

ORIGINAL ARTICLE

Anxiety and stress in mothers of food-allergic children

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Abstract

Background: Previous reports suggest that parents especially mothers of food-allergic children may have increased anxiety. Studies with an appropriate control group have not been undertaken, and the determinants of such anxiety are not known. We compared measures of anxiety and stress in mothers of food-allergic children and atopic non-food-allergic children, with anxiety and stress in mothers of children with no chronic illness.

Methods: Cross-sectional study of mothers attending a hospital appointment for their 8- to 16-year-old child. Mothers of children with food allergy, asthma but no food allergy or no chronic illness completed questionnaires including State-Trait Anxiety Inventory, Perceived Stress Scale and measures of anxiety and psychologic adjustment in their child.

Results: Forty mothers of food-allergic children, 18 mothers of asthmatic children without food allergy and 38 mothers of children with no chronic illness (controls) were recruited. Mothers of food-allergic children showed increased state anxiety – median anxiety score 38.0 (IQR 30.0, 44.0) food allergy, 27.0 (22.0, 40.0) control $p = 0.012$; and increased stress – median stress score 18.5 (12.0, 22.0) food allergy, 14.0 (7.5, 19.5) control $p = 0.035$. No significant differences were seen between mothers in the asthmatic group and controls. In multivariate analysis, previous food anaphylaxis ($p = 0.008$) and poorly controlled asthma ($p = 0.004$) were associated with increased maternal anxiety. Child anxiety and adjustment did not differ between food-allergic and control groups.

Conclusions: Mothers of food-allergic children have increased anxiety and stress compared with mothers of children with no chronic illness. Anaphylaxis and poorly controlled asthma are associated with maternal anxiety.

Food allergy is estimated to affect 6–7% of children and 1–2% of adults and may be increasing in prevalence (1). Standard management is based on avoidance of allergenic foods and the prompt administration of appropriate treatment for allergic reactions (1). Due to its unpredictable and potentially life-threatening nature, food allergy can provoke feelings of anxiety and stress for both sufferers and their caregivers. The constant need for allergen avoidance may result in food-allergic children and their parents feeling socially isolated (2). Previous studies have suggested that UK mothers of peanut-allergic children have increased anxiety and stress compared with US population norms – features which were not seen in fathers of the same children (3). However, these studies did not include assessment of anxiety and stress within a control group such as

mothers of non-food-allergic children within the same population. Allergic comorbidities such as asthma are often present in those with food allergy, and these can be associated with anxiety and depression in affected children and their caregivers (4, 5). It is unclear whether mothers of food-allergic children truly have increased anxiety and stress compared with mothers of non-food-allergic children, and if so, whether such increased anxiety/stress is due to the food allergy, to allergic comorbidity or to non-specific aspects of illness such as hospital attendance.

We undertook a cross-sectional survey of mothers of children attending a single hospital outpatient department, to establish whether having a child with food allergy is associated with increased maternal anxiety or stress and if so which features of the child's disease are associated with anxiety and

stress. We also assessed maternal report of child anxiety in the same population to identify any effects of food allergy on child mental health.

Methods

Study design

This is a cross-sectional survey investigating maternal anxiety, perceived stress and maternally reported child adjustment and anxiety in a hospital-based outpatient clinic at St Mary's Hospital, London, UK.

Participants

Participants were recruited from a mixed secondary and tertiary care paediatric service serving an ethnically and socioeconomically diverse urban population, between February 2011 and February 2012. We planned to evaluate up to 40 mothers each of food allergic, asthmatic and controls during the study period, to compare food allergies with controls, and asthmatics with controls. The study was approved by the West London Research Ethics Committee (10/H0711/76). All mothers gave written informed consent to the study procedures. Inclusion criteria for the study were mother of an 8- to 16-year-old child attending a secondary/tertiary care children's outpatient clinic during the study period, who suffered from either IgE-mediated food allergy diagnosed by a paediatric allergist (food-allergic group) or asthma diagnosed by a paediatrician, currently prescribed regular inhaled corticosteroid treatment, and no diagnosis of food allergy (asthmatic group) or no chronic (atopic or non-atopic) disease, where chronic disease is defined as a health condition requiring regular medical monitoring or treatment (control group). Exclusion criteria were chronic non-atopic disease as defined above, in child or child's sibling; food allergy diagnosed in child's sibling (asthmatic and control groups); asthma diagnosed in child's sibling (control group); maternal psychiatric illness at the time of assessment; and maternal inability to understand written and/or spoken English. The child's medical record, their parent and clinician were all consulted prior to confirming the absence of a chronic non-atopic disease. Potentially eligible mothers were identified from review of their child's medical records on the day of an outpatient appointment.

