ARTICLE

Two-year recall of maternal peanut consumption using a food-frequency questionnaire

Department of Paediatric Allergy, St Mary's Hospital, London, UK
A T Fox, MSc, MRCPCH
G du Toit, FRCPCH
G Lack, FRCPCH

Imperial College, St Mary's Hospital, London, UK
R Meyer, BSc Diet, MNutr

Cancer Research UK Centre for Epidemiology, Mathematics and Statistics, Wolfson Institute of Preventive Medicine, Charterhouse Square, London, UK
H Syed, PhD
P Sasieni, PhD

Objectives. To design a semi-quantitative food frequency questionnaire (FFQ) to estimate peanut consumption during pregnancy, and to determine reproducibility when this consumption was recalled after a 2-year period.

Methods. An FFQ that lists commonly consumed peanut-containing products was developed. This was completed by a group of pregnant women, relating to their current diet (initial recall). Two years later the same women were asked to complete the same FFQ with reference to the period of their pregnancy (follow-up recall).

Results. A total of 30 women completed both the initial and follow-up questionnaires. Follow-up recall was found to be an unbiased estimate of initial recall, with a correlation coefficient of 0.95. Confidence intervals were defined to allow prediction of the initial recall value from the follow-up recall value.

Conclusion. Using our FFQ, retrospective recall of peanut consumption during pregnancy correlated well with data collected at the time. This FFQ will, when validated, provide a useful tool for investigating the role of maternal peanut consumption in later development of peanut allergy in children.

Peanut allergy (PA) is one of the most serious of the food hypersensitivities in terms of persistence and severity. Its prevalence in the USA and UK has doubled in the past 10 years and it now affects almost 1 in 70 children.[1] Over 90% of PA children react on their first known exposure.[2] However, all type 1 hypersensitivity reactions require prior sensitisation to the allergen before such an allergic reaction can occur. The mechanism by which this sensitisation occurs remains unclear. The possibilities are that sensitisation occurs *in utero,* via breastmilk or via indirect low-dose environmental exposure.

Sensitisation of an atopic infant to an allergen such as peanut is more likely to occur with greater exposure. This dose-dependent relationship is seen with exposure to other allergens such as house dust mite (der p1) and cat (fel d1).[3] Furthermore, maternally ingested peanut protein needs to be consumed in considerable amounts before it becomes detectable in breastmilk[4] and available to the infant. The possibility of lactation as a possible route of sensitisation will therefore become increasingly relevant with higher maternal peanut consumption.

If sensitisation to peanut occurs during pregnancy or breastfeeding, we would therefore expect peanut consumption during these periods to have been higher among mothers of infants who go on to develop PA than in appropriate controls. Conversely, one would expect that avoidance of peanut during these periods would reduce the incidence of PA – this being the basis of current Department of Health advice.[5] A number of interventional trials have been conducted to determine the importance of maternal peanut consumption during pregnancy and breastfeeding. In these studies, mothers have been randomised either to diets that excluded a number of antigens, including peanut, during pregnancy and breastfeeding, or to non-exclusive diets.[6] At 7-year follow up the rates of food allergy were similar in both groups, although the study was inadequately powered to demonstrate that there was no difference between the groups.[7]

Although the ideal study design to observe dietary factors in mothers of infants who develop PA would be prospective, the relatively low prevalence of the condition requires a large cohort to be observed for many years in order to obtain a large enough sample

of PA children to provide meaningful data. However, a retrospective study design allows the inclusion of a large number of PA cases, in a fraction of the time period, with fewer resource implications. Retrospective estimations of maternal dietary peanut consumption during pregnancy and breastfeeding could give valuable insight into the relative importance of these periods in terms of sensitisation, especially when PA cases are compared with high-risk controls. However, this approach would require an accurate method for retrospectively assessing maternal peanut consumption up to 2 years earlier, taking errors of memory, conceptualisation and portion sizes into account.[8]

Evidence suggests that the best estimate of a previous diet may be derived directly from a retrospective dietary history which focuses on that past time period rather than simply using the current diet and inferring from that.[9]

