

# Relationship between anxiety and abnormal behavior in children with asthma in Lanzhou, China

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## Research

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# Abstract

**Background:** Asthma can increase the risk of anxiety and abnormal behavior among children but the correlation between anxiety and behavioral abnormalities in children with asthma was unclear.

**Methods:** The Self-Rating Anxiety Scale and the Rutter Children's Behavior Questionnaire were used to conduct surveys with 337 children aged 6 to 14 years who were diagnosed in the asthma clinic of Gansu Provincial Maternity and Child Care Hospital in Lanzhou, China from January to December 2019. SPSS 22.0 software was used to perform multivariate logistic regression and factor analysis on the items of the anxiety scale to extract different anxiety manifestations.

**Results:** The abnormal behavior rate was 37.1% among the 337 investigated children with asthma. A total of 3 factors were extracted by factor analysis on the 20 items of the anxiety scale, namely mental, sensory, and hand-and-foot manifestations. The 3 factors were divided into 3 groups using tertiles (Q1~Q3). After controlling for sex, age, wheezing history, marital status of parents, caregiver awareness, and caregiver's home care situation, compared with Q1, the multivariate logistic regression model showed that Q3 had a statistically significant relationship with abnormal behavior, regardless of mental or hand-and-foot manifestation. No connection between Q2 and behavior abnormalities was found. For sensory manifestations, neither Q3 nor Q2 was significantly related to abnormal behavior.

**Conclusions:** Abnormal behavior was related to only severe anxiety among children with asthma. Therefore, psychological intervention should be carried out as early as possible in the treatment of children with asthma to prevent and correct abnormal behavior.

## Introduction

Bronchial asthma is a common chronic airway inflammatory disease. The incidence and prevalence of asthma have increased in recent years<sup>1</sup>, and the incidence of children with asthma has also increased rapidly<sup>2</sup>. This chronic inflammation leads to hyperresponsiveness of the airways, usually with extensively variable and reversible airflow limitation. Due to the characteristics of long-term asthma, such as repeated attacks, long-term drug treatment, and repeated hospitalization, the disease has a great impact on children in the developmental stage, leading to psychological and behavioral problems in the children. Asthma and psychological problems mutually affect each other and form a vicious cycle, which often leads to various behavioral problems and psychological diseases of the children. Symptoms such as difficulty breathing, the feeling of impending death, coughing, wheezing, and sleep disturbance at night also trigger anxiety, depression, and other negative emotions, causing adverse effects on children's behavioral disorders and mental and physical growth<sup>3</sup>. Studies have shown that childhood asthma is related to stress and the occurrence of psychological and behavioral disorders<sup>4-6</sup>. With the gradual transformation of the biomedical model, asthma has become a representative type of psychosomatic disease, and its relationship with psychosocial factors has gradually aroused more and more attention from researchers<sup>7</sup>. A previous study showed that physicians' understanding of asthma patients'

responses is greatly independent of parents' understanding of their children's responses, which has clinical utility. Physicians' observations of the behavior of patients during treatment, screening, and intervention in the high-risk groups facilitate the correct guidance of patients' psychological behavior and disease treatment<sup>8</sup>. However, many parents and medical staff do not pay attention to the psychological and behavioral changes of children with asthma, resulting in a lack of awareness of the children's disease and improper home care. Thus, attention to the mental health of children with asthma and correct guidance of the children's behavior and lifestyle may help improve the overall quality of life of the pediatric patients. Although studies have shown that children with asthma may have some psychological problems, such as anxiety and behavioral disorders, few studies have revealed the quantitative relationship between psychological and behavioral interactions in children with asthma and the relationship between various manifestations of anxiety and behavioral abnormalities in children with asthma. This study aims to reveal the quantitative relationship between different manifestations of anxiety and behavioral abnormalities in children with asthma and to provide a basis for accurate clinical treatment of pediatric asthma.

## **Materials And Methods**

### **Participants**

A random hospital was selected from an asthma clinic in Lanzhou to conduct a survey. This study included children with asthma diagnosed in the asthma outpatient clinic of Gansu Provincial Maternity and Child Care Hospital in Lanzhou, Gansu, China, from January to December 2019. The inclusion criteria were pediatric patients (1) with a diagnosis in line with the national diagnostic criteria for childhood asthma<sup>9</sup>, (2) aged between 6 and 14 years, (3) without intellectual or cognitive impairment or mental illness, and (4) with a guardian who had no mental disorders and had the ability to read and understand the questionnaires by themselves. The pediatric patients and guardians participated in this study with informed consent. The exclusion criteria of this study were (1) patients or guardians who were unwilling to participate in this study and (2) guardians who failed to complete the questionnaires on their own.

