

Research Article

Food allergy response capabilities of mothers and related factors

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Abstract

A parent's ability to confidently manage a child's food allergy (i.e. food allergy response capability) is considered instrumental toward treating this disorder; however, little is known regarding this measure and associated factors. A questionnaire survey among 280 qualified participants identified the greatest food allergy response capability as "spousal collaboration", followed by "elimination diet capacity", "gathering information from medical professionals", "knowledge about food allergies", and "stress coping". These capabilities were associated with maternal and household health status, food items eliminated and their number, anaphylaxis experience, and type of medical facility used. This measure represented a predictor of maternal quality of life and health status, household health status, and overall life stress (not related to childrearing). Thus, to improve food allergy response capability, multidisciplinary cooperation and support are required from professionals, such as physicians, nurses, nutritionists, and clinical psychologists. Nurses in particular must take an interest in the situations these mothers face and in their emotions; elicit their power to cope with stress; provide knowledge about food allergies; provide individualized, specific information about elimination diets; and conduct interventions to enable spousal cooperation.

Key words

food allergy, parenting, quality of life, response capability diets.

INTRODUCTION

Food allergies are common among infants. In the USA and Australia, information is available for patients, including the parents of a child with food allergy related to introducing food to infants, provided by the American Academy of Pediatrics (Greer *et al.* 2008) and the Australian Society of Clinical Immunology and Allergy (2016). In Japan, the food allergy environment has changed considerably in the past 10 years, including the standardization of diagnosis and treatment (Ebisawa, 2014; Japanese Society of Pediatric Allergy and Clinical Immunology/Food Allergy Committee, 2016) and the expansion of social support (The Initiatives Propulsion Committee for Allergic Disease in School, 2008; Ministry of Health, Labour, and Welfare, 2011). However, owing to factors, such as individual differences in food allergy symptoms, complexity of coping methods, varied information from mass media, and skewed distribution of pediatric allergy specialists, families of children with food allergies continue to face heavy burdens and difficulties (Aika *et al.*, 2011; Alanne *et al.*, 2012). Mothers of 1–2 year children with atopic dermatitis or/and food allergies report experiencing stressful situations (Alanne *et al.*, 2012). Parents of a child with asthma also experience feelings of uncertainty, helplessness, and guilt, and the need for support from healthcare professionals. They eventually adapt to everyday life, develop coping strategies, attempt to manage

the asthma, and seek information (Trollvik & Severinsson, 2004). It is important for healthcare professionals to listen to parents' experiences thoughts and feeling regarding problems in their daily life and to make a mutual interaction.

Food allergy treatment is directly connected to daily living, which is based on eating, thus the mother plays an important role in raising her child while facing various burdens and stresses associated with her child's food allergy. It is necessary for her to have a proper understanding of the food allergy and its treatment, practice an elimination diet, and cope with the induced anxiety and stress to ensure the child's safety and maintain their quality of life (QOL) (Bollinger *et al.*, 2006; Aika *et al.*, 2011; Alanne *et al.*, 2012). She needs to collect information related to food allergies, negotiate with school personnel, and actively make an effort toward managing the child's food allergy. Specifically, family support has been shown to be important in facilitating her success (Bollinger *et al.*, 2006; Aika *et al.*, 2011; Alanne *et al.*, 2012). Thus, improving a mother's capacity to satisfactorily live her own life while managing her child's food allergy (hereafter referred to as "food allergy response capability") is the key to successfully treating a child with food allergies and is considered to reduce the mother's sense of burden (Aika *et al.*, 2014).

However, little is known regarding actual food allergy response capabilities of mothers and the factors that influence this measure. Previously, a food allergy parent questionnaire (Lebovidge *et al.*, 2006) measuring parental anxiety/distress, psychosocial impact of allergies, parental coping/competence, and family support was used in an intervention study with the parents of 5–7 year old children with food allergies (Lebovidge

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et al., 2008). We further considered that educating parents on elimination diet and food allergies would also be worthwhile. As stated previously, mothers undertake the majority of food preparation and responsibility, a measurement based on the mother's food allergy response capability rather than just her QOL is warranted. Therefore, the aim of this study was to determine actual food allergy response capabilities of mothers and factors related to this.

METHODS

Study design

This study used a descriptive, cross-sectional design which had allowed researchers to compare various different variables at the same time.

Participants

The participants were mothers of children who were aged between 0–6 years (preschool age) and diagnosed with a food allergy by a physician and currently undergoing treatment.

Data collection

The study was conducted in three prefectures in western Japan from September 2010 to March 2011. We distributed 650 anonymous, self-directed questionnaires through physicians at 11 general pediatric clinics, two pediatric clinics specializing in allergies, and eight general hospital pediatric departments. Questionnaires were collected by mail.

Ethical considerations

A request form explaining the study, including its objective, significance, methods, the voluntary nature of cooperation, response anonymity, and privacy protection was included with the questionnaire; returning the questionnaire was interpreted as consent. This study was approved by the Kawasaki University of Medical Welfare Research Institutional Review Board (approval no.: 198).

Participant background

Questions included mothers' age, employment status, health status, and allergic diseases; and the child's food allergy, age, sex, health status, type and number of food items eliminated, type of medical facility used, experience with changing physicians and number of changes, experience of anaphylaxis, allergic diseases (non-food related), nursery school/preschool attendance, and household health status (assessed on a five point scale ranging from "very poor" to "very good").

Food allergy response capability

The Food Allergy Response Capability Scale for Mothers (FARC-M) (Aika *et al.*, 2014) comprises 17 items across five factors: stress coping, elimination diet capacity, gathering information from medical professionals, knowledge about food allergies, and spousal collaboration. The Cronbach's alpha of

the scale is 0.81. For direct or reverse scoring, "not at all" received one or five points, whereas "very true" received five or one point, respectively. A higher score represented greater response capability.

Effects of food allergies on daily living

Based on a previous interview study conducted with mothers of children with food allergies (Aika *et al.*, 2011) and on earlier studies (Cohen *et al.*, 2004; Hayashi *et al.*, 2009), we independently created 20 question items considered to affect a mother's food allergy response capabilities based on the following factors: restrictions in going out with a child, restrictions in leaving a child with others, anxieties/concerns regarding a child's food allergies, stress caused by food allergies, and awareness of surroundings. A five-point scale was used: from "not at all" (1 point) to "very true" (5 points).

