Article

Effect of Symptom Levels of Children's Food Allergy on Maternal Depression: A Cross-sectional and Cohort Study

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Abstract

Background: Maternal depression may have negative impacts on children's behavior and mental health. Childhood food allergy is a common health issue, yet its relationship with maternal depression remains incompletely understood. This study aimed to analyze the association between children's food allergy symptoms and maternal depression through cross-sectional and cohort studies.

Methods: This study selected a total of 580 children with food allergy and their mothers who met the inclusion criteria in Ganzhou Women and Children's Health Care Hospital from April 2015 to April 2022, evaluated the symptom levels of children's food allergy according to the guidelines, assessed the depressive symptoms of mothers using self-rating depression scale (SDS), and analyzed the relationship between the symptom severity of children's food allergy and the risk of maternal depression; at the same time, one-year follow-up of mothers without depression was carried out to measure the incidence of depression to further explore this relationship.

Results: The 580 children with food allergies in the cross-sectional study consisted of 365 (62.93%) males and 215 (37.07%) females, aged (8.98 ± 2.30) years, with 298 (51.37%) experiencing Level-I, and 282 (48.63%) experiencing Level-II. A total of 56 (9.66%) mothers suffered from depression, aged (42.74 ± 5.42) years. Adjusting for confounders including mother's age, education level, marital status, family income, comorbidities, history of allergies, family history of food allergies, history of psychiatric disorders, current smoking status, current alcohol consumption, current regular exercise status, childhood food allergens and food allergy categorization, the mothers of children with child food allergy symptom Level-II were found to have a higher risk of depression compared with mothers with child food allergy symptom Level-I, odds ratio (OR) = 2.025 (95% confidence interval (CI): 1.319–3.128, p = 0.001). In the one-year cohort study, 38 (7.25%) mothers had new-onset depressive symptoms. Mothers of children with a child food allergy symptom Level-II had an OR = 2.165 (95% CI: 1.612–2.902, p < 0.001) for depressive symptoms compared to mothers with a child food allergy symptom Level-I.

Conclusion: Among children with food allergy symptom scores of Level-I and Level-II, higher levels were associated with a higher prevalence of depression in their mothers.

Keywords

children; food allergy; depression; mothers

Introduction

Maternal depression is a serious mental health issue that profoundly affects the growth and well-being of children. Past studies have indicated that maternal depression may lead to behavioral problems, emotional distress, and physical ailments in children [1,2]. These impacts are not confined to early childhood but may extend into adulthood [3]. Therefore, understanding the factors influencing maternal depression is crucial for providing more effective interventions and support.

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Childhood food allergy is a common health problem, with prevalence rates ranging from 7.9% to 10.2% [4,5]. Food allergies not only cause physical discomfort and health issues but may also have adverse effects on children's mental health. For instance, children may experience anxiety due to fear of specific foods, impacting their social activities and overall quality of life [6]. Despite some progress in research on food allergies, the understanding of the relationship between the symptom severity of children's food allergy and the risk of maternal depression remains limited.

Children's health issues may be closely related to the mental health status of mothers. Cortes *et al*. [7] revealed a significant correlation between children's allergy symptoms and maternal anxiety and depression. Feng *et al*. [8] demonstrated that the psychological well-being of mothers of food-allergic children is affected, experiencing a higher incidence of depression. However, existing studies on the relationship between childhood food allergies and maternal depression have certain limitations. Firstly, most studies are based on cross-sectional designs, making it difficult to establish causal relationships. Secondly, past research often failed to account for potential confounding factors. Therefore, there is a need for more further and long-term studies to delve into the relationship between childhood food allergies and maternal depression, as well as potential mechanisms.

Hence, this study aims to investigate the relationship between the level of childhood food allergy symptoms and maternal depression using a cross-sectional and cohort design. We hypothesize that there is a positive association between the level of childhood food allergy symptoms and maternal depression and that this association is moderated by certain underlying factors. By thoroughly investigating this relationship, we aim to provide new theoretical foundations and practical guidance for the prevention and intervention of maternal depression in children.

Materials and Methods

Subjects

As a cross-sectional and cohort study, this study selected 580 children with Level-I and Level-II food allergy symptoms and their mothers who met the inclusion criteria in Ganzhou Women and Children's Health Care Hospital from April 2015 to April 2022 as the study subjects.

Inclusion criteria: (1) The children aged <12 years old in a one-child family. (2) The children were diagnosed with Level-I and Level-II food allergy. (3) The mothers of the children signed informed consent.