### **Research methods**

After the respondent signed written informed consent, a one-to-one survey method was adopted for the investigator to record the general conditions of the pediatric patients and to explain the survey purpose, survey instructions, and confidentiality agreement to the guardians using unified and standard guidance language to aid the guardians in completing the questionnaires and scales, followed by promptly collecting the questionnaires after completion.

### **Questionnaire and scales**

A survey based on the general conditions, anxiety, and behavior of the children with asthma was conducted. First, a self-designed questionnaire on the general conditions of children with asthma, including name, sex, age, height, body weight, ethnicity, place of household registration, birth status,

feeding method, parental education level, parental marital status, monthly household income, caregiver's awareness of asthma, and caregiver's home care, was conducted. The maximum score of the caregiver's understanding of asthma was 21 points, with a total score  $\leq 12$  points being considered poor understanding and a total score  $\geq 13$  points being considered normal. The maximum score of the caregiver's home care situation was 8 points in this study, with a total score  $\leq 4$  points being considered poor home care and  $\geq 5$  points being considered good home care. Second, the Self-Rating Anxiety Scale (SAS) was used to assess the subjective feelings of the patients with anxiety. The SAS included a total of 20 items and was divided into 4 levels based on the frequency of the symptoms defined by the item: no or a little of the time; some of the time; a good part of the time; and most or all of the time. Third, the Rutter Children's Behavior Questionnaire (RCBQ, parent questionnaire), suitable for the epidemiological investigation of school-age children's behavioral disorders, was also adopted as a reference for the clinical diagnosis of children's emotional problems and behavioral disorders. The items were scored on a 3-point scale: 0, never showed such behavior; 1, symptoms occurred occasionally or less than once a week or were mild; 2, symptoms were severe or frequent, or symptoms occurred at least once a week. The maximum score of the parent's questionnaire was 64 points, with the critical value defaulting as 13 points. A total score on the RCBQ higher than or equal to the critical score was considered to indicate behavioral abnormality in the child<sup>10</sup>. This study also adopted the classification criteria of the Chinese school-age children and adolescent overweight and obesity screening body mass index (BMI) values published by Ji<sup>11</sup> to determine the specific BMI of the children. The research protocol of this study was approved by the Ethics Committee of Gansu Provincial Maternity and Child Care Hospital.

## Statistical analyses

In this study, the collected data were double-entered by EpiData using SPSS 22.0 statistical software (IBM SPSS Inc., Chicago, IL). The quantitative data were presented as the mean and standard deviation (*SD*), and the qualitative data were presented as the rate or composition ratio. Each item in the Anxiety Self-Assessment Scale was analyzed by factor analysis. Before the analysis, the Kaiser-Meyer-Olkin test and Bartlett's sphericity test were used to determine if the data were suitable for factor analysis. Subsequently, principal component analysis was used to extract the factors, and the varimax rotation method was used to clarify the meaning of the factors. The selection of the number of factors was mainly based on (1) characteristic root  $> 1$ , (2) a scree plot suggesting the distribution of the main factors, (3) interpretability of extracted factors, and (4) the proportion of variance explained by each factor, though this was for reference only (because the standard was greatly affected by the number of variables included in the analysis)<sup>12</sup>. Factor analysis was performed on 20 items of the anxiety scale. The extracted factors were anxiety manifestations. The naming of the factors was based on the characteristics of the anxiety items they contained; the higher the factor score, the more inclined the individual was toward this type of anxiety manifestation. The research subjects were divided into 3 categories according to the tertiles of the scores of each anxiety factor when analyzing the relationship between various anxiety factors and behavioral abnormalities (Q1:  $< 33.33\%$ , Q2:  $33.33\sim 66.67\%$ , and Q3:  $> 66.67\%$ ). The multivariate logistic

regression model was used to estimate the odds ratio (OR) and 95% confidential interval (CI) of various anxiety factors for abnormal behavior.  $P < 0.05$  was considered statistically significant.