QOL

We assessed QOL using the Japanese version of the World Health Organization Quality of Life-26 (WHOQOL26) (WHO, 2007). This 26 item scale comprises 24 items across the four domains of physical health, psychological health, social relationships, and environment, and two subjective items about health status satisfaction and QOL reference. "Not at all" or "very dissatisfied" score one point, and "an extreme amount" or "very satisfied" score five points (or the converse using reverse scoring). A higher score represents higher QOL.

Analysis methods

Statistical analysis was performed using IBM SPSS version 19.0 (SPSS, Chicago, IL, USA). Analyses were performed as follows.

Comparisons of food allergy response capabilities and participant basic attributes (employment status, type and number of food items eliminated, experience of anaphylaxis, examining facility, and experience with changing physicians) utilized *t*-tests and one-way analysis of variance.

Correlations with participant background (age, health status), effects of food allergies on daily living, and QOL utilized Pearson's or Spearman's rank correlation coefficient.

Multiple regression analysis (stepwise method) utilized QOL as the dependent variable and the following as independent variables: food allergy response capabilities, effects of food allergies on daily living (3 items each on restrictions in going out with a child or in leaving a child with others, or on anxieties/concerns regarding a child's food allergies, 2 items on stress caused by food allergies, and 2 items on awareness of surroundings), health status (mother, child with food allergy, household), and food items eliminated (eggs, milk, wheat), experience of anaphylaxis, type of medical facility used, and experience with changing physicians.

RESULTS

We received questionnaires from 328 mothers (50.5% response rate). We excluded 23 for large amounts of missing data and 25 for responses of zero food items excluded or no

response. Thus, 280 participants were included in the study (valid response rate: 45%).

Participant demographics

The mean ages of the participants were 33.6 ± 4.6 years (mothers) and 35.6 ± 19.8 months (offspring); the boy : girl ratio was 1.7:1. Among mothers, 74 (26.4%) worked full time, 44 (15.7%) worked part time, and 162 (57.9%) were unemployed (Table 1).

A total of 145 mothers (51.8%) claimed to have an allergy. Self-reported mothers' health status rated "very good" ($n = 57$, 20.4%) and "good" ($n = 130$, 46.4%). Mothers rated child health status as "very good" ($n = 98$, 35%) and "good" ($n = 133$, 47.5%). Household health status was rated as "very good" ($n = 42$, 15%) and "good" ($n = 156$, 55.7%). Thus,

approximately 70%, 80%, and 70% of mothers assessed their own, their children's, and household health status, respectively, as favorable.

Food items eliminated from diets of children with food allergies

The most common food item eliminated (multiple responses permitted) was eggs ($n = 255$, 91.1%), followed by milk ($n = 153$, 54.6%), wheat ($n = 78$, 27.9%), peanuts ($n = 32$, 11.4%), shellfish ($n = 26$, 9.3%), and soybeans ($n = 23$, 8.2%). The average number of items eliminated per child was 2.3 ± 1.3 , with 91 (32.5%), 90 (32.1%), 47 (16.8%), 30 (10.7%), and 22 (7.9%) children having eliminated from one to five or more, respectively.

Table 1. Participant background ($n = 280$)

Characteristic	N (%) or mean $\pm$ SD
Mother's age (years)	33.6 $\pm$ 4.6
Mother's employment	
Full time	74(26.4)
Part time	44(15.7)
Unemployed	162(57.9)
Mother's allergy	145(51.8)
Child's age (months)	35.6 $\pm$ 19.8
0–11	9(3.2)
12–23	83(29.6)
24–35	76(27.1)
36–47	37(13.2)
48–59	20(7.1)
60–71	36(12.9)
72–83	19(6.8)
Child's sex	
Boy	176(62.9)
Girl	104(37.1)
Eliminated foods	
Eggs	255(91.1)
Cow's milk	153(54.6)
Wheat	78(27.9)
Anaphylaxis	121(43.2)
Comorbid allergic diseases	
Atopic dermatitis	150(53.6)
Asthma	53(18.9)
Allergic rhinitis	21(7.5)
Medical facilities	
General hospital pediatric	32(11.4)
General pediatric clinic	50(17.9)
Allergist pediatric clinic	192(68.6)
Other	6(2.1)
No. times changed physicians	162(57.9)
1	85(30.3)
2	26(9.3)
3	26(9.3)
>4	17(6.1)
Unknown	8(2.9)
Nursery school/preschool	150(53.6)
Nursery school	106(37.9)
Preschool	35(12.5)
Other	9(3.2)

SD, standard deviation.

Comorbid allergic diseases in children with food allergy

Mothers' responses indicated that children with food allergies had comorbid atopic dermatitis ($n = 150$, 53.6%), bronchial asthma ($n = 53$, 18.9%), allergic rhinitis ($n = 21$, 7.5%), or had experienced anaphylaxis ($n = 121$, 43.2%) (Table 1).

Types of medical facilities used by children with food allergies

The primary medical facilities used for treating food allergies were pediatric departments at general hospitals ($n = 32$, 11.4%), general pediatric clinics ($n = 50$, 17.9%), pediatric clinics specializing in allergies ($n = 192$, 68.6%), and other ($n = 6$, 2.1%). Overall, 162 mothers ($n = 57.9$) had changed physicians, with 85 (30.3%), 26 (9.3%), 26 (9.3%), and 17 (6.1%) changing physicians from one to four or more times, respectively (Table 1).

Nursery school/preschool attendance by children with food allergies

Overall, 130 (46.4%) and 150 (53.6%) mothers, respectively, responded that their children did not or did attend nursery school/preschool, with 106 (37.9%) and 35 (12.5%) children attending nursery school, preschool, or other ($n = 9$, 3.2%) (Table 1).

Food allergy response capabilities and related factors

The average mother's FARC-M score was 3.42 ± 0.55 . Scores by subscales were as follows: stress coping, 2.96 ± 0.86 ; elimination diet capacity, 3.57 ± 0.96 ; gathering information from physicians, 3.45 ± 1.03 ; knowledge about food allergies, 3.45 ± 1.03 ; and spousal collaboration, 3.70 ± 1.00 . Of the 17 items, "I know how to read the allergy labels on food products" scored highest (4.06 ± 0.91), and "I know how medical judgements are made in eliminating or cancelling elimination of foods which cause allergies" was lowest (2.75 ± 1.00).

