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Parent-led or Baby-led? Associations between complementary feeding practices and health-related behaviours in a survey of New Zealand families

Journal:	*BMJ Open*
Manuscript ID:	bmjopen-2013-003946
Article Type:	Research
Date Submitted by the Author:	02-Sep-2013
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Primary Subject Heading:	Nutrition and metabolism
Secondary Subject Heading:	Nutrition and metabolism, Paediatrics
Keywords:	NUTRITION & DIETETICS, Complementary feeding, Baby-Led Weaning

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Title: Parent-led or Baby-led? Associations between complementary feeding practices and health-related behaviours in a survey of New Zealand families.

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Key words complementary feeding, baby-led weaning.
Word count = 3716

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ABSTRACT

Objective: To determine feeding practices and selected health-related behaviours in New Zealand families following a "baby-led" or more traditional "parent-led" method for introducing complementary foods.

Design, setting and participants: 199 mothers completed an online survey about introducing complementary foods to their infant. Participants were classified into one of three groups: "adherent Baby-Led Weaning (BLW)", the infant mostly or entirely fed themselves at 6-7 months; "self-identified BLW", mothers reported following BLW at 6-7 months but were using spoon-feeding at least half the time; and "parent-led feeding", the mother reported not having tried BLW.

Results: 8% were following "adherent BLW" and 21% "self-identified BLW". Compared to "self-identified BLW" and "parent-led feeding", a higher proportion of the "adherent BLW" met the WHO recommendations to exclusively breastfeed for 6 months and introduce complementary foods at 6 months. The "adherent BLW" group was more likely to have family foods (p=0.018), and less likely (p=0.002) to have commercially prepared baby food. Both BLW groups were more likely to share meals with the family compared to "parent-led feeding". In contrast to "self-identified BLW" and "parent-led feeding", the "adherent BLW" group did not offer iron-fortified cereal as a first food.

Conclusion: This study suggests that although many parents consider they follow BLW, very few are following it strictly. The extent to which BLW was followed was associated with potential benefits (e.g., sharing family meals) and risks (e.g., low iron first foods) highlighting the importance for health professionals and researchers of accurately describing the extent of adherence to BLW.

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ARTICLE SUMMARY

Article focus

- Baby-Led Weaning (BLW) is becoming increasingly popular amongst parents of young infants.
- There are a number of proposed benefits associated with BLW including a healthier BMI, and a number of possible risks, including poorer iron intakes.
- However, very little is known about how BLW is practised in the community and how strictly it is followed by parents.

Key messages

- The extent to which BLW is practised varies.
- The association of BLW with potential benefits and possible risks may differ depending on the extent to which the method is adhered to.
- Most parents use traditional spoon-feeding for introducing complementary foods, but many would be willing to try BLW if they had another infant.

Strengths and limitations of this study

- This is the first study to investigate BLW in the general population.
- The survey was advertised in main urban centres of New Zealand and may not be representative of rural families.
- As the sample size is small results should be interpreted with caution.

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INTRODUCTION

Baby-Led Weaning (BLW) is an alternative method for introducing complementary foods to infants in which the infant feeds themselves hand-held foods instead of being spoon-fed by an adult [1].

The small body of existing research suggests that BLW is feasible for most 6-month old infants from a motor development point of view. [2 3] It also suggests that BLW is associated with potential benefits including lower levels of maternal anxiety, restriction, pressure to eat and monitoring during the complementary feeding period; [4] and perhaps healthier eating patterns and BMI. [5] However, none of the studies to date have drawn their BLW cases and parent-led controls from the same population. Given the paucity of current research, and the lack of randomized controlled trials, healthcare professionals [6] and health governing bodies [7] are unwilling to support BLW as a population recommendation. Anecdotal reports suggest that the use of BLW is increasing in New Zealand and other countries including the United Kingdom.

Baby-Led Weaning in its strictest form requires that the infant has complete control over their own eating from the beginning of the complementary feeding period. [1] In theory, BLW is therefore a distinctly different method of infant feeding compared to the traditional method of spoon-feeding purées. [1] However, essential questions, such as how parents actually follow BLW in practice, and the extent to which BLW is associated with health-related behaviours in the general population, remain unanswered.

The aim of this survey was to determine feeding practices and selected health-related behaviours in New Zealand families following “baby-led” or more traditional “parent-led” methods for introducing complementary foods.

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METHODS

Participants

Two hundred and thirty parents who had an infant aged 6-12 months old were recruited from four main urban centres in New Zealand (Auckland, Wellington, Christchurch, Dunedin) by newspaper advertisement. Inclusion criteria were that participants had a healthy child aged 6-12 months who was born full term and was currently living in New Zealand, with no diagnosed neurological or developmental condition. Recruitment for the study stated that we were interested in when and how complementary foods were introduced to babies. To reduce selection bias, BLW was not mentioned. Advertisements for the study provided a web link to the online questionnaire. The study was approved by the Human Ethics Committee of the University of Otago, Dunedin, New Zealand.

Data collection

The population-based, cross-sectional survey was administered from May 2010 to August 2010 (three months in total). Participants could only complete the survey once for one child. Consent and eligibility were established using check boxes that had to be completed before the participant was allowed entry to the survey.

The survey

The current survey questions were based on a web-based infant feeding survey previously administered in the United Kingdom [8], current infant nutrition literature, and consultation with a paediatrician, a paediatric dietitian, and health researchers. The survey was designed and hosted using www.SurveyMonkey.com (Survey Monkey Copyright © 1999 - 2009 SurveyMonkey.com). A pretest was electronically administered to 15 parents with young children aged 1-10 years to verify survey functionality and understandability and the survey was modified based on the pretesting results. The modifications included deleting a repeated question and rephrasing some questions to improve clarity.

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The online survey was divided into four main sections (Table 1):

1. Starting complementary foods
2. Baby-Led Weaning
3. Attitudes towards, and experiences of, feeding the infant
4. Demographic information

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Table 1. Overview of data collected in the survey

Survey section	Data collected
Section 1: Starting complementary foods	***Timing and type of complementary food*** Participants were asked: Age (months) when infant first had complementary food, main reason(s) for starting food at this age, the type of food given, form the food was in (puréed, mashed, whole), whether the food was home made or commercially prepared. ***Mealtimes and eating patterns**** Participants were asked: Frequency with which they ate with the infant (could have been different foods but baby ate at the same time), frequency infant ate family foods (could have been at a different time but they ate the same food that the rest of the family ate). ***Gagging and choking*** Many parents confuse gagging with choking or find it hard to differentiate between the two [9]. We provided a written description before asking about gagging and choking. Participants were asked: If child had ever gagged or choked and if so, how often, the form (purée, mashed, whole) of food that was involved, child's age when choked.
Section 2: Baby-Led Weaning	Participants were asked: had they tried BLW, the extent to which they had followed BLW, whether they would recommend the method to other parents. Participants who reported not having tried BLW were directed to questions asking their opinion of BLW based on a brief description (table 2) and short 'introduction to BLW' video, which was embedded in the survey. They were asked whether they would try BLW if they had another child and to provide reasons why they would or would not try it.
Section 3: Attitudes towards, and experiences of, feeding the infant	Participants were asked: about their satisfaction with their choice of infant feeding method for the current infant, whether they would consider changing feeding methods if they had another child, reasons for liking or disliking the method of feeding used.
Section 4: Demographic information	Participants were asked: age, sex, ethnicity, education, household, number of other children, employment status, region of New Zealand they lived in.

* To obtain data for all infants at 6 to 7 months of age, parents were asked to answer questions relating to current age and also when the child was 6 to 7 months of age. Parents whose child was currently 6 to 7 months of age only completed this section once and then skipped to the following section.

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Table 2. Description of Baby-Led Weaning included in the Survey

Traditional infant feeding involves offering the baby puréed foods first, then gradually increasing the texture from purée to mash, to lumpy and then to family foods. Baby Led Weaning is different and involves the infant feeding themself right from the start. You offer your baby pieces of soft food of a size and shape that the baby can handle (for example steamed broccoli or carrots). The baby is allowed to explore the food at their own pace and they decide how much they will eat. Rather than preparing separate meals for your baby, they are offered foods similar to what the rest of the family is eating.

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Data analysis

To compare those who considered themselves to be following BLW with those who met stricter criteria for BLW at 6-7 months of age we defined two BLW groups. Figure 1 shows the questions that determined which of the three methods parents were considered to have used for introducing complementary foods.

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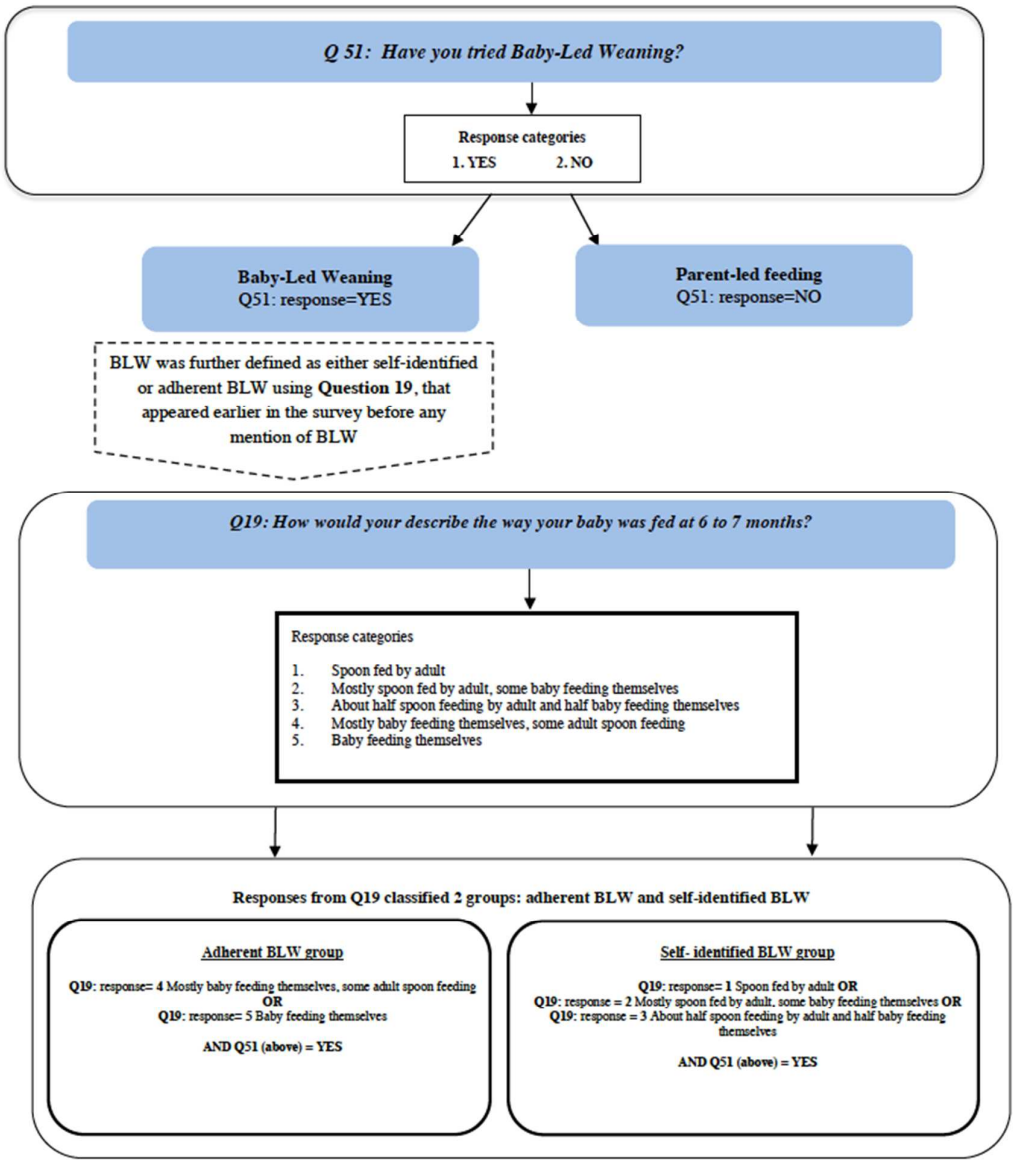

Figure 1. Survey questions used to classify infant feeding method

The ***adherent BLW group*** consisted of those who reported having tried BLW, and whose infant mostly or always self-fed at 6 to 7 months (Figure 1). A broader definition of BLW was used to assign parents to the ***self-identified BLW*** group. These participants reported having tried BLW, but spoon-fed their infant at least half the time. All other participants reported not having tried BLW. These participants were classified as ***parent-led feeding.***

Information on ethnicity was collected using the 2006 NZ Census of Populations and Dwellings question as recommended by Statistics NZ. [10] Participants who nominated two or more ethnic groups were assigned to a single group using the prioritization system recommended by Statistics NZ, with the order of priority being (from highest to lowest): Māori, Pacific, Asian, Other, NZ European. [10]

Statistical analysis

All analyses were conducted using Stata™ version 12 (STATA Corporation, College Station, Texas, USA). Descriptive statistics were tabulated and Chi-square tests and Fishers Exact test (when cell counts were less than 10) were performed to examine differences in proportions. A p-value < 0.05 was considered to indicate statistical significance. Characteristics, and feeding and health-related practices were compared across three groups: 1) "adherent BLW", 2) "self-identified BLW", and 3) "parent-led feeding".

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RESULTS

A total of 199 participants completed the online survey (20 of the 230 people recruited did not meet the eligibility criteria and eleven did not complete the entire survey). Most (n=140, 70%) of the sample were classified as "parent-led feeding", 42 (21%) as "self-identified BLW" and 17 (9%) as "adherent BLW". Table 3 presents the participant characteristics. All participants who answered the survey were mothers. The mean age of the infants was 8.6 months. Approximately half of the mothers in the sample were 30 to 39 years of age, 66% had a tertiary qualification, and 55% had more than one child. Maternal age ($p=0.047$; a greater proportion of mothers aged 20-29 followed "self-identified BLW") and residing region ($p=0.001$; "adherent BLW" was greater among those living in Christchurch and least likely among those living in Auckland) were significantly associated with feeding method. There were no other significant differences in participant characteristics between feeding methods ($p \geq 0.05$).

