequency questionnaire (CFFQ) against a reference method of a four-day weighed food record (4dWFR) for assessing nutrient intakes of New Zealand infants aged 9 to 12 months. A secondary objective was to assess the reproducibility of the CFFQ by having it completed on two separate occasions, four weeks apart.

**Methods:** A cross-sectional study design was used including ninety-five infants aged  $10 \pm 1$  months and their primary caregiver, who completed the CFFQ twice (CFFQ-1 and CFFQ-2), approximately four weeks apart (to assess reproducibility). Four days of weighed food records (4dWFR) were collected on non-consecutive days between CFFQ administrations (validity). Validity and reproducibility were assessed for intakes of energy, macronutrients and micronutrients using paired t-tests, Pearson's correlation coefficients, cross-classification and Bland-Altman analysis. Two data sets were created, one that included milk intake (breast milk and formula) and one that excluded milk intake. The data was also adjusted for energy intake, before being reassessed for validity and reproducibility.

**Results:** For validity, most nutrient intakes from the CFFQ were comparable to the 4dWFR (range <1% up to 27% different). The CFFQ produced significantly higher nutrient intakes for fat and saturated fat, but significantly lower nutrient intakes for carbohydrate, fibre, folate, potassium, thiamin, riboflavin, niacin and vitamin C ( $p < 0.01$ ). Correlation coefficients ranged from  $r = 0.18$  (saturated fat) to  $r = 0.81$  (iron; mean  $r = 0.52$ ). Over half of participants had the same tertile classification by both the 4dWFR and the

CFFQ (mean 53.9%, range 39.0% (selenium) to 67.4% (iron)). Between 2.1% (iron and calcium) and 14.7% (saturated fat) of participants (mean 7.1%) were misclassified into opposite tertiles. Most of the nutrients showed acceptable agreement between methods ( $\kappa=0.20-0.60$ ). Saturated fat and selenium showed poor agreement ( $\kappa<0.20$ ) and iron showed good agreement ( $\kappa>0.60$ ). Removing milk intake weakened the correlations (range  $r=0.21$  for vitamin E to  $r=0.60$  for niacin, mean  $r=0.44$ ) and reduced the agreement between methods (50.3% correctly classified and 9.2% grossly misclassified). Adjustment for energy intake showed comparable correlation coefficients (range  $r=0.24$  for fibre and  $r=0.78$  for calcium and iron, mean  $r=0.52$ ) and improved the agreement between methods (56.2% correctly classified and 6.8% grossly misclassified). The CFFQ had adequate performance for reproducibility for all nutrients and energy with acceptable correlations ( $r\geq 0.20$ ) and good cross-classification (>50% correctly classified and <10% grossly misclassified) apart from fat and saturated fat (40.9% and 47.3% correctly classified, respectively). All nutrients showed acceptable to good agreement between the CFFQ-1 and CFFQ-2 ( $\kappa>0.20$ ). When milk intake was excluded and when the data was adjusted for energy intake, there was comparable acceptable to good correlations and cross-classification.

**Conclusion:** Although there were some differences in absolute energy and nutrient intakes between the methods, the CFFQ appears to have acceptable validity for assessing 14 nutrients and good reproducibility for assessing 18 nutrients and energy in infants aged 9-12 months. The CFFQ could be used in future research to investigate infant nutrient intakes where using a simple tool with little participant burden is beneficial.

**Keywords:** infant, dietary assessment, reliability, validation, questionnaire, nutrient

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## Table of contents

<b>Abstract .....</b>	<b>iii</b>
<b>Acknowledgements .....</b>	<b>v</b>
<b>Table of contents .....</b>	<b>vi</b>
<b>Lists of tables .....</b>	<b>viii</b>
<b>Supplementary results tables.....</b>	<b>viii</b>
<b>List of figures .....</b>	<b>ix</b>
<b>Abbreviations .....</b>	<b>xi</b>
<b>Chapter 1. Introduction.....</b>	<b>1</b>
1.1 <i>Background.....</i>	1
1.2 <i>Purpose of the study.....</i>	5
1.3 <i>Aim.....</i>	5
1.4 <i>Thesis structure.....</i>	6
1.5 <i>Researcher’s contributions .....</i>	6
<b>Chapter 2. Literature review .....</b>	<b>8</b>
2.1 <i>Introduction .....</i>	8
2.2 <i>Nutrition during infancy.....</i>	8
2.3 <i>Dietary assessment methods and challenges in infants .....</i>	10
2.4 <i>Food frequency questionnaires exploring dietary intake.....</i>	14
2.5 <i>Food frequency questionnaires available for use in New Zealand infants.....</i>	15
2.6 <i>Considerations when assessing the validity and reproducibility of a food frequency questionnaire .....</i>	18
2.7 <i>Statistical analysis of a dietary assessment tool for validity and reproducibility.....</i>	25
2.8 <i>Summary.....</i>	27
<b>Chapter 3. Research manuscript: Determining the Relative Validity and Reproducibility of a Complementary Food Frequency Questionnaire to Assess Nutrient Intake in New Zealand Infants aged 9 to 12 months .....</b>	<b>29</b>
3.1 <i>Abstract .....</i>	29