Assessment of disease severity

A questionnaire was developed for self-completion by mothers to gather demographic details and risk factors for maternal anxiety including social class, age, marital status, maternal chronic disease, family history of psychologic disorders and mother's perceived social support (6, 7). Participants were assessed by questionnaire to establish the presence and severity of allergic disease in their child through parental recall. Grade of most severe reported food reaction was assessed using a published severity score (8). Grade 4 or 5 reactions were categorized as anaphylaxis. We assessed asthma, allergic rhinitis and eczema severity using the Global Initiative for

Asthma (GINA) criteria for asthma treatment intensity and control, Allergic Rhinitis and its Impact on Asthma (ARIA) classification of rhinitis and Patient-Oriented Eczema Measure (POEM), respectively (9–11). POEM is a parent-completed assessment of eczema severity, scored from 0 to 28 where high scores represent worse symptoms over the previous week; GINA asthma treatment steps are an index of asthma severity based on the intensity of treatment being used, graded from 1 to 5 where a higher score indicates more severe asthma; ARIA is a classification of rhinitis severity based on parent-reported frequency of symptoms and impact on daily activities. For binary analyses, we defined uncontrolled asthma as either 'partial control' or 'uncontrolled asthma' using GINA criteria.

Psychologic assessment

Maternal anxiety was assessed by the State-Trait Anxiety Inventory (STAI) (12). STAI measures anxiety at one point in time (state STAI) and an individual's general tendency to become anxious (trait STAI), each from 20 to 80 where higher scores indicate greater anxiety. The internal consistency for both state and trait STAI are high, with Cronbach's alpha >0.90 and >0.89, respectively. Maternal stress was assessed by the 10-point Perceived Stress Scale (PSS) (13). PSS assesses the degree to which situations in one's life are perceived as stressful, with a higher score indicating greater perceived stress. PSS has high internal consistency (Cronbach's alpha 0.78). Impact of food allergy on daily living was assessed by the Food Allergy Impact Scale (FAIS) (14). For assessment of maternally reported child adjustment, we used the Strengths and Difficulties Questionnaire (SDQ) (15). SDQ assesses behaviour, emotions and relationships and has been validated for children aged 4–16 (29). There are 25 attributes divided into five domains – each item is marked 0 = not true; 1 = somewhat true, 2 = certainly true. The scores for the four problem domains, conduct, hyperkinetic, emotional symptoms and peer problems are summed to generate a maximum possible total difficulties score of 40 (30). For assessment of maternally reported child anxiety, we used the Screen for Child Anxiety-Related Emotional Disorders (SCARED) (16). SCARED is designed to uncover anxiety in children and has been validated from aged 8 upwards. Forty-one items cover the 5 domains, which relate to the main areas of anxiety: generalized anxiety, panic or somatic symptoms, social anxiety, separation anxiety and school avoidance. Each item is scored as 0 = not true or hardly ever true; 1 = somewhat true or sometimes true and 2 = very true or often true. Total score is the sum of all responses, from 0 to 82 with higher scores indicating higher levels of anxiety, and scores can also be categorized into those at low or high risk of the specific anxiety disorder.

Data analysis

With a sample size of 40 in each group and standard deviation of 10, this study had 80% power at a 2-sided alpha to detect differences in state STAI score of 6.3 points between food allergy or asthma groups and controls, an effect size consistent with previous work (3). Data were entered and analysed using

IBM SPSS Statistics for Windows, version 20.0. (IBM Corp, Armonk, NY, USA). Data were explored using histograms and generally found to be nonparametric. Data are therefore expressed as median (25th, 75th centile) and analysed using Mann–Whitney *U*-test and Spearman's rank correlation coefficient. For univariate analyses, we compared food allergy and asthma groups with controls. For multivariate analysis, we combined all three groups. Analysis of covariance (ANCOVA) using the regression method was used for multivariate analyses, to identify risk factors for maternal and child anxiety and stress/adjustment in the total population studied. For multivariate analysis of maternal anxiety and stress, we included social class, marital status, maternal age, child history of food allergy, food anaphylaxis, asthma, uncontrolled asthma, eczema, allergic rhinitis and moderate/severe allergic rhinitis in the model using analysis of variance. Social class (17), marital status (18) and maternal age (19) were retained in the final model due to their known association with stress and anxiety in the general population (1, 20). For multivariate

