

Reliability and validity of a maternal food frequency questionnaire designed to estimate consumption of common food allergens

C. Venter,* B. Higgins,† J. Grundy,* C. B. Clayton,* C. Gant* & T. Dean*,†

*The David Hide Asthma and Allergy Research Centre, St. Mary's Hospital, Newport, Isle of Wight, UK; †School of Health Sciences and Social Work, University of Portsmouth, St. Georges Building, Portsmouth, UK

Correspondence

T. Dean,
School of Health Sciences and Social
Work,
University of Portsmouth,
St. George's Building,
141 High Street,
Portsmouth,
PO1 2HY,
UK.
Tel.: +44-23-92845243 (direct)
and 044 023 9284 5300 (general)
Fax: +44-23-92845200
E-mail: tara.dean@port.ac.uk

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Abstract

Background Maternal food intake during pregnancy may influence the development of food hypersensitivity (FHS) in the child. A food frequency questionnaire estimating the frequency with which some of the mains food allergens are consumed was designed and validated.

Materials and methods Pregnant women were recruited at the ante-natal clinic of St. Mary's Hospital, Isle of Wight, UK. A food frequency questionnaire was developed and validated by comparing responses to information recorded in 7 days food diaries. The reliability of the food frequency questionnaire was evaluated by asking women to complete the questionnaire on two separate occasions at 30 and 36 weeks gestation.

Results Fifty-seven women completed the validity study and 91 women completed the reliability study. For both validity and reliability, questions with dichotomous response categories showed the highest level of agreement. Frequency of intake of foods commonly 'hidden' in foods produced the lowest validity and reliability scores. In the validity study responses to the food frequency questionnaire identically matched information recorded in the food diaries 80% of the time, on average. In the reliability study, responses were identical on both questionnaires 85% of the time on average.

Conclusion In this study a food frequency questionnaire estimating the frequency with which some of the main food allergens are consumed during pregnancy was designed and validated. This food frequency questionnaire could be used in future studies to assess the role of maternal food intake in the development of FHS in the infant.

Introduction

A number of studies using food frequency questionnaires (FFQ) in pregnant women (Suito *et al.*, 1989; Brown *et al.*, 1996; Wild *et al.*, 1996; Wei

et al., 1999; Erkkola *et al.*, 2001; Bodnar & Siega-Riz, 2002; Siega-Riz *et al.*, 2002; Lagiou *et al.*, 2004; Rogers *et al.*, 2004) reported the FFQ to be a useful tool in determining food intake during pregnancy. These studies obtained information on

food intake during pregnancy in relation to size of the infant, (Lagiou *et al.*, 2004; Moore *et al.*, 2004), nutritional quality of the pregnancy diet (Bodnar & Siega-Riz, 2002; Siega-Riz *et al.*, 2002), pregnancy related changes in diet (Brown *et al.*, 1996), micronutrient intake (Rogers & Emmett, 1998; French *et al.*, 2003), relationship between pregnancy diet and disease development (Fronczak *et al.*, 2003), and the usefulness of the FFQ in pregnancy (Suitor *et al.*, 1989; Robinson *et al.*, 1996; Wei *et al.*, 1999; Erkkola *et al.*, 2001; Olsen *et al.*, 2001; French *et al.*, 2003).

FFQs are often used in large-scale population based studies, where the time used to complete the questionnaire should be kept to a minimum (Ocke *et al.*, 1997; Kroke *et al.*, 1999). FFQs in themselves will vary according to the purpose they are used for. FFQs can be used to determine simple frequency of food intake (Frank *et al.*, 1999), or they can be used to determine nutrient intake (Kroke *et al.*, 1999) based on frequency of food intake in conjunction with estimated portion size.