Comparisons of the FARC-M according to background factors

A comparison of mother's FARC-M scores by employment status revealed that compared to mothers who worked full time (2.69 ± 0.92) or were unemployed (2.73 ± 1.13), those working part time (3.34 ± 1.01) scored significantly higher for "I am able to take rest" ($P < 0.01$) (Table 2). Additionally, unemployed mothers (4.09 ± 0.90) scored significantly higher than mothers working full time (3.74 ± 1.02) on "I can ask my child's attending physician about his or her food allergy" ($P < 0.05$). No other items demonstrated significant differences according to employment status.

With respect to food items eliminated, no significant differences were observed in any FARC-M scores based on the elimination of eggs. Mothers who had eliminated milk scored significantly higher ($3.85 \pm 0.84/3.82 \pm 0.99$) than those who had not ($3.64 \pm 0.90/3.54 \pm 1.11$, $P < 0.05$) for "I know what kind of disease a food allergy is" and "My husband knows what kind of disease a food allergy is". Mothers who had not eliminated wheat (from 3.59 ± 1.11 to 3.75 ± 1.01) scored significantly higher on "elimination diet capacity" scores and all subitems than those who had eliminated wheat (from 3.12 ± 1.15 to 3.36 ± 1.16) ($P < 0.05$ – 0.01). Conversely, for "spousal collaboration" scores and subitems, mothers who had eliminated wheat (from 3.92 ± 1.00 to 3.96 ± 0.91) scored significantly higher than non-eliminators (from 3.59 ± 1.09 to 3.61 ± 1.22 , $P < 0.05$ to 0.01).

With respect to the number of food items eliminated, mothers who had eliminated four food items (from 4.17 ± 0.65 to 4.20 ± 0.81) demonstrated significantly higher scores on "I know what kind of disease a food allergy is" and "spousal collaboration" scores than mothers who had eliminated one (from 3.46 ± 1.05 to 3.59 ± 0.89) or two (from 3.60 ± 1.01 to 3.73 ± 0.79) items ($P < 0.05$ – 0.01). For "Preparing food for an elimination diet is difficult (reverse scoring)", those eliminating two food items (3.67 ± 1.08) scored significantly higher than mothers eliminating three items (3.43 ± 1.12 , $P < 0.05$). Although no significant difference was observed, mothers who had eliminated four food items demonstrated higher scores overall.

Based on experience of anaphylaxis, significant differences were observed for "knowledge of food allergies" scores, as well as the subitem "I know what to do when symptoms manifest", and "spousal collaboration" scores, including the subitem "My husband knows what kind of disease a food allergy is" ($P < 0.05$ – 0.01). For these, mothers whose children had experienced anaphylaxis (from 3.33 ± 1.23 to 3.84 ± 1.09) scored higher than those who had not (from 2.83 ± 1.18 to 3.59 ± 0.95).

Significant differences were observed based on the type of medical facility used for "gathering information from physicians" scores and the subitem "I can ask nurses about food allergies". Mothers who used pediatric clinics specializing in allergies ($3.58 \pm 0.99/3.53 \pm 1.23$) scored higher than those using general hospital pediatric departments ($3.00 \pm 1.21/2.75 \pm 1.50$, $P < 0.05$). Furthermore, for "I know what to do when symptoms manifest", mothers who used general hospital pediatric departments (3.31 ± 1.42) or

pediatric clinics specializing in allergies (3.17 ± 1.15) scored significantly higher than those using general pediatric clinics (2.47 ± 1.14 , $P < 0.05$).

A significant difference was observed based on experience with changing physicians only for "I know how medical judgements are made in eliminating or abolishing foods"; mothers who had changed physicians (2.87 ± 1.14) demonstrated a higher FARC-M score than mothers who had not (2.57 ± 1.10 , $P < 0.05$).

Relationships between background factors and FARC-M

Mother and household health status significantly correlated with "stress coping" scores ($r_s = 0.40/0.37$, $P < 0.001$). However, the health status of children with food allergies demonstrated almost no correlation with FARC-M scores, nor did mother or child age (Table 3).

Relationship between the FARC-M and effects of food allergies on daily life

FARC-M scores significantly correlated with "stress in childrearing" ($r = 0.48$, $P < 0.01$). "Stress coping" scores significantly negatively correlated with "stress in childrearing", "overall life stress aside from childrearing", and "feeling guilty/responsible for a child's food allergies" (from $r = -0.39$ to -0.41 , $P < 0.01$). "Elimination diet capacity" scores significantly negative correlated with "restrictions in going out with a child (outings, eating out, and traveling)" (from $r = -0.37$ to -0.39 , $P < 0.01$) and "stress in childrearing" ($r = -0.65$, $P < 0.01$). Scores for "gathering information from physicians", "knowledge about food allergies," and "spousal collaboration" were not correlated with daily life (Table 4).

Relationship between the FARC-M and QOL

FARC-M scores significantly correlated with the WHOQOL26 score ($r = 0.51$, $P < 0.001$). Slight correlations were also observed with the four domains of the WHOQOL26 (psychological, physical, social, and environmental) ($r = 0.38$ – 0.47 , $P < 0.001$). "Stress coping" scores significantly correlated with the WHOQOL26 and its four domains ($r = 0.43$ – 0.59), whereas the subitems of "stress coping" scores significantly correlated with the WHOQOL26 and its four domains ($r = 0.33$ – 0.51 , $P < 0.001$).

We also performed multiple regression analysis (stepwise method) using the mother's QOL as the dependent variable and independent variables as listed in the Methods section. We consequently created a multiple regression model in which mother's QOL was predicted by the FARC-M ($\beta = 0.31$, $P < 0.001$), mother's health status ($\beta = 0.29$, $P < 0.001$), overall life stress (non-childrearing) ($\beta = -0.24$, $P < 0.001$), and household health status ($\beta = 0.13$, $P < 0.05$) ($R^2 = 0.49$, $P < 0.001$) (Fig. 1).