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Table 3 Characteristics of participants

		All (n=199)	Parent-led feeding (n= 140) n (%)	Self-identified BLW (n= 42) n (%)	Adherent BLW (n=17) n (%)	p-value
Maternal age at child's birth (years)	<20	13	11 (8.2)	1 (2.4)	1 (6.25)	**0.005**
	20-29	49	28 (20.0)	17 (40.5)	4 (23.5)	
	30-39	103	71 (50.7)	24 (57.1)	8 (47.1)	
	40-49	28	24 (17.1)	0	4 (23.5)	
	Missing	*6*	*6*	*0*	*0*	
Infant age (months)						
	6-7	52	36 (25.7)	13 (30.9)	3 (17.6)	0.194
	7-8	23	18 (12.9)	2 (4.8)	3 (17.6)	
	8-9	34	27 (19.3)	5 (11.9)	2 (11.8)	
	9-10	31	18 (12.9)	12 (28.6)	1 (5.9)	
	10-11	29	19 (13.6)	5 (11.9)	5 (29.4)	
	11-12	30	22 (15.7)	5 (11.9)	3 (17.6)	
	Missing	*0*	*0*	*0*	*0*	
Maternal education	Year 11 or below**	6	3 (2.1)	3 (7.1)	0	0.572
	Year 12 or 13†	55	39 (27.9)	11 (26.2)	5 (29.4)	
	Post-secondary school	34	27 (19.3)	5 (11.9)	2 (11.8)	
	University degree or higher	98	65 (46.4)	23 (54.8)	10 (58.8)	
	Missing	*6*	*6*	*0*	*0*	
Ethnicity	NZ European	121	78 (55.7)	32 (76.2)	11 (64.7)	0.966
	NZ Māori	12	8 (5.7)	4 (9.5)	0	
	Samoan	2	2 (1.4)	0	0	
	Indian	4	4 (3.8)	0	0	
	Chinese	1	1 (2.9)	0	1 (5.9)	
	English	9	6 (5.7)	2 (4.8)	0	
	Other	9	6 (5.7)	3 (7.1)	1 (5.9)	
	Missing	*41*	*35*	*1*	*4*	
Parity	Primiparous	89	66 (47.1)	14 (33.3)	9 (52.9)	0.240
	Multiparous	110	74 (52.9)	28 (66.7)	8 (47.1)	
	Missing	*0*	*0*	*0*	*0*	
Household composition	Mother and father	160	115 (82.1)	30 (71.4)	15 (88.2)	0.271
	Single parent	23	17 (12.1)	6 (14.3)	0	
	Missing	*16*	*8*	*6*	*2*	
Residing region	Auckland	78	61 (43.6)	17 (43.6)	0	**0.001**
	Wellington	42	28 (20.0)	12 (28.6)	2 (11.8)	
	Christchurch	29	17 (12.1)	4 (9.5)	8 (47.1)	
	Dunedin	31	21 (15.0)	5 (11.9)	5 (29.4)	
	Other	8	7 (5.0)	1 (2.4)	0	
	Missing	*11*	*6*	*3*	*2*	
Maternal employment status	Currently in paid employment	44	25 (18.7)	15 (35.7)	4 (23.5)	0.119
	Not in paid employment	89	62 (46.3)	21 (50.0)	6 (35.3)	
	On parental leave, returning to paid employment	40	32 (23.9)	5 (11.9)	3 (17.6)	
	On parental leave, not returning to paid employment	18	15 (11.2)	1 (2.4)	2 (11.8)	
	Missing	*8*	*6*	*0*	*2*	

* p-value compares feeding methods
** Year 11 is usually at age 15-16 years
† Years 12 & 13 are usually at ages 16-18 years

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More than half (58%) of the sample surveyed exclusively breastfed their infant to five months of age, and only 4% reported never exclusively breastfeeding. However, 63% of infants received complementary food before the recommended age of six months. A greater number in the "adherent BLW" group (52.9%) met the WHO recommendation to exclusively breastfeed for 6 months [11] compared to the "self-identified" (27.5%) and "parent-led feeding" (21.4%) groups (p=0.026). Similarly, the number managing to meet the recommendation to introduce complementary foods at 6 months was significantly greater in the "adherent BLW" group. A total of 64.7% in the "adherent BLW" compared to the 33.3 % in the "self-identified BLW" and 33.6% in the "parent-led feeding" group introduced complementary food at ≥6 months (p=0.044).

Table 4 summarizes a range of feeding practices and health-related behaviours. Compared to the "self-identified BLW" and "parent-led feeding" groups, the "adherent BLW" group were more likely to be having foods that the family ate (i.e. the same food but not necessarily at the same time as the rest of the family) (p=0.018), more likely to begin eating family foods when they started complementary foods or within the first month of starting (p<0.001), and were less likely to be offering their baby commercially prepared baby food (p=0.002). Both BLW groups were more likely to be sharing all or most of their meals with the family (i.e. having meals at the same time but not necessarily the same food) compared to "parent-led feeding" (p=0.040). In contrast to the "self-identified BLW" and "parent-led feeding" groups, "adherent BLW" children were not offered infant iron-fortified cereal as their first food.

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Table 4 Feeding practices and health-related behaviours by feeding method used to introduce complementary foods

		All (n=199)	Parent-led feeding (n= 140) n (%)	Self-identified BLW (n= 42) n (%)	Adherent BLW (n=17) n (%)	p-value*
Baby eats family food (*may be modified or eaten at a different time*)	Doesn't eat family foods	8	2 (1.4)	6 (14.3)		**0.018**
	Occasionally	150	113 (80.7)	28 (66.7)	9 (52.9)	
	Most of the time or all of the time	41	25 (17.8)	8 (19.0)	8 (47.1)	
	Missing	*0*	*0*	*0*	*0*	
Age baby started eating family food	When started CF or within 1 mo	20 (10.1)	7 (5.0)	4 (9.5)	9 (52.9)	**<0.001**
	2-4mo after starting CF	68 (34.2)	50 (35.7)	13 (31.0)	5 (31.3)	
	Doesn't eat with family	111 (55.8)	83 (59.3)	25 (59.5)	3 (18.8)	
	Missing	*0*	*0*	*0*	*0*	
Baby shares their meal with the family (*even if food is different*)	None of their meals	43	34 (24.2)	7 (16.7)	2 (11.5)	**0.040**
	Some of their meals	90	67 (47.8)	19 (45.2)	4 (23.5)	
	Most of their meals	48	28 (20.0)	12 (28.6)	8 (47.1)	
	All of their meals	16	9 (6.5)	4 (9.5)	3 (17.6)	
	Missing	*2*	*2*	*0*	*0*	
First food offered	Baby rice cereal	100	75 (53.6)	24 (57.1)	1 (5.9)	**0.001**
	Fruit	70	48 (34.3)	12 (28.6)	10 (58.8)	
	Vegetables	29	17 (12.1)	6 (14.3)	6 (35.3)	
	Meat	*0*	*0*	*0*	*0*	
	Missing	*0*	*0*	*0*	*0*	
Amount of commercially prepared baby food	All of it	14	11(7.9)	3 (7.1)	0	**0.002**
	Most of it	34	21 (15.0)	11 (26.2)	2 (11.8)	
	Half of it	47	38 (27.0)	8 (19.0)	1 (5.9)	
	Hardly any of it	78	58 (41.4)	15 (35.7)	5 (29.4)	
	None of it	26	12 (8.6)	5 (11.9)	9 (52.9)	
	Missing	*0*	*0*	*0*	*0*	
Reported a choking episode	No	130 (67.3)	95 (69.3)	24 (60.0)	11 (68.8)	0.567
	Yes	63 (32.6)	42 (30.7)	16 (40.0)	5 (31.3)	
	Missing	7	*3*	*2*	*2*	
Reported a gagging episode	No	51 (26.2)	39 (27.9)	7 (16.6)	5 (29.4)	0.286
	Yes	143 (73.7)	99 (70.7)	34 (81.0)	10 (58.8)	
	Missing	*5*	*2*	*1*	*2*	

* p-value compares feeding methods
CF Complementary foods
Mo months

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Across the whole sample, 32.6% of participants reported at least one choking episode, and most (71.4%) of these participants reported that choking had occurred with whole food. There was no difference between groups for the proportion reporting at least one choking episode, the form (puréed, mashed or whole) that the food was in, or the method of feeding (spoon-feeding or self-feeding) when the choking episode occurred ($p>0.05$). There was also no group difference in the proportion reporting at least one gagging episode ($p>0.05$).

Thirty-eight per cent of all participants had not heard of BLW, 7.6% reported knowing a lot about it, and the remaining 54.1% reported knowing a moderate or small amount. A large proportion of the "parent-led feeding" group had never heard of BLW (64.4%). Participants reported hearing about BLW through a friend or family member rather than from a healthcare professional.

All families who had followed BLW reported that they would recommend the method, but interestingly more than half (59.6%) would recommend that BLW be used in combination with spoon-feeding. Forty-six per cent of those who had followed "parent-led feeding" would be willing to try BLW if they had another child. The main reasons reported for not wanting to try BLW were fear of their infant choking (55.3%), concern about the infant's ability to eat enough (44.2%), reservation that the infant would not have the necessary motor skills to self-feed (27.6%), or considering that "parent-led feeding" had worked fine, so there was no need to change (27.1%).

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DISCUSSION

This is the first study to describe BLW and parent-led feeding in a sample from the general population. In contrast, previous studies have recruited participants separately from BLW specific groups or websites, with controls coming from other sources such as patient lists [5], and nurseries and community centres [4 8 12]. We found that the association between infant feeding method and health-related behaviours differed depending on the extent to which families followed BLW. Compared to the "self-identified BLW" and "parent-led feeding" group, the "adherent BLW" were more likely to meet the WHO recommendations to exclusively breastfeed for 6 months, and to begin complementary foods at 6 months of age. [11] The "adherent BLW" group were also more likely to be having foods that the family ate, and were less likely to be offering their baby commercially prepared baby food. Both BLW groups were more likely to be sharing all or most of their meals with the family compared to the "parent-led feeding" group. In contrast to the "self-identified BLW" and "parent-led feeding", children, "adherent BLW" children were not offered infant iron-fortified cereal as their first food.

In this study, adherent BLW was defined as the baby feeding themselves all or most of the time at 6 to 7 months of age (i.e. little or no parent spoon-feeding). Previous studies [4 8] have defined BLW according to the extent of spoon-feeding and/or purées consumed. As our previous work [6] had suggested that purées could be offered to the self-feeding infant (for instance puréed mince on toast) the definition used here related only to the method of feeding (self-feeding vs. spoon-feeding) and not the form of food (purée, mashed, or whole). In practice only a small number of families (8% of this sample) were classified as following adherent BLW. A large proportion (21%) of families who reported using BLW were instead following a more flexible approach that included a combination of self-feeding and spoon-feeding. This agrees with our earlier qualitative study [6], in which families following BLW also reported using some spoon-feeding. Generally this occurred at times when their infant appeared unable to feed themselves (e.g., during illness) or specifically to ensure

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appropriate iron intake (parents spoon-fed iron-fortified baby cereal at breakfast). This suggests that BLW and spoon-feeding are not viewed as dichotomous methods within the community but instead as styles of infant feeding that can be combined to suit the needs of the child and the family in each feeding situation.

A concern that is commonly expressed about BLW [6] is the potential increased risk of choking when infants self-feed whole foods. When infants transition from milk to solid foods they are at increased risk of choking because they may not have developed the coordination of chewing, breathing and swallowing needed to eat food safely. [13 14] Choking is when the airway is obstructed and respiration is interrupted [15] and food related choking can be fatal. [14 16] Prevalence data on choking are limited, and no data exist on the rates of choking when complementary foods are being introduced, whether using a traditional or a BLW method. The most relevant data available show that in New Zealand in the period from 2002 to 2009, nine deaths occurred in children under six years of age as a result of the inhalation of food, specifically meat, sausage, peanuts, apple and grapes [16]. In contrast, gagging, which is very common among all infants, is less serious. [17] The gag reflex very effectively keeps large pieces of food well to the front of the mouth, only allowing well masticated food to reach the back of the mouth for swallowing. [1 18-20]. In this survey we found no difference between the groups in the proportion reporting at least one gagging or choking episode. However, more than 30% of the total sample reported at least one choking episode, and this mostly commonly involved whole foods. Since choking can be very serious it would be of concern if these reports reflect actual choking rates. Parents often find it difficult to distinguish between choking and gagging and therefore, although we included a definition of both choking and gagging in our survey, it is likely that parents have incorrectly identified choking, in particular mistaking gagging for choking.

We found a number of important associations between feeding method and the likelihood of achieving the nutrition recommendations for infants as outlined by the New Zealand Ministry of Health and WHO [11 21]. The “adherent BLW”

group were more likely to meet both the recommendation to exclusively breastfed to six months, and to introduce complementary foods at six months. Two possible explanations for this finding are that the desire to follow BLW results in parents waiting until six months, which is the age when it is considered that most healthy infants are developmentally ready to self-feed, [2 22 23] or that parents who choose BLW are more aware of and adhere to health recommendations. However, it is also feasible that parents who follow a parent-led method are able to encourage their infant to begin complementary foods earlier by feeding purées or infant cereal by spoon, which requires little input from the infant and therefore is not reliant on their developmental ability to actively participate in feeding. The results from the current study are consistent with a cross-sectional study from the United Kingdom where BLW (defined as less than 10% spoon-feeding or less than 10% purée use for total food intake) was associated with later introduction of complementary foods. [8] Furthermore a United Kingdom based survey examining the knowledge of infant feeding guidelines and the influence of healthcare professionals identified BLW as the strongest predictor for introducing complementary foods at the recommended age. [24]

The feeding method used by families was associated with many other potentially health-related behaviours. Those in the "adherent BLW" group were most likely to offer fruits and vegetables as first complementary foods rather than iron-fortified cereal. It is of concern that for the "adherent BLW group" the first foods reported in this survey were poor sources of iron, as this increases the infant's risk of suboptimal iron status [21 25-28]. Although fruits and vegetables are nutrient rich foods, they do not provide all the nutrients necessary for six-month-old children. [21] In particular, infants should receive iron-rich complementary foods such as meat, meat alternatives, or iron-fortified foods immediately when starting complementary foods to supply necessary iron. [21 25-28] We are unable to determine how long only fruit and vegetables were offered, and at what age iron-rich foods, such as meat, were introduced. However, spoon-feeding iron-fortified baby rice cereal is a popular way for parents to increase their infant's iron intake, [21] and the semi-liquid form of

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infant cereals makes them a difficult food for infants to feed themselves at six months. In this survey none of the "adherent BLW" group offered infant cereal as a first food. In contrast, some of the "self-identified BLW" group did - presumably by spoon. Conversely, because the infant following BLW is eating family foods there may be greater potential for a wider variety of iron-rich foods such as pieces of cooked red meat to be offered. The bioavailability of iron from these foods is also much higher (15.5%) than from infant cereals (3%) [29]. However the results of the current study suggest that parents following BLW may need to be encouraged to offer these sources of iron immediately at 6 months.

Family meals have been linked to healthier eating patterns including greater intake of fruits and vegetables and lower intake of unhealthy foods. [30-32] However this relationship has only been examined in older children (two years and over) and the benefits of family meals for younger children (i.e., 6 to 12 months) is yet to be determined. Furthermore, no longitudinal studies have investigated whether the health benefits associated with sharing family meals track into later life. Aside from the potential nutritional benefits associated with sharing family meals, there are other important reasons why infants should eat with the family, such as mealtimes providing an opportunity to communicate, learn, and develop family rituals. [33] Our results showed the "adherent BLW" parents were sharing a greater number of meals with their infant, and were likely to be doing this within one month of the initiation of complementary feeding. Brown and Lee [12] reported similar results in their qualitative study. Results from the pilot study (n=10) of Rowan and Harris [34] also showed BLW families were sharing most meals (average of 3 out of the 3.5 meals per day) with their child by 9 months of age.