The strengths of FFQs are that highly trained interviewers are not required, administration is simple, customary eating habits are not influenced, the response rates are high, the respondent burden is light and, in principle, the relationship between dietary intake and disease development can be measured (Burley *et al.*, 2000). However, weaknesses such as participants recall and problems in approximate quantification of food intake should not be ignored (Burley *et al.*, 2000).

It has been suggested that maternal food intake during pregnancy influences the development of food hypersensitivity (FHS) in the child. Previous studies have used dietary questionnaires, which have not been validated (Lilja *et al.*, 1988; Hourihane *et al.*, 1996; Ushiyama *et al.*, 2002; Lack *et al.*, 2003). To date there are no validated FFQs which could investigate this.

Therefore, the aim of this study was to design and test the validity and reliability of a FFQ that estimates the frequency with which some of the main food allergens are consumed during pregnancy that can be used in future studies aiming to investigate maternal dietary intake and the development of FHS in the infant.

Material and methods

Development of the food frequency questionnaire

The FFQ was developed mainly to determine frequency of intake of the major food allergens (European Union, 2003) namely milk and milk products, egg, wheat, fish (oily and white), shellfish, nuts (peanuts and tree nuts) and seeds. The frequencies used included never, moderate (≤ 3 times per week), frequently (≥ 4 times per week) or uncertain. The FFQ also aimed to assess the frequency of avoiding certain foods such as soya and food additives. In addition, questions regarding fruit and vegetable intake (Ushiyama *et al.*, 2002), oily fish and food supplements such as fish oils (Dunstan *et al.*, 2003) were included. Information on the type of diet (normal/vegetarian/vegan/special medical condition) pregnant women were following, their use of vitamin or mineral supplementation, medication use, smoking habits and exposure to environmental tobacco smoke was also recorded. In order to obtain the general information, a tick list with 11 dichotomous (yes/no) response variables were used. Three open ended questions were used to determine information on type of medical diet followed, e.g. diabetic diet, any other foods avoided from diet, and number of cigarettes smoked per day.

Once developed, the FFQ was pretested using six pregnant women (Armstrong *et al.*, 1992). The purpose of the pretesting was to test the comprehension of the FFQ, to check for ambiguity and to assess the utility of the different response categories.

Ethical approval

Approval for the study was obtained from the Isle of Wight, Portsmouth and South East Hampshire Local Research Ethics Committee (Ref 04/Q1701/18).

Recruitment of participants

Pregnant women were approached at the antenatal clinic of St. Mary's Hospital, Isle of Wight,

UK during 12–13 weeks of pregnancy for the validation study. An independent group of pregnant women (>20 weeks gestation) were approached for the reliability study. Once the study information was discussed, written consent was obtained from those who were willing to participate in the study.

At recruitment, detailed information on history of allergic disease and FHS, number of previous pregnancies and level of education, was obtained. This information enabled us to ensure the women recruited for the validation and reliability studies were not significantly different from the pregnant women who had participated in other studies, which have focused on maternal intake and development of FHS.

Validation of the FFQ

In order to validate the FFQ, responses were compared to information recorded in 7 days food diaries completed on four occasions during pregnancy (at weeks 12–16, 20, 28 and 32) (Bingham *et al.*, 1994; Bingham, 1997; De Vriese *et al.*, 2001; Erkkola *et al.*, 2001). In other words, four diaries consisting of 7 days (Monday–Sunday) were used. Participants were asked to give a detailed description of the foods eaten, but amounts of foods eaten were not required as we wanted to establish frequency of exposure rather than amounts eaten.

In order to validate intake of food supplements, avoidance of foods related to pregnancy and foods avoided due to own preference, we asked the following questions on the food diary:

- Are you taking any supplementation and if so what?
- Are you avoiding any foods, ingredients or supplements and if so, what?

In order to determine whether the pregnant women did eat products that 'may contain traces of nuts' all women were asked to keep a note of brand names when possible and questions regarding avoidance of hidden nuts and foods that 'may contain traces of nuts' were asked.