Table 2. Comparisons of food allergy response capabilities (FARC-M) according to background factors ($n = 280$)

Factors	FARC-M (17 items)	1. Stress coping	I can cope with my stress well.	I am able to take rest	I think I am coping with my child's food allergies well.	2. Elimination diet capacity	Planning the menu for an elimination diet is burden (reverse scoring)	Preparing food for an elimination diet is burden (reverse scoring)	Planning the menu for an elimination diet is difficult (reverse scoring)	Preparing food for an elimination diet is difficult (reverse scoring)	3. Gathering information from medical professionals	I can ask nurses about food allergies
Mother works												
full time	3.36±0.55	2.90±0.76	2.82±0.96	2.69±0.92	3.19±0.93	3.59±1.09	3.59±1.23	3.60±1.23	3.54±1.18	3.62±1.07	3.25±1.04	3.15±1.33
part time	3.47±0.53	3.20±0.86	2.93±1.04	3.34±1.01	3.32±0.98	3.68±0.79	3.70±0.95	3.61±0.92	3.55±1.09	3.84±0.96	3.34±1.00	3.20±1.25
unemployed	3.43±0.55	2.92±0.80	2.92±0.92	2.73±1.13	3.12±0.92	3.54±0.94	3.56±1.13	3.59±1.10	3.40±1.13	3.59±1.08	3.57±1.02	3.51±1.27
Food items eliminated												
eggs yes	3.42±0.54	2.96±0.79	2.89±0.92	2.81±1.07	3.17±0.93	3.56±0.97	3.57±1.14	3.59±1.12	3.44±1.14	3.64±1.07	3.46±1.03	3.34±1.31
eggs no	3.42±0.57	2.99±0.97	2.96±1.24	2.88±1.20	3.12±1.01	3.71±0.86	3.76±1.05	3.68±0.95	3.72±1.06	3.68±0.99	3.40±1.01	3.64±1.04
milk yes	3.47±0.56	2.98±0.74	2.94±0.85	2.82±1.04	3.20±0.89	3.59±0.97	3.60±1.16	3.63±1.09	3.48±1.12	3.65±1.07	3.51±1.01	3.40±1.30
milk no	3.36±0.52	2.93±0.88	2.84±1.05	2.82±1.13	3.13±0.98	3.55±0.95	3.58±1.10	3.56±1.13	3.44±1.16	3.63±1.05	3.39±1.05	3.33±1.27
wheat yes	3.38±0.57	2.90±0.84	2.88±0.95	2.77±1.12	3.05±0.94	3.29±1.05	3.31±1.23	3.36±1.16	3.12±1.15	3.36±1.14	3.51±1.03	3.42±1.28
wheat no	3.43±0.54	2.98±0.79	2.90±0.95	2.84±1.06	3.21±0.93	3.68±0.90	3.70±1.07	3.69±1.07	3.59±1.11	3.75±1.01	3.43±1.03	3.34±1.29
number of food items eliminated												
1 item	3.39±0.53	3.01±0.85	2.93±1.03	2.90±1.08	3.18±0.95	3.69±0.92	3.73±1.04	3.73±1.09	3.56±1.15	3.74±1.02	3.36±1.07	3.38±1.26
2 items	3.45±0.54	2.93±0.73	2.88±0.87	2.72±1.08	3.20±0.88	3.63±0.96	3.60±1.17	3.61±1.11	3.62±1.04	3.67±1.08	3.54±1.04	3.43±1.28
3 items	3.32±0.53	2.91±0.88	2.87±0.92	2.83±1.22	3.04±0.95	3.28±1.00	3.30±1.23	3.38±1.11	3.00±1.12	3.43±1.12	3.35±0.99	3.13±1.35
4 items	3.62±0.58	3.10±0.82	2.97±0.93	3.07±0.98	3.27±1.01	3.69±0.84	3.70±1.02	3.67±1.03	3.57±1.07	3.83±0.91	3.53±0.99	3.50±1.38
Over 5 items	3.37±0.59	2.80±0.75	2.77±1.02	2.50±0.86	3.14±0.99	3.34±1.10	3.45±1.22	3.36±1.22	3.23±1.38	3.32±1.13	3.56±0.95	3.36±1.22
Experience Anaphylaxis												
yes	3.48±0.59	3.01±0.86	2.90±1.04	2.85±1.19	3.27±0.91	3.56±1.05	3.56±1.20	3.56±1.14	3.42±1.26	3.68±1.09	3.48±1.07	3.33±1.35
no	3.37±0.51	2.92±0.76	2.89±0.87	2.79±0.99	3.08±0.94	3.59±0.89	3.61±1.08	3.63±1.08	3.50±1.03	3.62±1.03	3.43±1.00	3.39±1.24
Experience Changing physicians												
yes	3.43±0.54	2.97±0.75	2.86±0.88	2.86±1.05	3.18±0.89	3.59±0.90	3.61±1.09	3.60±1.03	3.47±1.07	3.67±0.98	3.41±1.02	3.32±1.34
no	3.40±0.56	2.95±0.88	2.94±1.04	2.78±1.12	3.15±1.00	3.56±1.01	3.59±1.17	3.60±1.18	3.47±1.22	3.60±1.13	3.48±1.03	3.41±1.22
Medical facilities												
General hospital Pediatric	3.24±0.61	2.78±0.76	2.78±0.97	2.59±0.91	2.97±1.00	3.40±1.21	3.34±1.36	3.39±1.31	3.34±1.33	3.50±1.16	3.00±1.21	2.75±1.50
General pediatric clinic	3.37±0.48	3.07±0.77	2.90±0.95	3.04±1.03	3.28±0.90	3.78±0.81	3.80±0.98	3.84±0.98	3.68±1.11	3.80±0.88	3.26±0.98	3.08±1.28
Allergist pediatric clinic	3.46±0.55	2.95±0.82	2.90±0.95	2.78±1.12	3.16±0.94	3.55±0.95	3.58±1.12	3.57±1.10	3.42±1.12	3.62±1.09	3.58±0.99	3.53±1.23
Other	3.45±0.44	3.39±0.53	3.33±0.52	3.33±0.82	3.50±0.55	3.54±0.80	3.33±1.37	3.50±1.05	3.67±0.82	3.67±0.82	3.28±0.83	3.67±0.52

