

ORIGINAL ARTICLE

Parental perceptions and dietary adherence in children with seafood allergy

Ian E. Ng¹, Paul J. Turner^{1,2}, Andrew S. Kemp² & Dianne E. Campbell^{1,2}

¹Discipline of Paediatrics and Child Health, School of Medicine, University of Sydney, NSW, Australia; ²Department of Allergy and Immunology, Children's Hospital at Westmead, Sydney, NSW, Australia

To cite this article: Ng IE, Turner PJ, Kemp AS, Campbell DE. Parental perceptions and dietary adherence in children with seafood allergy. *Pediatr Allergy Immunol* 2011; Doi: 10.1111/j.1399-3038.2011.01189.x.

Keywords

children; dietary adherence; food allergy; quality of life; seafood.

Correspondence

Paul Turner, Department of Allergy and Immunology, Children's Hospital at Westmead, Locked Bag 4001, Westmead, NSW 2145, Australia.
Tel.: +61 (0)2 9845 3418
Fax: +61 (0)2 9845 3421
E-mail: paulyt@doctors.org.uk

Accepted for publication 29 May 2011

DOI:10.1111/j.1399-3038.2011.01189.x

Abstract

Background: Allergy to seafood (fish, mollusc and crustacean) is increasing and is now a leading cause of food anaphylaxis, but there is only limited data on the impact of seafood allergy on affected children and their families.

Methods: We assessed dietary adherence and perceptions of seafood allergy amongst the parents of 94 children presenting to a specialist allergy clinic with proven seafood allergy, by means of a postal questionnaire and cross-referencing the data obtained to clinical records.

Results: One-quarter of parents were unable to correctly recall the dietary advice provided. Nonetheless 89% of parents implemented a safe diet, but over half followed a more stringent elimination than that recommended. One-fifth of the children had subsequent allergic reactions to seafood after diagnosis, and these were generally a result of accidental rather than intentional exposure or cross-contamination. Provision of an adrenaline auto-injector device was associated with increased adherence to dietary advice. Oral food challenges had a beneficial effect on parental perceptions and were helpful to parents in managing their child's allergy.

Conclusions: Seafood allergy has a significant adverse effect on anxiety and stress in the families of affected children. Parental recall of dietary advice is variable and many tend to impose more stringent dietary avoidance than that recommended. Despite this, subsequent accidental reactions are common. Thus, the avoidance of seafood in children may be more difficult than often presumed.

Allergy to seafood (fish, mollusc and crustacean) is increasing and is now a leading cause of food anaphylaxis (1, 2). Prevalence is more common in countries such as Australia, Asia and many parts of Europe, where there is a high rate of seafood consumption (3, 4). A telephone survey in 2004 found that 2.3% of the general population of the United States may be allergic to seafood (5). We recently published a retrospective study describing the characteristics of seafood allergy in 167 children, demonstrating a high rate of anaphylaxis and the degree of both clinical cross-reactivity and cross-IgE sensitization between fish and shellfish (6).

Management of IgE-mediated food allergies involves allergen avoidance and provision of an action plan in the event of an accidental reaction. There is only limited information regarding the dietary advice provided to the families of seafood-allergic children and, more importantly, compliance with the advice given. We recently reported that

adherence to dietary advice in egg-allergic children was not associated with the severity of initial or subsequent reactions nor with the source of advice, suggesting that other factors are of importance (7). Previous studies have demonstrated the adverse impact of food allergies on the quality of life of families (8, 9), with specific reports demonstrating increased anxiety in the families of children with food allergy to egg (10) and peanut (11, 12). However, there are limited data on how dietary advice and parental adherence affect the parental perceptions of food allergy and the consequent impact on the family.

The objective of this study was to investigate the factors affecting parental adherence to dietary advice in a large cohort of children with seafood allergy and the consequences of that advice on family life. We also sought to assess potential strategies that might reduce the impact of the allergy on the child and their families.

Methods

We undertook a postal questionnaire of all patients presenting to the Allergy Clinic at the Children's Hospital at Westmead between 2006 and 2009 with a diagnosis of seafood allergy. Patients were identified on the basis of a positive oral food challenge (OFC) to seafood performed under medical supervision, or alternatively, a convincing history of IgE-mediated symptoms within 2 h of known exposure to seafood as assessed by a paediatric allergist, together with the evidence of sensitization on skin testing/serum-specific IgE. Children with the evidence of IgE sensitization but no history of prior allergic reaction to seafood were not included in the study.