In addition to sharing family meals, exposure to family foods (the same foods eaten by other family members) may encourage healthier long-term eating patterns. [35-37] Results from a recent representative Scottish study showed that eating family foods was the most important aspect of family meals associated with a healthier diet at age five years (i.e., it is the food choice that has greater importance than the form and function of the meal). [38] Food

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neophobia (the reluctance to eat, or avoidance of new food [39]) and 'fussy or picky eating' (children who consume an inadequate variety of food through rejection of unfamiliar food [40]) are most prevalent around two to three years of age. [41] However early repeated exposures to a variety of different food textures and tastes during the introduction to complementary foods has been shown to reduce the extent of the food refusal. [37 42 43] In this survey, the "adherent BLW" infants were having a greater amount of family foods, as well as less commercially purchased food, whereas, families who followed the "parent-led feeding" method reported a greater proportion of commercially prepared food. Whilst purchased baby food is nutritionally appropriate [21] and many parents choose it for this reason, it is typically bland and of a smooth consistency. Only a longitudinal study would be able to determine the effects of early exposure to family foods compared with commercially prepared baby food on the infant's neophobia and fussy or picky eating in later infancy.

Most parents in the current study either supported BLW or would be willing to try it with a subsequent child. All families who had followed BLW reported that they would recommend the method, but interestingly more than half would recommend that BLW be used in combination with spoon-feeding. Although more than one-third of the sample had not heard of BLW, after watching a short video and reading the brief description of BLW embedded in the survey 46% reported being willing to try it with another child. Combining the parents who were willing to use BLW with those who reported already using it suggests that 79% of this sample would be willing to adopt, at least aspects of, a baby-led approach, even though a large proportion had, prior to the survey, not heard of BLW. Those not willing to try BLW were concerned about choking, energy intake, and developmental readiness of the infant to self-feed at six months or considered that the "parent-led feeding" method had worked well for their family, precluding any need to change.

This study has a number of strengths and weaknesses. We attempted to improve the representativeness of our sample by advertising the study in public domains (particularly community distributed free newspapers). Recruiting participants

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from the general population instead of specific groups improves the likelihood of a more representative sample. [44 45] We also avoided mentioning BLW in the advertisement to reduce the bias associated with recruiting only those familiar with BLW. However, as the survey was administered through the Internet it required participants to have access to the Internet and possess computer skills. Recent figures show that 86% of NZ families have personal internet access [46] suggesting a large proportion could access the current survey. However our newspaper advertising was restricted to urban areas and this may have affected our sample, as the demographics characteristics of the current sample do not reflect those of the general New Zealand population. In particular, the sample was highly educated with more mothers having a university degree (66%) compared to the general population (40%). [47] Therefore, as this study was relatively small (n=199) and may have comprised participants who were more computer literate, caution must be used when interpreting results.

In conclusion, the majority of our sample were using the parent-led method of spoon-feeding purées to introduce complementary foods to their child. Twenty-one percent of the sample reported using BLW but were not strictly limiting spoon-feeding, and a smaller number (8%) followed a strict BLW approach. We found several important associations between feeding method and health related behaviours, suggesting that greater adherence to the self-feeding tenet of BLW was associated with exclusively breastfeeding for 6 months, beginning complementary foods at 6 months, and eating the same foods as the rest of the family from the start of the complementary feeding period. However, it is concerning that these infants were not offered infant iron-fortified cereal as a first food. Both BLW groups were more likely to be sharing all or most of their meals with their family. The results of this study suggest that for many families the practice of BLW deviates substantially from the theory. It is therefore essential that health professionals, as well as researchers, do not rely on parental self-reports of BLW, but also quantify the extent of infant self-feeding.

Acknowledgements We would like to thank all the families who contributed to this study. SC was funded by a University of Otago PhD Scholarship.

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Contributors SC, ALH and RWT were all involved with the conception and design of the study, the analysis and interpretation of the data and the writing and editing of this paper. SC designed and executed the online survey and was responsible for the analysis and interpretation of the data. SC wrote the first draft of the paper, and A-L H and RWT made important intellectual contributions to the content and approved the final version.

Funding This research was conducted using the authors' (RWT) resources and received no specific grant from any funding agency in the public, commercial or non-profit sectors.

Competing interests None.

Ethical approval Ethical approval was obtained from the University of Otago Ethics Committee.

Provenance and peer review Not commissioned.

Data sharing statement No additional data are available.

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STROBE 2007 (v4) Statement—Checklist of items that should be included in reports of *cross-sectional studies*

Section/Topic	Item #	Recommendation	Reported on page #
Title and abstract	1	(*a*) Indicate the study's design with a commonly used term in the title or the abstract	1
		(*b*) Provide in the abstract an informative and balanced summary of what was done and what was found	2
Introduction			
Background/rationale	2	Explain the scientific background and rationale for the investigation being reported	4
Objectives	3	State specific objectives, including any prespecified hypotheses	4
Methods			
Study design	4	Present key elements of study design early in the paper	2 & 5
Setting	5	Describe the setting, locations, and relevant dates, including periods of recruitment, exposure, follow-up, and data collection	5
Participants	6	(*a*) Give the eligibility criteria, and the sources and methods of selection of participants	5
Variables	7	Clearly define all outcomes, exposures, predictors, potential confounders, and effect modifiers. Give diagnostic criteria, if applicable	11 & Table 1 & Figure 1
Data sources/ measurement	8*	For each variable of interest, give sources of data and details of methods of assessment (measurement). Describe comparability of assessment methods if there is more than one group	11 & Table 1
Bias	9	Describe any efforts to address potential sources of bias	16
Study size	10	Explain how the study size was arrived at	5
Quantitative variables	11	Explain how quantitative variables were handled in the analyses. If applicable, describe which groupings were chosen and why	11
Statistical methods	12	(*a*) Describe all statistical methods, including those used to control for confounding	6 & 7
		(*b*) Describe any methods used to examine subgroups and interactions	N/A
		(*c*) Explain how missing data were addressed	Treated as missing Table 3 & Table 4
		(*d*) If applicable, describe analytical methods taking account of sampling strategy	N/A
		(*e*) Describe any sensitivity analyses	N/A

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Results			
Participants	13*	(a) Report numbers of individuals at each stage of study—eg numbers potentially eligible, examined for eligibility, confirmed eligible, included in the study, completing follow-up, and analysed	5
		(b) Give reasons for non-participation at each stage	N/A
		(c) Consider use of a flow diagram	N/A
Descriptive data	14*	(a) Give characteristics of study participants (eg demographic, clinical, social) and information on exposures and potential confounders	8 & Table 3
		(b) Indicate number of participants with missing data for each variable of interest	Table 3 & 4
Outcome data	15*	Report numbers of outcome events or summary measures	12 -16
Main results	16	(*a*) Give unadjusted estimates and, if applicable, confounder-adjusted estimates and their precision (eg, 95% confidence interval). Make clear which confounders were adjusted for and why they were included	N/A
		(*b*) Report category boundaries when continuous variables were categorized	N/A
		(*c*) If relevant, consider translating estimates of relative risk into absolute risk for a meaningful time period	N/A
Other analyses	17	Report other analyses done—eg analyses of subgroups and interactions, and sensitivity analyses	N/A
Discussion			
Key results	18	Summarise key results with reference to study objectives	17
Limitations	19	Discuss limitations of the study, taking into account sources of potential bias or imprecision. Discuss both direction and magnitude of any potential bias	22
Interpretation	20	Give a cautious overall interpretation of results considering objectives, limitations, multiplicity of analyses, results from similar studies, and other relevant evidence	2 & 22
Generalisability	21	Discuss the generalisability (external validity) of the study results	22
Other information			
Funding	22	Give the source of funding and the role of the funders for the present study and, if applicable, for the original study on which the present article is based	23

*Give information separately for cases and controls in case-control studies and, if applicable, for exposed and unexposed groups in cohort and cross-sectional studies.

Note: An Explanation and Elaboration article discusses each checklist item and gives methodological background and published examples of transparent reporting. The STROBE checklist is best used in conjunction with this article (freely available on the Web sites of PLoS Medicine at http://www.plosmedicine.org/, Annals of Internal Medicine at http://www.annals.org/, and Epidemiology at http://www.epidem.com/). Information on the STROBE Initiative is available at www.strobe-statement.org.

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BMJ open

Parent-led or Baby-led? Associations between complementary feeding practices and health-related behaviours in a survey of New Zealand families

Journal:	*BMJ Open*
Manuscript ID:	bmjopen-2013-003946.R1
Article Type:	Research
Date Submitted by the Author:	30-Oct-2013
Complete List of Authors:	Cameron, Sonya; University of Otago, Human Nutrition Taylor, Rachael; University of Otago, Medicine Heath, Anne-Louise; University of Otago, Human Nutrition
Primary Subject Heading:	Nutrition and metabolism
Secondary Subject Heading:	Nutrition and metabolism, Paediatrics
Keywords:	NUTRITION & DIETETICS, Complementary feeding, Baby-Led Weaning

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Manuscripts

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Title: Parent-led or Baby-led? Associations between complementary feeding practices and health-related behaviours in a survey of New Zealand families.

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Key words complementary feeding, baby-led weaning.
Word count = 4442

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ABSTRACT

Objective: To determine feeding practices and selected health-related behaviours in New Zealand families following a "baby-led" or more traditional "parent-led" method for introducing complementary foods.

Design, setting and participants: 199 mothers completed an online survey about introducing complementary foods to their infant. Participants were classified into one of four groups: "adherent Baby-Led Weaning (BLW)", the infant mostly or entirely fed themselves at 6-7 months; "self-identified BLW", mothers reported following BLW at 6-7 months but were using spoon-feeding at least half the time; "parent-led feeding", the mother reported not having tried BLW; and "unclassified method", the mother reported they were not following BLW at 6-7 months but reported the infant mostly or entirely fed themselves at 6-7 months.

Results: 8% were following "adherent BLW", 21% "self-identified BLW" and 0% were following the "unclassified method". Compared to "self-identified BLW" and "parent-led feeding", a higher proportion of the "adherent BLW" met the WHO recommendations to exclusively breastfeed for 6 months and to introduce complementary foods at 6 months. The "adherent BLW" group was more likely to have family foods (p=0.018), and less likely (p=0.002) to have commercially prepared baby food. Both BLW groups were more likely to share meals with the family compared to "parent-led feeding". In contrast to "self-identified BLW" and "parent-led feeding", the "adherent BLW" group did not offer iron-fortified cereal as a first food.

Conclusion: This study suggests that although many parents consider they follow BLW, very few are following it strictly. The extent to which BLW was followed was associated with potential benefits (e.g., sharing family meals) and risks (e.g., low iron first foods) highlighting the importance for health professionals and researchers of accurately determining the extent of adherence to BLW.

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ARTICLE SUMMARY

Article focus

- Baby-Led Weaning (BLW) is becoming increasingly popular amongst parents of young infants.
- There are a number of proposed benefits associated with BLW including a healthier BMI, and a number of possible risks, including poorer iron intakes.
- However, very little is known about how BLW is practised in the community and how strictly it is followed by parents.

Key messages

- The extent to which BLW is practised varies.
- The association of BLW with potential benefits and possible risks may differ depending on the extent to which the method is adhered to.
- Most parents use traditional spoon-feeding for introducing complementary foods, but many would be willing to try BLW if they had another infant.

Strengths and limitations of this study

- This is the first study to investigate BLW in the general population.
- The survey was advertised in main urban centres of New Zealand and may not be representative of rural families.
- As the sample size is small results should be interpreted with caution.

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INTRODUCTION

Baby-Led Weaning (BLW) is an alternative method for introducing complementary foods to infants in which the infant feeds themselves hand-held foods instead of being spoon-fed by an adult [1]. Unlike the traditional method of infant feeding where infants may be given finger foods alongside spoon-feeding, and in many countries their introduction is delayed to 7 or 8 months of age ([2 3]), BLW, in its purest form, does not include any spoon-feeding by the adult. The infant is only offered pieces of food, appropriately prepared, so that they can feed themselves.

Although anecdotal evidence suggests that BLW is becoming popular with parents, scientific research is limited to eight publications [4-11]. The small body of existing research suggests that BLW is feasible for most 6-month old infants from a motor development point of view. [7 8] It also suggests that BLW is associated with potential benefits including lower levels of maternal anxiety, restriction, pressure to eat and monitoring during the complementary feeding period; [4] and perhaps healthier eating patterns and BMI. [9] However, none of the studies to date have drawn their BLW cases and parent-led controls from the same population. Given the paucity of current research, and the lack of randomized controlled trials, healthcare professionals [10] and health governing bodies [12] are unwilling to support BLW as a population recommendation. Anecdotal reports suggest that the use of BLW is increasing in New Zealand and other countries including the United Kingdom.

Baby-Led Weaning in its strictest form requires that the infant has complete control over their own eating from the beginning of the complementary feeding period. [1] In theory, BLW is therefore a distinctly different method of infant feeding compared to the traditional method of spoon-feeding purées. [1] However, essential questions, such as how parents actually follow BLW in practice, and the extent to which BLW is associated with health-related behaviours in the general population, remain unanswered.

The aim of this survey was to determine feeding practices and selected health-

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related behaviours in New Zealand families following "baby-led" or more traditional "parent-led" methods for introducing complementary foods.

METHODS

Participants

Two hundred and thirty parents who had an infant aged 6-12 months were recruited from four main urban centres in New Zealand (Auckland, Wellington, Christchurch, Dunedin) by newspaper advertisement. Inclusion criteria were that participants had a healthy child aged 6-12 months who was born full term and was currently living in New Zealand, with no diagnosed neurological or developmental condition. Recruitment for the study stated that we were interested in when and how complementary foods were introduced to babies. To reduce selection bias, BLW was not mentioned. Advertisements for the study provided a web link to the online questionnaire. The study was approved by the Human Ethics Committee of the University of Otago, Dunedin, New Zealand.

Data collection

The population-based, cross-sectional survey was administered from May 2010 to August 2010 (three months in total). Participants could only complete the survey once for one child. Consent and eligibility were established using check boxes that had to be completed before the participant was allowed entry to the survey.

The survey

The current survey questions were based on a web-based infant feeding survey previously administered in the United Kingdom [5], current infant nutrition literature, and consultation with a paediatrician, a paediatric dietitian, and health researchers. The survey was designed and hosted using www.SurveyMonkey.com (Survey Monkey Copyright © 1999 - 2009 SurveyMonkey.com). A pretest was electronically administered to 15 parents with young children aged 1-10 years to verify survey functionality and understandability and the survey was modified based on the pretesting results. The modifications included deleting a repeated question and rephrasing some

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questions to improve clarity.