The data obtained from the food diaries were transferred onto a FFQ (FFQV1). At 36 weeks of pregnancy, the women were asked to complete a

copy of the FFQ (FFQV2) and the information obtained from this FFQ was compared against the diary information.

Reliability of the FFQ at 36 weeks gestation

Reliability may be defined as the reproducibility of a measurement tool, i.e. the degree to which the FFQ produces identical responses each time it is used (Bohlscheid-Thomas *et al.*, 1997).

Study participants completed one FFQ at 30 weeks gestation (FFQR1) and another at 36 week's gestation (FFQR2). In allowing 6 weeks between FFQR1 and FFQR2, we aimed to determine reproducibility of the FFQ. By allowing a much longer period of time, changes in dietary habits may be measured rather than reproducibility (Burley *et al.*, 2000), especially as it is known that taste and food preferences change over the course of the pregnancy (Bowen, 1992).

Statistical analysis

All data was double entered into SPSS, compared and verified. The frequency of food intake was classified into four categories: Never, Moderate (up to three times a week), Frequently (more than three times a week) or uncertain. The number of subjects who provided identical responses to both validity and both reliability assessments was used to produce percentage agreement. We acknowledged misclassification errors, and assumed that these will be minimal. A clinical decision was made that agreement of 75% or above indicated good validity or reliability. Kappa statistics were also calculated to provide alternative indices of reliability and validity adjusting for chance agreement (Saw & Ng, 2001).

Results

Characteristics of participants in the validation and reliability study

Fifty-seven women completed the validity study by completing the four food diaries transferred onto a FFQ (FFQV1) and a FFQ at 36 weeks gestation (FFQV2). Ninety-one pregnant women completed

questionnaires at 30 and 36 weeks (FFQR1 and FFQR2) for the reliability study. All women were Caucasian.

The characteristics of the recruited women for the validation and reliability study are shown in Table 1.

Validity data

The data was divided into two sections, the first of which included general information relating to intended method of feeding, type of diet followed, avoidance of pregnancy related food. The second section recorded the frequency of food intake.

Tables 2 and 3 summarize the results of the validity study.

With regards to the general information, number of cigarettes smoked per day had the lowest agreement.

Frequency of intake of foods commonly 'hidden' in foods such as eggs and seeds and foods eaten infrequently such as tree nuts, produced poor agreement. Oily fish, peanut, shellfish, milk, wheat and white fish intake showed much better agreement ($\geq 75\%$) (Table 3).

We also asked a question regarding mothers' concern about weight gain as it could be argued that the 'concerned' pregnant women may be under

Characteristics	Validity study number (%)	Reliability study number (%)
Age range	20–44 years	18–44 years
First child	31 (54)	37 (41)
Pregnant women with reported FHS*	9 (16)	9 (10)
Intention to breast feed	43 (75)	68 (75)
Normal diet	54 (95)	84 (92)
Reported peanut avoidance during pregnancy	31 (54)	42 (46)
Education level (further and higher)	41 (72)	64 (70)

*FHS, food hypersensitivity.

Table 1 Characteristics of pregnant women in the validity ($n = 57$) and reliability ($n = 91$) study

