

RESEARCH PAPER

The accuracy of dietary recall of infant feeding and food allergen data

Z. van Zyl,^{1*} K. Maslin,^{2,3*} T. Dean,^{2,3} R. Blaauw¹ & C. Venter^{2,3}

¹Division of Human Nutrition, Department of Interdisciplinary Health Sciences, Faculty of Medicine and Health Sciences, Stellenbosch University, Stellenbosch, South Africa

²School of Health Sciences and Social Work, University of Portsmouth, Portsmouth, UK

³David Hide Asthma and Allergy Research Centre, St Mary's Hospital, Isle of Wight, UK

Keywords

dietary recall, food allergy, infant feeding, recall bias.

Correspondence

K. Maslin, School of Health Sciences and Social Work, University of Portsmouth, James Watson West, 2 King Richard 1st Road, Portsmouth PO1 2FR, UK.

Tel.: +44 23 9284 4440

E-mail: kate.maslin@port.ac.uk

How to cite this article

van Zyl Z., Maslin K., Dean T., Blaauw R. & Venter C. (2016) The accuracy of dietary recall of infant feeding and food allergen data. *J Hum Nutr Diet.*

doi: 10.1111/jhn.12384

*These authors contributed equally to the present study.

Abstract

Background: Research investigating the association of infant dietary factors with later health outcomes often relies on maternal recall. It is unclear what the effect of recall bias is on the accuracy of the information obtained. The present study aimed to determine the extent of recall bias on the accuracy of infant feeding and food allergen data collected 10 years later.

Methods: Mothers were recruited from a prospective birth cohort from the Isle of Wight. When their child was 10 years of age (2011/2012), mothers were requested to complete a retrospective infant feeding questionnaire asking the same questions as those solicited in 2001/2002.

Results: In total, 125 mothers participated. There was substantial agreement for recollection of any breastfeeding ($\kappa = 0.79$) and the duration of breastfeeding from 10 years earlier ($r = 0.84$). Some 94% of mothers recalled accurately that their child had received formula milk. The exact age at which formula milk was first given was reliably answered ($r = 0.63$). The brand of formula milk was poorly recalled. Recall of age of introduction of solid food was not reliable ($r = 0.16$). The age of introduction of peanuts was the only food allergen that was recalled accurately (86%).

Conclusions: The present study highlights the importance of maternal recall bias of infant feeding practices over 10 years. Recall related to breastfeeding and formula feeding were reliable, whereas recalls related to age of introduction of solid or allergenic foods, apart from peanut, were not. Caution should be applied when interpreting studies relying on dietary recall.

Introduction

Epidemiological research suggests that early dietary exposure is a contributing factor in the development of non-communicable diseases such as obesity, diabetes and food allergy^(1–4). In health conditions with some latency period between dietary exposure and outcome, past dietary exposure is of more relevance than current dietary intake. However, collection of data about prior dietary intake is often reliant on memory, either immediately or in the distant past. The accuracy, reliability and validity of

retrospectively collected data compared to prospectively collected data is therefore a very important question for nutritional epidemiological research.

Although retrospective data collection has many potential advantages, such as reduced study duration and cost, it is highly subject to recall bias. Recall bias is the tendency of participants to report past events about exposure or outcome in a different manner between two study periods⁽⁵⁾. This error in recall can lead to misclassification of study participants, with a resultant distortion of measure of association. Hence, recall bias contributes a

major threat to the internal validity of studies using self-reported data ⁽⁶⁾ and potentially may lead to incorrect hypothesis generation.

Longitudinal research examining the effect of infant feeding habits on later health often relies on maternal recall as a proxy measure of infant dietary intake. Outcomes such as adult intelligence, obesity, serum cholesterol and risk of diabetes have all been investigated regarding their relationship with breastfeeding and breastfeeding duration ⁽⁷⁾. Factors including the period of recall ⁽⁸⁾, family size ⁽⁹⁾, type of information recalled and mother's educational level ⁽¹⁰⁾ have been found to influence the accuracy of information recalled. Conversely, maternal age, race and the infant's sex do not appear to influence the accuracy of maternal recall.

Overall, studies investigating recall of breastfeeding have had inconsistent findings. Bland *et al.* ⁽⁹⁾ reported that 72% of mothers did not recall the period of exclusive breastfeeding (EBF) accurately 6–9 months post-delivery, with 57% overestimating the duration and 15% underestimating the duration. Agampodi *et al.* ⁽¹¹⁾ reported similar findings at 9 months follow-up, concluding that estimations of longer than observed EBF were likely a result of social desirability bias rather than recall bias. With regard to longer durations of recall, Promislow *et al.* ⁽⁷⁾ assessed the validity of maternal recall of the duration of breastfeeding in elderly American women 34–50 years later, reporting a sensitivity for recall of having breastfed of 94%. The duration of any breastfeeding therefore has been shown to be more reliable than duration of EBF, which was also reported by Natland *et al.* ^(8,12,13) who assessed reporting accuracy over an 8-year period.