analysis of child anxiety and adjustment, we included child gender, age, maternal STAI (state) score, maternal marital status, maternal social class, and child history of food allergy, food anaphylaxis, asthma, uncontrolled asthma, eczema and allergic rhinitis in the model using analysis of variance. Child gender, age and maternal STAI (state) score were retained in the final model due to their known association with child anxiety in the general population (21). All analyses were 2-sided with *p* values <0.05 considered significant.

Results

We recruited 40 mothers of food-allergic children, 18 asthmatic and 38 controls during the study period. Demographic features and anxiety risk factors in the three groups are shown in Table 1. Reasons for hospital attendance in the control group are shown in Table S1. Differences between groups were not statistically significant, except in relation to allergic conditions. Eczema and allergic rhinitis were significantly more common in

Table 1 Demographic characteristics of study participants

	Food allergy (40)	Asthma (18)	Control (38)
Mean (s.d.) age in years	44.1 (6.4)	38.2 (5.9)	42.3 (5.9)
Age at leaving full-time education	20.5 (18.0, 23.0)	18.0 (16.0, 20.8)	20.0 (17.0, 23.0)
Healthcare work (%)	11/39 (28.2)	7/16 (43.8)	9/29 (31.0)
Chronic illness in mother (%)	9/40 (22.5)	4/16 (25.0)	7/31 (22.6)
White ethnicity* (%)	23/40 (57.5)	7/17 (41.2)	15/38 (39.5)
Married (%)	28/40 (70.0)	11/17 (64.7)	25/37 (67.6)
Socio-economic status			
1 Managerial (%)	23/40 (57.5)	4/17 (23.6)	11/38 (28.9)
2 Intermediate (%)	8/40 (20.0)	2/17 (11.8)	9/38 (23.7)
3 Routine (%)	6/40 (15.0)	6/17 (35.3)	11/38 (28.9)
4 Not working (%)	3/40 (7.5)	5/17 (29.4)	7/38 (18.4)
Diagnosis of anxiety (%)	11/40 (27.5)	3/16 (18.8)	4/38 (10.5)
Anxiety diagnosis before first child (%)	2/11 (18.2)	0/3 (0.0)	0/5 (0.0)
Support from partner			
None (%)	5/40 (12.5)	2/17 (11.8)	5/38 (13.2)
Very little (%)	6/40 (15.0)	4/17 (23.5)	2/38 (5.3)
Enough (%)	14/40 (35.0)	5/17 (29.4)	16/38 (42.1)
More than enough (%)	15/40 (37.5)	6/17 (35.3)	15/38 (39.5)
Number of children	2 (2, 3)	3 (2, 3)	3 (2, 3)
Index child's Age	11.0 (9.0, 13.0)	12.0 (9.0, 12.3)	11.0 (9.0, 14.0)
Male sex (%)	27/40 (67.5)	12/18 (66.7)	26/38 (68.4)
Eczema	34/40 (85.0)	10/18 (55.6)	1/38 (2.6)
†POEM score	9 (5, 14)	10 (7, 16)	–
Allergic rhinitis	34/40 (85.0)	15/18 (83.3)	7/38 (18.4)
Moderate–severe persistent rhinitis	25/34 (73.6)	10/11 (91.0)	3/7 (42.9)
Asthma	26/40 (65)	18/18 (100)	0/38 (0)
Asthma treatment step	1.0 (0.5, 3.0)	3.0 (1.5, 4.0)	–
Asthma control			
Controlled (%)	6/25 (24.0)	2/18 (11.1)	–
Partially controlled (%)	11/25 (44.0)	7/18 (38.9)	–
Uncontrolled (%)	8/25 (32.0)	9/18 (50.0)	–

*Ethnicity was reported by participants as White, Asian, Afro-Caribbean, Middle Eastern or other.

†Patient-Oriented Eczema Measure (10).

Data are median (interquartile range), except where stated. All mothers of food-allergic children received dietetic advice.

the food allergy and asthma groups than in the control group ($p < 0.05$ for all comparisons). The asthmatic group had significantly greater asthma severity than the food allergy group – 90% partially or uncontrolled asthma in the asthma group, vs. 76% of asthmatics food allergy group, $p = 0.003$ – and significantly higher asthma treatment step, $p = 0.038$. Twenty-six (65%) children in the food allergy group had a history of anaphylaxis, and 36 (90%) had an adrenaline autoinjector.