The online survey was divided into four main sections (Table 1):

1. Starting complementary foods
2. Baby-Led Weaning
3. Attitudes towards, and experiences of, feeding the infant
4. Demographic information

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Table 1. Overview of data collected in the survey

Survey section	Data collected
Section 1: Starting complementary foods	***Timing and type of complementary food*** Participants were asked: Age (months) when infant first had complementary food, main reason(s) for starting food at this age, the type of food given, form the food was in (puréed, mashed, whole), whether the food was home made or commercially prepared. ***Mealtimes and eating patterns**** Participants were asked: Frequency with which they ate with the infant (could have been different foods but baby ate at the same time), frequency infant ate family foods (could have been at a different time but they ate the same food that the rest of the family ate). ***Gagging and choking*** Many parents confuse gagging with choking or find it hard to differentiate between the two [13]. We provided a written description before asking about gagging and choking. Participants were asked: If child had ever gagged or choked and if so, how often, the form (purée, mashed, whole) of food that was involved, child's age when choked.
Section 2: Baby-Led Weaning	Participants were asked: had they tried BLW, the extent to which they had followed BLW, whether they would recommend the method to other parents. Participants who reported not having tried BLW were directed to questions asking their opinion of BLW based on a brief description (table 2) and short 'introduction to BLW' video, which was embedded in the survey. They were asked whether they would try BLW if they had another child and to provide reasons why they would or would not try it.
Section 3: Attitudes towards, and experiences of, feeding the infant	Participants were asked: about their satisfaction with their choice of infant feeding method for the current infant, whether they would consider changing feeding methods if they had another child, reasons for liking or disliking the method of feeding used.
Section 4: Demographic information	Participants were asked: age, sex, ethnicity, education, household, number of other children, employment status, region of New Zealand they lived in.

* To obtain data for all infants at 6 to 7 months of age, parents were asked to answer questions relating to current age and also when the child was 6 to 7 months of age. Parents whose child was currently 6 to 7 months of age only completed this section once and then skipped to the following section.

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Table 2. Description of Baby-Led Weaning included in the Survey

Traditional infant feeding involves offering the baby puréed foods first, then gradually increasing the texture from purée to mash, to lumpy and then to family foods. Baby Led Weaning is different and involves the infant feeding themself right from the start. You offer your baby pieces of soft food of a size and shape that the baby can handle (for example steamed broccoli or carrots). The baby is allowed to explore the food at their own pace and they decide how much they will eat. Rather than preparing separate meals for your baby, they are offered foods similar to what the rest of the family is eating.

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Data analysis

To compare those who considered themselves to be following BLW with those who met stricter criteria for BLW at 6-7 months of age we defined two BLW groups. Figure 1 shows the questions that determined which of the methods parents were considered to have used for introducing complementary foods.

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Figure 1. Survey questions used to classify infant feeding method

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The ***adherent BLW group*** consisted of those who reported having tried BLW, and whose infant mostly or always self-fed at 6 to 7 months (Figure 1). A broader definition of BLW was used to assign parents to the ***self-identified BLW*** group. These participants reported having tried BLW, but spoon-fed their infant at least half the time. All other participants who reported not having tried BLW were classified as either: i) ***parent-led feeding*** (if they reported spoon-feeding their infant at least half the time), or ii) ***unclassified method*** **(**if they reported their infant mostly or always self-fed at 6 to 7 months)**.** This group was named "unclassified" as they were allowing their infant to self-feed (a key premise of BLW) but did not identify themselves as doing BLW.

Information on ethnicity was collected using the 2006 NZ Census of Populations and Dwellings question as recommended by Statistics NZ. [14] Participants who nominated two or more ethnic groups were assigned to a single group using the prioritization system recommended by Statistics NZ, with the order of priority being (from highest to lowest): Māori, Pacific, Asian, Other, NZ European. [14]

Statistical analysis

All analyses were conducted using Stata™ version 12 (STATA Corporation, College Station, Texas, USA). Descriptive statistics were tabulated and Pearson's chi-squared tests and Fishers Exact test (when cell counts were less than 10) were performed to examine differences in proportions. A p-value < 0.05 was considered to indicate statistical significance. Characteristics, and feeding and health-related practices were compared across three groups: 1) "adherent BLW", 2) "self-identified BLW", and 3) "parent-led feeding".

RESULTS

A total of 199 participants completed the online survey (20 of the 230 people recruited did not meet the eligibility criteria and eleven did not complete the entire survey). Most (n=140, 70%) of the sample were classified as "parent-led feeding", 42 (21%) as "self-identified BLW", 17 (9%) as "adherent BLW", and 0 (0%) as "unclassified method". Table 3 presents the participant characteristics.

All participants who answered the survey were mothers. The mean age of the infants was 8.6 months. Approximately half of the mothers in the sample were 30 to 39 years of age, 66% had a tertiary qualification, and 55% had more than one child. Maternal age (p=0.047; a greater proportion of mothers aged 20-29 followed "self-identified BLW") and residing region (p=0.001; "adherent BLW" was most likely among those living in Christchurch and least likely among those living in Auckland) were significantly associated with feeding method. There were no other significant differences in participant characteristics between feeding methods (p≥0.05). Compared to recent national maternity data, the current sample had a higher proportion of New Zealand European (61% vs. 55%), and a lower proportion of Māori (6% vs. 20%), women [15]. The sample also had a higher proportion of mothers with tertiary level education (66% vs. 45%) [16] and a lower proportion of single parents (23% vs. 31%) [17].

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Table 3 Characteristics of participants

		All (n=199)	Parent-led feeding (n= 140) n (%)	Self-identified BLW (n= 42) n (%)	Adherent BLW (n=17) n (%)	p-value
Maternal age at child's birth (years)	<20	13	11 (8.2)	1 (2.4)	1 (6.25)	**0.005**
	20-29	49	28 (20.0)	17 (40.5)	4 (23.5)	
	30-39	103	71 (50.7)	24 (57.1)	8 (47.1)	
	40-49	28	24 (17.1)	0	4 (23.5)	
	Missing	*6*	*6*	*0*	*0*	
Infant age (months)	6-7	52	36 (25.7)	13 (30.9)	3 (17.6)	0.194
	7-8	23	18 (12.9)	2 (4.8)	3 (17.6)	
	8-9	34	27 (19.3)	5 (11.9)	2 (11.8)	
	9-10	31	18 (12.9)	12 (28.6)	1 (5.9)	
	10-11	29	19 (13.6)	5 (11.9)	5 (29.4)	
	11-12	30	22 (15.7)	5 (11.9)	3 (17.6)	
	Missing	*0*	*0*	*0*	*0*	
Maternal education	Year 11 or below**	6	3 (2.1)	3 (7.1)	0	0.572
	Year 12 or 13†	55	39 (27.9)	11 (26.2)	5 (29.4)	
	Post-secondary school	34	27 (19.3)	5 (11.9)	2 (11.8)	
	University degree or higher	98	65 (46.4)	23 (54.8)	10 (58.8)	
	Missing	*6*	*6*	*0*	*0*	
Ethnicity	NZ European	121	78 (55.7)	32 (76.2)	11 (64.7)	0.966
	NZ Māori	12	8 (5.7)	4 (9.5)	0	
	Samoan	2	2 (1.4)	0	0	
	Indian	4	4 (2.9)	0	0	
	Chinese	1	1 (0.7)	0	1 (5.9)	
	English	8	6 (4.3)	2 (4.8)	0	
	Other	10	6 (4.3)	3 (7.1)	1 (5.9)	
	Missing	*40*	*35*	*1*	*4*	
Parity	Primiparous	89	66 (47.1)	14 (33.3)	9 (52.9)	0.240
	Multiparous	110	74 (52.9)	28 (66.7)	8 (47.1)	
	Missing	*0*	*0*	*0*	*0*	
Household composition	Mother and father	160	115 (82.1)	30 (71.4)	15 (88.2)	0.271
	Single parent	23	17 (12.1)	6 (14.3)	0	
	Missing	*16*	*8*	*6*	*2*	
Residing region	Auckland	78	61 (43.6)	17 (43.6)	0	**0.001**
	Wellington	42	28 (20.0)	12 (28.6)	2 (11.8)	
	Christchurch	29	17 (12.1)	4 (9.5)	8 (47.1)	
	Dunedin	31	21 (15.0)	5 (11.9)	5 (29.4)	
	Other	8	7 (5.0)	1 (2.4)	0	
	Missing	*11*	*6*	*3*	*2*	
Maternal employment status	Currently in paid employment	44	25 (18.7)	15 (35.7)	4 (23.5)	0.119
	Not in paid employment	89	62 (46.3)	21 (50.0)	6 (35.3)	
	On parental leave, returning to paid employment	40	32 (23.9)	5 (11.9)	3 (17.6)	
	On parental leave, not returning to paid employment	18	15 (11.2)	1 (2.4)	2 (11.8)	
	Missing	*8*	*6*	*0*	*2*	

211 * p-value compares feeding methods
212 ** Year 11 is usually at age 15-16 years
213 † Years 12 & 13 are usually at ages 16-18 years
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More than half (58%) of the sample surveyed exclusively breastfed their infant to five months of age, and only 4% reported never exclusively breastfeeding. However, 63% of infants received complementary food before the recommended age of six months. A greater number in the "adherent BLW" group (53 %) met the WHO recommendation to exclusively breastfeed for 6 months [18] compared to the "self-identified" (28 %) and "parent-led feeding" (21 %) groups (p=0.026). Similarly, the number managing to meet the recommendation to introduce complementary foods at 6 months was significantly greater in the "adherent BLW" group. A total of 65 % in the "adherent BLW" compared to the 33 % in the "self-identified BLW" and 34% in the "parent-led feeding" group introduced complementary food at ≥6 months (p=0.044).

Table 4 summarizes a range of feeding practices and health-related behaviours. Compared to the "self-identified BLW" and "parent-led feeding" groups, the "adherent BLW" group were more likely to be having foods that the family ate (i.e. the same food but not necessarily at the same time as the rest of the family) (p=0.018), more likely to begin eating family foods when they started complementary foods or within the first month of starting (p<0.001), and were less likely to be offering their baby commercially prepared baby food (p=0.002). Both BLW groups were more likely to be sharing all or most of their meals with the family (i.e. having meals at the same time but not necessarily the same food) compared to "parent-led feeding" (p=0.040). In contrast to the "self-identified BLW" and "parent-led feeding" groups, "adherent BLW" children were not offered infant iron-fortified cereal as their first food.

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Table 4 Feeding practices and health-related behaviours by feeding method used to introduce complementary foods

		All (n=199)	Parent-led feeding (n= 140) n (%)	Self-identified BLW (n= 42) n (%)	Adherent BLW (n=17) n (%)	p-value*
Baby eats family food (*may be modified or eaten at a different time*)	Doesn't eat family foods	8	2 (1.4)	6 (14.3)		**0.018**
	Occasionally	150	113 (80.7)	28 (66.7)	9 (52.9)	
	Most of the time or all of the time	41	25 (17.8)	8 (19.0)	8 (47.1)	
	Missing	*0*	*0*	*0*	*0*	
Age baby started eating family food	When started CF or within 1 mo	20 (10.1)	7 (5.0)	4 (9.5)	9 (52.9)	**<0.001**
	2-4mo after starting CF	68 (34.2)	50 (35.7)	13 (31.0)	5 (31.3)	
	Doesn't eat with family	111 (55.8)	83 (59.3)	25 (59.5)	3 (18.8)	
	Missing	*0*	*0*	*0*	*0*	
Baby shares their meal with the family (*even if food is different*)	None of their meals	43	34 (24.2)	7 (16.7)	2 (11.5)	**0.040**
	Some of their meals	90	67 (47.8)	19 (45.2)	4 (23.5)	
	Most of their meals	48	28 (20.0)	12 (28.6)	8 (47.1)	
	All of their meals	16	9 (6.5)	4 (9.5)	3 (17.6)	
	Missing	*2*	*2*	*0*	*0*	
First food offered	Baby rice cereal	100	75 (53.6)	24 (57.1)	1 (5.9)	**0.001**
	Fruit	70	48 (34.3)	12 (28.6)	10 (58.8)	
	Vegetables	29	17 (12.1)	6 (14.3)	6 (35.3)	
	Meat	*0*	*0*	*0*	*0*	
	Missing	*0*	*0*	*0*	*0*	
Amount of commercially prepared baby food	All of it	14	11(7.9)	3 (7.1)	0	**0.002**
	Most of it	34	21 (15.0)	11 (26.2)	2 (11.8)	
	Half of it	47	38 (27.0)	8 (19.0)	1 (5.9)	
	Hardly any of it	78	58 (41.4)	15 (35.7)	5 (29.4)	
	None of it	26	12 (8.6)	5 (11.9)	9 (52.9)	
	Missing	*0*	*0*	*0*	*0*	
Reported a choking episode	No	130 (67.3)	95 (69.3)	24 (60.0)	11 (68.8)	0.567
	Yes	63 (32.6)	42 (30.7)	16 (40.0)	5 (31.3)	
	Missing	7	*3*	*2*	*2*	
Reported a gagging episode	No	51 (26.2)	39 (27.9)	7 (16.6)	5 (29.4)	0.286
	Yes	143 (73.7)	99 (70.7)	34 (81.0)	10 (58.8)	
	Missing	*5*	*2*	*1*	*2*	

* p-value compares feeding methods
CF Complementary foods
Mo months

Across the whole sample, 32.6% of participants reported at least one choking episode, and most (71.4%) of these participants reported that choking had occurred with whole food. There was no difference between groups for the proportion reporting at least one choking episode, the form (puréed, mashed or whole) that the food was in, or the method of feeding (spoon-feeding or self-feeding) when the choking episode occurred (p>0.05). There was also no group difference in the proportion reporting at least one gagging episode (p>0.05).

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Thirty-eight per cent of all participants had not heard of BLW, 7.6% reported knowing a lot about it, and the remaining 54.1% reported knowing a moderate or small amount. A large proportion of the "parent-led feeding" group had never heard of BLW (64.4%). Participants reported hearing about BLW through a friend or family member rather than from a healthcare professional.

All families who had followed BLW reported that they would recommend the method, but interestingly more than half (59.6%) would recommend that BLW be used in combination with spoon-feeding. Forty-six per cent of those who had followed "parent-led feeding" would be willing to try BLW if they had another child. The main reasons reported for not wanting to try BLW were fear of their infant choking (55.3%), concern about the infant's ability to eat enough (44.2%), reservation that the infant would not have the necessary motor skills to self-feed (27.6%), or considering that "parent-led feeding" had worked fine, so there was no need to change (27.1%).

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DISCUSSION

This is the first study to describe BLW and parent-led feeding in a sample from the general population. In contrast, previous studies have recruited participants separately from BLW specific groups or websites, with controls coming from other sources such as patient lists [9], and nurseries and community centres [4-6]. We found that the association between infant feeding method and health-related behaviours differed depending on the extent to which families followed BLW. This indicates that it is essential for healthcare professionals, as well as researchers, to collect information on the extent of infant self-feeding when parents report following BLW. Compared to the "self-identified BLW" and "parent-led feeding" group, the "adherent BLW" were more likely to meet the WHO recommendations to exclusively breastfeed for 6 months, and to begin complementary foods at 6 months of age. [18] The "adherent BLW" group were also more likely to be having foods that the family ate, and were less likely to be offering their baby commercially prepared baby food. Both BLW groups were more likely to be sharing all or most of their meals with the family compared to the "parent-led feeding" group. In contrast to the "self-identified BLW" and "parent-led feeding", children, "adherent BLW" children were not offered infant iron-fortified cereal as their first food.