In terms of the introduction of solid food, research suggests dietary recall is also unreliable. Gillespie *et al.* ⁽¹⁴⁾ reported that the age of introduction of solid foods tended to be overestimated in interviews conducted 1–3.5 years after birth compared to those carried out within 3 weeks of the event. Recall accuracy appears to diminish with increasing time gap. Vobecky *et al.* ⁽⁸⁾ reported that age of introduction of solids was recalled very poorly after 8 years, with a correlation of only 0.16 for meat and 0.35 for cereals. Barbosa *et al.* ⁽¹⁵⁾ also found little agreement in age of introduction of solid foods over a 6-year period of recall. Tienboon *et al.* ⁽¹⁶⁾ examined mothers' recall of infant feeding practices after a period of 14–15 years, demonstrating that the timing of the introduction of solids and duration of breastfeeding was less accurately recalled than the recall of any breastfeeding.

Predictors for inconsistencies of recall with infant feeding practices have been shown. Questions described in the literature are not always valid or reliable; for example, when asking a mother how long she breastfed exclusively

for, without explaining exactly what EBF means as well as using the question 'When did you stop breastfeeding' to find out when a mother started weaning. Another predictor for inconsistency of recall is when the criteria for agreement changes over the two time points; for example, recording in weeks when a mother started with the introduction of solid foods and asking her to recall in months.

Information regarding timing of introduction of solids food is of particular importance in food allergy because this has led to important hypothesis generation in the past ⁽¹⁷⁾. Food allergy negatively impacts quality of life ⁽¹⁸⁾ and has a substantial impact on the health economy ^(19,20). Because there is currently conflicting evidence in the area of food allergy prevention ^(21,22), it is particularly important that the evidence generated is robust. Of note, some studies investigating pregnancy, breastfeeding and weaning practices, as well as the potential effect on the development of food allergy, have relied on parents reporting information up to 15 years retrospectively ⁽²³⁾. Despite suspecting that this period of recall in food allergy prevention studies may have an effect on the reliability of the data, it was still used to inform national policies ⁽²⁴⁾. There is paucity in the literature regarding the effect of recall bias on infant feeding information obtained retrospectively and how this may affect the development of allergic diseases. The present study therefore investigated the impact of recall bias on the accuracy of information obtained regarding breastfeeding and weaning practices, specifically in relation to food allergy and the introduction of allergenic foods.

Materials and methods

Parent study

The present study formed part of the Food Allergy and Intolerance Research (FAIR) study, an unselected birth cohort study from the Isle of Wight. Data were obtained in 2001/2002 from 969 families investigating factors associated with maternal dietary intake, feeding and weaning practices in relation to the development of food hypersensitivity in the infant. Methods and data from the study have been published previously in detail ^(25–27).

In brief, all pregnant mothers with an approximate delivery date between 1 September 2001 and 31 August 2002 were approached at antenatal clinics. At 36 weeks of gestation, a validated maternal food frequency questionnaire was completed ⁽²⁵⁾. At 3, 6, 9 and 12 months, information was obtained regarding feeding practices and reported symptoms of atopy, using a standardised questionnaire. Children were seen at 1, 2 and 3 years when a medical assessment was performed. Participants were invited for further follow-up in 2012, when the children were between 9 and 11 years of age. A flow diagram of

the study population showing the stages from recruitment to the 10-year follow-up is provided in Fig. 1.

Questionnaires

The 2001/2002 questionnaires used at 3, 6, 9 and 12 months consisted of questions relating to dietary intake when pregnant⁽²⁵⁾, breastfeeding practices in terms of exclusivity and duration, age of introduction of formula and specific weaning foods and dietary avoidance. Mothers were not informed that they would be answering some of these same questions at any point again in the future. The questionnaires were tested for face validity by checking the understanding of the questions with a separate group of mothers. Criterion-related validity took place by comparing answers with those charted in participants' personal child health record (also known as the child's 'red book'). The personal child health record is given to parents/carers at a child's birth in the UK and is the main record of a child's health, growth and development. Answers from the 2001/2002 questionnaire are used as the 'gold standard' for comparison with the answers from the current (2012) feeding questionnaire. At the 10-year follow-up study in 2012, parents were asked to complete a feeding questionnaire consisting of 18 of the same questions that were asked in 2001/2002.

Sample

Nonrandom, purposive sampling was used. All parents of the 969 children who participated in the original FAIR study (a nonselective group) and who attended the FAIR clinics during the 10-year follow-up were asked to take part. Parents/carers attending the clinic who did not complete the original feeding questionnaires were not included in the study. The sample size for the study was

calculated using power analyses for repeated measures experiment, which, in this case, equalled two repetitions. A paired *t*-test was used for this purpose. Power analyses were carried out yielding 90% power with a Cohen's *D* of 0.298. To detect the smallest standardised effect, a sample size of 121 was set as the minimum for the present study.