## Results

### General conditions

A total of 337 children with asthma were investigated in this study, including 209 boys and 128 girls, with a mean age of 6.79 years ( $SD$ : 1.50 years), average body weight of 22.68 kg ( $SD$ : 8.06 kg), and average height of 115.74 cm ( $SD$ : 13.68 cm). Among all the surveyed children, approximately 28% were overweight or obese. More than two-thirds of the children had had cough or night symptoms, and less than half of the children had wheezing. The proportion of mixed feeding exceeded 50% among the children with asthma. Many children with asthma were urban residents, and the proportion of children with asthma with separated parents was less than 5%. The caregivers' awareness of asthma was generally low, and the home care of children with asthma was relatively poor. Table 1 shows the general information of the children with asthma in this study.

### Anxiety manifestation

#### Frequency distribution of items in the anxiety scale

There were 20 items included in the anxiety scale, including 15 positively worded items and 5 negatively worded items. Table 2 shows the distribution of all items in the anxiety scale. Among the positively worded items, more than 70% of the children indicated rarely having the following conditions: "shaking hands and feet," "being distressed by headache, neck pain, or back pain," "having a fast heartbeat," "having a fainting episode or feeling faint," or "having numbness and tingling in the hands and feet." Among the negatively worded items, 50% of the children indicated "feeling fine about everything and that no unfortunate things would happen" and "falling asleep easily and sleeping well all night," and slightly less than 50% of the children claimed to "often have dry and warm hands."

### Factor analysis

According to the classification and relationship of anxiety in the factor load, the factors were named as the states most representative of anxiety. In addition, according to the characteristics of the factor load, the anxiety states with the absolute value of the load exceeding 0.5 were selected for analysis in this study. A total of 3 main factors were extracted (reflecting the 3 different manifestations of anxiety). Factor 1, named mental manifestation, included nightmares, madness, facial flushing, fear, anxiety, and panic. Factor 2, named sensory manifestation, included physical pain and distress, feeling susceptible to weakness and fatigue, and fainting. Factor 3, named hand-and-foot manifestation, included hand and foot tremors and hand and foot tingling. Among the 3 anxiety manifestations, the first factor was an important group that dominated anxiety, with an explained variance of 40.01%, and the latter 2 factors had explained variance of 13.73% and 11.54%, respectively (Table 3).

To facilitate the subsequent regression analysis, this study used tertiles to divide the extracted 3 factors (mental, sensory, and hand-and-foot manifestation) into 3 categories, Q1~Q3. Among the 3 anxiety manifestations, Q1 had the highest proportion, followed by Q2 and Q3, which had the lowest proportion. No significant difference in the distribution of the 3 anxiety manifestations was found between males and females (mental manifestation:  $\chi^2=0.36$ ,  $P=0.84$ ; sensory manifestation:  $\chi^2=4.11$ ,  $P=0.13$ ; hand-and-foot manifestation:  $\chi^2=0.02$ ,  $P=0.99$ ).

In this study, 125 children with asthma had abnormal behavior, a percentage of 37.1% (95% CI: 31.8~42.2%), including 39.2% behavioral abnormalities in boys and 33.6% behavioral abnormalities in girls, without significant differences between the sexes ( $P>0.05$ ). The percentage of behavioral abnormalities in the children with asthma with previous cough or previous night symptoms was more than 30%. The percentages of behavioral abnormalities in the children varied significantly by the type of household registration and maternal education ( $P<0.05$ ); however, the percentage of behavioral abnormalities in the children did not differ by the marital status of their parents (divorced vs. married,  $P>0.05$ ). Figure 1 shows the percentages of behavioral abnormalities of different anxiety manifestations. Among the 3 anxiety manifestations, Q3 had the highest percentage of behavioral abnormalities. Significant differences in the percentage of behavioral abnormalities were found between the Q categories in the mental manifestation and the hand-and-foot manifestation. However, no significant differences in the percentage of behavioral abnormalities were found between the Q categories in the sensory manifestation (mental manifestation:  $\chi^2=15.81$ ,  $P<0.001$ ; sensory manifestation:  $\chi^2=5.25$ ,  $P=0.07$ ; hand-and-foot manifestation:  $\chi^2=10.06$ ,  $P<0.05$ ).