Table 2 Summary of general information from validation questionnaires

Questionnaire item	Number (%) responding yes			Validity index	
	FFQV1 ($n = 57$)	FFQV2 ($n = 57$)	Both V1 & V2 (n)	Agreement* (%)	Kappa
No. of cigarettes smoked per day	6	6	2	40	NA (numeric data)
Taken folic acid	28 (49)	53 (93)	30	53	0.1
Excluding pregnancy related foods	40 (70)	53 (93)	42	74	0.2
Taken iron	21 (37)	24 (42)	44	77	0.5
Claim to exclude peanuts	26 (46)	31 (54)	45	79	0.6
Exclude foods due to personal choice	2 (4)	11 (19)	46	81	0.1
Taken calcium	12 (21)	9 (16)	48	84	0.5
Taken other supplements	3 (5)	7 (12)	51	90	0.4
Taken multi-mineral	19 (33)	16 (28)	52	91	0.8
Eaten ≥ 5 portions fruit & vegetables daily	6 (11)	9 (16)	52	91	NA
Normal diet	54 (95)	54 (95)	53	93	0.3
Normally smoke	5 (9)	9 (16)	53	93	0.7
Taken multivitamin	20 (35)	24 (42)	53	93	0.9
Excluded additives	0	2 (4)	55	97	NA
Following medical diet	0	1 (2)	56	98	NA
Excluded soya	0	1 (2)	56	98	NA
Average (min.–max.)			83.3 (40–98)	0.5 (0.1–0.9)	

*Agreement (%): number of participants providing the same answer to both FFQV1 and FFQV2/total number of participants. This applies to Tables 2–5.

Table 3 Summary of food intake from validation questionnaires

Food item	Questionnaire	Frequency of consumption (<i>n</i> = 57)				Validity index	
		Never <i>n</i> (%)	Moderate [†] <i>n</i> (%)	Frequently [‡] <i>n</i> (%)	Uncertain <i>n</i> (%)	Agreement (%)	Kappa
Egg	FFQV1	0	14 (25)	43 (75)	0	49	0.2
	FFQV2	0	43 (75)	14 (25)	0		
Tree nuts*	FFQV1	18 (32)	37 (65)	2 (4)	0	67	0.3
	FFQV2	11 (19)	40 (70)	5 (9)	0		
Seeds	FFQV1	28 (49)	29 (51)	0	0	67	0.4
	FFQV2	15 (26)	40 (70)	0	2 (4)		
Citrus fruits	FFQV1	1 (2)	32 (56)	24 (42)	0	67	0.5
	FFQV2	1 (2)	34 (60)	21 (37)	1 (2)		
Oily fish	FFQV1	33 (58)	24 (42)	0	0	75	0.5
	FFQV2	28 (49)	27 (47)	1 (2)	1 (2)		
Peanuts*	FFQV1	33 (58)	22 (39)	2 (4)	0	77	0.6
	FFQV2	31 (54)	26 (46)	0	0		
Shellfish	FFQV1	34 (60)	23 (40)	0	0	79	0.6
	FFQV2	36 (63)	21 (37)	0	0		
Milk	FFQV1	0	0	57 (100)	0	91	NA
	FFQV2	0	5 (9)	52 (91)	0		
Wheat	FFQV1	0	0	57 (100)	0	95	NA
	FFQV2	0	3 (5)	54 (95)	0		
White fish	FFQV1	4 (7)	53 (93)	0	0	95	0.5
	FFQV2	3 (5)	54 (95)	0	0		
Mean (min.–max.)						76 (49–95)	0.4 (0.2–0.6)

*Of the pregnant women who reported that they never ate peanuts, only one avoided traces of nuts and six avoided hidden nuts.

[†]Moderate = ≤ 3 times per week.

[‡]Frequently ≥ 4 times per week.

reporting. Of the 57 pregnant women, 18 (32%) reported that they were concerned about weight gain. Of the 18 women concerned about weight gain, 16 (88%) consumed milk on a regular basis compared to 35 (90%) of the 39 women not concerned about weight gain. The difference is not statistically significant (Fisher's exact test $P > 0.999$). There was no significant difference between these two subgroups regarding frequent consumption of eggs (9/18, 50% versus 22/39, 56%, $P = 0.777$), wheat (17/18, 94% versus 34/39, 87% $P = 0.653$) or fish (1/18, 5% versus 0/39, 0%, $P = 0.316$).

An additional question regarding avoidance of hidden and traces of nuts was asked on the food diaries. Only 11% (6/57) of pregnant women said that they had avoided hidden nuts and only 2% (1/57) had avoided traces of nuts.