Ethical considerations

Ethics approval was obtained from the NRES Committee South Central in Southampton, UK, for the larger FAIR follow-up study (10/H0504/11) and the study of recall bias. Ethical approval from the Health Research Ethics Committee of Stellenbosch University, South Africa was obtained (S12/01/002) for the study investigating the impact of recall on the accuracy of dietary information.

The present study and the preparation of the manuscript both comply with STROBE guidelines for transparent and accurate reporting of observational studies.

Statistical analysis

Data were entered into SPSS (SPSS, Chicago, IL, USA), and then exported to EXCEL (Microsoft Corp, Redmond, WA, USA) and STATISTICA, version 11 (StatSoft Inc., Tulsa, OK, USA). Descriptive statistics and frequencies were calculated. Accuracy or agreement of recall in all cases, unless specified otherwise, was calculated by testing for the agreement of the answer given in 2012 with the 'gold standard' answer given in 2001/2002, based on a significance value of $P < 0.05$. The criterion for agreement was against the precise answer given in 2001/2002. The kappa (κ) coefficient and 95% confidence intervals (CIs) were computed to measure the agreement before and later for categorical 2×2 responses (e.g. Yes/No). Sensitivity and specificity tests were used to compute the 'true positive'

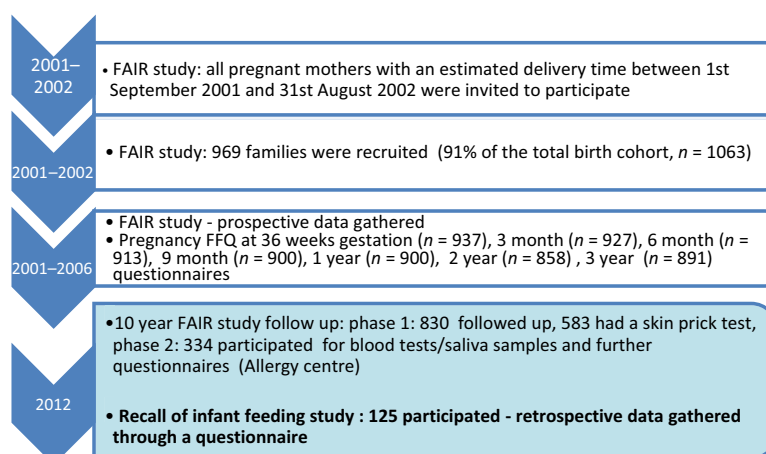


Figure 1 Flow diagram of the study population from recruitment. FFQ, food frequency questionnaire; FAIR, Food Allergy and Intolerance Research.

and 'true negative' for 2×2 tables where the answer was dichotomous.

Results

Participant recruitment and demographics

There were 830 participants recruited for the 10-year FAIR follow up study, of whom 334 attended the allergy centre for an appointment. Of these 334 participants, 125 took part in the dietary recall study. Table 1 shows the participant demographic characteristics.

Accuracy of recall of breastfeeding

Ninety-three percent (114/123) of mothers reported accurately that they had breastfed ($\kappa = 0.79$, 95% CI = 0.63–0.90). The specificity of recall was 100% (i.e. mothers reported not to have breastfed were 100% accurate in the pre- and post-questionnaire). The sensitivity of breastfeeding recall was 91%, meaning that 9% of mothers who did breastfeed reported not to have breastfed.

There was substantial agreement between the answers reported in 2012 for duration of any breastfeeding and those reported 10 years earlier ($r = 0.84$, $P < 0.05$). In terms of duration of exclusive breastfeeding, a strong significant correlation was found between the answers over 10 years ($r = 0.70$, $P < 0.05$).

Accuracy of recall of formula feeding

The percentage of accurate answers to whether a child had a bottle of formula milk when in hospital was 84% (103/123) ($\kappa = 0.67$, 95% CI = 0.54–0.80). Ninety-four percent (116/124) of mothers recalled accurately that their child had received formula milk at some stage, irrespective of when and how much. The specificity of the answers over this time period of recall was 95.7%. The sensitivity was 62.5%; therefore, 37.5% of mothers recalled that their child had some formula milk even if they did not 10 years earlier.

There was a substantial agreement in the reported age at which mothers introduced formula milk ($r = 0.63$, $P < 0.05$). The trend for both the gold standard answer in 2001/2002 and the reported answer in 2012 was for fewer mothers to introduce formula milk as time went on. Some mothers recalled introducing formula milk after their child was 1 year old, although this was not the case 10 years earlier.