Exclusion criteria: (1) Children had other serious diseases, such as cancer and serious injury of other organs. (2) Mothers of children had other serious diseases, such as cancer and serious injury of other organs. (3) Children or mothers did not cooperate with data collection. (4) Children or mothers were lost to follow-up.

This study adhered to the principles of the Declaration of Helsinki (2013) and has been approved by the ethical committee of Ganzhou Women and Children's Health Care Hospital (approval No.: 2015A-532; approval date: October 11, 2015).

Methods

Cross-sectional Survey

At the first visit, the children and their mothers' information was collected, including: ① Children's characteristics, such as gender, age, and body mass index (BMI). ② Maternal characteristics including age, education level, marital status, family income, comorbidities, family history, history of mental illness, lifestyle, and health-related habits (smoking, drinking, regular exercise). ③ Children's allergy status, such as food allergens (cow milk, egg/nut, wheat, and others), food allergy classification (IgE mediated, non-GIE mediated, and mixed mediated), symptom levels of food allergy, and presence of depressive symptoms in the mother.

Cohort Study

Mothers with depression in the first stage were excluded, and the remaining mothers were followed up for one year. At the end of the follow-up, the depression situation of the mothers was diagnosed.

Diagnosis of Symptom Levels of Children's Food Allergy

According to the World Allergy Organization (WAO) grading systems [9], Level-I allergic reaction presents only mild symptoms/signs, like nausea, mild abdominal pain, nausea, mild urticaria, etc., with no change in activity level. Level-II allergic reaction encompasses any one (or multiple) of the following moderate symptoms/signs: ① Skin symptoms/signs: Generalized urticaria (e.g., extensive or widespread hives); extensive (>50% body surface area) erythema; extensive itching accompanied by persistent scratching; significant angioedema (excluding lip swelling and throat edema). ② Gastrointestinal symptoms/signs: Persistent (≥20 minutes) and intolerable abdominal pain; vomiting (not due to nausea or aversion to taste) and diarrhea.

Assessment of Depressive Symptoms

The self-rating depression scale (SDS) [10] was used to assess maternal depressive symptoms. This scale comprises 20 items, with each item scored on a scale of 1–4 points, resulting in a total score of 80 points. The cutoff value is 53 points, with scores ranging from 53 to 62 indicating mild depression, 63 to 72 indicating moderate depression, and scores above 72 indicating severe depression. Higher scores correspond to more severe depressive symptoms. The Cronbach's alpha coefficient for this scale is 0.844, and the content validity is 0.836.

Observation Indicators

A cross-sectional survey was conducted to analyze the relationship between the symptom levels of food allergy in 580 children and the risk of depression in their mothers. A one-year cohort study was conducted on mothers without depression to measure the occurrence of maternal depression and to explore the relationship between the symptom levels of food allergy and the risk of maternal depression.

Statistical Methods

SPSS25.0 statistical software (IBM Corp., Armonk, NY, USA) was used to analyze the data with categorical data expressed as [n (%)], and the χ^2 test was taken. Measured data conforming to normal distribution were expressed as ($\bar{x} \pm$ s) with a t-test adopted. In the cross-sectional investigation, t-tests and chi-square tests were employed to analyze factors influencing maternal depression, followed by binary logistic regression. In the cohort study component, mothers without depression at baseline were followed up for one year to assess the incidence of depressive symptoms one year later. Factors influencing maternal depression were examined using t-tests and chi-square tests, and then subjected to binary logistic regression. In the binary logistic regression analysis, maternal depression status was the dependent variable, while the level of childhood food allergy symptoms served as the independent variable. The adjusted model accounted for confounding factors, including the child's gender, age, body mass index, specific food allergens and food allergy classification, maternal age, education level, marital status, household income, comorbidities, personal history of allergies, family history of food allergies, psychiatric history, current smoking status, current alcohol consumption, and current regular exercise habits. Differences were considered statistically significant at $p < 0.05$.

Results

Baseline Data

A total of 580 children with food allergies (365 males and 215 females) with an average age of (9.98 ± 2.30) years participated in the cross-sectional study. At baseline, 298 (51.37%) children had a Level-I allergy severity, and 282 (48.63%) had Level-II. 56 (9.66%) mothers suffered from depressive symptoms. Specific baseline characteristics are shown in Table 1.