In this study, adherent BLW was defined as the baby feeding themselves all or most of the time at 6 to 7 months of age (i.e. little or no parent spoon-feeding). Previous studies [4 5] have defined BLW according to the extent of spoon-feeding and/or purées consumed. As our previous work [10] had suggested that purées could be offered to the self-feeding infant (for instance puréed mince on toast) the definition used here related only to the method of feeding (self-feeding vs. spoon-feeding) and not the form of food (purée, mashed, or whole). In practice only a small number of families (8% of this sample) were classified as following adherent BLW. A large proportion (21%) of families who reported using BLW were instead following a more flexible approach that included a combination of self-feeding and spoon-feeding. This agrees with our earlier qualitative study [10], in which families following BLW also reported using some

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spoon-feeding. Generally this occurred at times when their infant appeared unable to feed themselves (e.g., during illness) or specifically to ensure appropriate iron intake (parents spoon-fed iron-fortified baby cereal at breakfast). This suggests that BLW and spoon-feeding are not viewed as dichotomous methods within the community but instead as styles of infant feeding that can be combined to suit the needs of the child and the family in each feeding situation.

A concern that is commonly expressed about BLW [10] is the potential increased risk of choking when infants self-feed whole foods. When infants transition from milk to solid foods they are at increased risk of choking because they may not have developed the coordination of chewing, breathing and swallowing needed to eat food safely. [19 20] Choking is when the airway is obstructed and respiration is interrupted [21] and food related choking can be fatal. [20 22] Prevalence data on choking are limited, and no data exist on the rates of choking when complementary foods are being introduced, whether using a traditional or a BLW method. The most relevant data available show that in New Zealand in the period from 2002 to 2009, nine deaths occurred in children under six years of age as a result of the inhalation of food, specifically meat, sausage, peanuts, apple and grapes [22]. In contrast, gagging, which is very common among all infants, is less serious. [23] The gag reflex very effectively keeps large pieces of food well to the front of the mouth, only allowing well masticated food to reach the back of the mouth for swallowing. [1 24-26]. In this survey we found no difference between the groups in the proportion reporting at least one gagging or choking episode. However, more than 30% of the total sample reported at least one choking episode, and this mostly commonly involved whole foods. Since choking can be very serious it would be of concern if these reports reflect actual choking rates. Parents often find it difficult to distinguish between choking and gagging and therefore, although we included a definition of both choking and gagging in our survey, it is likely that parents have incorrectly identified choking, in particular mistaking gagging for choking. It is also important to note that because serious choking episodes are rare, this relatively small study was not powered to identify differences in these rates between the complementary

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feeding groups.

We found a number of important associations between feeding method and the likelihood of achieving the nutrition recommendations for infants as outlined by the New Zealand Ministry of Health and WHO [3 18]. The "adherent BLW" group were more likely to meet both the recommendation to exclusively breastfed to six months, and to introduce complementary foods at six months. Two possible explanations for this finding are that the desire to follow BLW results in parents waiting until six months, which is the age when it is considered that most healthy infants are developmentally ready to self-feed, [7 27 28] or that parents who choose BLW are more aware of and adhere to health recommendations. However, it is also feasible that parents who follow a parent-led method are able to encourage their infant to begin complementary foods earlier by feeding purées or infant cereal by spoon, which requires little input from the infant and therefore is not reliant on their developmental ability to actively participate in feeding. The results from the current study are consistent with a cross-sectional study from the United Kingdom where BLW (defined as less than 10% spoon-feeding or less than 10% purée use for total food intake) was associated with later introduction of complementary foods. [5] Furthermore a United Kingdom based survey examining the knowledge of infant feeding guidelines and the influence of healthcare professionals identified BLW as the strongest predictor for introducing complementary foods at the recommended age. [29]

The feeding method used by families was associated with many other potentially health-related behaviours. Those in the "adherent BLW" group were most likely to offer fruits and vegetables as first complementary foods rather than iron-fortified cereal. It is of concern that for the "adherent BLW group" the first foods reported in this survey were poor sources of iron, as this increases the infant's risk of suboptimal iron status [3 30-33]. Although fruits and vegetables are nutrient rich foods, they do not provide all the nutrients necessary for six-month-old children. [3] In particular, infants should receive iron-rich complementary foods such as meat, meat alternatives, or iron-fortified foods immediately when starting complementary foods to supply necessary iron. [3

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30-33] We are unable to determine how long only fruit and vegetables were offered, and at what age iron-rich foods, such as meat, were introduced. However, spoon-feeding iron-fortified baby rice cereal is a popular way for parents to increase their infant's iron intake, [3] and the semi-liquid form of infant cereals makes them a difficult food for infants to feed themselves at six months. In this survey none of the "adherent BLW" group offered infant cereal as a first food. In contrast, some of the "self-identified BLW" group did - presumably by spoon. Conversely, because the infant following BLW is eating family foods there may be greater potential for a wider variety of iron-rich foods such as pieces of cooked red meat to be offered. The bioavailability of iron from these foods is also much higher (15.5%) than from infant cereals (3%) [34]. However, biochemical iron status was not determined in this study so we are unable to determine whether the risk of iron deficiency differed amongst the different complementary feeding groups.

Family meals have been linked to healthier eating patterns including greater intake of fruits and vegetables and lower intake of unhealthy foods. [35-37] However this relationship has only been examined in older children (two years and over) and the benefits of family meals for younger children (i.e., 6 to 12 months) is yet to be determined. Furthermore, no longitudinal studies have investigated whether the health benefits associated with sharing family meals track into later life. Aside from the potential nutritional benefits associated with sharing family meals, there are other important reasons why infants should eat with the family, such as mealtimes providing an opportunity to communicate, learn, and develop family rituals. [38] Our results showed the "adherent BLW" parents were sharing a greater number of meals with their infant, and were likely to be doing this within one month of the initiation of complementary feeding. Brown and Lee [6] reported similar results in their qualitative study. Results from the pilot study (n=10) of Rowan and Harris [11] also showed BLW families were sharing most meals (average of 3 out of the 3.5 meals per day) with their child by 9 months of age.

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In addition to sharing family meals, exposure to family foods (the same foods eaten by other family members) may encourage healthier long-term eating patterns. [39-41] Results from a recent representative Scottish study showed that eating family foods was the most important aspect of family meals associated with a healthier diet at age five years (i.e., it is the food choice that has greater importance than the form and function of the meal). [42] In our survey, the "adherent BLW" infants were having a greater amount of family foods, as well as less commercially purchased food, whereas, families who followed the "parent-led feeding" method reported a greater proportion of commercially prepared food. Whilst purchased baby food is nutritionally appropriate [3] and many parents choose it for this reason, it is typically bland and of a smooth consistency. Only a longitudinal study would be able to determine the effects of early exposure to family foods compared with commercially prepared baby food on long term dietary behaviours.

Most parents in the current study had either followed BLW or would be willing to try it with a subsequent child. All families who had followed BLW reported that they would recommend the method, but interestingly more than half would recommend that BLW be used in combination with spoon-feeding. Although more than one-third of the sample had not heard of BLW, after watching a short video and reading the brief description of BLW embedded in the survey 46% reported being willing to try it with another child. Combining the parents who were willing to use BLW with those who reported already using it suggests that 79% of this sample would be willing to adopt, at least aspects of, a baby-led approach, even though a large proportion had, prior to the survey, not heard of BLW. Those not willing to try BLW were concerned about choking, energy intake, and developmental readiness of the infant to self-feed at six months or considered that the "parent-led feeding" method had worked well for their family, precluding any need to change.

This study has a number of strengths and weaknesses. We attempted to improve the representativeness of our sample by advertising the study in public domains (particularly community distributed free newspapers). Recruiting participants

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from the general population instead of specific groups improves the likelihood of a more representative sample. [43 44] We also avoided mentioning BLW in the advertisement to reduce the bias associated with recruiting only those familiar with BLW. However, as the survey was administered through the Internet it required participants to have access to the Internet and possess computer skills. Recent figures show that 86% of NZ families have personal internet access [45] suggesting a large proportion could access the current survey. However our newspaper advertising was restricted to urban areas and this may have affected our sample, as the demographic characteristics of the current sample do not reflect those of the general New Zealand population in some respects. In particular, the sample was highly educated with more mothers having a university degree (66%) compared to the general population (40%) [46], and the rate of exclusive breastfeeding to 6 months (26 %) was greater than that of the general population (16%) [47]. In addition, although we observed significant associations between the method used for introducing complementary foods and health outcomes, the direction of these associations cannot be determined due to the cross-sectional study design. This highlights the urgency with which prospective studies, and randomised controlled trials of BLW are required so that the nature and direction of health-related associations can be firmly established. Therefore, as this study was relatively small (n=199), may have comprised participants who were more computer literate, and was cross-sectional, caution must be used when interpreting these results.

In conclusion, the majority of our sample were using the parent-led method of spoon-feeding purées to introduce complementary foods to their child. Twenty-one percent of the sample reported using BLW but were not strictly limiting spoon-feeding, and a smaller number (8%) followed a strict BLW approach. We found several important associations between feeding method and health related behaviours, suggesting that greater adherence to the self-feeding tenet of BLW was associated with exclusively breastfeeding for 6 months, beginning complementary foods at 6 months, and eating the same foods as the rest of the family from the start of the complementary feeding period. However, it is concerning that these infants were not offered infant iron-fortified cereal as a

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first food. Both BLW groups were more likely to be sharing all or most of their meals with their family. The results of this study suggest that for many families the practice of BLW deviates substantially from the theory. It is therefore essential that health professionals, as well as researchers, do not rely on parental self-reports of BLW, but also quantify the extent of infant self-feeding.

Acknowledgements We would like to thank all the families who contributed to this study. SC was funded by a University of Otago PhD Scholarship.

Contributors SC, ALH and RWT were all involved with the conception and design of the study, the analysis and interpretation of the data and the writing and editing of this paper. SC designed and executed the online survey and was responsible for the analysis and interpretation of the data. SC wrote the first draft of the paper, and A-L H and RWT made important intellectual contributions to the content and approved the final version.

Funding This research was conducted using the authors' (RWT) resources and received no specific grant from any funding agency in the public, commercial or non-profit sectors.

Competing interests None.

Ethical approval Ethical approval was obtained from the University of Otago Ethics Committee.

Provenance and peer review Not commissioned.

Data sharing statement No additional data are available.

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Title: Parent-led or Baby-led? Associations between complementary feeding practices and health-related behaviours in a survey of New Zealand families.

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Key words complementary feeding, baby-led weaning.
Word count = 4442

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ABSTRACT

Objective: To determine feeding practices and selected health-related behaviours in New Zealand families following a "baby-led" or more traditional "parent-led" method for introducing complementary foods.

Design, setting and participants: 199 mothers completed an online survey about introducing complementary foods to their infant. Participants were classified into one of four groups: "adherent Baby-Led Weaning (BLW)", the infant mostly or entirely fed themselves at 6-7 months; "self-identified BLW", mothers reported following BLW at 6-7 months but were using spoon-feeding at least half the time; "parent-led feeding", the mother reported not having tried BLW; and "unclassified method", the mother reported they were not following BLW at 6-7 months but reported the infant mostly or entirely fed themselves at 6-7 months.

Results: 8% were following "adherent BLW", 21% "self-identified BLW" and 0% were following the "unclassified method". Compared to "self-identified BLW" and "parent-led feeding", a higher proportion of the "adherent BLW" met the WHO recommendations to exclusively breastfeed for 6 months and to introduce complementary foods at 6 months. The "adherent BLW" group was more likely to have family foods (p=0.018), and less likely (p=0.002) to have commercially prepared baby food. Both BLW groups were more likely to share meals with the family compared to "parent-led feeding". In contrast to "self-identified BLW" and "parent-led feeding", the "adherent BLW" group did not offer iron-fortified cereal as a first food.

Conclusion: This study suggests that although many parents consider they follow BLW, very few are following it strictly. The extent to which BLW was followed was associated with potential benefits (e.g., sharing family meals) and risks (e.g., low iron first foods) highlighting the importance for health professionals and researchers of accurately determining the extent of adherence to BLW.

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ARTICLE SUMMARY

Article focus

- Baby-Led Weaning (BLW) is becoming increasingly popular amongst parents of young infants.
- There are a number of proposed benefits associated with BLW including a healthier BMI, and a number of possible risks, including poorer iron intakes.
- However, very little is known about how BLW is practised in the community and how strictly it is followed by parents.

Key messages

- The extent to which BLW is practised varies.
- The association of BLW with potential benefits and possible risks may differ depending on the extent to which the method is adhered to.
- Most parents use traditional spoon-feeding for introducing complementary foods, but many would be willing to try BLW if they had another infant.

Strengths and limitations of this study

- This is the first study to investigate BLW in the general population.
- The survey was advertised in main urban centres of New Zealand and may not be representative of rural families.
- As the sample size is small results should be interpreted with caution.

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INTRODUCTION

Baby-Led Weaning (BLW) is an alternative method for introducing complementary foods to infants in which the infant feeds themselves hand-held foods instead of being spoon-fed by an adult [1]. Unlike the traditional method of infant feeding where infants may be given finger foods alongside spoon-feeding, and in many countries their introduction is delayed to 7 or 8 months of age ([2 3]), BLW, in its purest form, does not include any spoon-feeding by the adult. The infant is only offered pieces of food, appropriately prepared, so that they can feed themselves.

Although anecdotal evidence suggests that BLW is becoming popular with parents, scientific research is limited to eight publications [4-11]. The small body of existing research suggests that BLW is feasible for most 6-month old infants from a motor development point of view. [7 8] It also suggests that BLW is associated with potential benefits including lower levels of maternal anxiety, restriction, pressure to eat and monitoring during the complementary feeding period; [4] and perhaps healthier eating patterns and BMI. [9] However, none of the studies to date have drawn their BLW cases and parent-led controls from the same population. Given the paucity of current research, and the lack of randomized controlled trials, healthcare professionals [10] and health governing bodies [12] are unwilling to support BLW as a population recommendation. Anecdotal reports suggest that the use of BLW is increasing in New Zealand and other countries including the United Kingdom.

Baby-Led Weaning in its strictest form requires that the infant has complete control over their own eating from the beginning of the complementary feeding period. [1] In theory, BLW is therefore a distinctly different method of infant feeding compared to the traditional method of spoon-feeding purées. [1] However, essential questions, such as how parents actually follow BLW in practice, and the extent to which BLW is associated with health-related behaviours in the general population, remain unanswered.

The aim of this survey was to determine feeding practices and selected health-

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related behaviours in New Zealand families following "baby-led" or more traditional "parent-led" methods for introducing complementary foods.