Mothers who had given formula milk to their baby were asked to recall which formula milk was given. Only 17/125 (13.6%) mothers answered this question. Fifty-nine percent (11/17) recalled the exact brand name over this 10-year period. Forty-one percent (7/17) of mothers recalled accurately the exact variant of the brand of formula milk. Neither of these results are statistically significant as a result of the low numbers.

Table 1 Participant demographic characteristics

Variable	
Mean age of child (years)	10.5 (SD 0.32)
Sex (n)	60% male (75)
Mean maternal age at child's birth (minimum-maximum)	30.2 (19–43)
Maternal education level (n)	0.8% did not finish school (1) 33% School (41) 52.4% Further education (66) 13.7% Higher education (17)
First born (n)	46% (58)
Ever had eczema	31.6%
Ever had hayfever	27.6%
Maternal asthma	21.5%
Maternal eczema	28.6%
Maternal hayfever	37.8%
Maternal food allergy	13.3%
Sibling with food allergy (n)	19% (13)
Diagnosed to food allergy using DBPCFC at age 1 (n)	1.6% (2)
Diagnosed to food allergy using DBPCFC at age 2 (n)	0.8% (1)
Diagnosed to food allergy using DBPCFC at age 3 (n)	1.6% (2)

DBPCFC, double-blind placebo controlled food challenge.

Accuracy of recall of solid food introduction

Timing of solid food introduction

Mothers were asked an open question about how old (weeks) their child was when first given solid foods. There was weak agreement between the two periods of reporting ($r = 0.16$). Figure 2 shows the distribution of answers from the mothers in 2001/2002 and 2012. The mean (SD) age answered was 14.93 (2.48) weeks and 15.56 (4.57) weeks for 2001/2002 and 2012, respectively, showing that the answers in 2012 varied more than those in 2001/2002. More mothers recalled to have weaned earlier than they actually did. Some 76% of mothers could accurately remember when they first gave solid foods to their child within a 4-week margin.

Type of solid food introduced

Mothers were asked an open question to determine which first three baby foods were introduced at weaning. A food was either categorised as a standalone food item or a food group, based on the categories set for the FAIR study⁽²⁸⁾. Fifty-three percent ($n = 66$) of mothers were able to recall two or more of the foods/food groups accurately, leaving 47% who recalled one or no foods/food groups

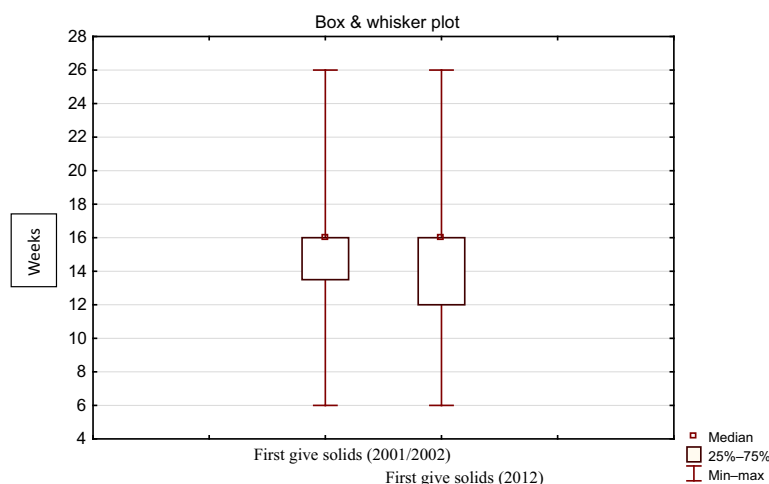


Figure 2 Recall of when solid foods were first introduced.

accurately. Rice, non-citrus fruit/juice and vegetables (not potato or tomato) were the most common foods/food groups that were accurately recalled. Some 87% (101/116) of mothers recalled correctly whether they had given their child commercial baby foods 10 years earlier.

Introduction of allergenic foods

Mothers were asked the age of their child when they first introduced some major food allergen groups into their diet. Each major food allergen group was listed with an option for mothers to select a categorical age range of introduction (<3 months, <6 months, <9 months and >9 months). Table 2 shows the number and percentage of mothers who recalled correctly when they first introduced certain allergenic foods into their child's diet. Most foods were poorly recalled, apart from peanuts, which showed 86% accuracy.

Food avoidance

Asking mothers to recall 10 years later whether they excluded any foods from their child's diet when their child was 6 months was not at all accurate ($\kappa = 0.09$, 95% CI = 0.07–0.27). The specificity of the answers from

the mothers in 2012 is 54.5%. Almost half of mothers who therefore reported 'No' to avoiding food items were incorrect. The sensitivity was computed to be 54.5%; therefore, just under half of mothers who reported that they did avoid food items 10 years earlier did not. From those mothers who were avoiding any foods, they were asked again which specific foods were avoided. Out of the 79 accounts of avoidance, 40.5% (32/79) of the recalled food/food group matched the answers given 10 years earlier.

