Relative validity of a dietary interview for assessing infant diet and compliance in a dietary intervention trial

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Abstract

The objective of this study was to assess the relative validity of a dietary interview method for use in an infant population. A dietary interview covering a 1-month period was completed during a study visit at 3 or 6 months of age. It included structured questions and a short food frequency questionnaire (FFQ). The information was compared with data from two 48-h recall interviews conducted during the month previous to the study visit. The agreement between the FFQ and 48-h recalls was analysed as proportion of subjects classified into the same categories of consumption frequency and by the kappa analysis. A total of 100 subjects, at the age of 2–3 months ($n = 50$) and 5–6 months ($n = 50$), were included. The kappa values for breastmilk and study formula ranged from 0.82 to 0.95, indicating very good agreement. The agreement for other foods and vitamin D supplementation ranged from fair to very good. We also found a strong correlation for the reported amount of study formula consumed per feeding at 3 months ($r_s = 0.87$, $n = 24$) and 6 months of age ($r_s = 0.73$, $n = 35$) between the questionnaire and 48-h recall data. However, the average amount of study formula per feeding was significantly higher when estimated for a 1-month period, compared with a mean calculated from the two 48-h recalls. As a conclusion, the interview was found to be a useful tool for assessing diet and compliance in a dietary intervention for infants.

Keywords: dietary methodology, food frequency questionnaire, infants.

Introduction

There is increasing evidence that diet during early infancy may affect the risk of developing type 1 diabetes (IDDM: insulin-dependent diabetes mellitus) during childhood (Virtanen & Knip 2003). The Trial to Reduce IDDM in the Genetically at Risk (TRIGR) was designed to determine whether wean-

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ing infants to a highly hydrolyzed infant formula compared with a regular cow's milk-based one prevents type 1 diabetes. The TRIGR is an international randomized double-blind trial. Families with a member(s) with type 1 diabetes (father, mother, full sibling) expecting a baby or having a newborn baby are recruited to the TRIGR, and infants with increased genetic risk are invited to continue in the study (Åkerblom *et al.* 2005). During the dietary intervention period, the parents are advised to eliminate all foods that contain cow's milk or beef from the child's diet. Apart from this, national recommendations on infant nutrition are followed. Mothers are encouraged to breastfeed, but should additional milk be needed, study formula, which is either regular cow's milk-based or hydrolyzed infant formula, should be used. The diet and dietary compliance of the infant is assessed by a dietary interview at 2 weeks (± 3 days), and 1 and 2 months of age (± 7 days), and once a month thereafter (± 14 days) until the end of the dietary intervention between 6 and 8 months of age. The interview consists of structured questions on breastfeeding and study formula use, as well as on frequency of use of breastmilk, study formula and other recommended and non-recommended complementary foods. The aim of this study was to examine the performance of the dietary interview in assessing diet and dietary compliance during the dietary intervention at two time points: 3 and 6 months of age.

Subjects

The subjects in the present validation study were the first 100 consecutive children participating in the TRIGR in Finland. They were born between 2002 and 2003 and recruited at 16 study centres. At the time of the validation study, the children were between the age of 2–3 months ($n = 50$) or between the age of 5–6 months ($n = 50$). Their parents' mean age and self-reported length of education are presented in Table 1.

Methods

The TRIGR study protocol was approved by The Coordinating Ethics Committee of the Hospital District of Helsinki and Uusimaa.

Table 1. Characteristics of the sample

	3-month age group	6-month age group
<i>n</i>	50	50
Girls/boys	26/24	21/29
Parents' age (years): mean (min, max)		
Mothers	30 (21, 40)	30 (19, 41)
Fathers	33 (20, 47)	32 (19, 49)
Parents' education (years): mean (min, max)		
Mothers	15 (11, 24)	15 (9, 21)
Fathers	14 (9, 22)	14 (9, 20)