Maternal anxiety and stress

Figure 1 demonstrates the distribution of anxiety and stress in the three groups. We found increased state anxiety in mothers of food-allergic children – median 38.0, interquartile range (IQR) 30.0, 44.0 food allergy; 27.0 (IQR 22.0, 40.0) controls $p = 0.012$; and increased perceived stress – 18.5, (IQR 12.0, 22.0) food allergy; 14.0 (IQR 7.5, 19.5) controls $p = 0.035$. We found weaker evidence of increased trait anxiety – 38.0 (IQR 30.8, 46.3) food allergy; 32.0 (IQR 27.0, 45.0) controls $p = 0.098$. In the asthmatic group, there was a trend to increased state anxiety – 35.5 (IQR 30.0, 40.8) asthmatic; 27.0 (IQR 22.0, 40.0) control $p = 0.079$, but no evidence of increased trait anxiety or perceived stress. In univariate analysis (Table 2), we found asthma diagnosis, asthma control, food allergy diagnosis, eczema diagnosis, moderate/severe rhinitis and history of anaphylaxis were all associated with at least one measure of maternal anxiety/stress. In multivariate analysis (Table 3; Table S2), previous food anaphylaxis and uncontrolled asthma were independent predictors of state anxiety; uncontrolled asthma, but not history of anaphylaxis, for trait anxiety; anaphylaxis history, but not uncontrolled asthma, for perceived stress. Due to finding an association between food allergy diagnosis and maternal anxiety/stress, we ran a *post hoc* analysis, where we found no evidence that number of years since diagnosis of food allergy was associated with maternal STAI or PSS score, either in univariate or multivariate analysis (data not shown).

Relationship between maternal anxiety and food allergy impact

We evaluated correlations between measures of maternal anxiety and stress, and maternal report of the impact of their child's food allergy on family life using the FAIS (14) (Table S3). Positive correlations were identified between all maternal anxiety/stress measures and the perceived impact of food allergy on parental stress/free time; between trait anxiety/perceived stress and perceived impact of food allergy on family relations; and between state anxiety/perceived stress and perceived impact of food allergy on family employment and finances. No relationship was found between measures of maternal anxiety/stress and impact of food allergy on other domains of family life.

Child anxiety and adjustment

Table S4 shows measures of maternally reported child anxiety and adjustment in the three groups. We found no significant difference between food-allergic and control groups in any of the SDQ or SCARED domains. The asthmatic group had increased scores for the panic/somatic symptoms domain of SCARED – median 3.0 (IQR 0.0, 6.0) asthma; 0.0 (IQR 0.0, 3.0) control $p = 0.03$, and the school avoidance domain – 2.0 (IQR 0.0, 3.0) asthma; 0.0 (IQR 0.0, 1.3) control $p = 0.03$. Multivariate analysis showed maternal STAI (state) score was associated with both SCARED ($p < 0.001$) and SDQ ($p < 0.001$) scores. No association was found between SCARED, SDQ and other maternal or child variables.

Discussion

We assessed maternal anxiety, perceived stress and maternally reported child adjustment and anxiety in mothers of 8-to 16-year-old children with and without food allergy in a hospital outpatient population. We found that in comparison with controls, mothers of food-allergic children but not mothers of asthmatic children without food allergy have increased anxiety and stress. In multivariate analysis, we