Semiquantitative food frequency questionnaires (FFQs) were considered to be the most appropriate tool to use for the retrospective assessment of peanut consumption. They represent an appropriate measure in a study involving relatively large numbers of subjects, where comparative consumption between groups is of greater importance than accurate absolute intakes of peanut protein in individuals.[10] A major barrier to the conduct and interpretation of retrospective studies linking dietary consumption with disease in later life has been uncertainty about the reliability of retrospective assessments of diets from the distant past. FFQs have been shown to be a reliable method of assessing consumption of both individual nutrients and food components.[10] In addition, there is also good evidence of a strong correlation between retrospective and contemporaneous estimates of food intake using FFQs[11] with reasonable reproducibility.[10] Despite this, any new FFQ used to estimate the previous diet of mothers of PA children and their controls needs to be assessed within the population of interest for accuracy of recall over the time frame that recall would be required in the study setting.

Materials and methods

FFQ design

In the absence of a previous validated FFQ looking at peanut consumption, it was necessary to generate a new food list. Ideally, this list needed to include all commonly consumed foods containing significant quantities of peanut protein in the diet of our target population (pregnant women and young mothers in the UK). Normally foods included in an FFQ are taken from a 7-day food history from the target population. This method was not used because parents are not always aware of which foods do or do not contain peanuts rather than tree nuts. The researchers were therefore concerned that many of the commonly consumed peanut-containing foods would not be included in the final FFQ. Therefore both the paediatric dietitians' peanut-avoidance diet sheets, with common peanut-containing foods (in use in our own tertiary allergy clinic for the past 5 years), as well as food lists from the Anaphylaxis Campaign (a charitable organisation that offers support to families of children with allergies) were used when developing the FFQ. Given that peanut oils contain no protein (or minimal quantities),[12] and that it is specifically peanut protein which is implicated in allergic sensitisation, foods containing only peanut oil were not included. Similarly, items that listed peanut either as a trace ingredient or as a possible contaminant were not included as they contain no more than a few hundred micrograms of protein and will therefore not contribute significantly to overall peanut consumption.[13]

Once a list of commonly consumed peanut-containing foods had been compiled, foods were categorised to form the FFQ. Different brands of the same food, such as peanut butter, were simply grouped as the generic item as identifying each brand would have considerably lengthened the food list while adding little information given the similar peanut content in different peanut butters. Peanut-containing foods were then grouped according to their presentation, viz. spreads, bars, sauces, and snacks.

Once the FFQ food list was completed it was pre-tested on a group of 50 mothers, from different ethnic backgrounds, at our food allergy clinics. This is the same clinic from which our later study population will be drawn. This first pilot study aimed to evaluate the list of foods in the FFQ. In addition to completing the FFQ, respondents were also asked to name any other foods containing peanut (plus portion sizes) that they had consumed, which were not listed in the current FFQ. Foods brought to our attention through the open-ended questions were only included in the FFQ if they were listed as containing peanut ingredients as stipulated by the European Labelling Law. Members of ethnic groups were also further interviewed to obtain a clearer understanding of peanut consumption in their culture, which enabled the researchers to add two further foods commonly consumed in these groups.

The revised FFQ was then pre-tested again on a further sample of 50 women from our allergy clinics. In addition to assessing the foods listed in the FFQ, this pilot also aimed to confirm the portion sizes consumed. Foods were converted into standard portion sizes, which were translated into household measurements. This was considered important in light of evidence that individuals have difficulty estimating portion size when reporting what they have consumed.[14] In the case of foods that come prepackaged in standard sizes, such as chocolate bars, the amount consumed was requested in terms of this standard unit. Standard portion sizes were obtained for other food items using the Ministry of Agriculture's Food Portion Sizes.[15] The actual peanut protein content in each product on the FFQ was

obtained from the manufacturers directly. Consumption frequency was measured by weekly intake. The most commonly and frequently eaten foods were listed at the top of the FFQ (Fig. 1), as there is an evidence base to suggest that accuracy of responses may decline through boredom and fatigue towards the end of questionnaires.[16]

A final pre-testing enabled us to ensure that the final questionnaire could be completed in a reasonable time frame and was easy to understand. Feedback also suggested that a simple worked example should be included in the instructions for completing the FFQ, and this was done in the final version (Fig. 1).