METHODS

Participants

Two hundred and thirty parents who had an infant aged 6-12 months were recruited from four main urban centres in New Zealand (Auckland, Wellington, Christchurch, Dunedin) by newspaper advertisement. Inclusion criteria were that participants had a healthy child aged 6-12 months who was born full term and was currently living in New Zealand, with no diagnosed neurological or developmental condition. Recruitment for the study stated that we were interested in when and how complementary foods were introduced to babies. To reduce selection bias, BLW was not mentioned. Advertisements for the study provided a web link to the online questionnaire. The study was approved by the Human Ethics Committee of the University of Otago, Dunedin, New Zealand.

Data collection

The population-based, cross-sectional survey was administered from May 2010 to August 2010 (three months in total). Participants could only complete the survey once for one child. Consent and eligibility were established using check boxes that had to be completed before the participant was allowed entry to the survey.

The survey

The current survey questions were based on a web-based infant feeding survey previously administered in the United Kingdom [5], current infant nutrition literature, and consultation with a paediatrician, a paediatric dietitian, and health researchers. The survey was designed and hosted using www.SurveyMonkey.com (Survey Monkey Copyright © 1999 - 2009 SurveyMonkey.com). A pretest was electronically administered to 15 parents with young children aged 1-10 years to verify survey functionality and understandability and the survey was modified based on the pretesting results. The modifications included deleting a repeated question and rephrasing some

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questions to improve clarity.

The online survey was divided into four main sections (Table 1):

1. Starting complementary foods
2. Baby-Led Weaning
3. Attitudes towards, and experiences of, feeding the infant
4. Demographic information

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Table 1. Overview of data collected in the survey

Survey section	Data collected
Section 1: Starting complementary foods	***Timing and type of complementary food*** Participants were asked: Age (months) when infant first had complementary food, main reason(s) for starting food at this age, the type of food given, form the food was in (puréed, mashed, whole), whether the food was home made or commercially prepared. ***Mealtimes and eating patterns**** Participants were asked: Frequency with which they ate with the infant (could have been different foods but baby ate at the same time), frequency infant ate family foods (could have been at a different time but they ate the same food that the rest of the family ate). ***Gagging and choking*** Many parents confuse gagging with choking or find it hard to differentiate between the two [13]. We provided a written description before asking about gagging and choking. Participants were asked: If child had ever gagged or choked and if so, how often, the form (purée, mashed, whole) of food that was involved, child's age when choked.
Section 2: Baby-Led Weaning	Participants were asked: had they tried BLW, the extent to which they had followed BLW, whether they would recommend the method to other parents. Participants who reported not having tried BLW were directed to questions asking their opinion of BLW based on a brief description (table 2) and short 'introduction to BLW' video, which was embedded in the survey. They were asked whether they would try BLW if they had another child and to provide reasons why they would or would not try it.
Section 3: Attitudes towards, and experiences of, feeding the infant	Participants were asked: about their satisfaction with their choice of infant feeding method for the current infant, whether they would consider changing feeding methods if they had another child, reasons for liking or disliking the method of feeding used.
Section 4: Demographic information	Participants were asked: age, sex, ethnicity, education, household, number of other children, employment status, region of New Zealand they lived in.

* To obtain data for all infants at 6 to 7 months of age, parents were asked to answer questions relating to current age and also when the child was 6 to 7 months of age. Parents whose child was currently 6 to 7 months of age only completed this section once and then skipped to the following section.

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Table 2. Description of Baby-Led Weaning included in the Survey

Traditional infant feeding involves offering the baby puréed foods first, then gradually increasing the texture from purée to mash, to lumpy and then to family foods. Baby Led Weaning is different and involves the infant feeding themself right from the start. You offer your baby pieces of soft food of a size and shape that the baby can handle (for example steamed broccoli or carrots). The baby is allowed to explore the food at their own pace and they decide how much they will eat. Rather than preparing separate meals for your baby, they are offered foods similar to what the rest of the family is eating.

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Data analysis

To compare those who considered themselves to be following BLW with those who met stricter criteria for BLW at 6-7 months of age we defined two BLW groups. Figure 1 shows the questions that determined which of the methods parents were considered to have used for introducing complementary foods.

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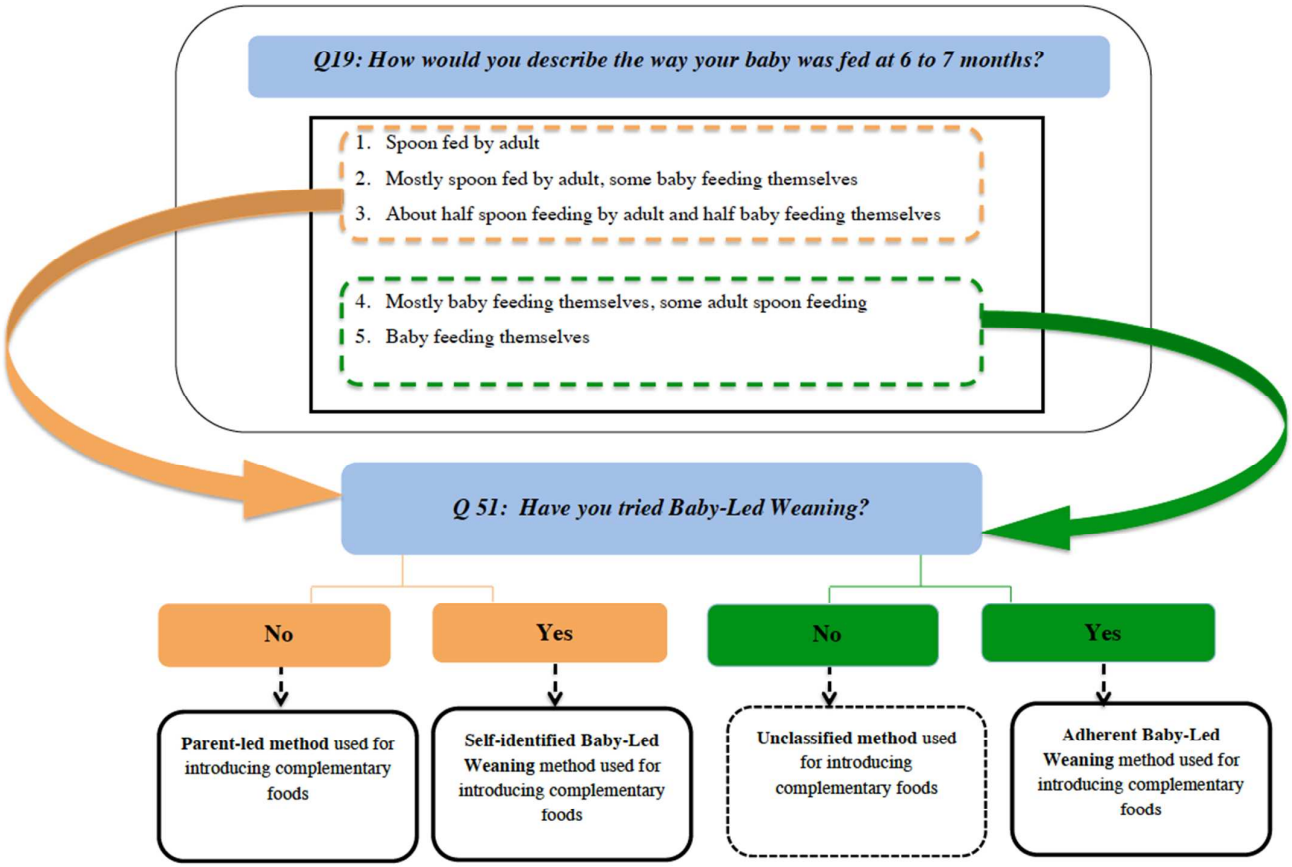

Figure 1. Survey questions used to classify infant feeding method

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The ***adherent BLW group*** consisted of those who reported having tried BLW, and whose infant mostly or always self-fed at 6 to 7 months (Figure 1). A broader definition of BLW was used to assign parents to the ***self-identified BLW*** group. These participants reported having tried BLW, but spoon-fed their infant at least half the time. All other participants who reported not having tried BLW were classified as either: i) ***parent-led feeding*** (if they reported spoon-feeding their infant at least half the time), or ii) ***unclassified method*** **(**if they reported their infant mostly or always self-fed at 6 to 7 months**).** This group was named "unclassified" as they were allowing their infant to self-feed (a key premise of BLW) but did not identify themselves as doing BLW.

Information on ethnicity was collected using the 2006 NZ Census of Populations and Dwellings question as recommended by Statistics NZ. [14] Participants who nominated two or more ethnic groups were assigned to a single group using the prioritization system recommended by Statistics NZ, with the order of priority being (from highest to lowest): Māori, Pacific, Asian, Other, NZ European. [14]

Statistical analysis

All analyses were conducted using Stata™ version 12 (STATA Corporation, College Station, Texas, USA). Descriptive statistics were tabulated and Pearson's chi-squared tests and Fishers Exact test (when cell counts were less than 10) were performed to examine differences in proportions. A p-value < 0.05 was considered to indicate statistical significance. Characteristics, and feeding and health-related practices were compared across three groups: 1) "adherent BLW", 2) "self-identified BLW", and 3) "parent-led feeding".

RESULTS

A total of 199 participants completed the online survey (20 of the 230 people recruited did not meet the eligibility criteria and eleven did not complete the entire survey). Most (n=140, 70%) of the sample were classified as "parent-led feeding", 42 (21%) as "self-identified BLW", 17 (9%) as "adherent BLW", and 0 (0%) as "unclassified method". Table 3 presents the participant characteristics.

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All participants who answered the survey were mothers. The mean age of the infants was 8.6 months. Approximately half of the mothers in the sample were 30 to 39 years of age, 66% had a tertiary qualification, and 55% had more than one child. Maternal age (p=0.047; a greater proportion of mothers aged 20-29 followed "self-identified BLW") and residing region (p=0.001; "adherent BLW" was most likely among those living in Christchurch and least likely among those living in Auckland) were significantly associated with feeding method. There were no other significant differences in participant characteristics between feeding methods (p≥0.05). Compared to recent national maternity data, the current sample had a higher proportion of New Zealand European (61% vs. 55%), and a lower proportion of Māori (6% vs. 20%), women [15]. The sample also had a higher proportion of mothers with tertiary level education (66% vs. 45%) [16] and a lower proportion of single parents (23% vs. 31%) [17].

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Table 3 Characteristics of participants

		All (n=199)	Parent-led feeding (n= 140) n (%)	Self-identified BLW (n= 42) n (%)	Adherent BLW (n=17) n (%)	p-value
Maternal age at child's birth (years)	<20	13	11 (8.2)	1 (2.4)	1 (6.25)	**0.005**
	20-29	49	28 (20.0)	17 (40.5)	4 (23.5)	
	30-39	103	71 (50.7)	24 (57.1)	8 (47.1)	
	40-49	28	24 (17.1)	0	4 (23.5)	
	Missing	*6*	*6*	*0*	*0*	
Infant age (months)						
	6-7	52	36 (25.7)	13 (30.9)	3 (17.6)	0.194
	7-8	23	18 (12.9)	2 (4.8)	3 (17.6)	
	8-9	34	27 (19.3)	5 (11.9)	2 (11.8)	
	9-10	31	18 (12.9)	12 (28.6)	1 (5.9)	
	10-11	29	19 (13.6)	5 (11.9)	5 (29.4)	
	11-12	30	22 (15.7)	5 (11.9)	3 (17.6)	
	Missing	*0*	*0*	*0*	*0*	
Maternal education	Year 11 or below**	6	3 (2.1)	3 (7.1)	0	0.572
	Year 12 or 13†	55	39 (27.9)	11 (26.2)	5 (29.4)	
	Post-secondary school	34	27 (19.3)	5 (11.9)	2 (11.8)	
	University degree or higher	98	65 (46.4)	23 (54.8)	10 (58.8)	
	Missing	*6*	*6*	*0*	*0*	
Ethnicity	NZ European	121	78 (55.7)	32 (76.2)	11 (64.7)	0.966
	NZ Māori	12	8 (5.7)	4 (9.5)	0	
	Samoan	2	2 (1.4)	0	0	
	Indian	4	4 (2.9)	0	0	
	Chinese	1	1 (0.7)	0	1 (5.9)	
	English	8	6 (4.3)	2 (4.8)	0	
	Other	10	6 (4.3)	3 (7.1)	1 (5.9)	
	Missing	*40*	*35*	*1*	*4*	
Parity	Primiparous	89	66 (47.1)	14 (33.3)	9 (52.9)	0.240
	Multiparous	110	74 (52.9)	28 (66.7)	8 (47.1)	
	Missing	*0*	*0*	*0*	*0*	
Household composition	Mother and father	160	115 (82.1)	30 (71.4)	15 (88.2)	0.271
	Single parent	23	17 (12.1)	6 (14.3)	0	
	Missing	*16*	*8*	*6*	*2*	
Residing region	Auckland	78	61 (43.6)	17 (43.6)	0	**0.001**
	Wellington	42	28 (20.0)	12 (28.6)	2 (11.8)	
	Christchurch	29	17 (12.1)	4 (9.5)	8 (47.1)	
	Dunedin	31	21 (15.0)	5 (11.9)	5 (29.4)	
	Other	8	7 (5.0)	1 (2.4)	0	
	Missing	*11*	*6*	*3*	*2*	
Maternal employment status	Currently in paid employment	44	25 (18.7)	15 (35.7)	4 (23.5)	0.119
	Not in paid employment	89	62 (46.3)	21 (50.0)	6 (35.3)	
	On parental leave, returning to paid employment	40	32 (23.9)	5 (11.9)	3 (17.6)	
	On parental leave, not returning to paid employment	18	15 (11.2)	1 (2.4)	2 (11.8)	
	Missing	*8*	*6*	*0*	*2*	

214 * p-value compares feeding methods
215 ** Year 11 is usually at age 15-16 years
216 † Years 12 & 13 are usually at ages 16-18 years
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More than half (58%) of the sample surveyed exclusively breastfed their infant to five months of age, and only 4% reported never exclusively breastfeeding. However, 63% of infants received complementary food before the recommended age of six months. A greater number in the "adherent BLW" group (53 %) met the WHO recommendation to exclusively breastfeed for 6 months [18] compared to the "self-identified" (28 %) and "parent-led feeding" (21 %) groups (p=0.026). Similarly, the number managing to meet the recommendation to introduce complementary foods at 6 months was significantly greater in the "adherent BLW" group. A total of 65 % in the "adherent BLW" compared to the 33 % in the "self-identified BLW" and 34% in the "parent-led feeding" group introduced complementary food at ≥6 months (p=0.044).

Table 4 summarizes a range of feeding practices and health-related behaviours. Compared to the "self-identified BLW" and "parent-led feeding" groups, the "adherent BLW" group were more likely to be having foods that the family ate (i.e. the same food but not necessarily at the same time as the rest of the family) (p=0.018), more likely to begin eating family foods when they started complementary foods or within the first month of starting (p<0.001), and were less likely to be offering their baby commercially prepared baby food (p=0.002). Both BLW groups were more likely to be sharing all or most of their meals with the family (i.e. having meals at the same time but not necessarily the same food) compared to "parent-led feeding" (p=0.040). In contrast to the "self-identified BLW" and "parent-led feeding" groups, "adherent BLW" children were not offered infant iron-fortified cereal as their first food.