Recall of peanut consumption during pregnancy and in early childhood

Mothers were asked about their consumption of peanuts at 36 weeks of gestation and their child's consumption when they were 2 and 10 years old. Both the 2-year and 10-year questionnaires also allowed for parents to explain why they avoided giving peanuts. The answers recalled by mothers from 36 weeks of gestation to 2 years were shown to be substantially agreeable ($\kappa = 0.64$ CI 0.50–0.77). The agreement between mother's answers in 2012 from 8 years earlier in 2003/2004 was 0.39 (95% CI = 0.25–0.53), which is considered as fair agreement.

Table 2 Number and percentage of correct answers for introduction of allergenic foods/food groups in 2001/2002 and 2012

At what age did you introduce the following foods into your child's diet? Allergenic food group options	% accurate (n)
Wheat containing foods (e.g. baby rusk, baby cereals, cereals, pasta, bread, cakes, biscuits)	44.8 (52/116)
Dairy foods (e.g. yoghurt, fromage frais, custard, ice cream, butter, margarine, cow's milk in food, cheese)	50.9 (59/116)
Fish	34.5 (30/87)
Whole egg	30.8 (28/91)
Soya	34.5 (10/29)
Tree nuts – almonds, brazil nuts, pecan nuts, hazel nuts, walnuts, cashew nuts, macadamia nuts. (e.g. in chocolate, crunchy nut cornflakes, choc chip cookies, pesto sauce, vegetarian meals)	66.2 (51/77)
Peanuts (e.g. Bombay mix, peanut butter, peanut)	85.7 (72/84)

Birth order and accuracy of recall

There was stronger agreement for recall of whether they breastfed or not for mothers of children who were born second or later compared to those for first born children ($r = 0.85$ versus $r = 0.62$, respectively). There was substantial agreement for the reported duration of breastfeeding in all groups, irrespective of whether mothers were recalling for first borns or children born second or later. A similar pattern was noted for introduction of formula, with mothers of children who were born second or later tending to provide more reliable answers than mothers of first born children.

Discussion

To our knowledge, the present study is unique because it is the first to demonstrate dietary recall bias in a food allergy cohort; it captures data from maternal diet pre-pregnancy through to advanced stages of weaning; and it specifically addresses recall bias in the age of introduction of allergenic foods. The present study, using longitudinal, descriptive cohort data with a retrospective analytical component, was designed to explore recall bias relating to infant feeding practices over a 10-year period. Data on breastfeeding and infant feeding practices were collected prospectively from mothers in the FAIR study⁽²¹⁾ and the accuracy of recall was tested by asking some of the same questions 10 years later. The results showed that it is reliable to ask mothers questions related to breastfeeding and formula feeding over a 10-year period. Less reliable is recall relating to introduction of solid and allergenic foods and whether certain foods were excluded from a child's diet during weaning.

In agreement with previous research of breastfeeding recall over a 15- or 22-year period^(12,13,16), the present study confirmed that asking a mother whether she breastfed her child after 10 years is highly reliable. Natland *et al.*⁽¹³⁾ specifically reported that close to 100% of mothers in Norway at the time were likely to have breastfed, even if for 1 week; therefore, the strong accuracy of recall may not be entirely applicable to populations where BF rates are lower. Surprisingly, in the present study, the results showed a sensitivity of 91%, meaning that there were some mothers who had breastfed who did not recall breastfeeding. Because the majority of mothers in the study breastfed for up to 1 month, it could be that some mothers did not consider that the short duration of breastfeeding justified a 'yes' answer. We also found it highly reliable to ask a mother to recall over 10 years how long she breastfed for and whether exclusively or not. The influence of the duration of breastfeeding has been investigated for

many health outcomes such as adult intelligence^(29,30), obesity^(3,31), diabetes risk⁽³²⁾, serum cholesterol⁽³³⁾ and blood pressure⁽³⁴⁾, as well as for aspects of maternal health, including risk of breast cancer⁽³⁵⁾, ovarian cancers⁽³⁶⁾ and osteoporosis⁽³⁷⁾. As a result of the prolonged latency period between exposure and outcome, it is imperative to assess the validity of studies investigating the accuracy of recall over long periods. Although some long term recall studies reported good accuracy^(8,12,13), other studies with a shorter duration of recall did not find this question as reliable^(9,11,14).