Univariate Analysis of the Occurrence of Depression in Mothers of Children with Food Allergy

Fifty-six (9.66%) mothers with depression were included in the occurrence group, and the remaining 524 (90.34%) mothers without depression were included in the non-occurrence group. There were no significant differences in gender, BMI, maternal age, education level, marital status, family income, complications, family history of food allergy, smoking, drinking, and regular exercise between the two groups ($p > 0.05$). However, there were significant differences in the age of the children, the source of food allergy, the classification of food allergy, symptom levels of food allergy, and history of allergy and mental illness in mothers ($p < 0.05$), as shown in Table 2.

Association between Symptom Levels of Children's Food Allergy and Baseline Maternal Prevalence of Depressive Symptoms

Model 1 was a rough model without adjusting the confounding factors. Model 2 was a model that was developed after adjusting the confounding factors of gender, age, and body mass index of children. Model 3 was the final model after adjusting the confounding factors of the mother's age, education level, marital status, family income, comorbidities, allergy history, family history of food allergy, psychiatric history, current smoking, current drinking, current regular exercise, children's food allergens, and food allergy classification. The final model showed that compared with mothers whose children had Level-I food allergy symptoms, the odds ratio (OR) and 95% confidence interval (CI) of depressive symptoms of mothers whose children had Level-II food allergy symptoms were 2.025 and 1.319, 3.128, respectively ($p = 0.001$) (Table 3).

Table 1. Baseline data of children with food allergy (n = 580).

Project	[n (%)] or ($\bar{x} \pm s$)
Characteristics of children	
Gender	
Male	365 (62.93)
Female	215 (37.07)
Age (years)	8.98 ± 2.30
BMI (kg/m^2)	19.86 ± 1.85
Food allergens	
Cow milk	160 (27.59)
Egg/nut	222 (38.28)
Wheat	99 (17.07)
Others	99 (17.07)
Food allergy classification	
IgE mediated	206 (35.52)
Non-IgE mediated	188 (32.41)
Mixed mediated	186 (32.07)
Symptom levels of food allergy	
Level-I	298 (51.37%)
Level-II	282 (48.63%)
Characteristics of mothers	
Age (years)	42.74 ± 5.42
Level of education	
Junior high school or below	310 (53.55)
High school or above	270 (46.45)
Marital status	
Married	498 (85.83)
Divorced	82 (14.17)
Household income	
≥3000 yuan/month	368 (63.45)
<3000 yuan/month	212 (36.55)
Comorbidity	
Yes	53 (9.14)
None	527 (90.86)
Allergy history	
Yes	70 (12.07)
None	510 (87.93)
Family history of food allergy	
Yes	31 (5.34)
None	549 (94.66)
Psychiatric history	
Yes	30 (5.17)
No	550 (94.83)
Current smoking	
Yes	10 (1.72)
No	570 (98.28)
Current drinking	
Yes	6 (1.03)
No	574 (98.97)

Table 1. Continued.

Project	[n (%)] or ($\bar{x} \pm s$)
Current regular exercise	
Yes	122 (21.03)
No	458 (78.97)
Depression	
Yes	56 (9.66)
No	524 (90.34)

Note: 1 dollar ≈ 6.4596 yuan. BMI, body mass index.

Occurrence of Depression in Mothers without Depression at One-year Follow-up

After excluding 56 mothers with previous depressive symptoms, the remaining 524 mothers were followed up for one year. At the end of the follow-up, 38 mothers (7.25%) were newly diagnosed with moderate to severe depressive symptoms, as shown in Table 4.

Adjusted Association between Symptom Levels of Children's Food Allergy and Risk of Depressive Symptoms during One Year of Follow-up

Model 1 was a rough model without adjusting the confounding factors. Model 2 was a model that was developed after adjusting the confounding factors of gender, age, and body mass index of children. Model 3 was the final model after adjusting the confounding factors of the mother's age, education level, marital status, family income, comorbidities, family history of food allergy, psychiatric history, current smoking, current drinking, current regular exercise, children's food allergens, and food allergy classification. The final model showed an OR = 2.165 (95% CI: 1.612, 2.902, $p < 0.001$) for depressive symptoms associated with mothers whose children with a child food allergy symptom Level-II compared to mothers with a child food allergy symptom Level-I, as shown in Table 5.

Discussion

This study explored the relationship between children's food allergy symptoms and maternal depression through a cross-sectional and cohort study design, thereby partially addressing the limitations of past research with a cross-sectional design. Through the cohort study, we were able to understand better the causal relationship between children's food allergy symptoms and maternal depression, although there were still challenges in establishing causality. In the analysis, various confounding factors were

Table 2. Univariate analysis of the occurrence of depression in mothers of children with food allergy.