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Table 4 Feeding practices and health-related behaviours by feeding method used to introduce complementary foods

		All (n=199)	Parent-led feeding (n= 140) n (%)	Self-identified BLW (n= 42) n (%)	Adherent BLW (n=17) n (%)	p-value*
Baby eats family food (*may be modified or eaten at a different time*)	Doesn't eat family foods	8	2 (1.4)	6 (14.3)		**0.018**
	Occasionally	150	113 (80.7)	28 (66.7)	9 (52.9)	
	Most of the time or all of the time	41	25 (17.8)	8 (19.0)	8 (47.1)	
	Missing	*0*	*0*	*0*	*0*	
Age baby started eating family food	When started CF or within 1 mo	20 (10.1)	7 (5.0)	4 (9.5)	9 (52.9)	**<0.001**
	2-4mo after starting CF	68 (34.2)	50 (35.7)	13 (31.0)	5 (31.3)	
	Doesn't eat with family	111 (55.8)	83 (59.3)	25 (59.5)	3 (18.8)	
	Missing	*0*	*0*	*0*	*0*	
Baby shares their meal with the family (*even if food is different*)	None of their meals	43	34 (24.2)	7 (16.7)	2 (11.5)	**0.040**
	Some of their meals	90	67 (47.8)	19 (45.2)	4 (23.5)	
	Most of their meals	48	28 (20.0)	12 (28.6)	8 (47.1)	
	All of their meals	16	9 (6.5)	4 (9.5)	3 (17.6)	
	Missing	*2*	*2*	*0*	*0*	
First food offered	Baby rice cereal	100	75 (53.6)	24 (57.1)	1 (5.9)	**0.001**
	Fruit	70	48 (34.3)	12 (28.6)	10 (58.8)	
	Vegetables	29	17 (12.1)	6 (14.3)	6 (35.3)	
	Meat	*0*	*0*	*0*	*0*	
	Missing	*0*	*0*	*0*	*0*	
Amount of commercially prepared baby food	All of it	14	11(7.9)	3 (7.1)	0	**0.002**
	Most of it	34	21 (15.0)	11 (26.2)	2 (11.8)	
	Half of it	47	38 (27.0)	8 (19.0)	1 (5.9)	
	Hardly any of it	78	58 (41.4)	15 (35.7)	5 (29.4)	
	None of it	26	12 (8.6)	5 (11.9)	9 (52.9)	
	Missing	*0*	*0*	*0*	*0*	
Reported a choking episode	No	130 (67.3)	95 (69.3)	24 (60.0)	11 (68.8)	0.567
	Yes	63 (32.6)	42 (30.7)	16 (40.0)	5 (31.3)	
	Missing	7	*3*	*2*	*2*	
Reported a gagging episode	No	51 (26.2)	39 (27.9)	7 (16.6)	5 (29.4)	0.286
	Yes	143 (73.7)	99 (70.7)	34 (81.0)	10 (58.8)	
	Missing	*5*	*2*	*1*	*2*	

* p-value compares feeding methods
CF Complementary foods
Mo months

Across the whole sample, 32.6% of participants reported at least one choking episode, and most (71.4%) of these participants reported that choking had occurred with whole food. There was no difference between groups for the proportion reporting at least one choking episode, the form (puréed, mashed or whole) that the food was in, or the method of feeding (spoon-feeding or self-feeding) when the choking episode occurred (p>0.05). There was also no group difference in the proportion reporting at least one gagging episode (p>0.05).

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Thirty-eight per cent of all participants had not heard of BLW, 7.6% reported knowing a lot about it, and the remaining 54.1% reported knowing a moderate or small amount. A large proportion of the "parent-led feeding" group had never heard of BLW (64.4%). Participants reported hearing about BLW through a friend or family member rather than from a healthcare professional.

All families who had followed BLW reported that they would recommend the method, but interestingly more than half (59.6%) would recommend that BLW be used in combination with spoon-feeding. Forty-six per cent of those who had followed "parent-led feeding" would be willing to try BLW if they had another child. The main reasons reported for not wanting to try BLW were fear of their infant choking (55.3%), concern about the infant's ability to eat enough (44.2%), reservation that the infant would not have the necessary motor skills to self-feed (27.6%), or considering that "parent-led feeding" had worked fine, so there was no need to change (27.1%).

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DISCUSSION

This is the first study to describe BLW and parent-led feeding in a sample from the general population. In contrast, previous studies have recruited participants separately from BLW specific groups or websites, with controls coming from other sources such as patient lists [9], and nurseries and community centres [4-6]. We found that the association between infant feeding method and health-related behaviours differed depending on the extent to which families followed BLW. This indicates that it is essential for healthcare professionals, as well as researchers, to collect information on the extent of infant self-feeding when parents report following BLW. Compared to the "self-identified BLW" and "parent-led feeding" group, the "adherent BLW" were more likely to meet the WHO recommendations to exclusively breastfeed for 6 months, and to begin complementary foods at 6 months of age. [18] The "adherent BLW" group were also more likely to be having foods that the family ate, and were less likely to be offering their baby commercially prepared baby food. Both BLW groups were more likely to be sharing all or most of their meals with the family compared to the "parent-led feeding" group. In contrast to the "self-identified BLW" and "parent-led feeding", children, "adherent BLW" children were not offered infant iron-fortified cereal as their first food.

In this study, adherent BLW was defined as the baby feeding themselves all or most of the time at 6 to 7 months of age (i.e. little or no parent spoon-feeding). Previous studies [4 5] have defined BLW according to the extent of spoon-feeding and/or purées consumed. As our previous work [10] had suggested that purées could be offered to the self-feeding infant (for instance puréed mince on toast) the definition used here related only to the method of feeding (self-feeding vs. spoon-feeding) and not the form of food (purée, mashed, or whole). In practice only a small number of families (8% of this sample) were classified as following adherent BLW. A large proportion (21%) of families who reported using BLW were instead following a more flexible approach that included a combination of self-feeding and spoon-feeding. This agrees with our earlier qualitative study [10], in which families following BLW also reported using some spoon-feeding. Generally this occurred at times when their infant appeared

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unable to feed themselves (e.g., during illness) or specifically to ensure appropriate iron intake (parents spoon-fed iron-fortified baby cereal at breakfast). This suggests that BLW and spoon-feeding are not viewed as dichotomous methods within the community but instead as styles of infant feeding that can be combined to suit the needs of the child and the family in each feeding situation.

A concern that is commonly expressed about BLW [10] is the potential increased risk of choking when infants self-feed whole foods. When infants transition from milk to solid foods they are at increased risk of choking because they may not have developed the coordination of chewing, breathing and swallowing needed to eat food safely. [19 20] Choking is when the airway is obstructed and respiration is interrupted [21] and food related choking can be fatal. [20 22] Prevalence data on choking are limited, and no data exist on the rates of choking when complementary foods are being introduced, whether using a traditional or a BLW method. The most relevant data available show that in New Zealand in the period from 2002 to 2009, nine deaths occurred in children under six years of age as a result of the inhalation of food, specifically meat, sausage, peanuts, apple and grapes [22]. In contrast, gagging, which is very common among all infants, is less serious. [23] The gag reflex very effectively keeps large pieces of food well to the front of the mouth, only allowing well masticated food to reach the back of the mouth for swallowing. [1 24-26]. In this survey we found no difference between the groups in the proportion reporting at least one gagging or choking episode. However, more than 30% of the total sample reported at least one choking episode, and this mostly commonly involved whole foods. Since choking can be very serious it would be of concern if these reports reflect actual choking rates. Parents often find it difficult to distinguish between choking and gagging and therefore, although we included a definition of both choking and gagging in our survey, it is likely that parents have incorrectly identified choking, in particular mistaking gagging for choking. It is also important to note that because serious choking episodes are rare, this relatively small study was not powered to identify differences in these rates between the complementary feeding groups.

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We found a number of important associations between feeding method and the likelihood of achieving the nutrition recommendations for infants as outlined by the New Zealand Ministry of Health and WHO [3 18]. The "adherent BLW" group were more likely to meet both the recommendation to exclusively breastfed to six months, and to introduce complementary foods at six months. Two possible explanations for this finding are that the desire to follow BLW results in parents waiting until six months, which is the age when it is considered that most healthy infants are developmentally ready to self-feed, [7 27 28] or that parents who choose BLW are more aware of and adhere to health recommendations. However, it is also feasible that parents who follow a parent-led method are able to encourage their infant to begin complementary foods earlier by feeding purées or infant cereal by spoon, which requires little input from the infant and therefore is not reliant on their developmental ability to actively participate in feeding. The results from the current study are consistent with a cross-sectional study from the United Kingdom where BLW (defined as less than 10% spoon-feeding or less than 10% purée use for total food intake) was associated with later introduction of complementary foods. [5] Furthermore a United Kingdom based survey examining the knowledge of infant feeding guidelines and the influence of healthcare professionals identified BLW as the strongest predictor for introducing complementary foods at the recommended age. [29]

The feeding method used by families was associated with many other potentially health-related behaviours. Those in the "adherent BLW" group were most likely to offer fruits and vegetables as first complementary foods rather than iron-fortified cereal. It is of concern that for the "adherent BLW group" the first foods reported in this survey were poor sources of iron, as this increases the infant's risk of suboptimal iron status [3 30-33]. Although fruits and vegetables are nutrient rich foods, they do not provide all the nutrients necessary for six-month-old children. [3] In particular, infants should receive iron-rich complementary foods such as meat, meat alternatives, or iron-fortified foods immediately when starting complementary foods to supply necessary iron. [3 30-33] We are unable to determine how long only fruit and vegetables were

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offered, and at what age iron-rich foods, such as meat, were introduced. However, spoon-feeding iron-fortified baby rice cereal is a popular way for parents to increase their infant's iron intake, [3] and the semi-liquid form of infant cereals makes them a difficult food for infants to feed themselves at six months. In this survey none of the "adherent BLW" group offered infant cereal as a first food. In contrast, some of the "self-identified BLW" group did - presumably by spoon. Conversely, because the infant following BLW is eating family foods there may be greater potential for a wider variety of iron-rich foods such as pieces of cooked red meat to be offered. The bioavailability of iron from these foods is also much higher (15.5%) than from infant cereals (3%) [34]. However, biochemical iron status was not determined in this study so we are unable to determine whether the risk of iron deficiency differed amongst the different complementary feeding groups.

Family meals have been linked to healthier eating patterns including greater intake of fruits and vegetables and lower intake of unhealthy foods. [35-37] However this relationship has only been examined in older children (two years and over) and the benefits of family meals for younger children (i.e., 6 to 12 months) is yet to be determined. Furthermore, no longitudinal studies have investigated whether the health benefits associated with sharing family meals track into later life. Aside from the potential nutritional benefits associated with sharing family meals, there are other important reasons why infants should eat with the family, such as mealtimes providing an opportunity to communicate, learn, and develop family rituals. [38] Our results showed the "adherent BLW" parents were sharing a greater number of meals with their infant, and were likely to be doing this within one month of the initiation of complementary feeding. Brown and Lee [6] reported similar results in their qualitative study. Results from the pilot study (n=10) of Rowan and Harris [11] also showed BLW families were sharing most meals (average of 3 out of the 3.5 meals per day) with their child by 9 months of age.

In addition to sharing family meals, exposure to family foods (the same foods eaten by other family members) may encourage healthier long-term eating

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patterns. [39-41] Results from a recent representative Scottish study showed that eating family foods was the most important aspect of family meals associated with a healthier diet at age five years (i.e., it is the food choice that has greater importance than the form and function of the meal). [42] In our survey, the "adherent BLW" infants were having a greater amount of family foods, as well as less commercially purchased food, whereas, families who followed the "parent-led feeding" method reported a greater proportion of commercially prepared food. Whilst purchased baby food is nutritionally appropriate [3] and many parents choose it for this reason, it is typically bland and of a smooth consistency. Only a longitudinal study would be able to determine the effects of early exposure to family foods compared with commercially prepared baby food on long term dietary behaviours.

Most parents in the current study had either followed BLW or would be willing to try it with a subsequent child. All families who had followed BLW reported that they would recommend the method, but interestingly more than half would recommend that BLW be used in combination with spoon-feeding. Although more than one-third of the sample had not heard of BLW, after watching a short video and reading the brief description of BLW embedded in the survey 46% reported being willing to try it with another child. Combining the parents who were willing to use BLW with those who reported already using it suggests that 79% of this sample would be willing to adopt, at least aspects of, a baby-led approach, even though a large proportion had, prior to the survey, not heard of BLW. Those not willing to try BLW were concerned about choking, energy intake, and developmental readiness of the infant to self-feed at six months or considered that the "parent-led feeding" method had worked well for their family, precluding any need to change.

This study has a number of strengths and weaknesses. We attempted to improve the representativeness of our sample by advertising the study in public domains (particularly community distributed free newspapers). Recruiting participants from the general population instead of specific groups improves the likelihood of a more representative sample. [43 44] We also avoided mentioning BLW in the

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advertisement to reduce the bias associated with recruiting only those familiar with BLW. However, as the survey was administered through the Internet it required participants to have access to the Internet and possess computer skills. Recent figures show that 86% of NZ families have personal internet access [45] suggesting a large proportion could access the current survey. However our newspaper advertising was restricted to urban areas and this may have affected our sample, as the demographic characteristics of the current sample do not reflect those of the general New Zealand population in some respects. In particular, the sample was highly educated with more mothers having a university degree (66%) compared to the general population (40%) [46], and the rate of exclusive breastfeeding to 6 months (26 %) was greater than that of the general population (16%) [47]. In addition, although we observed significant associations between the method used for introducing complementary foods and health outcomes, the direction of these associations cannot be determined due to the cross-sectional study design. This highlights the urgency with which prospective studies, and randomised controlled trials of BLW are required so that the nature and direction of health-related associations can be firmly established. Therefore, as this study was relatively small (n=199), may have comprised participants who were more computer literate, and was cross-sectional, caution must be used when interpreting these results.

In conclusion, the majority of our sample were using the parent-led method of spoon-feeding purées to introduce complementary foods to their child. Twenty-one percent of the sample reported using BLW but were not strictly limiting spoon-feeding, and a smaller number (8%) followed a strict BLW approach. We found several important associations between feeding method and health related behaviours, suggesting that greater adherence to the self-feeding tenet of BLW was associated with exclusively breastfeeding for 6 months, beginning complementary foods at 6 months, and eating the same foods as the rest of the family from the start of the complementary feeding period. However, it is concerning that these infants were not offered infant iron-fortified cereal as a first food. Both BLW groups were more likely to be sharing all or most of their meals with their family. The results of this study suggest that for many families

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the practice of BLW deviates substantially from the theory. It is therefore essential that health professionals, as well as researchers, do not rely on parental self-reports of BLW, but also quantify the extent of infant self-feeding.

Acknowledgements We would like to thank all the families who contributed to this study. SC was funded by a University of Otago PhD Scholarship.