The TRIGR dietary interview questionnaires used at the 3- and 6-month interviews include two parts. In both of the questionnaires, the first part includes questions concerning breastfeeding and study formula use. Parents are asked whether the child is being breastfed at the time of the interview. Furthermore, the age (as weeks) at the end of breastfeeding, the age at the end of exclusive breastfeeding, the age at starting study formula, the duration of study formula feeding and the average amount of study formula used per feeding during the previous month are asked. The definition of exclusive breastfeeding is that the child has not received anything other than breastmilk (banked or mother's own), supplementary vitamins or minerals, or water. The second part is a food frequency questionnaire (FFQ), which includes foods that are allowed during the dietary intervention according to the study protocol (10 items, see Appendix 1), as well as foods that contain cow's milk protein or beef and are not recommended during the dietary intervention (seven items). The FFQ is identical for both age groups and covers the month previous to the interview. In the FFQ, the parent is asked to specify the frequency of consumption of each food as one of the following: not at all; less than once a week; 1–3 times a week; 4–6 times a week; 1–2 times a day; 3–4 times a day; and 5 times or more a day. If the child has started to receive some food less than 1 month earlier, the interviewer asks the frequency during the period the child has been receiving the food, and the average frequency during the 1-month period is calculated. As a part of the normal trial protocol, a study

dietician or nurse completed the dietary interview questionnaire during the TRIGR study visit at the hospital at 3 and 6 months of age. The study visit also included height and weight measurement and a blood draw.

To assess the relative validity of the dietary interview questionnaire described above, food consumption data for 4 days that represent the period covered by the dietary interview questionnaire were collected by two 48-h recall interviews. A dietician conducted the interviews with the mothers by telephone. The mother was asked to report in detail what the infant had eaten during the two previous days. The dietician recorded the time of each breastfeeding, and the time and amount of complementary foods, infant formula and dietary supplements consumed. The two 48-h recalls were conducted during the month prior to the 3- or 6-month dietary interview, and the time between the recalls was 5–20 days (median 9 days). In addition to the 48-h recall interviews, the parents were asked to report the age of giving different foods to the child for the first time. This information was recorded on a short additional questionnaire during the 3- or 6-month study visit.

The 48-h recall data were used to calculate the mean consumption frequency of each food. The mean values were then recoded into the same categories as in the FFQ. In addition, the mean amount (mL) of study formula used per feeding was calculated from the 48-h recall data.

The relative agreement between the FFQ and the 48-h recalls was assessed by proportion of subjects classified into same categories of consumption frequency by both methods and by the kappa analysis. For analyses, we collapsed the data into new combined categories. Foods other than breastmilk or study formula were not used more than four times a day; thus the highest category of the FFQ was not used for these foods. The new categories for solid foods and vitamin D supplementation were daily use; weekly use; and less than weekly use or not at all. The frequencies of breastmilk and study formula consumption were distributed differently than the frequencies of other foods due to the fact that breastmilk and infant formula tend to be used either daily or not at all. The new categories for breastfeed-

ing and study formula were the following: ≥ 5 times per day; 1–4 times per day; and < 1 time per day or not at all.

Spearman correlation coefficients were analysed for the amount of study formula used per feeding from the two methods. For comparisons of the amounts, Wilcoxon signed rank test was used. Statistical analyses were performed by SPSS 11.0.

Results

Among the 3-month-olds, study formula consumption was reported for 26 subjects by the FFQ and for 24 of those by the 48-h recalls; the remaining two reported consumption less than once a week in the FFQ. Among the 6-month-olds, consumption of study formula was reported for the same 35 subjects by both methods. Among the subsamples of 24 and 35 subjects, who reported consumption of study formula by both methods, the mean amount of study formula per feeding assessed by the dietary interview and 48-h recall correlated significantly at 3 months ($r_s = 0.87$) and at 6 months ($r_s = 0.73$), respectively. The mean amounts per feeding were higher by the dietary interview than by the 48-h recall at 3 months (109 mL vs. 97 mL, $P = 0.015$) and at 6 months (108 mL vs. 91 mL, $P < 0.001$).

In the 3-month age group, 49 children out of 50 were classified into the same category of breastfeeding frequency by the FFQ and 48-h recall methods, and in the 6-month age group, 48 out of 50, respectively (Table 2). The kappa coefficients for breastfeeding and study formula use ranged from 0.82 to 0.95 (Table 3), indicating very good agreement between the two methods (Altman 1991).