Project	n	Group of occurrence (n = 56)	No occurrence group (n = 524)	χ^2/t	p
Characteristics of children					
Gender				0.131	0.718
Male	365	34 (60.71)	331 (63.17)		
Female	215	22 (39.29)	193 (36.83)		
Age (years)		6.65 ± 1.45	8.24 ± 1.56	7.297	0.001
BMI (kg/m^2)		19.54 ± 1.78	19.70 ± 1.82	0.627	0.531
Classification of food allergy				36.483	<0.001
IgE mediated	206	10 (17.86)	196 (37.40)		
Non-IgE mediated	188	8 (14.29)	180 (34.35)		
Mixture mediated	186	38 (67.86)	148 (28.24)		
Food allergens				40.416	<0.001
Cow milk	160	35 (62.50)	125 (23.85)		
Egg/nut	222	15 (26.79)	207 (39.50)		
Wheat	99	5 (8.93)	94 (17.94)		
Others	99	1 (1.79)	98 (18.70)		
Symptom levels of food allergy				44.714	<0.001
Level-I	298	5 (1.18)	293 (55.92)		
Level-II	282	51 (98.82)	231 (44.08)		
Characteristics of mothers					
Age (years)		42.25 ± 5.38	42.60 ± 5.54	0.451	0.652
Level of education				0.000	0.984
Junior high school or below	310	30 (53.57)	280 (53.44)		
High school or above	270	26 (46.43)	244 (46.56)		
Marital status				0.001	0.973
Married	498	48 (85.71)	450 (85.88)		
Get divorced	82	8 (14.29)	74 (14.12)		
Household income				0.019	0.891
≥3000 yuan/month	368	36 (64.29)	332 (63.36)		
<3000 yuan/month	212	20 (35.71)	192 (36.64)		
Comorbidity				0.003	0.954
Yes	53	5 (8.93)	48 (9.16)		
None	527	51 (91.07)	476 (90.84)		
History of allergy				32.655	<0.001
Yes	70	20 (35.71)	50 (9.54)		
None	510	36 (64.29)	474 (90.46)		
Family history of food allergy				20.334	0.997
Yes	31	3 (5.36)	28 (5.34)		
None	549	53 (94.64)	496 (94.66)		
History of mental illness				20.334	0.004
Yes	30	10 (17.86)	20 (3.82)		
None	550	46 (82.14)	504 (96.18)		
Current smoking				1.248	0.264
Yes	10	2 (3.57)	8 (1.53)		
No	570	54 (96.43)	516 (98.47)		
Current drinking				0.342	0.559
Yes	6	1 (1.79)	5 (0.95)		
No	574	55 (98.21)	519 (99.05)		

Table 2. Continued.

Project	n	Group of occurrence (n = 56)	No occurrence group (n = 524)	χ^2/t	p
Current regular exercise				0.006	0.939
Yes	122	12 (21.43)	110 (20.99)		
No	458	44 (78.52)	414 (79.01)		

Note: 1 dollar ≈ 6.4596 yuan.

Table 3. Association between symptom levels of children's food allergy and baseline maternal prevalence of depressive symptoms (OR, 95% CI).

n = 580	Model 1	Model 2	Model 3
Children's Food Allergy Symptom Level-II	2.265 (1.721, 2.984)	2.140 (1.145, 4.014)	2.025 (1.319, 3.128)
p	<0.001	0.017	0.001

Note: Model 1 ($\beta = 0.818$, SE = 0.140); Mode 2 ($\beta = 0.763$, SE = 0.320); Model 3 ($\beta = 0.709$, SE = 0.220). OR, odds ratio; CI, confidence interval.

Table 4. Occurrence of depression in one-year follow-up of mothers without depression.

Depression	[n (%)]
Yes	38 (7.25)
No	486 (92.75)
Total	524 (100.00)

adjusted to minimize their influence. Firstly, our cross-sectional analysis revealed a significant correlation between the severity of children's food allergy symptoms and the occurrence of maternal depression. Cortes's study [7] demonstrated a significant association between children's allergy symptoms and maternal depression. Additionally, Kılıç *et al.* [11] found that mothers of food-allergic children had higher levels of anxiety, depression, and caregiving burden compared to the control group. Secondly, our cohort study indicated that among mothers who did not have depression at baseline, those with children experiencing severe food allergy symptoms had a significantly increased incidence of depression symptoms during the one-year follow-up period. This finding highlights the long-term impact of childhood food allergies on maternal mental health. While previous study hinted at the influence of maternal mental health on childhood allergies [12], our research provides new evidence suggesting a bidirectional relationship whereby the severity of childhood food allergy symptoms may contribute to maternal depression.