### **Relationship between different anxiety manifestations and behavioral abnormalities in children with asthma**

Table 4 shows the relationships between different anxiety manifestations and behavioral abnormalities in the children with asthma. After adjusting for possible confounding factors (sex, age, history of wheezing, marital status of parents, caregiver's degree of understanding of asthma, caregiver's home care situation), the results of multivariate logistic regression analysis showed that Q3 had increased risk of abnormal behavior compared with Q1, regardless of mental manifestation or hand-and-foot manifestation (mental manifestation Q3: aOR=2.56, 95% CI: 1.32~4.99; hand-and-foot manifestation Q3: aOR=1.86, 95% CI: 1.01~3.43). However, Q2 of both of the mental manifestation and the hand-and-foot manifestation was not associated with an increased risk of abnormal behavior (mental manifestation Q2: aOR=1.30, 95% CI: 0.72~2.37; hand-and-foot manifestation Q2: aOR=1.09, 95% CI: 0.60~1.98). Regarding the sensory manifestation, neither Q2 nor Q3 was found to be significantly related to the increased risk of abnormal behavior (Q3: aOR=1.66, 95% CI: 0.94~2.92; Q2: aOR=1.40, 95% CI: 0.73~2.67).

## **Discussion**

Asthma is the most common chronic non-communicable disease in childhood. Children usually have a rapid onset, which is characterized by shortness of breath, cough, wheezing, or chest tightness and

decreased lung function<sup>1</sup>. Anxiety is characterized by excessive and persistent (but often unrealistic) concerns. Long-term anxiety significantly affects the daily life and activities of the patients<sup>13</sup>. Studies have shown that generalized anxiety disorder and social phobia are closely related to asthma<sup>14</sup>. A case-control study found that compared with healthy subjects, the prevalence of one or more anxiety or depression disorders increased approximately 2-fold in patients with asthma; the higher the prevalence of anxiety, the greater the correlation between anxiety and asthma<sup>15</sup>. Another study found that adolescents with a history of severe life-threatening asthma attacks are more likely to have symptoms of post-traumatic stress disorder than patients with mild disease or healthy individuals, which is directly related to the life-threatening experience of asthma<sup>16</sup>. Due to the characteristics of repeated asthma attacks and protracted healing, asthma seriously affects physical and mental health and the daily life of pediatric patients and is likely to cause various psychological symptoms of anxiety and depression. A recent study showed that peripheral blood CD4 + T cells are a key mediator of stressful emotional disorders, confirming that a specific CD4 + T cell subset regulates the mood and behavior of patients with anxiety<sup>17</sup>. A study has also shown that the main pathogenesis of asthma is related to the abnormal regulation of immune cytokines mediated by CD4 + T cells<sup>18</sup>. These studies have shown the physiological immune mechanism of asthma causing anxiety. Studies have also shown that children with anxiety mostly have behavioral problems as an external manifestation. Children with anxiety disorders have more serious behavioral disorders than healthy children<sup>19</sup>. Some clinical and community studies have shown a link between asthma and suicidal behavior, which is associated with anxiety. Therefore, further attention needs to be paid to the risk of abnormal behavior in patients with asthma and anxiety<sup>20,21</sup>.

This study aimed to explore the quantitative relationship between anxiety and behavioral abnormalities in children with asthma. To our knowledge, this is the first study in China to factorize the anxiety of children with asthma through factor analysis to reveal the relationship between different anxiety manifestations and behavioral abnormalities. Our results showed that the percentage of behavioral abnormalities in the children with asthma was 37.1% (95% CI: 0.32 ~ 0.42), which was higher than the results of Huang et al. (33.3%) and the results of a Brazilian study (35%)<sup>22,23</sup>. In addition, Huang et al. found that the percentage of behavioral abnormalities of children with asthma is significantly higher than that of healthy children<sup>22</sup>. Studies have also shown that children with severe asthma have more behavioral disorders<sup>6,24</sup>, and a curvilinear effect has been found between the severity of asthma and behavioral disorders, i.e., children with the mildest and the most severe symptoms have the most behavioral disorders, while children with moderate symptoms have the least problems<sup>25</sup>. Poverty, family stress, and general environmental factors have certain effects on the prevalence and incidence of asthma and child behavior<sup>26</sup>.