According to the FFQ, nine children out of 50 in the 3-month age group received complementary foods. For one of them, consumption of cereals from the corn/rice/buckwheat/millet group was reported less than once a week in the FFQ, but no consumption appeared in the 48-h recalls. Agreement for strained potato or vegetables, and strained fruit or berries is presented in Table 4. Eggs, fish, meat or cereals from the oat/wheat/barley/rye group were not reported by either of the methods in the younger age group. For vitamin D supplement use, 88% of the children in this

Table 2. Distribution of consumption frequencies of breastmilk and study formula

		48-h recalls	Food frequency questionnaire		
			≥5 per day	1–4 per day	<1 per day or not at all
3-month age group (<i>n</i> = 50)					
Breastmilk					
	≥5 per day	37	1		
	1–4 per day		1		
Study formula	<1 per day or not at all				11
	≥5 per day	10	1		
	1–4 per day	1	8		
	<1 per day or not at all				30
	6-month age group (<i>n</i> = 50)				
	Breastmilk				
	≥5 per day	26	1		
	1–4 per day		6		1
	<1 per day or not at all				16
Study formula	≥5 per day	16	2		
	1–4 per day	1	9		1
	<1 per day or not at all		2		19

Table 3. Percentages of subjects classified into the same categories of breastmilk and study formula use, and the level of agreement (kappa) between the food frequency questionnaire (FFQ) and 48-h recalls

Age group	Food	Number of users according to FFQ	% in the same category*	Kappa
3 months (<i>n</i> = 50)				
	Breastmilk	39	98	0.95
	Study formula	26	96	0.93
6 months (<i>n</i> = 50)				
	Breastmilk	34	96	0.93
	Study formula	37	88	0.82

*Five times or more per day; 1–4 per day; and <1 per day or not at all.

age group were correctly classified with moderate agreement ($\kappa = 0.52$).

In the 6-month age group, the proportion of children correctly classified for different food groups and vitamin D supplementation ranged from 64% to 88% (Table 4). The corresponding kappa values ranged between 0.33 and 0.56, indicating fair to moderate agreement (Altman 1991). Egg consumption less than once a week was reported for two children in the FFQ, but for none according to the 48-h recalls.

Use of non-recommended foods was reported for four subjects in the 3-month age group and four subjects in the 6-month age group. All the non-

recommended foods reported in the 48-h recall were also reported in the FFQ. Statistical analyses of agreement were not conducted for non-recommended foods due to the low number of users.

Discussion

We found that a dietary interview method including a short FFQ is a useful tool for ranking infant subjects according to the consumption frequency of breastmilk and infant/study formula, as well the amount of formula used. However, the amounts of study formula are overestimated by the dietary interview as

Table 4. Percentages of subjects classified into the same categories of food and vitamin D supplementation use, and the level of agreement (kappa) between the food frequency questionnaire (FFQ) and 48-h recalls

Age group	Food	Number of users according to FFQ	% in the same category*	Kappa
3 months (<i>n</i> = 50)	Strained potato or vegetables	7	92	†
	Strained fruit or berries	6	100	1.0
	Vitamin D supplementation	49	88	0.52
6 months (<i>n</i> = 50)	Strained potato or vegetables	48	80	0.37
	Strained fruit or berries	47	88	0.56
	Oat, wheat, barley or rye	39	70	0.54
	Corn rice, buckwheat or millet	35	70	0.54
	Meat other than beef	43	64	0.45
	Fish	20	88	†
	Vitamin D supplementation	47	78	0.33

*Once or more per day; 1–6 times per week; and <1 per week or not at all. †Kappa could not be computed.

compared with two 48-h recalls. The dietary interview method was also found to be a good tool for assessing compliance with the dietary restrictions during the intervention, as all the non-recommend foods reported by the 48-h recalls were also captured by the FFQ.

In previous studies including children up to 3 years of age, the relative validity of FFQs has been assessed by comparison with three to four 24-h recalls (Stein *et al.* 1992; Blum *et al.* 1999), food records with a length of 3–7 days (Blom *et al.* 1989; Iannotti *et al.* 1994; Taylor & Goulding 1998; Andersen *et al.* 2003; Marshall *et al.* 2003; Andersen *et al.* 2004), a 3-day food record and blood iron status measurements (Williams & Innis 2005), multiple 24-h recalls and nutrient biomarkers in plasma (Parrish *et al.* 2003), and a combination of one 24-h recall and a 2-day food record (Klohe *et al.* 2005). Two of these studies included subjects below the age of 1 year (Marshall *et al.* 2003; Williams & Innis 2005).