Factors	I can ask dietitian about food allergies	I can ask my child's attending physician about his or her food allergy	4. Knowledge about food allergies	I know there are alternative foods I can use when preparing on my child's an elimination diet.	I know what to do when symptoms manifest	I understand how to read allergy labels displayed on food products.	I know what kind of disease a food allergy is	I know how medical judgments are made in eliminating or abolishing foods	5. Spousal collaboration	My husband knows what kind of disease a food allergy is	My husband collaborates in the raising of our child with food allergies.
Mother works											
full time	2.86±1.37	3.74±1.02	3.41±0.82	3.60±1.02	3.04±1.25	3.95±0.95	3.66±0.90	2.77±1.21	3.61±1.07	3.58±1.04	3.64±1.29
part time	2.95±1.31	3.86±1.07	3.45±0.76	3.59±1.21	2.89±1.28	4.20±0.85	3.80±0.85	2.77±1.10	3.74±0.99	3.70±1.07	3.77±1.16
unemployed	3.09±1.46	4.10±0.90	3.45±0.70	3.54±1.06	3.10±1.20	4.07±0.90	3.78±0.87	2.74±1.12	3.73±0.97	3.75±1.06	3.70±1.12
Food items eliminated											
eggs yes	3.02±1.42	4.00±0.96	3.44±0.74	3.57±1.07	3.05±1.22	4.06±0.91	3.75±0.87	2.78±1.16	3.70±1.00	3.70±1.05	3.70±1.18
eggs no	2.92±1.38	3.64±1.04	3.38±0.74	3.56±1.12	3.04±1.27	4.04±0.93	3.76±0.93	2.46±0.88	3.62±1.00	3.60±1.08	3.64±1.08
milk yes	3.03±1.44	4.08±0.92	3.51±0.72	3.68±0.97	3.11±1.26	4.05±0.90	3.85±0.84	2.83±1.09	3.79±0.93	3.82±0.99	3.76±1.12
milk no	2.98±1.38	3.83±1.02	3.35±0.76	3.43±1.17	2.98±1.18	4.07±0.92	3.64±0.90	2.65±1.19	3.58±1.07	3.54±1.11	3.62±1.23
wheat yes	3.05±1.41	4.05±0.91	3.45±0.72	3.60±0.94	2.91±1.18	3.99±0.90	3.81±0.88	2.91±1.14	3.94±0.79	3.96±0.91	3.92±1.00
wheat no	2.99±1.41	3.94±0.99	3.44±0.75	3.55±1.12	3.10±1.24	4.08±0.91	3.73±0.87	2.69±1.13	3.60±1.05	3.59±1.09	3.61±1.22
number of food items eliminated											
1 item	2.91±1.38	3.74±1.06	3.34±0.77	3.53±1.19	2.92±1.27	4.11±0.91	3.59±0.89	2.51±1.18	3.54±1.03	3.46±1.05	3.62±1.20
2 items	3.19±1.44	4.01±0.99	3.49±0.74	3.68±0.91	3.18±1.28	4.06±0.89	3.73±0.79	2.76±1.10	3.60±1.01	3.61±1.07	3.60±1.18
3 items	2.85±1.43	4.09±0.83	3.39±0.75	3.32±1.09	3.00±1.16	4.00±0.93	3.79±1.06	2.85±1.08	3.78±1.11	3.85±1.14	3.70±1.33
4 items	2.90±1.45	4.20±0.85	3.71±0.67	3.77±0.97	3.30±1.15	4.13±0.82	4.17±0.65	3.17±1.21	4.18±0.69	4.20±0.81	4.17±0.83
Over 5 items	3.14±1.39	4.18±0.80	3.40±0.65	3.50±1.22	2.82±1.01	3.86±1.04	3.86±0.77	2.90±0.94	3.91±0.70	4.00±0.82	3.82±0.91
experience with Anaphylaxis											
yes	3.12±1.44	4.00±0.97	3.56±0.79	3.66±1.09	3.33±1.23	4.05±0.95	3.85±0.91	2.89±1.22	3.83±1.05	3.84±1.09	3.82±1.21
no	2.94±1.38	3.94±0.98	3.34±0.69	3.49±1.05	2.83±1.18	4.06±0.88	3.68±0.84	2.65±1.06	3.59±0.95	3.58±1.01	3.60±1.13
experience with changing physicians											
yes	2.88±1.44	4.02±0.94	3.48±0.70	3.59±0.99	3.04±1.16	4.04±0.88	3.82±0.82	2.87±1.14	3.71±1.01	3.73±1.04	3.69±1.19
no	3.16±1.36	3.88±1.01	3.37±0.79	3.51±1.17	3.05±1.32	4.06±0.94	3.65±0.93	2.57±1.10	3.66±0.98	3.62±0.71	3.70±1.14
Medical facilities											
General hospital Pediatric	2.69±1.47	3.56±1.16	3.47±0.89	3.38±1.01	3.31±1.42	3.31±1.42	3.72±0.89	2.97±1.20	3.42±0.99	3.34±1.07	3.50±1.19
General pediatric clinic	2.82±1.32	3.88±1.10	3.19±0.76	3.32±1.19	2.47±1.26	2.47±1.26	3.60±0.83	2.49±1.10	3.62±1.02	3.56±1.13	3.68±1.19
Allergist pediatric clinic	3.13±1.41	4.07±0.89	3.50±0.71	3.65±1.04	3.17±1.15	3.17±1.15	3.80±0.88	2.79±1.14	3.76±0.99	3.80±1.02	3.73±1.17
Other	2.50±1.64	3.67±0.52	3.39±0.62	4.20±1.10	2.67±1.03	2.67±1.03	3.83±0.98	2.33±0.52	3.67±0.98	3.33±1.03	4.00±1.10

t-tests/one-way analysis of variance. * $P<0.05$, ** $P<0.01$, *** $P<0.001$.