The mechanisms behind these findings may be multifaceted. Firstly, the stress and anxiety associated with managing a child's food allergy may contribute to maternal depression. Parents of allergic children often experience heightened vigilance and anxiety due to concerns about their child's safety, dietary restrictions, and potential allergic reactions, which may impact their mental well-being.

In a study by Acaster *et al.* [13], caregivers of allergic children reported a burden on health-related quality of life, psychosocial aspects, and productivity, along with high levels of anxiety. Jung's study [14] showed that parents of children who experienced allergic reactions had significantly higher Food Allergy Quality of Life-Parental Burden total scores than parents of children who did not experience allergic reactions. More significant anxiety and depressive symptoms were associated with poorer quality of life. Furthermore, the social and emotional challenges associated with food allergies, such as social stigma, dietary restrictions, and disruptions to family routines, may further exacerbate maternal stress and depression [15,16].

Moreover, maternal depression is considered a risk factor for children's socio-emotional and cognitive development [17]. The impact of maternal depression on parenting styles and family dynamics may exacerbate the severity of children's food allergy symptoms. Mothers with depression may pay insufficient attention to their children's dietary needs, medication adherence, and symptom management, increasing allergic reactions and symptom severity in children. Maternal depression may also negatively affect parent-child relationships, hindering effective communication and emotional support, which are crucial for managing food allergies and coping with related stressors.

While this study provides valuable insights into the relationship between childhood food allergy symptoms and maternal depression, several limitations need to be considered. The sample for this study was drawn from a single institution, which may not fully represent the characteristics of children with food allergies and their mothers nationwide. Additionally, maternal self-assessment of depression symptoms may be influenced by subjective factors. Despite adjusting for various confounding factors in the analysis,

Table 5. Adjusted association between symptom levels of children's food allergy and risk of depressive symptoms during one year of follow-up (OR, 95% CI).

n = 524	Model 1	Model 2	Model 3
Children's Food Allergy Symptom Level-II	2.372 (1.194, 4.711)	2.284 (1.515, 3.446)	2.165 (1.612, 2.902)
p	0.014	<0.001	<0.001

Note: Model 1 ($\beta = 0.864$, SE = 0.350); Mode 2 ($\beta = 0.827$, SE = 0.210); Model 3 ($\beta = 0.771$, SE = 0.150).

there may still be unexplained potential confounding factors, such as other family environmental factors and psychosocial support, which could affect the interpretation and inference of the results. Lastly, a significant limitation of this study is that the children with food allergy levels between Level-I and II were included as study subjects. Our sample may not represent all characteristics of children with food allergies. This may result in our findings being only partially generalizable to the entire population of children with food allergies, and our study conclusions may be restricted. Therefore, careful consideration of this sample selection limitation is needed when interpreting and generalizing the study results to ensure an accurate comprehension of the research conclusions. Future research should expand the sample range to include a broader spectrum of allergy symptom levels to understand the relationship between food allergies and maternal depression comprehensively.

Conclusion

This study provides evidence of a significant association between the severity of children's food allergy symptoms and maternal depression. The findings suggest that higher levels of food allergy symptoms in children are associated with an increased risk of depression in mothers. Despite the limitations regarding sample representativeness, subjective assessment of depression symptoms, and the lack of long-term follow-up, the results of this study underscore the importance of addressing both children's food allergies and maternal mental health in clinical practice and public health interventions.

Availability of Data and Materials

The corresponding author will provide the data that underpin the study's conclusions with a reasonable application.

Author Contributions

JZ and MYX contributed to the concept and designed the research study. XQL and YZ performed the research.

YZ and JZ provided help and advice on the experiments. XQL and HC contributed to the analysis and interpretation of the data. All authors contributed to the drafting or important editorial changes in the manuscript. All authors read and approved the final manuscript. All authors have participated sufficiently in the work to take public responsibility for appropriate portions of the content and agreed to be accountable for all aspects of the work in ensuring that questions related to its accuracy or integrity.

Ethics Approval and Consent to Participate

This study has been approved by the ethical committee of Ganzhou Women and Children's Health Care Hospital (approval No.: 2015A-532; approval data: October 11, 2015). The mothers of the children signed informed consent.

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Conflict of Interest

The authors declare no conflict of interest.

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