The questionnaire was based on a similar published survey conducted by us in 2006 investigating parental perceptions of egg allergy and its impact on family life (10). The present questionnaire was developed with the input of four paediatric allergists and consisted of 51 items including demographic data, medical history, other atopy, details of previous reactions to seafood, dietary management, prescription of adrenaline auto-injector device and impact on family life. Dietary recommendations, both recalled and practised by the family, were categorized as avoiding all seafood (i.e. both fish and shellfish), either fish or shellfish, avoiding specific seafood species, avoiding foods labelled 'may contain traces of seafood' (avoid traces) and avoiding restaurants serving seafood (avoid restaurants). Further details were obtained as to whether this occurred all the time, most of the time, a little bit or not at all (those considered adherent complied with advice all the time). Parents were also asked to provide a diary of all seafood consumed by their child in the last 6 months. Compliance was assessed by comparing the advice recorded in the medical notes that recalled by the family in

the questionnaire and the dietary management as reported by parents. Responses were assessed either as dichotomous values or on a 4-point Likert scale, as shown in Table 1. Questionnaires, together with a study information sheet and consent form, were sent to a total of 167 children with seafood allergy. Parents had the option to decline participation if they preferred not to participate. Parents who had not returned the questionnaire were contacted by telephone 6 wks later to confirm receipt and offer assistance with the completion of the questionnaire if needed. A further questionnaire was sent if required.

Data obtained from medical records included patient demographics, previous reactions to seafood, sensitization to food and aeroallergens, presence of other atopy (including food allergy, defined as a previous clinical reaction rather than sensitization alone), management advice, prescription of adrenaline auto-injector device, compliance with advice and subsequent reactions (whether accidental or not). Dietary adherence was defined as adequate where parents described the implementation of dietary advice as provided by health professionals 'all the time', with no record of intentional exposure to seafood subsequent to diagnosis.

Prior food reactions were classified as localized contact reactions, mild-moderate (skin and subcutaneous tissue involvement and gastrointestinal symptoms) or anaphylaxis (respiratory or cardiovascular symptoms), in line with the criteria of the 2005 National Institute of Allergy and Infectious Disease/Food Allergy and Anaphylaxis Network Symposium (13). Where data were ambiguous or the medical records contradicted the items reported in the questionnaire, families were interviewed to provide clarification.

Sensitization was assessed by skin prick testing (SPT) rather than by the detection of serum-specific IgE, because of the lack of commercial availability of species-specific IgE

Table 1 Parental perceptions

Questionnaire	Possible responses
1 Does your child's allergy to seafood affect your out-of-home care arrangements for your child? e.g. childcare, preschool, babysitting?	Yes/no
2 How severe do you feel your child's allergy to seafood is in comparison to other common childhood illnesses such as fever, otitis media (middle ear infections), bronchitis or diarrhoea?	Less severe/same severity/ more severe
3 How difficult is it to manage your child's seafood allergy?	Not at all difficult/slightly difficult/difficult/very difficult
4 How much control do you feel you have over your child's allergy to seafood?	None/a little/some/a lot
5 Has your families' lifestyle changed because of your child's allergy to seafood?	Yes/no
6 If your child has other food allergies, do you find these more or less stressful than their allergy to seafood?	Less/about the same/a little more/much more stressful
7 In the future, how much inconvenience do you anticipate your child will have due to seafood allergy?	Not at all/a little bit/ somewhat/a lot
8 Do people treat your child differently to other children because of their allergy to seafood?	Yes/no
9 If your child underwent a food challenge to seafood in hospital, how useful was this in relieving your concerns relating to the seafood allergy?	Not at all/a little bit/ somewhat/a lot

testing for the majority of commonly consumed Australian fish. Skin prick testing was performed according to standard guidelines using commercial allergen extracts (Hollister Stier Laboratories, Spokane, WA, USA) or to the fresh fish (where indicated), with histamine 10 mg/ml as a positive control (14). A positive SPT was defined as a wheal size of at least 3 mm greater than a saline control read at 15 min. Oral food challenges to seafood were performed where deemed appropriate by treating clinician following a protocol consistent with established guidelines, either to clarify the diagnosis or to assist with dietary management (15).

Data analysis was performed using GRAPHPAD PRISM 5 software (GraphPad Software Inc, La Jolla, CA, USA). Associations between the quality-of-life measures were assessed using 2-tailed Fisher's exact test, with $p < 0.05$ considered significant. Adherence to dietary advice was assessed by the calculation of the kappa coefficient. The study was approved by the Ethics Committee at the Children's Hospital at Westmead.

Results

The questionnaire was sent to 167 families, of which 119 confirmed receipt. Of these, there were 94 completed questionnaires, a response rate of 79% from those known to have received the questionnaire. Questionnaires were completed on average 5.3 yrs after diagnosis. The characteristics of these children are described in Table 2. There were no significant differences in patient characteristics between those returning the questionnaire and non-responders (data not shown).