Reproducibility of recall

The FFQ was designed for interviewer administration, as this method has been shown to have superior correlation coefficients between FFQs and reference measures than self-administered questionnaires, and also improved repeatability.[16] It should be administered by a single researcher, thus limiting issues of reliability between different interviewers. The interviewer was also able to ensure clarity when foods were consumed less than once a week, which could potentially have caused confusion as weekly amounts were required.

As the FFQ is to be used retrospectively to report peanut consumption during a time period in the past, assessment of recall reliability when using this FFQ is required. This was achieved through repetition of the same questionnaire, on the same sample population at a 2-year interval (for reasons discussed below). It should be noted that this does not represent a validation of the accuracy of the FFQ, which would require comparison between the peanut consumption reported in the FFQ and a 'truth reference'. This is considered in more detail below.

A group of 40 women attending routine antenatal appointments during the second trimester of pregnancy at St Mary's Hospital, London, were approached and asked to fill in the revised FFQ with reference to their previous month's consumption (initial recall). Detailed contact information was taken but women were not informed that they would be asked to repeat the exercise at a later date. Two years after initial administration of the questionnaire we attempted to contact the group of women and asked them to again complete the FFQ with reference to the period of their pregnancy (follow-up recall). All analyses were carried out using the Stata 8.0 for Windows (StataCorp LP, College Station, Texas, USA) statistical software package.

Results

A total of 30 of the 40 women completed both the initial and follow-up questionnaires (Table I). The remaining 10 women were not contactable on follow-up. None of those successfully contacted refused to complete the follow-up questionnaire.

Table I. Reported peanut consumption (grams of peanut per week) at initial and follow-up recall

Case	Initial recall (g/week)	Follow up recall (g/week)
1	25	1.61
2	0	0
3	0	0
4	25.2	13.3
5	10	10
6	6.4	6.4
7	1.4	2.7
8	32.7	29.4
9	44.4	41.4
10	47.7	59.2
11	0	0
12	0	0
13	0	0
14	94.5	96.5
15	37.5	36.9
16	0	0
17	0	0
18	6.3	6.3
19	0	0
20	111.1	83.8
21	13.5	13.5
22	29.1	54
23	14.7	14.7
24	0	0
25	0	0
26	0	5.0
27	0	2.1
28	32.8	26
29	0	0
30	10.5	13.9

Fig. 2 shows a plot of peanut consumption (grams/week), viz. initial recall versus follow-up recall, together with a linear- and a smooth-fit line. As the initial consumption value given by case 20 (111.14 g/week) was considerably underestimated on follow-up recall, the smooth-fit dips lower at higher values; otherwise it stays close to the linear-fitted line. This suggests a linear relationship between the initial and follow-up questionnaire on peanut consumption (correlation 0.95). The lack of a significant difference between the best fit-line and y = x plot ($p = 0.14$) indicates that there is no apparent bias in predicting the recall values of one questionnaire from the other.

The squared difference between the follow-up and initial values are plotted against the initial recall values (Fig. 3). This shows us that variation between follow-up recall and initial recall increased with higher initial recall values. Where more peanut consumption

Try to remember back to when you were pregnant with your child.

How many times did you eat the foods listed in a normal week and how much of the food did you eat each time?

Example:

If you ate 1 snickers bar on 2 occasions in a normal week then you would fill in:

Snickers 2 times 1 bar

and if you ate 2 slices of bread and peanut butter on 4 occasions during a normal week:

Peanut butter 4 times 2 slices

A sandwich consisting of 2 slices of bread filled with peanut butter would only count as 1 slice of peanut butter.

Type of food	Times eaten in a week	Amount eaten each time
Peanut butter		slices
Snickers		bars
Peanut M&Ms		packs
Whole peanuts		handfuls
Crunchy Nut Cornflakes		bowls
Crunchy Nut Cornflakes Red		bowls
Revels		bars
Tracker Roasted nut		bars
Rowntree's Lion Bar		bars
Cadbury's Star Bar		bars
Cadbury's Fuse		bars
Cadbury's Picnic		bars
Reese's Peanut Butter Cups		cups
Satay sauce		servings
Peanut soup		servings
Bamba snack		packs

Please write down any other sources of peanuts you may have eaten, and how much per week:

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Fig. 1. Excerpt from FFQ.