This study analyzed the items of the anxiety scale through factor analysis and extracted 3 factors as the 3 manifestations of anxiety, namely mental manifestation, sensory manifestation, and hand-and-foot manifestation, with a cumulative variance contribution rate of 65.28%. Among them, the variance contribution rate of the mental manifestation, which was the main type of anxiety in children with asthma, was 40.01%. This manifestation was mainly characterized by nightmares, fear, anxiety, panic,

and other abnormal mental symptoms. The sensory manifestation involved physical pain and distress, susceptibility to weakness, fatigue, and fainting, with an explained variance of 13.73%. The hand-and-foot manifestation included hand and foot tremors and hand and foot tingling, with an explained variance of 11.54%. After adjusting for the confounding factors, such as sex, age, history of wheezing, marital status of parents, caregiver's awareness, and caregiver's home care situation, the multivariate logistic regression results showed that Q3 of the mental manifestation (aOR = 2.56, 95% CI: 1.32 ~ 4.99) and the hand-and-foot manifestation (aOR = 1.86, 95% CI: 1.01 ~ 3.43) was associated with an increased risk of behavioral abnormalities in children with asthma, compared with Q1. However, Q2 of the above 2 manifestations had no significant relationship with the risk of abnormal behavior (mental manifestation Q2: aOR = 1.30, 95% CI: 0.72 ~ 2.37; hand-and-foot manifestation Q2: aOR = 1.09, 95% CI: 0.60 ~ 1.98). These findings suggested that only severe anxiety symptoms may increase the risk of abnormal behavior in pediatric patients. Therefore, appropriate psychological and behavioral interventions should be added to the treatment of children with asthma to avoid the occurrence of anxiety symptoms or to control the anxiety symptoms, thereby possibly significantly reducing the incidence of abnormal behavior in children with asthma. However, in the sensory manifestation, neither Q3 (aOR = 1.40, 95% CI: 0.73 ~ 2.67) nor Q2 (aOR = 1.66, 95% CI: 0.94 ~ 2.92) was significantly related to the risk of abnormal behavior. Compared with the mental manifestation or the hand-and-foot manifestation, the sensory manifestation was mostly manifested as bad feelings or being distressed by abnormal feelings, and the degree was generally mild. This manifestation mainly occurred in the mild and moderate anxiety of children with asthma. The sensory manifestation may also exist in children with severe anxiety, but due to the relatively mild manifestation, it could easily be eclipsed by the mental manifestation or the hand-and-foot manifestation. This may be the reason why even the high-quantity anxious sensory manifestation in this study did not have a statistically significant correlation with abnormal behavior. The influencing mechanism between the sensory manifestation and behavioral abnormalities needs to be verified by further research. When we explored the relationship between different anxiety manifestations and behavioral abnormalities in children with asthma, only a scoring method was used to define the behavioral abnormalities in children with asthma, and no behavioral abnormalities were classified. However, Bernstein et al.<sup>27</sup> found that children's anxiety disorders can cause many behavioral disorders, including withdrawal, anxiety, and depression (internalized behavior) as well as discipline violations and aggressive behavior (externalized behavior), mainly manifesting as losing one's temper, irritability, stealing, truancy, frequent sucking of fingers and biting of nails, and neuroticism. Another study found that children with asthma have suicidal thoughts and behavior, which are closely related to anxiety<sup>28</sup>. Therefore, strengthening the prevention of anxiety in children with asthma has important significance for preventing the possible adverse consequences of behavioral abnormalities in the children.

This study classified the anxiety manifestations in children with asthma through factor analysis to quantitatively characterize the relationships between different anxiety manifestations and behavioral abnormalities of children with asthma and to provide a basis for accurate clinical treatment for pediatric asthma. The limitations of this study included the cross-sectional design, which could not infer a causal relationship between the anxiety manifestations and behavioral abnormalities. In addition, the child

anxiety scale and the survey of previous illness history were completed by the pediatric patients or the parents, which might be subject to the recall bias of the parents and the subjective judgment of the children's illness.

## **Conclusion**

This study concluded that only severe anxiety increased the risk of abnormal behavior in children with asthma. Therefore, psychological intervention should be carried out as early as possible in the treatment of children with asthma to avoid anxiety or progression to severe anxiety, thereby reducing the incidence of behavioral abnormalities in pediatric patients.

## **Abbreviations**

SAS Self-Rating Anxiety Scale

RCBQ Rutter Children's Behavior Questionnaire

BMI Body mass index

## **Declarations**

### **Ethics approval and consent to participate**

All research meets ethical guidelines and affirm that the research protocol of this study was approved by the Ethics Committee of Gansu Provincial Maternity and Child Care Hospital.