Table 3. Relationships between background factors and food allergy response capabilities (FARC-M) ($n = 280$)

	FARC-M (17 items)	1. Stress coping	I can cope with my stress well	I am able to take rest	I think I am coping with my child's food allergies well	2. Elimination diet capacity	Planning the menu for an elimination diet is burdensome (reverse scoring)	Preparing food for an elimination diet is burdensome (reverse scoring)	Planning the menu for an elimination diet is difficult (reverse scoring)	Preparing food for an elimination diet is difficult (reverse scoring)	3. Gathering information from medical professionals	I can ask nurses about food allergies
Mother's age	0.08	0.06	0.03	0.06	0.08*	-0.02	-0.03	-0.10*	0.05	0.02	-0.10*	-0.12
Child's age	0.10	0.08	0.01	0.15*	0.03	0.08*	0.09*	-0.02	0.14*	0.05	-0.09	-0.12*
Mother's health	0.30***	0.40***	0.32***	0.34***	0.26***	0.27***	0.31***	0.22***	0.22***	0.15**	0.16***	0.17**
Child's health	0.23***	0.27***	0.20***	0.25***	0.22***	0.17**	0.20**	0.19**	0.13*	0.09	0.17***	0.16**
Family's Health	0.29***	0.37***	0.31***	0.29***	0.27***	0.20***	0.26***	0.18**	0.17**	0.11	0.16***	0.15*

	I can ask dietitian about food allergies	I can ask my child's attending physician about his or her food allergy	4. Knowledge about food allergies	I know there are alternative foods I can use when preparing my child's elimination diet	I know what to do when symptoms manifest	I understand how to read allergy labels displayed on food products	I know what kind of disease a food allergy is	I know how medical judgements are made in eliminating or abolishing foods	5. Spousal collaboration	My husband knows what kind of disease a food allergy is	My husband collaborates in the raising of our child with food allergies.
Mother's age [†]	-0.11	0.00	0.22***	0.17**	0.17**	0.12*	0.15*	0.15*	0.09	0.11	0.05
Child's age [†]	-0.08	0.00	0.18***	0.08	0.21***	0.02	0.24***	0.09	0.04	0.05	0.01
Mother's health [‡]	0.06	0.22***	0.02	0.04	0.01	0.06	0.02	-0.06	0.13*	0.09	0.13*
Child's health [‡]	0.07	0.24***	0.08	0.11	-0.03	0.20**	0.13*	-0.06	0.17**	0.15*	0.15*
Family's health [‡]	0.08	0.21***	0.06	0.04	0.02	0.08	0.07	0.01	0.16**	0.13*	0.15*

* $P < 0.05$, ** $P < 0.01$, *** $P < 0.001$. [†]Pearson correlation coefficient: r ; [‡]Spearman's rank correlation coefficient: r_s . FARC-M, Food Allergy Response Capability Scale for Mothers.

Table 4. Relationship between food allergy response capabilities (FARC-M) and effects of food allergies on daily living ($n = 280$)

	FARC-M (17 items)	1. Stress coping	I can cope with my stress well	I am able to take rest	I think I am coping with my child's food allergies well	2. Elimination diet capacity	Planning the menu for an elimination diet is burdensome (reverse scoring)	Preparing food for an elimination diet is burdensome (reverse scoring)	Planning the menu for an elimination diet is difficult (reverse scoring)	Preparing food for an elimination diet is difficult (reverse scoring)	3. Gathering information from medical professionals	I can ask nurses about food allergies
Restrictions in going out with a child	-0.22***	-0.29***	-0.22***	-0.29***	-0.20***	-0.39***	-0.40***	-0.36***	-0.33***	-0.26***	-0.12	-0.11
Restrictions in eating out with a child	-0.15*	-0.20**	-0.15*	-0.19**	-0.13*	-0.39***	-0.37***	-0.36***	-0.34***	-0.29***	-0.09	-0.13*
Restrictions in traveling with a child	-0.14***	-0.20***	-0.15*	-0.20***	-0.13*	-0.37***	-0.36***	-0.35***	-0.32***	-0.26***	-0.14*	-0.15**
Restrictions in leaving a child at nursery school/preschool	-0.17**	-0.14*	-0.03	-0.11	-0.21***	-0.28***	-0.30***	-0.22***	-0.27***	-0.16**	-0.06	0.00
Restrictions in leaving a child at a family support center	-0.07	-0.13*	-0.06	-0.13*	-0.12*	-0.25***	-0.26***	-0.25***	-0.18**	-0.17**	-0.05	-0.07
Restrictions in leaving a child with parents/siblings	-0.13*	-0.20***	-0.11	-0.17**	-0.20***	-0.22***	-0.23***	-0.21***	-0.19**	-0.13*	-0.11	-0.09
Concerns regarding late growth and development	-0.29***	-0.35***	-0.30***	-0.23***	-0.34***	-0.34***	-0.35***	-0.26***	-0.30***	-0.26***	-0.12*	-0.13*
Anxiety that a child will not outgrow food allergy	-0.21***	-0.24***	-0.20***	-0.12*	-0.28***	-0.26***	-0.26***	-0.23***	-0.20***	-0.22***	-0.13*	-0.09
Concerns about child's safety	0.00	-0.10	-0.07	-0.10	-0.07	-0.24***	-0.21***	-0.19***	-0.22***	-0.20***	0.05	0.06
Stress in childrearing	-0.48***	-0.39***	-0.35***	-0.27***	-0.35***	-0.65***	-0.66***	-0.60***	-0.54***	-0.44***	-0.20***	-0.21***
Overall life stress aside from childrearing	-0.34***	-0.39***	-0.34***	-0.34***	-0.26***	-0.28***	-0.27***	-0.25***	-0.21***	-0.23***	-0.17**	-0.13*
Mental/emotional obstacles in forming relationships with others	-0.24***	-0.30***	-0.20***	-0.30***	-0.24***	-0.33***	-0.32***	-0.30***	-0.31***	-0.23***	-0.11	-0.10
Feeling guilty/responsible for a child's food allergies	-0.25***	-0.41***	-0.37***	-0.33***	-0.29***	-0.26***	-0.26***	-0.25***	-0.22***	-0.18**	-0.01	0.03

(Continues)

Table 4. (Continued)