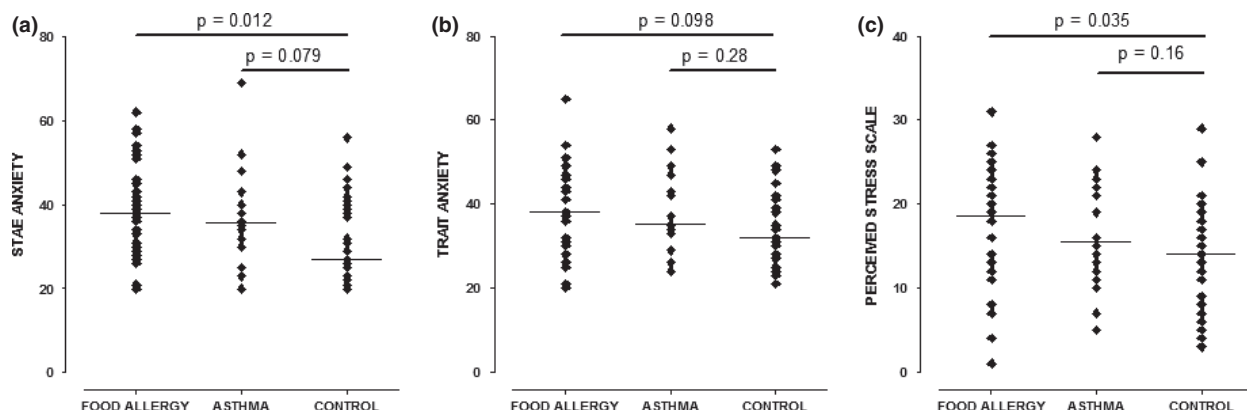


Figure 1 Measures of state anxiety (a), trait anxiety (b) and perceived stress (c) in mothers of children with food allergy, asthma or no chronic disease (control). Horizontal bars represent median values.

Table 2 Univariate analyses of selected variables in relation to maternal STAI state, trait and perceived stress scores

	<i>r</i>	State STAI	<i>p</i>	<i>r</i>	Trait STAI	<i>p</i>	<i>r</i>	PSS-10	<i>p</i>
Maternal age	0.07		0.53	0.11		0.30	0.07		0.54
Years of education	−0.08		0.44	−0.03		0.75	−0.04		0.71
Number of children	−0.02		0.83	0.09		0.39	0.13		0.23
Child age	0.05		0.65	0.05		0.67	−0.07		0.50
Eczema severity	0.14		0.50	0.10		0.63	0.053		0.79
Marital status									
Married		33.0 (26.0, 40.0)	0.09		37.0 (28.0, 42.0)	0.24		15.0 (11.0, 21.0)	0.77
Not married		39.0 (26.8, 50.5)			40.5 (30.3, 48.0)			17.0 (12.0, 21.0)	
Social class									
One		32.0 (24.5, 41.0)	0.29		36.0 (28.5, 45.5)	0.59		16.0 (12.0, 22.5)	0.57
Other		36.0 (27.0, 43.0)			38.0 (30.0, 45.0)			16.0 (11.0, 21.0)	
Maternal ethnicity									
White		34.0 (27.0, 42.0)	0.89		37.0 (30.0, 44.5)	0.80		15.0 (11.0, 21.5)	0.91
Other		34.5 (23.0, 43.8)			37.0 (28.0, 45.0)			16.0 (11.5, 21.0)	
Maternal illness									
Yes		37.0 (26.0, 46.0)	0.53		38.0 (31.0, 46.0)	0.40		16.5 (11.0, 21.0)	0.74
No		34.0 (25.5, 41.0)			36.5 (28.0, 45.0)			16.0 (10.5, 21.0)	
Food allergy									
Yes		38.0 (30.0, 44.0)	0.044		38.0 (30.0, 44.0)	0.13		18.5 (12.0, 22.0)	0.11
No		32.0 (23.0, 40.0)			34.0 (28.0, 45.0)			15.0 (9.0, 20.0)	
Anaphylaxis									
Yes		40.0 (33.5, 45.5)	0.002		41.0 (36.0, 48.0)	0.027		20.0 (12.8, 23.0)	0.010
No		31.5 (23.0, 40.0)			34.0 (28.0, 45.0)			14.0 (9.3, 20.0)	
Eczema diagnosis									
Yes		37.0 (31.0, 43.0)	0.028		38.0 (33.3, 43.8)	0.10		18.0 (12.0, 22.0)	0.08
No		30.0 (23.0, 40.0)			31.0 (27.5, 45.0)			14.0 (8.8, 23.6)	
Asthma diagnosis									
Yes		38.0 (33.0, 45.3)	<0.001		38.0 (33.0, 47.0)	0.018		19.5 (12.3, 22.0)	0.017
No		29.5 (22.0, 38.8)			32.0 (27.0, 42.8)			14.0 (9.0, 20.0)	
Asthma controlled									
Yes		31.0 (22.0, 39.5)	<0.001		34.0 (27.0, 45.0)	0.031		14.0 (9.0, 20.0)	0.039
No		38.0 (34.5, 46.5)			39.5 (33.0, 46.3)			19.0 (13.0, 22.0)	
Rhinitis diagnosis									
Yes		36.0 (28.5, 43.0)	0.13		38.0 (30.0, 44.3)	0.20		18.0 (12.0, 21.0)	0.32
No		32.0 (23.0, 40.5)			32.0 (28.0, 45.0)			14.0 (9.0, 20.0)	
Mod/severe rhinitis									
Yes		37.0 (30.0, 49.5)	0.023		38.0 (33.5, 45.5)	0.034		19.0 (12.0, 21.5)	0.041
No		32.0 (25.3, 40.0)			33.5 (28.0, 45.0)			14.0 (10.3, 20.0)	