Demographics

Of children, 89% had evidence of other pre-existing atopy and 52% had at least one sibling with a reported food allergy. There was over 90% agreement between reactions reported by parents on the questionnaire and those documented in medical notes. Prawn (27%), 'white fish' (10%), salmon (9%) and tuna (8%) were the most commonly reported seafood triggers in this subcohort of previously published data (Fig. 1). In 8% of reactions, the type of seafood could not be recalled by the parent or identified retrospectively by the physician on history. The size of the SPT was not related to the severity of the clinical reaction ($p > 0.05$, Mann-Whitney *U*-test) (see Fig. 2). Sensitization and allergy to both fish and crustacean in the same individual was common, as shown in Fig. 3. Sixty (64%) cases were allergic to fish, of whom 15 (25%) were also crustacean-allergic (on the basis of a convincing history of prior reaction with positive SPT) and a further 24 (40%) were sensitized on SPT to crustacean. Twenty-one children (22%) had experienced anaphylaxis to seafood prior to presentation. Seventeen children (18%) developed ocular or upper respiratory symptoms (rhinorrhoea and nasal pruritus) on exposure to vapours from seafood.

Twenty-one children (22%) experienced subsequent reactions to seafood after diagnosis. In 14 cases, the reactions were because of accidental ingestion, while in two cases, the reaction was thought to be caused by cooking of potato chips

Table 2 Patient characteristics

Characteristics	No. of patients
Total no. of patients	94
Age at first reaction, median (interquartile range)	3 yrs (1.0–4.0 yrs)
Duration of follow-up, median (interquartile range)	4 yrs (2.4–7.2 yrs)
Age at completion of questionnaire, median (interquartile range)	8.1 yrs (5.2–10.3 yrs)
Gender, no. (%)	
Male	56 (60)
Female	38 (40)
Other atopy, no. (%)	
Asthma	45 (48)
Allergic rhinitis	29 (31)
Eczema	72 (77)
Other food allergy besides seafood	78 (83)
Egg	40 (43)
Cow's milk	22 (23)
Peanut	39 (41)
Tree nut	18 (19)
Initial symptoms of seafood allergy, no. (%)	
Anaphylaxis	21 (22)
Gastrointestinal symptoms	17 (18)
Previously tolerated seafood causing reaction	17 (18)
History of reaction to vapours from seafood	17 (18)
Subsequent reaction to seafood (%)	21 (22)
Subsequent reaction more severe than initial	9 (10)
Adrenaline auto-injector device (%)	
Prescribed owing to seafood allergy	26 (28)
Prescribed prior to diagnosis owing to other food allergies	57 (61)
No device prescribed	11 (12)
Used for previous food reaction	6 (6)
Oral food challenge performed as part of management	26 (28%)

in oil previously used to fry seafood. In three children, reactions were because of intentional exposure to the allergen outside hospital against medical advice. Otherwise, we did not find any cases of allergic reaction to seafood thought to be a result of contamination or 'traces of seafood'. While underadherence was a risk factor for subsequent reactions, there was no difference in the incidence of subsequent reactions between those families adhering to dietary recommendations and those following more stringent dietary elimination.

Open oral food challenges (OFCs) were performed in 26 (28%) children to clarify the diagnosis and/or to determine other species of seafood that could be tolerated. Of the 40 challenges performed, nine were positive. The mean age at OFC was 7.0 yrs.

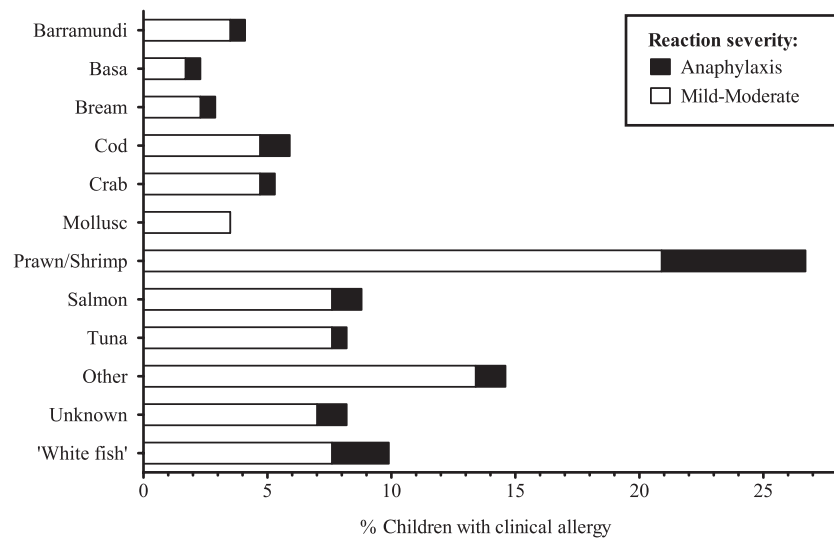


Figure 1 Seafood triggers identified.