It is suggested that, in case control studies, cases are more likely to remember past exposures owing to concern about their condition⁽⁵⁾. Cows' milk allergy (CMA) often presents when formula milk is introduced. An assumption could therefore be made that mothers of children with CMA are more likely to accurately recall when they first introduced formula milk into their child's diet compared to mothers of children who were not allergic to milk. We are unaware of any studies that have examined whether accuracy of recall of infant feeding practices is affected by a diagnosis of allergy in the child the recall is based upon. Unfortunately, as a result of low numbers of food allergic children, no significant conclusions could be drawn from the present study. The overall recall of timing of introduction of formula was reliable, with 84% of mothers accurately recalling whether her child received a bottle of formula milk within the first 1–2 days of birth. This is noteworthy because intervention studies have previously reported that infants exposed to cows' milk formula in hospital immediately after birth have a higher risk of developing CMA compared to those who are fed pasteurised human milk or whey hydrolysate formula, or who are exclusively breastfed⁽²⁾.

The timing of introduction of solid and allergenic foods is a matter of significant debate in the allergy field. Advice for parents/carers has changed over time because research in this area has been conflicting^(18,20,38). The age at which solid foods were introduced into the diets of infants was poorly recalled by mothers. There was a tendency for mothers to report that they weaned earlier than they did a decade earlier, although there were also some mothers who reported to have weaned much later too. Previous studies investigating the accuracy of recall of the introduction of certain foods over time periods from 1 to 22 years also reported poor accuracy^(8,12,14). One study⁽¹⁴⁾ acknowledged that a poorly constructed question was used ('When did you stop breastfeeding') as the measurement for the duration of breastfeeding and the time point when solid food was introduced. This underlines the importance of constructing a question appropriately

to ensure that it extracts the intended answer and distinguishes between exclusive breastfeeding and any breastfeeding.

Overall, the recall of age of introduction of allergenic foods was poor, with the exception of peanuts. There was also a very poor agreement as to whether any foods were excluded from the child's diet at the age of 6 months ($r = 0.09$). Gustafsson *et al.*⁽³⁹⁾ studied the impact of age of weaning and introduction of certain food allergens on the risk of the development of sensitisation and clinical allergy, relying on a recall period of up to 3 years. Based on the results of this study, the outcomes should be interpreted with caution. Two studies^(40,41) that investigated the relationship between the timing of the introduction of peanuts and the development of peanut allergy relied on mothers to recall details up to 2 and 3 years later. The results of the present study, demonstrating that 86% of mothers recalled correctly the timing of peanut introduction over an assessment period of 10 years, would suggest that recall of the timing of peanut introduction over 2–3 years should be reliable.

Food allergens cross the placenta from a mother to her child during pregnancy⁽⁴²⁾. The results of a study investigating the exposure of peanuts during pregnancy and the prevalence of peanut allergy⁽⁴³⁾ contributed to the development of national guidelines for pregnant mothers of high-risk infants to avoid peanuts during their pregnancy⁽²⁴⁾. The study relied on mothers recalling whether they consumed peanuts during pregnancy when their children were up to 18 years of age. Further studies by Dean *et al.*⁽⁴⁴⁾ and Hourihane *et al.*⁽²³⁾ were commissioned by the Food Standards Agency aiming to investigate whether the guidance on peanut avoidance was being followed by the target group and whether it was having an impact on the prevalence of peanut allergy in the UK. Hourihane *et al.*⁽²³⁾ reported no reduction in the prevalence of peanut allergy and only 3.8% of the mothers interviewed had followed the advice of stopping the consumption of peanuts during pregnancy, although their study relied on mothers recalling 5–6 years earlier whether they had avoided peanuts or not. According to the present study, research examining the association between maternal consumption of peanuts and the development of peanut allergy can rely on mother's recall up to 2 years post-pregnancy, although recall of maternal peanut consumption over a period of 8 years was shown to be unreliable. These findings, however, used recall at 2 years of age as the gold standard for comparison. Although results showed that answers up to 2 years are reliable, the level of agreement ($r = 0.70$) was not perfect. The 'gold standard' answer that the 8-year recall

answer is assessed against is therefore not 100% accurate.

Unlike the majority of existing studies that have assessed the accuracy of recall of infant feeding practices, the present study also explores the duration of EBF, as well as the introduction of solids and allergenic foods on recall bias. Participation bias cannot be ruled out because recall data were collected for 125 out of the 969 mothers; however, recruitment stopped once adequate numbers for power were reached. It is possible that social desirability bias may have influenced the response to questions at either time points and that this influence could have changed over time. Time points were only explored at 36 weeks of gestation, and at the first year, second year and 10 years, and hence recall bias at other intervals could not be assessed. Although the study involved a good sample size, it was not sufficiently powered to explore bias in those specifically suffering from food allergy. Although the population on the Isle of Wight is reflective of the population in the South of England, the results of the present study need to be interpreted with caution in populations that are dissimilar.