3.2	<i>Introduction</i> .....	31
3.3	<i>Methods</i> .....	32
3.4	<i>Results</i> .....	38
3.5	<i>Discussion</i> .....	52
3.6	<i>Conclusions</i> .....	61
3.7	<i>Acknowledgements</i> .....	61
3.8	<i>Author contributions</i> .....	62
3.9	<i>Conflicts of interest</i> .....	62
	<b>Chapter 4. Conclusions and recommendations</b> .....	<b>63</b>
4.1	<i>Strengths and limitations</i> .....	63
4.2	<i>Impact of research and recommendations</i> .....	66
4.3	<i>Conclusion</i> .....	67
	<b>Chapter 5. Appendices</b> .....	<b>68</b>
	<i>Appendix A: Complementary Food Frequency Questionnaire (CFFQ)</i> .....	68
	<i>Appendix B: Four-day Weighed Food Record (4dWFR)</i> .....	83
	<i>Appendix C: Supplementary results</i> .....	87
	<i>Appendix D: Participant materials</i> .....	99
	<b>References</b> .....	<b>104</b>

## Lists of tables

### Chapter 1.

Table 1.1 Contribution of each researcher to the completion of the study .....	6
--	---

### Chapter 2.

Table 2.1 Summary of tools and characteristics of validation studies in infants (n=5). .....	16
---	----

### Chapter 3.

Table 3.1 Participant characteristics .....	39
---	----

Table 3.2 Mean daily nutrient intakes over four days and correlations between the 4dWFR and CFFQ-1 among infants aged 9-12 months (n=95).....	42
---	----

Table 3.3 Cross-classification by tertiles of nutrient intakes and weighted kappa based on the 4dWFR and CFFQ-1 among infants aged 9-12 months (n=95).....	44
--	----

Table 3.4 Mean daily nutrient intake over four days and correlations between the CFFQ-1 and CFFQ-2 among infants aged 9-12 months (n=93).....	49
---	----

Table 3.5 Cross-classification by tertiles of nutrient intakes and weighted kappa based on the CFFQ-1 and CFFQ-2 among infants aged 9-12 months (n=93).....	51
---	----

## Supplementary results tables

Supplementary Table 1 Mean daily nutrient intakes over four days and correlations between the 4dWFR and CFFQ-1 among infants aged 9-12 months (n=95). .....	87
---	----

Supplementary Table 2 Cross-classification by tertiles of nutrient intakes and weighted kappa based on the 4dWFR and CFFQ-1 among infants aged 9-12 months (n=95). .....	88
--	----

Supplementary Table 3 Bland-Altman statistics comparing nutrient intakes from the 4dWFR and CFFQ-1 among infants aged 9-12 months (n=95).....	93
---	----

Supplementary Table 4 Bland-Altman statistics comparing energy-adjusted nutrient intakes from the 4dWFR and CFFQ-1 among infants aged 9-12 months (n=95).....	94
Supplementary Table 5 Mean daily nutrient intakes over four days and correlations between the CFFQ-1 and CFFQ-2 among infants aged 9-12 months (n=93). .....	95
Supplementary Table 6 Cross-classification by tertiles of nutrient intakes and weighted kappa based on the CFFQ-1 and CFFQ-2 among infants aged 9-12 months (n=93). .....	96
Supplementary Table 7 Weight (g) conversion used for each food item from the CFFQ used for statistical analysis. ....	97

## List of figures

### Chapter 3.

Figure 3.4.1 Participant flow diagram .....	38
Figure 3.4.2 Example of Bland-Altman plots of the agreement between intakes for nutrients for (A) protein, (B) vitamin E, (C) selenium, and (D) vitamin B <sub>12</sub> (n=95)....	46
Figure 3.4.3 Examples of Bland-Altman plots of the agreement between intakes for nutrients for (A) protein, (B) vitamin B <sub>12</sub> and (C) zinc, excluding milk (breast milk and formula) intake from analysis) (n=95).....	47

### Appendices

Supplementary Figure 1. Bland-Altman plots of the agreement between intakes for nutrients for (A) energy, (B) calcium, (C) zinc, (D) iodine, (E) saturated fat, and (F) total fat (n=95). ....	89
Supplementary Figure 2. Bland-Altman plots of the agreement between intakes for energy-adjusted nutrients for (A) fat, (B) saturated fat, (C) carbohydrate, (D) fibre, (E) vitamin E, (F) folate, (G) potassium, (H) calcium, (I) selenium, (J) thiamin, (K) riboflavin, (L) niacin, (M) vitamin B <sub>12</sub> and (N) iodine (n=95). ....	91

Supplementary Figure 3. Examples of Bland-Altman plots of the agreement between intakes for energy-adjusted nutrients for (A) zinc, (B) protein, (C) vitamin C and (D) iron (n=95). ..... 92

## Abbreviations

24HR	Twenty-four hour recall
4dWFR	Four-day weighed food record
7dWFR	Seven-day weighed food record
CFFQ	Complementary food frequency questionnaire
CFFQ-1	First Complementary food frequency questionnaire (week 1)
CFFQ-2	Second Complementary food frequency questionnaire (week 4)
CI	Confidence intervals
FFQ	Food frequency questionnaire
$\kappa$	Kappa statistic (statistical analysis)
LOA	Limits of agreement
NIP	Nutrition information panel
NRV	Nutrient Reference Values
NZ	New Zealand
p	p-value (statistical analysis)
r	Correlation coefficient (statistical analysis)
SD	Standard deviation
Tbsp	Tablespoon
tsp	Teaspoon
WFR	Weighed food record
<	Less than
≤	Equal to or less than
>	Greater than
≥	Equal to or greater than