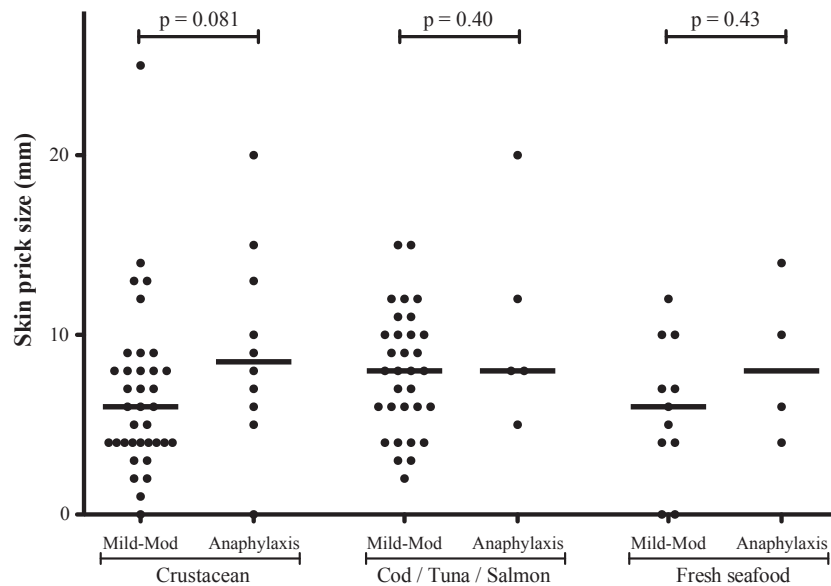


Figure 2 Size of skin prick test (SPT) wheal in relation to reaction severity in children allergic to crustacean (SPT to commercial extracts), cod/salmon/tuna (SPT to commercial extracts), or seafood

(SPT to fresh pulverized seafood). p Values by Mann–Whitney U test.

Dietary advice

Overall, 56% of parents were advised to avoid all seafood (both fish and shellfish), 45% to avoid either fish or crustacean and the remainder receiving instructions to avoid a specific type of seafood. Eleven per cent underadhered to the advice given. Fifty-two per cent followed a more stringent diet than recommended ('overadherence'), such as avoiding all seafood, though being advised to only avoid crustacean, or avoiding all foods labelled 'may contain traces' of crustacean or fish. Forty per cent avoided taking

their seafood-allergic child to restaurants serving seafood. Parents reported receiving dietary advice from multiple sources, including an allergy specialist (83%), dietician (13%), paediatrician (12%) and general practitioner (12%). The source of dietary advice did not alter the rates of compliance. Only one-third of the families recalled receiving written advice.

Parents of the children with previous anaphylaxis to seafood were less likely to underadhere to advice ($p = 0.011$) and more likely to follow more stringent avoidance than that recommended ($p = 0.051$), as shown in Table 3. A history of

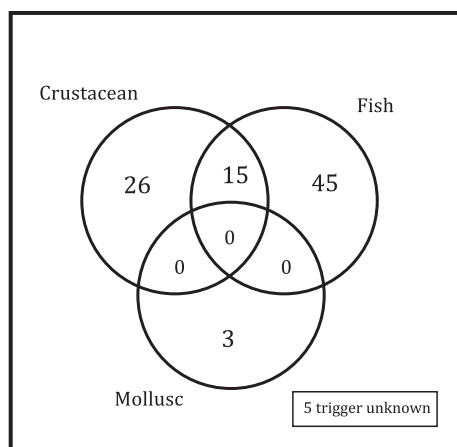


Figure 3 Schema demonstrating study population and degree of cross-reactivity between crustacean, mollusc and fish.

anaphylaxis was associated with a higher degree of agreement between the diet followed by the family and that recommended by the doctor (agreement 86%, kappa 0.67, implying substantial agreement). Agreement was also greater in those advised to avoid all seafood, compared with those advised to avoid either crustacean or finned fish. Non-prescription of

adrenaline auto-injector device was associated with under-compliance ($p = 0.007$). Adherence did not otherwise vary with the type of allergy (i.e. crustacean vs. finned fish vs. allergy to both), recency of last reaction, recommended dietary advice or whether the child underwent in-hospital OFC.

Recall of dietary advice

Seventy-seven per cent of the families recalled the same dietary advice as was documented in the medical notes (i.e. avoid all seafood/either fish or crustacean/avoid specific species) (kappa coefficient 0.58, implying moderate agreement). Comparing adherence to dietary advice as recalled by parents, 24% failed to adhere to the recommendations and 60% of this group following a more stringent diet. Parental recall was not affected by other variables (type of seafood allergy, previous OFC and prescription of adrenaline auto-injector device). Seventeen families recall being told to avoid foods labelled 'may contain traces of seafood', despite no documentation of this advice being given in the medical notes.