Conclusions

The results of the present study show that the accuracy of maternal recall over a 10-year period varies considerably according to the specific aspect of infant feeding being recalled. The recall of answers related to breastfeeding and formula feeding agrees substantially over these two time points. Whether commercial baby food was provided and the age of introduction of peanuts into a child's diet 10 years earlier is well recalled; however, other aspects of introduction of solid foods are poorly recalled. Mothers recalled avoiding peanuts during pregnancy well over the 2-year period after birth but, a further 8 years on, peanut avoidance during pregnancy was not so well-recalled. Whether a family history of atopy/allergy or diagnosis of food allergy in the infant influences the ability to accurately recall infant feeding practices warrants further exploration, although a larger study population will be needed. Studies that employ a retrospective collection of dietary data design need to carefully consider the strength of recall bias when interpreting the results.

Acknowledgments

We would like to acknowledge the study participants and their families. We would like to thank Professor Daan Nel (University of Stellenbosch, South Africa) for statistical support.

Conflict of interests, source of funding and authorship

The authors declare that they have no conflicts of interest.

The UK Food Standards Agency funded years 1–3 of the FAIR study (ref T0703).

ZvZ collected, analysed data and assisted with the drafting of the manuscript. KM drafted the manuscript. CV designed the study. All authors critically reviewed and approved the final paper.

References

- Williams TC & Drake AJ (2015) What a general paediatrician needs to know about early life programming. *Arch Dis Child* **100**, 1058–1063.
- Saarinen UM & Kajosaari M (1995) Breastfeeding as prophylaxis against atopic disease: prospective follow-up study until 17 years old. *Lancet* **346**, 1065–1069.
- Parsons TJ, Power C & Manor O (2006) Infant feeding and obesity through the lifecourse. *Arch Dis Child* **88**, 793–794.
- Monasta L, Batty GD, Cattaneo A *et al.* (2010) Early-life determinants of overweight and obesity: a review of systematic reviews. *Obes Rev* **11**, 695–708.
- Delgado-Rodriguez M & Llorca J (2014) Bias. *J Epidemiol Community Heal* **58**, 635–641.
- Hassan E (2005) Recall bias can be a threat to retrospective and prospective research designs. *Internet. J Epidemiol* **3**, 1–11.
- Promislow JHE, Gladen BC & Sandler DP (2005) Maternal recall of breastfeeding duration by elderly women. *Am J Epidemiol* **161**, 289–296.
- Vobecky JS, Vobecky J & Froda S (1988) The reliability of the maternal memory in a retrospective assessment of nutritional status. *J Clin Epidemiol* **41**, 261–265.
- Bland RM, Rollins NC, Solarsh G *et al.* (2003) Maternal recall of exclusive breast feeding duration. *Arch Dis Child* **88**, 778–783.
- Burns TL, Moll PP, Rost CA *et al.* (1987) Mothers remember birthweights of adolescent children: the Muscatine Ponderosity Family study. *Int J Epidemiol* **16**, 550–555.
- Agampodi SB, Fernando S, Dharmaratne SD *et al.* (2011) Duration of exclusive breastfeeding; validity of retrospective assessment at nine months of age. *BMC Pediatr* **11**, 80.
- Kark JD, Troya G, Friedlander Y *et al.* (1984) Validity of maternal reporting of breast feeding history and the association with blood lipids in 17 year olds in Jerusalem. *J Epidemiol Community Health* **38**, 218–225.
- Natland ST, Andersen LF, Nilsen TIL *et al.* (2012) Maternal recall of breastfeeding duration twenty years after delivery. *BMC Med Res Methodol* **12**, 179.
- Gillespie B, d'ArcyH, Schwartz K *et al.* (2006) Recall of age of weaning and other breastfeeding variables. *Int Breastfeed J* **1**, 4.
- Barbosa R, Oliveira A, Zandonade E *et al.* (2012) Mothers' memory about breastfeeding and sucking habits in the first months of life for their children. *Rev Paul Pediatr* **30**, 180–186.
- Tienboon P, Rutishauser I & Wahlqvist M (1994) Maternal recall of infant feeding practices after an interval of 14 to 15 years. *Aust J Nutr Diet* **51**, 25–27.
- Fox AT, du Toit G, Lack G *et al.* (2006) Two-year recall of maternal peanut consumption using a food-frequency questionnaire. *S Afr J Clin Nutr* **19**, 154–160.
- Flokstra-de Blok BMJ, Dubois AEJ, Vlieg-Boerstra BJ *et al.* (2010) Health-related quality of life of food allergic patients: comparison with the general population and other diseases. *Allergy* **65**, 238–244.
- Gupta R, Holdford D, Bilaver L *et al.* (2013) The economic impact of childhood food allergy in the United States. *JAMA Pediatr* **167**, 1026–1031.
- Protudjer JLP, Jansson S-A, Heibert Arnlin M *et al.* (2015) Household costs associated with objectively diagnosed allergy to staple foods in children and adolescents. *J Allergy Clin Immunol Pract* **3**, 68–75.
- Du Toit G, Roberts G, Sayre PH *et al.* (2015) Randomized trial of peanut consumption in infants at risk for peanut allergy. *N Engl J Med* **372**, 803–813.
- Muraro A, Halken S, Arshad SH *et al.* (2014) EAACI Food Allergy and Anaphylaxis Guidelines. Primary prevention of food allergy. *Allergy Eur J Allergy Clin Immunol* **69**, 590–601.
- Hourihane JO, Aiken R, Briggs R *et al.* (2007) The impact of government advice to pregnant mothers regarding peanut avoidance on the prevalence of peanut allergy in United Kingdom children at school entry. *J Allergy Clin Immunol* **119**, 1197–1202.
- Woods HF (1999) Committee on Toxicity of Chemicals in Food, Consumer Products and the Environment. Department of Health Crown Copyright.
- Venter C, Higgins B, Grundy J *et al.* (2006) Reliability and validity of a maternal food frequency questionnaire designed to estimate consumption of common food allergens. *J Hum Nutr Diet* **19**, 129–138.
- Venter C, Pereira B, Voigt K *et al.* (2009) Factors associated with maternal dietary intake, feeding and weaning practices, and the development of food hypersensitivity in the infant. *Pediatr Allergy Immunol* **20**, 320–327.
- Venter C, Pereira B, Voigt K *et al.* (2008) Prevalence and cumulative incidence of food hypersensitivity in the first 3 years of life. *Allergy* **63**, 354–359.
- Venter C, Pereira B, Grundy J *et al.* (2006) Incidence of parentally reported and clinically diagnosed food