STAI, State-Trait Anxiety Inventory; PSS, Perceived Stress Scale; IQR, interquartile range; *r*, Spearman's rank correlation coefficient. Data are presented as median (interquartile range) or as a correlation coefficient. Differences between groups were compared using Mann–Whitney *U*-test.

Values in bold are statistically significant, *p* < 0.05.

Table 3 Multivariate (ANCOVA) analysis using the regression method of risk factors for maternal anxiety and stress

	Ln STAI- S	<i>p</i> value	STAI-T	<i>p</i> value	PSS	<i>p</i> value
Social class 1	0.05 (−0.11, 0.20)	0.54	−0.27 (−5.30, 4.80)	0.92	−0.15 (−3.45, 3.15)	0.93
Married	0.05 (−0.08, 0.19)	0.44	0.66 (−3.90, 5.20)	0.78	−0.03 (−3.00, 3.01)	0.98
Maternal age	0.004 (−0.01, 0.01)	0.46	0.26 (−0.10, 0.60)	0.12	0.04 (−0.18, 0.26)	0.71
Anaphylaxis	0.19 (0.05, 0.33)	0.008	—	—	3.42 (0.33, 6.50)	0.031
Uncontrolled asthma*	0.21 (0.07, 0.35)	0.004	5.00 (0.50, 9.50)	0.031	—	—

Data shown are unstandardized B coefficient (95% CI) for variables which may contribute to maternal anxiety and stress. Social class (17), marriage (18) and maternal age (19) were retained in the final model due to their known association with stress and anxiety in the general population. It was necessary to Ln transform STAI-S scores for this analysis, to satisfy the assumption of normally distributed residuals.

*'Uncontrolled asthma' = either 'partial control' or 'uncontrolled' according to GINA criteria (9).

Values in bold are statistically significant, *p* < 0.05.

identified history of anaphylaxis and poor asthma control as independent predictors of maternal anxiety and stress within the total population. We identified specific food allergy impacts which were associated with maternal anxiety, and these mainly related to effects of food allergy on parental stress/family relations/family economics. We did not find any evidence of adverse mental health effects of food allergy on the child.

Overall the data are consistent with the view that improved disease control in children with food allergy and/or asthma may be associated with lower maternal anxiety. Previous studies have identified a link between maternal/child depression, and childhood asthma, but not with level of asthma control (22). Previous studies of maternal anxiety and child food allergy are inconsistent, and lack a comparator group of mothers of non-food-allergic children drawn from the same population (3, 23). Our finding that mothers of food-allergic children (and possibly asthmatic children) are more stressed and anxious than a relevant control group is in keeping with some previous studies (2, 22). Our finding that disease variables in the atopic child are strongly associated with maternal anxiety/stress extends previous findings in relation to childhood asthma, and although the direction of the relationship is not clear, it is possible that improved disease control may have benefits for maternal mental health. Mothers may be more anxious when their child has poor asthma control or prior anaphylaxis due to fear of severe consequences, or to the distress caused by witnessing episodes of breathlessness.

While several strategies have been shown to improve asthma control in children, the optimal approach to prevention of anaphylaxis is less clear. Early diagnosis, good dietary advice and improved food-labelling policies may help prevent food anaphylaxis (1). Some of the increased anxiety seen in mothers with food-allergic children may be adaptive and associated with increased maternal concern and vigilance regarding food avoidance. However, it is possible that some of the anxiety is experienced as distressing and so may be a target for intervention (e.g. ISRCTN 12504076 <http://www.controlled-trials.com/ISRCTN12504076/mama>).