Parental perceptions and impact on quality of life

In general, parents reported that their child's seafood allergy had a significant impact on their quality of life (Table 4). Sixty-three per cent of the families had significantly changed

Table 3 Dietary advice, parental recall, adherence and agreement according to prior anaphylaxis to seafood and dietary recommendations provided

	Prior anaphylaxis (n = 21)	No prior anaphylaxis (n = 73)	p-value*	Avoid fish/shellfish (n = 45)	Avoid all seafood (n = 47)	p-value*
Dietary advice						
Avoid fish or shellfish	8 (38%)	36 (49%)	0.46			
Avoid all seafood	13 (62%)	35 (48%)	0.33			
Avoid specific fish	0	2 (3%)	1.00			
Parental recall						
Avoid fish or shellfish	7 (33%)	29 (40%)	0.62	30 (67%)	5 (11%)	
Avoid all seafood	14 (67%)	37 (51%)	0.22	9 (20%)	42 (89%)	
Avoid specific fish	0	7 (10%)	0.20	6 (13%)	0	
Adherence						
Avoid fish or shellfish	5 (23%)	25 (34%)	0.43	27 (60%)	3 (6%)	
Avoid all seafood	16 (76%)	37 (51%)	0.047	9 (20%)	43 (92%)	
Adherence	6 (29%)	29 (40%)	0.44	16 (36%)	18 (38%)	0.83
Non-adherence	0	10 (14%)	0.011	7 (16%)	3 (6%)	0.19
Over-adherence	15 (71%)	34 (47%)	0.051	22 (49%)	26 (55%)	0.68
Avoid traces	13 (62%)	34 (47%)	0.32	21 (47%)	25 (53%)	0.68
Avoid restaurants	11 (52%)	27 (37%)	0.22	15 (33%)	22 (47%)	0.21
Subsequent exposures	3 (14%)	18 (25%)	0.39	9 (20%)	11 (23%)	0.80
Agreement						
Dietary advice vs. parental recall	76%	78%		68%	89%	
Parental recall vs. avoidance	81%	75%		77%	87%	
Dietary advice vs. avoidance	86%	74%		64%	94%	

*Fisher's exact test.

Table 4 Comparison of parental perception in children with seafood allergy and egg allergy

	Response	Seafood allergic (n = 94) (%)	Egg allergic* (n = 167) (%)	p-value†
Change in out-of-home care arrangements	Yes	43 (46)	104 (62)	0.013
Comparative severity	More	47 (50)	81 (49)	0.90
Difficulty in managing condition	Difficult/very	18 (19)	51 (31)	0.06
Degree of control over symptoms	Some	21 (22)	41 (25)	0.76
	A lot	60 (64)	115 (69)	0.41
Change in lifestyle	Yes	59 (63)	106 (63)	0.92
Predicted future inconvenience	None	13 (14)	52 (31)	0.003
	A little	34 (36)	52 (31)	0.41
	Some/a lot	47 (50)	63 (38)	0.07
Child treated differently	Yes	43 (46)	89 (53)	0.25

*Data from Kemp et al. (10). †Fisher's exact test.

their lifestyle following diagnosis, and in 46%, this had resulted in a change in out-of-home care arrangements. Parental perceptions were influenced by the severity of the child's previous reaction: a previous anaphylactic reaction was associated with a higher perceived level of severity ($p = 0.012$) and greater difficulty in managing the condition ($p = 0.004$) (Table 5). Parents also reported that children with a history of previous anaphylaxis to seafood were treated differently by others, compared with those who had previously had mild reactions ($p = 0.002$). Parents of children with prior seafood anaphylaxis were also more likely to have long-term concerns regarding their child's seafood allergy ($p = 0.046$). Parents avoiding foods labelled 'may contain traces' perceived the seafood allergy to be more severe than typical childhood illness, with subsequent greater inconvenience expected in the future. Parental perceptions were otherwise unaffected by the type of seafood allergy (i.e. crustacean vs. finned fish vs. allergy to both), recency of last reaction, recommended dietary advice or prescription of

adrenaline auto-injector. Compared with egg-allergic children, parents reported less impact on quality of life measures, although there was a greater level of concern as to the future impact of the allergy for seafood compared with egg (Table 4).

Parental perceptions and dietary adherence

A significant association was noted between dietary overadherence and perceived severity of the child's seafood allergy ($p = 0.023$, Fisher's exact test). Increasing SPT wheal was associated with increasing parental anxiety but not with dietary overadherence, as shown in Fig. 4.

OFCs

There were no differences in demographic parameters between those children undergoing OFC to seafood and those not (data not shown). There was a trend towards those

Table 5 Parental perceptions in parents of seafood-allergic children according to prior anaphylaxis and dietary advice given

	Response	Prior anaphylaxis (n = 21) (%)	No prior anaphylaxis (n = 73) (%)	p-value*	Avoid fish/shellfish (n = 45) (%)	Avoid all seafood (n = 47) (%)	p-value*
Change in out-of-home care arrangements	Yes	12 (57)	31 (42)	0.32	18 (40)	24 (51)	0.30
Comparative severity	More	16 (76)	31 (42)	0.012	19 (42)	28 (60)	0.14
Difficulty in managing condition	Difficult/very	9 (43)	9 (12)	0.004	5 (11)	13 (28)	0.07
Degree of control	Some/a lot	20 (95)	61 (84)	0.28	40 (89)	41 (87)	1.00
Change in lifestyle	Yes	16 (76)	43 (59)	0.20	22 (49)	36 (77)	0.009
Stress compared with other food allergies	Less	9 (45)	38 (57)	0.45	26 (65)	20 (44)	0.08
	Same	7 (35)	25 (37)	1.00	11 (28)	20 (44)	0.08
Predicted future inconvenience	None	2 (10)	11 (15)	0.73	7 (16)	6 (13)	0.77
	A little	4 (19)	30 (41)	0.08	20 (44)	13 (28)	0.13
	Some/a lot	15 (71)	32 (44)	0.046	18 (40)	28 (60)	0.10
Child treated differently	Yes	16 (76)	27 (37)	0.002	19 (42)	24 (51)	0.41

*Fisher's exact test.