In many previous studies, the primary aim has been to test the capability to rank subjects according to total nutrient intake. For example, Blum *et al.* (1999) found Pearson correlation coefficients over 0.5 for 13 out of the 19 nutrients studied among 1–5-year-old children. Andersen *et al.* (2003) studied the diet of 12-month-old children, and found Spearman correlation coefficients above 0.5 for protein, total fat, saturated fatty acids, monounsaturated fatty acids, polyunsaturated fatty acids, sugar, riboflavin, calcium and iron. Spearman correlations at this level are considered

desirable in epidemiological studies (Masson *et al.* 2003).

In the present validation study, breastfeeding was a major source of energy for many of the subjects, which would have ruled out the possibility to calculate total energy and nutrient intake. Our FFQ was not designed to measure quantities, but to provide an easy method for assessing dietary compliance and the frequency of food consumption.

Some studies have also taken into account other aspects of the diet than the total nutrient intake. For example, Andersen *et al.* (2003) analysed daily absolute intake of foods, for which the Spearman correlation between the food records and FFQ ranged from 0.28 to 0.83. Klohe *et al.* (2005) studied 1–3-year-old children from low-income families and calculated the number of servings of food per day using standardized serving sizes. The Spearman correlations for number of servings per day between recalls/records and FFQ ranged from 0.10 to 0.69, and proportion of children classified into the same or within one quartile of servings per day ranged from 71% to 94%.

In the present study, a high proportion of the subjects were correctly classified in categories of food consumption by a FFQ as compared with two 48-h recalls in both age groups. However, in some food groups, the kappa values did not directly correspond with the percentage agreement. For example, 78% of the subjects in the 6-month group were correctly classified for vitamin D supplementation while the kappa

value was only 0.33. The low kappa value was due to a few subjects that were classified in the opposite categories by the two methods.

The relative agreement for the frequency of breastmilk and study formula consumption was found to be very good, both by the kappa analysis and percentage agreement. We also found a strong correlation for the amount of study formula estimated by the two methods. Previously, Andersen *et al.* (2003) have found a correlation of $r_s = 0.62$ for the amount of infant formula between the food record and FFQ, and no significant difference in the reported breastfeeding frequencies. Marshall *et al.* (2003) reported that 71% of 6-month-old subjects were classified in the same quartile of infant formula intake by the food record and FFQ, with a weighed kappa of 0.73.

The consequences of early nutrition on later health are currently receiving considerable interest, and active research in this field is needed (Delisle *et al.* 2005; Koletzko 2005). Tools for assessing dietary exposures in infancy will be required in future studies, and FFQs similar to the one validated in the present study may prove to be valuable.

Conclusions

We assessed the ability of a FFQ to rank infants according to frequency of food consumption, and found it to be very good for breastmilk and study formula, and from fair to very good for other foods. A brief FFQ is easy and fast to complete, and it enables assessment of infant diet and dietary compliance.

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Appendix I. Food frequency questionnaire

Type of food (foods allowed during dietary intervention)	Average frequency during the preceding month					
	Not at all	Times per week			Times per day	
		Less	1–3	4–6	1–2	3–4 5 or more
Breastmilk						
Study formula						
Strained potato/vegetables						
Strained fruit/berries, fruit/berry juices						
Foods containing oat, wheat, barley or rye (e.g. gruels, hot cereals, bread, biscuits)						
Foods containing corn, rice, buckwheat or millet (e.g. gruels, hot cereals, bread, biscuits)						
Foods containing pork, chicken, broiler, turkey, lamb, reindeer or game (e.g. strained meat and vegetables)						
Foods containing fish (e.g. strained fish and vegetables)						
Egg						
Vitamin D supplementation or cod liver oil – please list: _____						
Other food item – please list: _____						
Other food item – please list: _____						
Type of food (foods not recommended during dietary intervention)	Average frequency during the preceding month					
	Not at all	Times per week			Times per day	
		Less	1–3	4–6	1–2	3–4 5 or more
Regular cow's milk-based formula, as such or used in cooking						
Brand name? _____						
Nutramigen or other hydrolyzed formula						
Brand name? _____						
Soy-based formula						
Brand name? _____						
Soured milk and sour milk products (e.g. soured milk, cultured milk, yoghurt, quark)						
Regular cow's milk, ice cream or cheese, as such, in commercial baby foods, or when used in cooking (e.g. baby foods)						
Foods containing beef, veal or meat extract (e.g. strained beef and vegetables)						
Sausage and other meat products containing beef						
Other – please list (e.g. milk containing lactic acid bacteria supplements) _____						