- hypersensitivity in the first year of life. *J Allergy Clin Immunol* **117**, 1118–1124.
29. Gale C & Martyn C (1996) Breastfeeding, dummy use, and adult intelligence. *Lancet* **347**, 1072–1075.
 30. Mortensen EL, Michaelsen KF, Sanders SA *et al.* (2002) The association between duration of breastfeeding and adult intelligence. *JAMA* **287**, 2365–2371.
 31. Victora CG, Barros F, Lima RC *et al.* (2003) Anthropometry and body composition of 18 year old men according to duration of breast feeding: birth cohort study from Brazil. *BMJ* **327**, 901.
 32. Pettitt DJ, Forman MR, Hanson RL *et al.* (1997) Breastfeeding and incidence of non-insulin-dependent diabetes mellitus in Pima Indians. *Lancet* **350**, 166–168.
 33. Marmot MG, Page CM, Atkins E *et al.* (1980) Effect of breast-feeding on plasma cholesterol and weight in young adults. *J Epidemiol Community Health* **34**, 164–167.
 34. Owen CG, Whincup PH, Gilg JA *et al.* (2003) Effect of breast feeding in infancy on blood pressure in later life: systematic review and meta-analysis. *BMJ* **327**, 1189–1195.
 35. London SJ, Colditz GA, Stampfer MJ *et al.* (1990) Lactation and risk of breast cancer in a cohort of US women. *Am J Epidemiol* **132**, 17–26.
 36. Tung K-H (2003) Reproductive factors and epithelial ovarian cancer risk by histologic type: a multiethnic case-control study. *Am J Epidemiol* **158**, 629–638.
 37. Kojima N, Douchi T, Kosha S *et al.* (2002) Cross-sectional study of the effects of parturition and lactation on bone mineral density later in life. *Maturitas* **41**, 203–209.
 38. Committee on Toxicity of Chemicals in Food Consumer Products and the Environment (1998) *COT Consumer Products and the Environment – Peanut Allergy*.
 39. Gustafsson D, Sjöberg O & Foucard T (2000) Development of allergies and asthma in infants and young children with atopic dermatitis – a prospective follow-up to 7 years of age. *Allergy* **55**, 240–245.
 40. Frank L, Marian A, Visser M *et al.* (1999) Exposure to peanuts in utero and in infancy and the development of sensitization to peanut allergens in young children. *Pediatr Allergy Immunol* **10**, 27–32.
 41. Du Toit G, Katz Y, Sasieni P *et al.* (2008) Early consumption of peanuts in infancy is associated with a low prevalence of peanut allergy. *J Allergy Clin Immunol* **122**, 984–991.
 42. Loibichler C, Pichler J, Gerstmayr M *et al.* (2002) Materno-fetal passage of nutritive and inhalant allergens across placentas of term and pre-term deliveries perfused in vitro. *Clin Exp Allergy* **32**, 1546–1551.
 43. Hourihane JO, Dean TP & Warner JO (1996) Peanut allergy in relation to heredity, maternal diet, and other atopic diseases: results of a questionnaire survey, skin prick testing, and food challenges. *BMJ* **313**, 518–521.
 44. Dean T, Venter C, Pereira B *et al.* (2007) Government advice on peanut avoidance during pregnancy – is it followed correctly and what is the impact on sensitization? *J Hum Nutr Diet* **20**, 95–99.