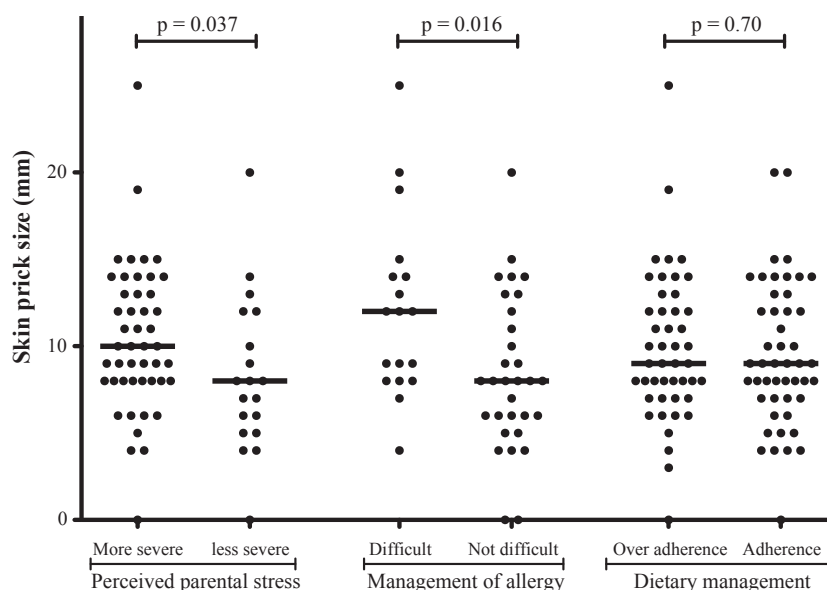


Figure 4 Size of skin prick test (SPT) wheal in relation to parental-perceived severity of seafood allergy and association with over-adherence to dietary management by family. p Values by Mann–Whitney *U* test.

Table 6 Parental perceptions in children who had a seafood challenge and those who did not

	Response	Challenge (n = 26) (%)	No challenge (n = 68) (%)	p-value*
Change in out-of-home care arrangements	Yes	12 (46)	31 (46)	1.00
Comparative severity	More	1 (4)	18 (26)	0.019
Difficulty in managing condition	Difficult/very	6 (23)	12 (18)	0.57
Degree of control over symptoms	Some/a lot	22 (85)	59 (87)	1.00
Stress compared with other food allergies	Less	8 (38)	39 (59)	0.13
	Same	11 (52)	21 (32)	0.12
Predicted future inconvenience	None	3 (12)	10 (15)	0.76
	A little	8 (31)	26 (38)	0.63
	Some/a lot	15 (58)	32 (47)	0.49

*Fisher's exact test.

families with children undergoing OFC to seafood reporting lower levels of stress (Table 6). For example, 26% of those not challenged reported that the seafood allergy was more severe than other childhood illnesses, compared with just one of 26 families in the OFC group ($p = 0.019$). Over 90% of parents of children undergoing OFC reported that the challenge were beneficial in managing their child's allergy. Despite this finding, there were no differences in the degree of dietary overadherence between the parents of children undergoing OFC and those not (58% vs. 50%, $p = 0.64$).

Discussion

Our principal findings are that seafood allergy has a significant adverse effect on anxiety and stress in the family of

seafood-allergic children and that families tend to impose more stringent dietary avoidance of seafood than they received or recalled receiving at initial assessment. To our knowledge, our study is the first to report on adherence to dietary advice and impact on quality of life in a large population of clinician-assessed, seafood-allergic children and their parents.

Adherence to dietary advice requires parents to be able to recall the recommendations made. We found that while a high proportion of parents were compliant with the advice they were given, one-quarter were unable to correctly recall the nature of that advice and over half undertook more stringent dietary practices than recommended. A common scenario for the parents of crustacean-allergic children (who have previously tolerated finned fish) is to exclude all seafood and fish from the child's diet, even though the child has no

evidence of sensitization to non-crustacea and had previously tolerated finned fish. In terms of avoidance advice, we would recommend assessing each case individually. In view of our experience with food labelling legislation in Australia and lack of reactions which can be accounted to 'traces' in the context of seafood allergy, avoidance of foods labelled 'may contain traces' has not been our universal recommendation with commercially produced foods of Australian origin. The situation is likely to vary according to the country. We do caution against food produced in restaurants and fast-food outlets. Moreover, it is theoretically possible that overadherence may result in the development of sensitization owing to the avoidance of a previously tolerated allergen in an atopic child. We found that overadherence was associated with high reported levels of anxiety and decreased quality of life, but not with a decreased incidence of subsequent accidental reactions.