	I can ask dietitian about food allergies	I can ask my child's attending physician about his or her food allergy	4. Knowledge about food allergies	I know there are alternative foods I can use when preparing my child's elimination diet	I know what to do when symptoms manifest	I understand how to read allergy labels displayed on food products	I know what kind of disease a food allergy is	I know how medical judgements are made in eliminating or abolishing foods	5. Spousal collaboration	My husband knows what kind of disease a food allergy is	My husband collaborates in the raising of our child with food allergies
Restrictions in going out with a child	-0.17**	0.02	0.12*	-0.02	0.14*	-0.06	0.11	0.22***	0.03	0.10	-0.04
Restrictions in eating out with a child	-0.12	0.07	0.14*	0.00	0.12*	0.01	0.22***	0.16**	0.17**	0.21***	0.10
Restrictions in traveling with a child	-0.19**	0.04	0.20***	0.02	0.14*	0.00	0.24***	0.29***	0.16***	0.20***	0.08
Restrictions in leaving a child at nursery school/preschool	-0.14*	0.02	0.04	-0.05	0.12*	-0.12*	0.07	0.08	-0.05	0.03	-0.11
Restrictions in leaving a child at a family support center	-0.07	0.04	0.17**	0.00	0.22***	-0.01	0.12*	0.22***	0.09	0.15*	0.02
Restrictions in leaving a child with parents/siblings	-0.12*	-0.04	0.13*	0.03	0.14*	-0.05	0.14*	0.15*	0.01	0.06	-0.03
Concerns regarding late growth and development	-0.11	-0.10	0.00	-0.03	0.06	-0.10	-0.05	0.07	-0.04	0.04	-0.10
Anxiety that a child will not outgrow food allergy	-0.10	-0.11	0.02	-0.04	0.08	-0.09	0.06	0.06	-0.02	0.04	-0.06
Concerns about child's safety	0.01	0.09	0.21***	0.11	0.24***	0.00	0.16**	0.21***	0.09	0.13*	0.04
Stress in childrearing	-0.15***	-0.15**	-0.07	-0.16**	-0.03	-0.16**	0.00	0.08	-0.05	0.00	-0.08
Overall life stress aside from childrearing	-0.11	-0.18**	-0.10	-0.09	-0.04	-0.10	-0.07	-0.05	-0.13*	-0.13*	-0.10
Mental/emotional obstacles in forming relationships with others	-0.11	-0.05	0.03	-0.05	0.10	-0.13*	0.03	0.13*	0.01	0.08	-0.05
Feeling guilty/responsible for a child's food allergies	-0.03	-0.02	-0.01	-0.05	0.06	-0.06	-0.04	0.04	-0.13*	-0.11	-0.12*

Pearson correlation coefficient; * $P < 0.05$, ** $P < 0.01$, *** $P < 0.001$. FARC-M, Food Allergy Response Capability Scale for Mothers.

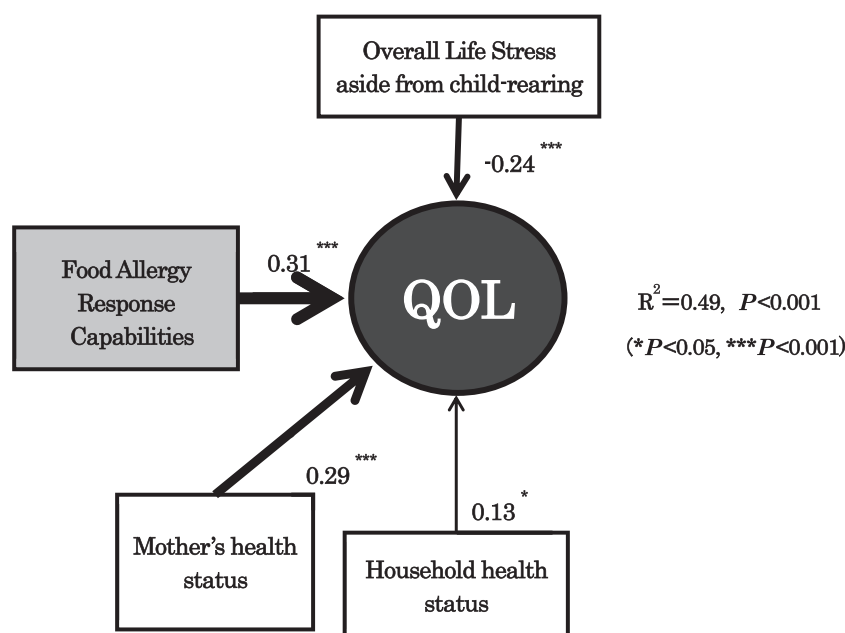


Figure 1. Multiple regression analysis of quality of life (QOL), food allergy response capabilities, mother's health status, household health status, and stress. $R^2 = 0.49$; * $P < 0.05$, ** $P < 0.01$, *** $P < 0.001$.

DISCUSSION

Food allergy response capabilities and related factors

Approximately 70% of children with food allergy in the present study underwent treatment at pediatric clinics specializing in allergies, and approximately 80% of mothers assessed their child's health status as favorable. These results indicate that the mothers who participated in this study had children with relatively stable control of their food allergies. Additionally, nearly 60% of all mothers had previously changed physicians and approximately 40% had changed physicians once or twice. It suggested that many of the study participant mothers were capable of actively seeking a physician who would properly diagnose and treat their children. Their food allergy response capabilities were thus interpreted accordingly.

An elimination diet is a form of treatment for children with food allergies. However, food simultaneously satisfies a basic need and is the source of nutrition, which is essential for growth and development. In addition, the joy of eating is an important part of daily life. Therefore, the preparation of meals for a child with food allergies and their family places a major burden on the mother.

In this study, mothers who had eliminated wheat from their children's diets had lower elimination diet capacity scores than those who had not; mothers who had eliminated wheat felt it burdensome, and that it was difficult to devise and prepare elimination diet meals. These results are consistent with those in previous studies, which found that wheat elimination was associated with an increased sense of burden (Hayashi *et al.*, 2009; Sago *et al.*, 2009). The recent prevalence of foods tailored to food allergies has made it possible to purchase egg-free and milk-free foods without going to a specialty store. However, in

Japan, little variation is available in wheat-free foods at the supermarket or when eating out. Wheat is particularly common in bread, pasta, and sweets; thus, the inability to use wheat in preparing meals and snacks reduces a mother's elimination diet capacity and diminishes her response capability. Additionally, elimination diet capacity scores tended to decline as the number of food items eliminated increased, suggesting that increasing numbers of eliminated food items might also reduce response capability. The number of food allergies negatively correlates with parental confidence in managing a child's food allergy (Knibb *et al.*, 2015). Strengthening food allergy response capabilities would result in improved parental confidence in managing the child's food allergy.