In summary, on average 83% of responses to questions of a general nature produced identical information to that obtained from the food diaries. With regards to food intake, on average 76% of responses to questions were corroborated by data extracted from the food diaries.

Reliability data

The data obtained from the two FFQs were compared and the results are summarized in Tables 4 and 5.

Agreement between responses to general questions on the two reliability questionnaires was higher than 75% for all the questions asked (Table 4).

As with the validity test, frequency of intake of foods commonly 'hidden' in foods such as seeds, and foods eaten infrequently such as tree nuts, produced poor agreement. In addition intake of citrus fruit showed the lowest degree of agreement (Table 5). In contrast, consumption of oily fish, peanut, shellfish, milk, wheat and white fish showed good agreement.

Again, pregnant women were asked about concern over weight gain as the women who said they were concerned (yes/no answer) may be under reporting. Of the 91 pregnant women, 30 (33%) said that they were concerned regarding weight gain. The reported rate of milk, egg, wheat and fish

Table 4 Summary of general information from reliability questionnaires

Questionnaire item	Number (%) responding yes			Validity index	
	FFQR1 (<i>n</i> = 91) <i>n</i> (%)	FFQR2 (<i>n</i> = 91) <i>n</i> (%)	Both R1 & R2 (<i>n</i>)	Agreement (%)	Kappa
Excluded pregnancy related foods	74 (81)	70 (77)	73	80	0.4
Excluded foods due to personal choice	15 (17)	19 (21)	75	82	0.4
Exposed to smoke at home	27 (30)	27 (30)	76	84	0.7
Method of feeding: intention to breast feed	55 (60)	58 (64)	77	85	0.8
Taken iron	30 (33)	34 (37)	77	85	0.7
Claimed to exclude peanuts	48 (53)	42 (46)	79	87	0.7
Exposed to smoke at work	11 (12)	9 (10)	54/60	90	0.6
Taken Medication	75 (82)	72 (79)	82	90	0.7
Eaten ≥5 portions fruit & vegetables	12 (13)	15 (17)	83	91	NA
Taken multivitamin	20 (22)	22 (24)	85	93	0.8
Taken multi-mineral	11 (12)	11 (12)	85	93	0.8
Taken folic acid	78 (86)	76 (84)	85	93	0.8
Taken calcium	9 (10)	8 (9)	86	95	0.7
Normally smokes	40 (44)	39 (43)	86	95	0.9
Stopped smoking	16 (18)	15 (17)	36/38	95	0.9
Normal diet	87 (96)	84 (92)	87	96	0.7
Excluded soya	5 (6)	3 (3)	88	97	0.7
Excluded additives	7 (8)	6 (7)	88	97	0.8
Cut down on smoking	28 (31)	27 (30)	28/29	97	0.8
Following medical diet	7 (8)	9 (9.9)	89	98	0.9
Taken other supplements	2 (2)	1 (1.1)	90	99	0.7
Mean (min.–max.)				91.5 (80–99)	0.8 (0.4–0.9)