Overadherence might reflect the high levels of anxiety observed in this cohort of parents and/or be a consequence of the high rate of anaphylaxis to seafood and/or the highly atopic nature of this cohort of children. Interestingly, while an increasing size of SPT was associated with increased perceived severity, it was not associated with overadherence, implying that other factors are involved in the perception of severity which might result in overadherence to diet. We observed that the parents of children with previous anaphylactic reactions or those who had been advised to avoid all seafood were more likely to follow their doctor's advice regarding diet. This may be due to higher perceived stress associated with food allergy. Springston et al. suggested that the experience of anaphylaxis impacted less on quality of life than the recency of an allergic food reaction (9); however, we did not observe this in our cohort of patients. Provision of an adrenaline auto-injector device was associated with improved adherence, perhaps because parents appeared to consider the food allergy to be more significant where such a device was prescribed. This is in contrast to the study conducted by Cummings et al. (12) who reported that adrenaline auto-injectors might reduce food-allergy-associated anxiety but did not improve dietary adherence or reduce risk-taking behaviour. Provision of a standard information sheet on seafood allergy did not improve adherence, although only one-third of the parents recalled receiving this. One approach to improve compliance might therefore be through printed information recommending the avoidance of all seafood with specified exceptions determined on an individual basis. However, it is unclear whether such stringent dietary avoidance in childhood might have any lasting effects on the child. For example, overadherence in childhood may be frustrating for the child and result in underadherence later in life once the child is responsible for his or her own diet. Unfortunately, there are little published data to determine whether this may be an issue.

Overall, our study suggests that there is a high degree of anxiety and stress for the families of children with seafood allergy related directly to their child's allergy. In contrast to some food allergies, seafood allergy does not, in general, resolve with age (5, 16) and therefore requires

life-long dietary avoidance. It is therefore not surprising that Kemp et al. (10) found that parents of egg-allergic children reported less long-term concerns regarding their child's allergy than we observed to be the case in seafood allergy. Otherwise, we observed a similar range of responses assessing parental perceptions of allergy as that seen for egg-allergic children (assessed using a similar methodology). Thus, the impact of a food allergy on parental attitudes may not necessarily be related to the specifics and risks of a particular food allergy, but more the perception of food allergy in general.

Our study suggests that OFC might have a beneficial effect on parental perceptions. Parents who did not undergo a challenge were more likely to regard their child's allergy to be more severe, although there were no differences between the OFC and non-challenge group with regard to previous severity of reaction or provision of adrenaline auto-injector. It is possible that those parents with greater perceptions of severity refused OFC; though, one might then expect to see a higher degree of adherence and overadherence in dietary practice. We did not observe this pattern, although we cannot exclude this possibility altogether owing to the study design. All but one parent reported that OFC was helpful in managing their child's seafood allergy, a finding consistent with those of previous studies. Kemp et al. (10) demonstrated similar beneficial effects of an OFC in an egg-allergic population. Roberts and colleagues (17) conducted a survey of 83 children in South Manchester with documented food allergy, of which more than 80% of respondents reported that the OFC provided them with useful information. Uncertainty surrounding food allergies has been shown to be a major contributing factor to parental perceptions (11, 18, 19). An OFC addresses these concerns and allows parents to better understand the scope and extent of their child's allergy. Parents in our study found it especially helpful when their child passed an OFC and were able to incorporate a specific type of seafood into their diet. However, because of the limited number of children undergoing OFC in our study, we were unable to further assess the effect of a positive or negative result. Earlier studies (10, 17, 18) have shown that even a positive food challenge conferred benefit for parents managing their child's allergy. The demonstration that exposure to some food allergen could occur without devastating consequences may have served to reassure parents and alleviate their concerns.

Overadherence to advice and subsequent dietary stringency can pose unnecessary limitations on the family's lifestyle but might, in turn, be safer for the child. It was therefore surprising that 22% of children reported subsequent reactions to seafood after being clinically diagnosed, despite the high rate of overadherence to dietary elimination. It might be expected that the avoidance of seafood to be relatively straightforward in this age group, yet most subsequent reactions were a result of accidental exposure rather than intentional non-compliance. This relatively high rate of subsequent clinical reaction on accidental exposure may also contribute to the heightened levels of parental stress in these families, compared with that observed in egg allergy (10).