A negative correlation was observed between restrictions in going out with a child (outings, eating out, traveling) and stress in rearing a child with food allergy; this suggests that increasing the elimination diet capacity helps to alleviate these issues. Nurse support in conjunction with nutritionists, allowing examples of individualized menus, substitute food items, processed food items for example, food from allergy-free restaurants are important considerations, enabling mothers to implement elimination diets on a daily basis without undue stress. Physicians might also improve mothers' food allergy response capabilities and reduce their burden by canceling or relaxing food elimination at the appropriate time in an appropriate manner, which necessitates supporting the mother to enable her to continue medical visits.

As the stress associated with raising a child with food allergy is reduced by improvement of elimination diet capacity, such stress might therefore be rooted in the burden of an elimination diet. However, stress coping was negatively correlated with "overall life stress aside from childrearing", and "feeling guilty/responsible for a child's food allergies", suggesting that

stress might instead arise from the mother's support network, relationship with her surroundings resulting from her child's food allergy and her awareness of that relationship. Stress coping is the main factor comprising response capability. The power to independently control stress is a key point for mothers in adapting well to their children's food allergies. For nurses, it is important to take an interest in the mother's support network, relationships and to be empathetic. Thus, nurses in affiliation with physicians and clinical psychologists, can elicit mothers' coping abilities and support them.

Anaphylaxis, a symptom that manifests systemically owing to food allergy, sometimes results in shock and can be life-threatening (Statistics and Information Department, Minister's Secretariat, Ministry of Health, Labour and Welfare, 2013). In this study, nearly 50% of mothers responded that their children had experienced anaphylaxis; these mothers better understood what to do upon manifestation of allergic symptoms than those with no anaphylaxis experience, and demonstrated a high score of 3.56 for knowledge about food allergies. Although not limited to children, the Monitoring Survey 2011 for Immediate-Type Food Allergy in Japan (Imai & Ebisawa, 2013) reported that 11% of individuals who manifested symptoms within 60 mins of consuming a particular food and underwent examination at a medical institution presented with symptoms of shock, suggesting that at least approximately 10% of children who manifest symptoms of anaphylaxis are at risk of developing shock. For mothers, personal experience of a threat to their child's life might have led them to acquire knowledge about food allergies. However, such experiences inflict great physical and psychological damage on mothers and children with food allergies. Providing individualized information about food allergies, such as the nature and characteristics of food allergies, treatment, testing, handling, consumption, and contact with allergy-causing foods, as well as information about handling symptom manifestations, is necessary to deepen maternal knowledge regarding food allergies and help them to avoid risks.

Conversely, knowledge about food allergies was positively correlated, albeit extremely weakly, with constant concerns about child safety. This might be due to "being worried due to knowing the risks." Healthcare workers should recognize that, for mothers, having knowledge about food allergies does not necessarily lead to a sense of relief.

Although mothers of children with food allergies tend to assume the burden of their roles alone (Aika *et al.*, 2011), those in the present study had a high score (3.70) for the response capability of spousal collaboration. Mothers who had eliminated four food items received more collaboration from their husbands than those who eliminated one or two items, whereas mothers who had eliminated wheat and whose child had experienced anaphylaxis received more spousal collaboration than others who had not. As food allergies become more complex and difficult to handle, mothers collaborate with their husbands more; therefore, it is inferred that mothers themselves assess the extent to which they can deal with their children's food allergies or require and receive spousal support. Parental collaboration is an important skill for adapting to a child's food allergy. Healthcare workers should support mothers to enable them to collaborate with

their husbands; this support must come soon after being informed of the child's diagnosis (i.e. before the food allergy becomes more complex and difficult to deal with). While consulting with the mother, it is important to recommend that the husband also be present at examinations, and health education sessions to use research material such as pamphlets emphasizing that spousal collaboration is essential in raising a child with food allergies.

We confirmed that maternal response capability, along with "mother's health status", "overall life stress aside from childrearing", and "household health status" are predictors of QOL. Improvement in response capability leads to the maintenance and improvement of QOL for mothers raising children with food allergies. After a diagnosis of a food allergy is made, it is important to perform regular screening of the maternal response capability and effectively improve necessary skills on an individual basis.

Limitations of the present study and future concerns

Approximately 70% of the mothers who participated in this study had their children with food allergies treated at pediatric clinics specializing in allergies; therefore, it is difficult to declare that the results of this study sufficiently reflect the overall situation of mothers of children with food allergies throughout Japan. It will be necessary to accumulate data for mothers who have their children treated at general pediatric departments and conduct further investigations. In addition, although the length of time following a diagnosis of a food allergy is considered to affect response capability, we were unable to obtain accurate information for the large number of participants who had changed physicians, thus imposing a limitation on this study.

Conclusions

In this study, we identified that the greatest response capability for mothers of children with food allergy was "spousal collaboration", followed by "elimination diet capacity", "gathering information from physicians", "knowledge about food allergies", and "stress coping".

Food allergy response capabilities of mothers who raise children with food allergies were related to employment status, maternal/household health status, food items eliminated (wheat and milk), number of food items eliminated, experience of anaphylaxis, type of medical facility used, stress in childrearing, overall life stress aside from childrearing, and restrictions in going out with a child.

Food allergy response capabilities of mothers who raise children with food allergies, as well as the mother's own health status, overall life stress (non-childrearing), and household health status, were found to be predictors of QOL for mothers of children with food allergies.

Overall, the results of this study indicate that after a diagnosis of food allergy is made, it is important to perform regular screening of the maternal response capability. To improve this, multidisciplinary coordination and support by physicians, nurses, nutritionists, and clinical psychologists are important. It is recommended that healthcare workers take

an interest in the situations these mothers face and in their emotions; elicit their power to cope with stress; provide knowledge about food allergies; provide individualized, specific information about elimination diets; and conduct interventions to enable spousal cooperation.

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CONTRIBUTIONS

Study Design: SA, Y.Y

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