We found no difference in maternally reported child anxiety or adjustment when comparing the food-allergic and control groups. Children with food allergy had been diagnosed a median of 8.0 years (IQR 5.3, 10.0) prior to the survey, implying that the child may have learned to cope with their allergy over time or may not recall their most severe reaction. In one qualitative study of 22 parents and children with a history of food anaphylaxis, the anxieties and fears of both children and parents appeared to be most intense at age 6–11 (24). Another study suggested that maternal anxiety may reduce as they learn to cope with their child's food allergy (25). We did not find any evidence that maternal anxiety differed according to time since food allergy diagnosis, but this would be best investigated in a prospective study. Our findings regarding child anxiety in the asthma group are consistent with previous work showing increased anxiety and school avoidance in asthmatic children, especially those with more severe disease (26, 27).

There are a number of limitations to this study. The sample size did not allow for the detection of small differences between groups, or indeed larger differences for the asthmatic group where under-recruitment meant that the study was powered to detect 8.2 points difference between asthmatic and control groups in state STAI rather than 6.3 points, under the assumptions of the power calculation. Despite this, we have found clear evidence of increased anxiety and stress in mothers of food-allergic children and have identified two disease-related risk factors. Second, the study participants were all recruited from a hospital outpatient department. There is therefore a risk of sampling bias, related to patterns of referral and healthcare attendance for different conditions in the referral population. It is important that our findings are now confirmed in a population-based community survey. Finally, the mental health measures which we used are simple to administer and extensively validated – however, interview-based assessment of children/parents would be needed for more detailed assessment of the mental health effects of food allergy on parent and child. Our reliance on maternal report of child anxiety is subject to bias, and teacher report of childhood psychologic distress, child social function and bullying at school would make for a more complete assessment of the effects of food allergy on the child (28). We cannot therefore exclude the possibility that food allergy has significant effects on child adjustment and psychologic health. In this study, we have only investigated maternal anxiety, without considering the psychologic impact of paediatric food allergy on other members of the family. The reason for this is that previous work suggested the major psychologic effect of childhood food allergy is on mothers (3).

In summary, we have confirmed previous findings of increased anxiety and stress in mothers of children with food allergy by demonstrating increases in comparison with a control group of mothers sampled from the same population. We have also identified new independent risk factors for maternal anxiety – uncontrolled asthma and previous food anaphylaxis in their child. Measures to target these factors may potentially improve maternal psychologic well-being in addition to reducing allergic manifestations in the child. Future work should confirm these findings in a representative population-based sample and explore the nature of the relationship between childhood anaphylaxis and maternal anxiety in more detail, in order to identify interventions to promote maternal mental health in this setting.

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Supporting Information

Additional Supporting Information may be found in the online version of this article:

Table S1. Reasons for hospital attendance for control group study participants.

Table S2. Multivariate (ANCOVA) analysis of risk factors for

maternal anxiety and stress.

Table S3. Relationship between maternal anxiety/stress and impact of food allergy on the family.

Table S4. Maternally reported adjustment in children with food allergy, asthma or no chronic disease.

- 1 **Supplementary Table 1.** Reasons for hospital attendance for control group
- 2 study participants.

Clinic type	Clinical problems [no.]	Total
General Paediatrics/ Paediatric Neurology	Dizziness [1], headache [1], cough [1], migraine [1]	4
Paediatric audiology/ENT	Hearing concerns/chronic serous otitis media [5], follow up nasal fracture [1], mucocele [1], recurrent epistaxis [1]	8
Paediatric nephrology/ urology	Haematuria [3], varicocele [1], surgical follow up [2], other urinary issues [2]	8
Paediatric ophthalmology	Strabismus [7], astigmatism [1]	8
Paediatric dermatology	Keloid [2], warts [2], birth mark [1], hypopigmentation [1], acne vulgaris [1], hyperhidrosis [1], pityriasis versicolor, multiple naevi [1]	10

4 **Supplementary Table 2.** Multivariate (ANCOVA) analysis of risk factors for
5 maternal anxiety and stress.

	Ln STAI-S	STAI-T	PSS
Model			
R2	0.25	0.08	0.07
Adjusted R2	0.20	0.03	0.02
F	5.03	4.64	1.43
P value	<0.001	0.001	0.15
Standardised B [social class]	0.07	-0.01	-0.01
Standardised B [maternal age]	0.08	0.17	0.04
Standardised B [marriage]	0.08	0.03	0.00
Standardised B [anaphylaxis]	0.29	-	0.24
Standardised B [asthma control]	0.32	0.25	-
Shapiro-Wilk test of residuals			
D	0.98	0.98	0.98
P value	0.24	0.24	0.32

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19 **Supplementary Table 3:** Relationship between maternal anxiety/stress and
 20 impact of food allergy on the family.