Although a number of standardized questionnaires are now available to assess the impact of food allergies, we chose to use a similar pro forma to that of Allen et al. (10) as the contents were more appropriate for the specific issues of interest, assessed adherence to diet as well as quality of life and permitted direct comparisons to be made with a similar cohort of children with egg allergy. Although recall bias is a potential issue in this study, we sought to minimize the impact of this through direct linkage to clinical notes. While recall might also affect factual details concerning the cases, the questions relating to parental perceptions related to how the parents felt at the time of completing the questionnaire. Parental perceptions probably vary with time following diagnosis, and a further prospective study could assess how perceptions and management might change following diagnosis over time, as well as whether perceptions vary according to the number and/or type of foods to which the child is allergic. Given the high degree of atopy in this cohort, there are also caveats to the application of this data beyond seafood-allergic children attending a paediatric tertiary referral centre. This study did not assess the impact of tertiary-level

management on parental perceptions, and it would be interesting to assess parental anxiety in a similar cohort of children managed outside a tertiary service.

In summary, our study demonstrates that the parents of seafood-allergic children tend to impose additional dietary restrictions beyond those recommended, which may result in a greater impact on quality of life. Up to one-quarter of the parents did not recall basic dietary advice correctly, and we would therefore recommend provision of a simple, written dietary plan tailored to the individual child. Repetition of this advice in a consistent manner is necessary for the families of children with persistent food allergies, such as seafood. Management and its impact on quality of life may also be improved through the selective use of OFC to determine whether affected individuals can eat other species of seafood.

Acknowledgment

We thank the parents and children who participated in this study.

References

- Ross MP, Ferguson M, Street D, Krontz K, Schroeder T, Luccioli S. Analysis of food-allergic and anaphylactic events in the national electronic injury surveillance system. *J Allergy Clin Immunol* 2008; **121**: 166–71.
- Webb LM, Lieberman P. Anaphylaxis: a review of 601 cases. *Ann Allergy Asthma Immunol* 2006; **97**: 39–43.
- Pascual CY, Reche M, Fiandor A, Valbuena T, Cuevas T, Martin-Esteban MM. Fish allergy in childhood. *Pediatr Allergy Immunol* 2008; **19**: 573–9.
- Chiang WC, Kidon MI, Liew WK, Goh A, Tang JPL, Chay OM. The changing face of food hypersensitivity in an Asian community. *Clin Exp Allergy* 2007; **37**: 1055–61.
- Sicherer SH, Munoz-Furlong A, Sampson HA. Prevalence of seafood allergy in the United States determined by a random telephone survey. *J Allergy Clin Immunol* 2004; **114**: 159–65.
- Turner PJ, Ng IE, Kemp AS, Campbell DE. Seafood allergy in children – a descriptive study. *Ann Allergy Asthma Immunol* 2011; **106**: 494–501.
- Allen CW, Kemp A, Campbell DE. Dietary advice, dietary adherence and the acquisition of tolerance in egg-allergic children: a 5-yr follow-up. *Pediatr Allergy Immunol* 2009; **20**: 213–8.
- Cummings AJ, Knibb RC, King RM, Lucas JS. The psychological impact of food allergy and food hypersensitivity in children, adolescents and their families: a review. *Allergy* 2010; **65**: 933–45.
- Springston EE, Smith B, Shulruff J, Pongracic J, Holl J, Gupta RS. Variations in quality of life among caregivers of food allergic children. *Ann Allergy Asthma Immunol* 2010; **105**: 287–94.
- Kemp A, Allen CA, Campbell DE. Parental perceptions in egg allergy: does egg challenge make a difference? *Pediatr Allergy Immunol* 2009; **20**: 648–53.
- Avery NJ, Knight RM, Hourihane JO. Assessment of quality of life in children with peanut allergy. *Pediatr Allergy Immunol* 2003; **14**: 378–82.
- Cummings AJ, Knibb RC, Erlewyn-Lajunesse M, King RM, Roberts G, Lucas JS. Management of nut allergy influences quality of life and anxiety in children and their mothers. *Pediatr Allergy Immunol* 2010; **21**: 586–94.
- Sampson HA, Muñoz-Furlong A, Campbell RL, et al. Second symposium on the definition and management of anaphylaxis: summary report – Second National Institute of Allergy and Infectious Disease/Food Allergy and Anaphylaxis Network symposium. *J Allergy Clin Immunol* 2006; **117**: 391–7.
- Bernstein IL, Li JT, Bernstein DI, et al. Allergy diagnostic testing: an updated practice parameter. *Ann Allergy Asthma Immunol* 2008; **100**: s1–148.
- Nowak-Węgrzyn A, Assa'ad AH, Bahna SL, et al. Work Group report: oral food challenge testing. *J Allergy Clin Immunol* 2009; **123**: S365–83.
- Lopata AL, Lehrer SB. New insights into seafood allergy. *Curr Opin Allergy Clin Immunol* 2009; **9**: 270–7.
- Roberts S. Challenging times for food allergy tests. *Arch Dis Child* 2005; **90**: 564–6.
- Jones SM, Scurlock AM. The impact of food allergy: the real “fear factor”. *Ann Allergy Asthma Immunol* 2006; **96**: 385–6.
- Hu W, Kerridge I, Kemp A. Risk, rationality, and regret: responding to the uncertainty of childhood food anaphylaxis. *Med Humanit* 2005; **31**: 12–6.