Contributors SC, ALH and RWT were all involved with the conception and design of the study, the analysis and interpretation of the data and the writing and editing of this paper. SC designed and executed the online survey and was responsible for the analysis and interpretation of the data. SC wrote the first draft of the paper, and A-L H and RWT made important intellectual contributions to the content and approved the final version.

Funding This research was conducted using the authors' (RWT) resources and received no specific grant from any funding agency in the public, commercial or non-profit sectors.

Competing interests None.

Ethical approval Ethical approval was obtained from the University of Otago Ethics Committee.

Provenance and peer review Not commissioned.

Data sharing statement No additional data are available.

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STROBE 2007 (v4) Statement—Checklist of items that should be included in reports of *cross-sectional studies*

Section/Topic	Item #	Recommendation	Reported on page #
Title and abstract	1	(*a*) Indicate the study's design with a commonly used term in the title or the abstract	1
		(*b*) Provide in the abstract an informative and balanced summary of what was done and what was found	2
Introduction			
Background/rationale	2	Explain the scientific background and rationale for the investigation being reported	4
Objectives	3	State specific objectives, including any prespecified hypotheses	4
Methods			
Study design	4	Present key elements of study design early in the paper	2 & 5
Setting	5	Describe the setting, locations, and relevant dates, including periods of recruitment, exposure, follow-up, and data collection	5
Participants	6	(*a*) Give the eligibility criteria, and the sources and methods of selection of participants	5
Variables	7	Clearly define all outcomes, exposures, predictors, potential confounders, and effect modifiers. Give diagnostic criteria, if applicable	11 & Table 1 & Figure 1
Data sources/ measurement	8*	For each variable of interest, give sources of data and details of methods of assessment (measurement). Describe comparability of assessment methods if there is more than one group	11 & Table 1
Bias	9	Describe any efforts to address potential sources of bias	16
Study size	10	Explain how the study size was arrived at	5
Quantitative variables	11	Explain how quantitative variables were handled in the analyses. If applicable, describe which groupings were chosen and why	11
Statistical methods	12	(*a*) Describe all statistical methods, including those used to control for confounding	6 & 7
		(*b*) Describe any methods used to examine subgroups and interactions	N/A
		(*c*) Explain how missing data were addressed	Treated as missing Table 3 & Table 4
		(*d*) If applicable, describe analytical methods taking account of sampling strategy	N/A
		(*e*) Describe any sensitivity analyses	N/A

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Results			
Participants	13*	(a) Report numbers of individuals at each stage of study—eg numbers potentially eligible, examined for eligibility, confirmed eligible, included in the study, completing follow-up, and analysed	5
		(b) Give reasons for non-participation at each stage	N/A
		(c) Consider use of a flow diagram	N/A
Descriptive data	14*	(a) Give characteristics of study participants (eg demographic, clinical, social) and information on exposures and potential confounders	8 & Table 3
		(b) Indicate number of participants with missing data for each variable of interest	Table 3 & 4
Outcome data	15*	Report numbers of outcome events or summary measures	12 -16
Main results	16	(*a*) Give unadjusted estimates and, if applicable, confounder-adjusted estimates and their precision (eg, 95% confidence interval). Make clear which confounders were adjusted for and why they were included	N/A
		(*b*) Report category boundaries when continuous variables were categorized	N/A
		(*c*) If relevant, consider translating estimates of relative risk into absolute risk for a meaningful time period	N/A
Other analyses	17	Report other analyses done—eg analyses of subgroups and interactions, and sensitivity analyses	N/A
Discussion			
Key results	18	Summarise key results with reference to study objectives	17
Limitations	19	Discuss limitations of the study, taking into account sources of potential bias or imprecision. Discuss both direction and magnitude of any potential bias	22
Interpretation	20	Give a cautious overall interpretation of results considering objectives, limitations, multiplicity of analyses, results from similar studies, and other relevant evidence	2 & 22
Generalisability	21	Discuss the generalisability (external validity) of the study results	22
Other information			
Funding	22	Give the source of funding and the role of the funders for the present study and, if applicable, for the original study on which the present article is based	23

*Give information separately for cases and controls in case-control studies and, if applicable, for exposed and unexposed groups in cohort and cross-sectional studies.

Note: An Explanation and Elaboration article discusses each checklist item and gives methodological background and published examples of transparent reporting. The STROBE checklist is best used in conjunction with this article (freely available on the Web sites of PLoS Medicine at http://www.plosmedicine.org/, Annals of Internal Medicine at http://www.annals.org/, and Epidemiology at http://www.epidem.com/). Information on the STROBE Initiative is available at www.strobe-statement.org.

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UNIVERSITY of OTAGO
Te Whare Wānanga o Otāgo

Professor Richard Sands
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28/10/2013

Dear Professor Sands

Thank you for your email on 14/10/2013 advising us that our manuscript "Parent-led or Baby-led? Associations between complementary feeding practices and health-related behaviours in a survey of New Zealand families" (Manuscript ID bmjopen-2013-003946) has been recommended for publication in *BMJ Open*.

We have carefully considered the comments of each reviewer and provide an itemized discussion of each point (reviewer's comments in italics) with our revised manuscript as follows:

Reviewer #1 (Remarks to the Author):

1. ***The discussion would benefit from more explicit articulation and examination of the problem of causality in the relationship between adherent BLW and related health behaviours.***

Additional discussion regarding causality has been added to the Discussion (page 22, lines 445-451).

2. ***The tables would benefit from having the test statistics added rather than just the p-values.***

We used the Pearson's chi-squared test to determine whether there were statistically significant differences between the complementary feeding groups because this enabled us to compare proportions. This approach does not produce a meaningful test statistic. To clarify this we have replaced "chi square test" with "Pearson's chi-squared test" in the statistical methods section (page 11, line 188).

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Reviewer #2 (Remarks to the Author):

1. ***As a minor point, the first sentence doesn't seem to quite flow. I think a clear and slightly more detailed definition of blw is needed.***

Further detail about BLW has been added as requested (page 4, lines 87- 95).

2. ***I think the categorization using the two elements of whether the parent identified themselves as baby-led or not and then their behavior is very interesting. I think this needs further consideration in the discussion section though and is a critical point for future research. There must be some parents in the sample (or in the general population currently weaning their babies) who display similar behaviours but label themselves as baby-led or not. So they have the same amount of spoon feeding, but one considers themselves to be baby-led, the other has never heard of it. Is this important? Might this affect outcomes for the child?***

This is a very interesting point and certainly warrants further investigation. We have revised Figure 1 to better reflect the nature of the groups, i.e., participants were classified first by whether they were self-feeding, and then by whether or not they considered that they were following BLW. We had not included a group for participants who were self-feeding but did not identify themselves as following BLW because there were no cases of this in the study sample. For completeness, and clarity, Figure 1 now includes a group who were "unclassified", and we have specifically stated in the Results (page 11, lines 200-201) that no cases of the "unclassified" method were found. We agree that it would be very interesting to see a study in which the elements of responsive feeding were considered alongside those of BLW, because it is possible that any health benefits of BLW are mediated by responsive feeding.

3. ***You raise the point in the discussion that parents want to do a mix of blw and spoon feeding – but how is that different to normal weaning practices? In the UK it is recommended that babies are given finger foods alongside purees from six months. Does this matter? Does the label of baby-led matter? Is it a way of thinking?***

In New Zealand BLW is not compatible with the New Zealand Ministry of Health (MOH) guidelines and, indeed, is not supported by the Ministry of Health (at least as a population approach) due to a lack of evidence regarding its use (*http://www.health.govt.nz/our-work/preventative-health-wellness/nutrition/baby-led-weaning-ministry-position-statement*). The conventional method of infant feeding currently advised and supported by the MOH and NZ healthcare professionals is to spoon-feed purées from 6 months and not to introduce finger foods until at least 7-8 months, at which time they would generally only represent a small proportion of the diet. Therefore, mothers following BLW are seen as following an alternative method in NZ, at least at this point in time. Although infants in the UK are recommended to have finger-foods from 6 months of age we would assume that only a small proportion would be making these the main component of their diet. It would be interesting to see a similar study from the UK in which spoon-

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feeding and self-feeding rates are compared in parents who identify as doing BLW, and parents following the traditional method of feeding. Certainly studies to date (including the present one) suggest that the mothers who follow BLW are demographically different and have different levels of control around feeding. This suggests that BLW may be a group of behaviours, perhaps including a more responsive feeding style, and not just a single behaviour working in isolation.

4. ***This leads me to my second point. Essentially, what is baby-led weaning? Is it about what foods the baby is given? How they are fed/feed themselves? Whether they join in mealtimes? Or is it more about letting the baby control their intake or even just a way of thinking about weaning and child feeding in general? When does someone become classed as blw? I know a key debate on blw forums is whether someone classes themselves as blw or not. Some believe you have to be very adherent, others are more relaxed and occasionally give purees. Does spoon feeding matter? Or is it more about how they are spoon fed if they are – responsively? I think a key question for future research is 'what is important about the method'. Evidence is starting to emerge that the method may have a positive impact upon child eating behavior and weight but WHY does this occur? What is 'special' about the method? Or is it just something different about the mothers who choose to follow it? Finally can those elements ever be applied to standard weaning for those who don't want to follow blw?***

Please see response to point 3.

5. ***There are very high rates of exclusive breastfeeding in your sample which I presume are far exceeding population norms for NZ. This limitation needs to be considered.***

We acknowledge the reviewer's point and agree that is it uncommon for mothers to exclusively breastfeed to 6 months in New Zealand (current national rate of exclusive breastfeeding at 6 months is 16%). We have added a sentence to the Discussion (page 22, lines 443-445).

6. ***The numbers in the sample of those who are adherent to blw are very low. This is natural due to the recruitment methods used but does offer a small group for comparison.***

We acknowledge the reviewer's comment. It is reassuring that although the number of parents who were adherent to BLW was small, it did still provide sufficient power to demonstrate small, but statistically significant, associations between this group and health related outcomes. However, it would be important to examine the non-significant variables such as choking and gagging in a larger sample before coming to any conclusions about their presence or absence in infants following BLW (a comment to this effect has been added to the Discussion page 18 lines 334-337).

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7. ***Also, even within this adherent group, many report behaviours that are at odds with definitions of adherent BLW. For example a proportion gave baby rice as their first food. Many use commercial foods to some extent. Others don't eat as a family with their baby. I think any definition of BLW needs to allow some variation – but I think this could possibly be a further discussion point. Again, what is BLW, do you have to follow it strictly and what elements are most important?***

This is a very interesting point. As our previous work (Cameron, Heath and Taylor BMJ Open 2012) had suggested that purées could be offered to the self-feeding infant (for instance puréed mince on toast) the definition used here related only to the method of feeding (i.e., self-feeding vs. spoon-feeding) and not to the form of food (i.e., purée, mashed, or whole). Therefore we classified 'adherent BLW' as meeting a minimum and specific criterion (i.e., infant always or mostly self-feeds). Only a longitudinal study could determine what are the important aspects of BLW and presumably this would depend on the desired outcome.

Reviewer #3 (Remarks to the Author):

1. ***More could be done in the ms to show how representative of the population this sample was. I feel information should be divided by the four main regions sampled. So, for example, how many children were eligible to be included in this study from health records, and how many were actually recruited? How did this vary across key demographic groups (such as maternal age)? The authors touch on this, but I feel more could and should be done to support the initial claim.***

   We acknowledge the reviewer's comment about the representativeness of the sample and have added detail to the Results (page 12, lines 210-214). However, we do not feel it is appropriate to present the data by region because (a) this would substantially reduce the sample size for comparisons, and (b) we do not know how many children were eligible in each region. Unlike other BLW studies where participants have been recruited from health records, the participants in the current study were recruited from the general population via advertisement in local newspapers. Thus, no response rate can be calculated.

2. ***Is it that health professionals should be more willing to promote BLW because parents are open to this approach when given information about it, and that it doesn't seem to be associated with a higher incidence of the types of behaviours parents are concerned with the approach, such as choking? I feel the key messages could be pulled out more explicitly through carefully rewriting some sections of text.***

   The main message of this study was that although parents may identify themselves as following BLW, it is important that healthcare professionals delve deeper into what BLW means for each family. We found that different levels of adherence to BLW were associated with different health related behaviours. We

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have re-written sections of the manuscript to make this more apparent.

3. ***Comments were made in the discussion about picky eating but the ms does not report data on this. Other studies have looked at this though, so maybe some reference to these studies would be appropriate.***

   We agree with the authors and have removed these comments from the Discussion.

4. ***When discussing the intake of iron rich foods was there any evidence that the A-BLW group were deficient in iron? If this wasn't studied perhaps indicate this as a limitation to the study, as without objective data we cannot tell if there is a difference in iron deficiency between the two groups so the discussion might be somewhat redundant.***

   We agree and have added this cautionary note on page 20, lines 378-380.

We hope that the revised manuscript is considered suitable for publication in *BMJ Open* and look forward to hearing from you in due course.

Yours sincerely,

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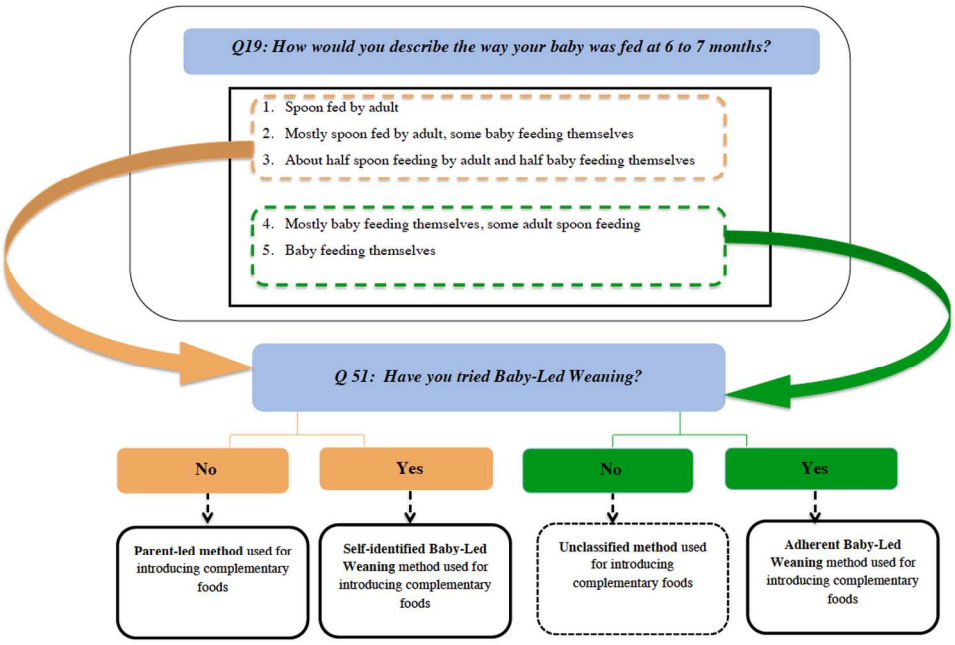

Figure 1. Survey questions used to classify infant feeding method

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