Food Allergy Impact Scale	STAI-S	STAI-T	PSS
Meal Preparation	-0.15 (0.38)	0.10 (0.57)	0.07 (0.68)
Family social activities	-0.00 (0.98)	0.02 (0.91)	-0.05 (0.76)
Caregiver-supervised child social activities	0.11 (0.50)	0.18 (0.27)	0.17 (0.30)
Family relations	0.27 (0.11)	0.47 (0.004)	0.37 (0.02)
Stress and free time	0.51 (0.001)	0.41 (0.01)	0.52 (0.001)
School or structured activities	0.10 (0.57)	0.25 (0.14)	0.17 (0.30)
Autonomous social activities	0.18 (0.30)	0.29 (0.24)	0.23 (0.15)
Employment and finances	0.35 (0.04)	0.32 (0.05)	0.38 (0.02)

21 Data shown are Spearman’s rank correlation coefficient (p value) for bivariate
 22 correlations between measures of maternal anxiety and stress, and food
 23 allergy impact on different domains of daily life as reported by the mother.

24 **Supplementary Table 4.** Maternally reported adjustment in children with food allergy, asthma or no chronic disease.

	Control (38)	Food allergy(40)	P [FA vs control]	Asthma (17)	P [Asthma vs control]
SDQ Total	7.5 (4.0,15.0)	9.0 (6.0,14.0)	0.58	10.0 (6.0,13.5)	0.52
- Impact score	0.0 (0.0, 0.0)	0.0 (0.0,0.8)	0.23	0.0 (0.0,1.0)	0.26
- Emotional symptoms	2.0 (0.0, 4.3)	2.0 (1.0,4.0)	0.52	2.0 (2.0,3.5)	0.43
- Conduct problems	1.0 (0.0, 3.0)	2.0 (1.0,3.0)	0.19	2.0 (1.0,3.0)	0.24
- Hyper kinetic	3.0 (2.0, 6.0)	3.0 (2.0,6.0)	0.98	3.0 (1.5,4.0)	0.90
- Peer problems	1.0 (0.0, 3.0)	1.0 (0.0,2.8)	0.83	2.0 (1.0,3.0)	0.46
- Prosocial behaviour	8.0 (7.0, 10.0)	9.0 (8.0,10.0)	0.31	10.0 (8.0,10.0)	0.08
SCARED Total	7.5(1.8, 17.3)	7.5 (3.3,21.0)	0.39	11.0 (6.5, 17)	0.33
- Generalised Anxiety	2.0 (0.0,6.0)	3.0 (0.0,7.5)	0.37	3.0 (1.0,5.5)	0.31
- Panic or somatic symptoms	0.0 (0.0,3.0)	1.0 (0.0,2.8)	0.21	3.0 (0.0,6.0)	0.03
- Social anxiety	2.0 (0.0,5.3)	2.0 (0.0,5.0)	0.79	2.0 (0.5,3.0)	0.80
- Separation anxiety	1.0 (0.0,4.0)	1.0 (0.0,4.0)	0.90	1.0 (0.5,3.0)	0.90
- School avoidance	0.0 (0.0,1.3)	1.0 (0.0,2.0)	0.26	2.0 (0.0,3.0)	0.03
Anxiety disorder (%)	6/37(16.2)	8/39 (20.5)	0.77	3/17(17.6)	1.00
Generalised anxiety disorder (%)	4/38 (10.5)	9/40 (22.5)	0.23	3/17(17.6)	0.66
Panic disorder (%)	2/37(5.4)	5/39 (12.8)	0.43	3/17(17.6)	0.31
Separation anxiety disorder (%)	8/38 (21.1)	9/40 (22.5)	1.00	3/17(17.6)	1.00

Social anxiety disorder (%)	5/38(13.2)	4/40(10.0)	0.73	1/17(5.9)	0.65
Significant school avoidance (%)	4/38(10.5)	7/40(17.5)	0.52	5/17(29.4)	0.12

25 Data presented are median (interquartile range), except where stated otherwise. SDQ – Strengths and Difficulties Questionnaire;

26 SCARED – Screen for Childhood Anxiety Related Disorders. The categorisation of risk of different forms of anxiety disorder is

27 based on SCARED subscale score