Table 5 Summary of food intake from reliability questionnaires

Food item	Questionnaire	Frequency of consumption (<i>n</i> =91)				Validity index	
		Never <i>n</i> (%)	Moderate* <i>n</i> (%)	Frequently† <i>n</i> (%)	Uncertain <i>n</i> (%)	Agreement (%)	Kappa
Citrus fruits	FFQR1	3 (3)	54 (59)	34 (37)	0	66	0.4
	FFQR2	6 (7)	46 (51)	38 (42)	1 (1)		
Tree nuts	FFQR1	26 (29)	58 (64)	7 (8)	0	67	0.3
	FFQR2	29 (32)	59 (65)	2 (2)	1 (1)		
Seeds	FFQR1	39 (43)	50 (55)	2 (2)	0	71	0.4
	FFQR2	43 (47)	47 (52)	0	1 (1)		
Egg	FFQR1	4 (4)	74 (81)	12 (13)	1 (1)	76	0.3
	FFQR2	2 (2)	74 (81)	15 (17)	0		
Oily fish	FFQR1	39 (43)	50 (55)	1 (1)	1 (1)	82	0.7
	FFQR2	44 (48)	45 (50)	1 (1)	1 (1)		
Peanut	FFQR1	51 (56)	37 (41)	2 (2)	1 (1)	82	0.7
	FFQR2	49 (54)	39 (43)	2 (2)	1 (1)		
Wheat	FFQR1	0	13 (14)	76 (84)	2 (2)	82	0.3
	FFQR2	0	11 (12)	80 (88)	0		
Shell fish	FFQR1	63 (69)	27 (30)	0	1 (1)	84	0.6
	FFQR2	65 (71)	26 (29)	0	0		
Milk	FFQR1	0	12 (13)	78 (86)	1 (1)	87	0.4
	FFQR2	0	8 (9)	83 (91)	0		
White fish	FFQR1	10 (11)	73 (80)	6 (7)	2 (2)	90	0.7
	FFQR2	12 (13)	77 (85)	2 (2)	0		
Mean (min.–max.)						79 (66–90)	0.5 (0.3–0.7)

*Moderate = ≤ 3 times per week.

†Frequently ≥4 times per week.

intake in these pregnant women was compared to the rest to test whether they were under reporting. Of the 30 women concerned about weight gain, 26 (87%) consumed milk on a regular basis compared to 54 (89%) of the 61 women not concerned about weight gain. The difference is not statistically significant (Fisher's exact test $P > 0.999$). There was no significant difference between these two sub-groups regarding frequent consumption of eggs (6/30, 20% versus 10/61, 16%, $P = 0.272$), wheat (26/

30, 86% versus 54/61, 89% $P > 0.999$) or fish (1/30, 3% versus 3/61, 5%, $P > 0.999$).

In summary, on average 92% of responses to questions of a general nature were identical on both questionnaires. With regards to questions on food intake, the average was 79%.

Excluding questions with validity or reliability agreement scores below 75% leads to a reduced set of questions that we would recommend for use in future studies (Table 6).

Table 6 Suggested food frequency questionnaire

1. Please tick all of the following statements that are applicable to you:				
I am excluding peanuts due to my pregnancy		Yes ¹		No ²
I am following a special diet due to medical reasons (please state medical condition)		Yes ¹		No ²
I am excluding certain foods due to personal choice		Yes ¹		No ²
2. Have you taken any of the following supplements during this pregnancy?				
		Yes ¹		No ²
Multivitamin				
Multi mineral				
Calcium				
Iron				
Other	What?			
3. On average, how often have you eaten these foods during pregnancy?				
	Never ¹	Moderate (1–2 per month up to 1–3 per week) ²	Frequently ³	Uncertain ⁴
Milk and milk products (e.g. custard, yoghurt, ice cream, chocolate, butter, margarines, cheese–pizza, cheese sauce, lasagne, cheesy biscuits)				
Wheat (e.g. bread, cereals, pasta, pizza, cakes, pies and pastry)				
White fish (e.g. tuna, fish cakes, battered fish and fish fingers)				
Shellfish (e.g. crab, prawns, shrimps, lobster and crayfish)				
Oily fish (e.g. mackerel, salmon, sardines, pilchards, herring, kipper, white bait, trout, crab and FRESH tuna)				
Peanuts (e.g. Bombay mix, peanut butter, peanut brittle, peanut cookies, sate and some vegetarian meals)				
4. How many helpings/portions of fruit and vegetables do you eat daily? (1 portion is: 1 fruit, 1 bowl of salad, 2–3 tablespoons of vegetables, 1 bowl of fruit salad, large slice of melon or other large fruit, a handful of dried fruit or a cupful of berries or grapes)				
	<5 portions ¹		=5 portions ²	
5. Have you deliberately excluded soya from your diet during pregnancy?		Yes ¹		No ²
6. Have you deliberately excluded any additives from your diet during pregnancy?		Yes ¹		No ²
7. Do you normally smoke?		Yes ¹		No ²

Thank you for taking the time to complete this questionnaire.

Discussion

As no previous FFQs were designed to estimate maternal intake of major food allergens, a FFQ was developed to determine general information regarding food intake, use of supplementation, avoidance of foods and smoking habits during pregnancy. The main purpose of this FFQ was to determine frequency of intake of the foods containing the major food allergens. In the validation exercise, agreement between responses to questions on the FFQ and data extracted from the food diaries averaged 80%. In assessment of reliability, agreement between responses to questions from the two FFQs averaged 85%. As we might expect, there was a negative association between the number of response categories and the percentage of agreement. Also, foods eaten more often produced better agreement scores than foods not eaten very often. In addition, it may be easier to answer the general questions than the food questions.

In our study we used the food diaries as the reference method in order to establish a relative validation for our FFQ.

A vital component of the validation process is the selection of the appropriate reference method against which to assess the test measurement. It is well recognized that there is a lack of accuracy with most methods of assessing dietary intake and that there is no 'gold standard' for determining dietary intake (Ocke *et al.*, 1997). Previous studies have used 24 h recall questionnaires (Focke *et al.*, 2003), 4 days weighed food diaries (Block *et al.*, 1990; Ogawa *et al.*, 2003), 5 days food records (Erkkola *et al.*, 2001) and 7 days diaries (Kaaks & Riboli, 1997; Kipnis *et al.*, 2002; Marshall *et al.*, 2003; Khani *et al.*, 2004) as in this study.

Of these methods, the 7 days food diary was the method of choice for validating this FFQ as it measures actual food consumption and its errors do not correlate with those of the FFQ (Erkkola *et al.*, 2001). De Vriese *et al.* (2001) showed that the 7 days food diary gives similar results for fat intake as the FFQ. In support of this, Bingham *et al.*, concluded that repeated food diaries compared well with information obtained from biomarkers

and 16 days weighed diaries (Bingham *et al.*, 1994; Bingham, 1997).

Ultimately the reference method used will depend on the purpose of the FFQ. If, for example, only frequency of food intake is required then this is what should be determined by the chosen reference method. Very few studies in the past used both methods for validation. According to a systematic review carried out by the authors of the consensus document on validation, 75% of FFQs were validated against another dietary method, 19% against a dietary method and biomarker and 12% against a biomarker only (Burley *et al.*, 2000). For validating our FFQ, we felt that the degree of information only warranted the use of another dietary reference method without any need for biomarkers.

We were concerned about under reporting when collecting the data. Under reporting is particularly a problem in women with a history of frequent dieting, self-reported binge eating and dissatisfaction with body weight. This could be less of a problem in pregnant women, a group that are less likely to be concerned about weight. Our FFQ did not enquire about exact amounts of foods eaten, which could lead to less under reporting. Furthermore, Caan *et al.*, established that subjects that are not undergoing any intervention, as with our study, are more likely to accurately report food intake than those in intervention trials (Caan *et al.*, 2004). Nevertheless, we incorporated a question regarding concern about weight gain during pregnancy to test for under reporting. Our results provide no evidence of under reporting. It is also worth noting that all our participants were Caucasians and mostly well educated which may indicate the study sample may have not been a good representation of the target population.

In summary, in this study, we have validated and tested the reliability of a FFQ estimating the frequency with which four (milk, wheat, fish/shellfish and peanuts) of the main food allergens are consumed during pregnancy. The estimate will however include measurement error as with all dietary assessment methods. We feel that our modified FFQ can be used to assess the frequency of food intake during pregnancy and the devel-

opment of FHS in the infant. We have aimed to take all possible factors into account to ensure adequate validation and reliability.

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