### **Consent for publication**

### **Availability of data and materials**

### **Conflict of Interest**

The authors report no conflicts of interest.

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### **Authors' contributions**

- 1) Study design: DY Shi, GR Li and WL Gao
- 2) The collection, analysis, and interpretation of data: DY Shi, GR Li and YL Li
- 3) Wrote the first draft of the manuscript: DY Shi, GR Li and WL Gao, without an honorarium, grant, or other form of payment was given to anyone to produce the manuscript.
- 4) Results interpretation and critically commented on and revised the manuscript: RF Zhang, WL Gao and FY Na
- 5) The decision to submit the manuscript for publication: WL Gao
- 6) All authors read and approved the final manuscript.

### **Availability of data and material**

The data that support the finding of this study are available on request from the corresponding author. The data are not publicly available due to privacy or ethical restrictions.

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## Tables

Table 1 The general information of the children with asthma

Population characteristics	Numbers	Results
Age (years, $\pm$ s)	337	6.79 $\pm$ 1.50
Weight (kg $\bar{x}\pm$ s)	337	22.71 $\pm$ 8.05
Height (cm $\bar{x}\pm$ s)	337	115.86 $\pm$ 13.64
Age-specific BMI (%)		
Normal	133	39.5
Emaciation	111	32.9
Overweight or obese	93	27.6
Previous cough (%)		
Not cough	105	31.2
Cough	232	68.8
Previous wheezing (%)		
Not wheezing	180	53.4
Wheezing	157	46.6
Previous night symptoms (%)		
No	102	30.3
Yes	235	69.7
Feeding method (%)		
Exclusive breastfeeding	92	27.3
Not breastfed	50	14.8
Mixed feeding	195	57.9
Father's education level (%)		
Primary school or below	14	4.2
Junior high school	66	19.6
High school and technical school	98	29.1
Graduate and above	159	47.2
Mother's education level (%)		
Primary school or below	21	6.2
Junior high school	67	19.9

High school and technical school	89	26.4
Graduate and above	160	47.5
Marital status of parents (%)		
divorced	11	3.3
Married	326	96.7
Residence (%)		
urban	247	73.3
Rural	90	26.7
Monthly family income (%)		
<2000	25	7.4
2000~9999	207	61.4
≥10000	105	31.2
Caregiver's degree of understanding of asthma (%)		
Low	281	83.4
Normal	56	16.6
Caregiver's home care situation (%)		
Bad	233	69.1
Good	104	30.9

Table 2 The distribution of all items in the anxiety scale

Items	No or a little of the time	Some of the time	A good part of the time	Most or all of the time
1 Feeling more nervous and anxious than usual	171(50.7)	77(22.8)	79(23.5)	10(3.0)
2 Fear without cause	169(50.2)	80(23.7)	72(21.4)	16(4.7)
3 Easily upset or frightened	218(64.7)	78(23.1)	37(11.0)	4(1.2)
4 Feeling like I'm going crazy	219(65.0)	44 (13.1)	63(18.7)	11(3.2)
*5 Feeling fine about everything and that no unfortunate things would happen	20(5.9)	67(19.9)	73(21.7)	177(52.5)
6 Shaking hands and feet	261(77.4)	72(21.4)	3(0.9)	1(0.3)
7 Being distressed by headache, neck pain, or back pain	251(74.5)	82(24.3)	4(1.2)	0
8 Feel weak and tired easily	174(51.6)	111(32.9)	45(13.4)	7(2.1)
*9 Feel calm and easy to sit quietly	38(11.3)	40(11.9)	225(66.8)	34(10.0)
10 Having a fast heartbeat	251(74.5)	68(20.2)	18(5.3)	0
11 Suffering from bouts of dizziness	211(62.6)	76 (22.6)	46(13.6)	4(1.2)
12 Having a fainting episode or feeling faint	263(78.0)	73(21.7)	1 (0.3)	0
*13 It's easy to breathe in and out	6(1.8)	60(17.8)	159(47.2)	112(33.2)
14 Having numbness and tingling in the hands and feet	246(73.0)	87(25.8)	4(1.2)	0
15To suffer from a stomachache or indigestion	171(50.8)	113(33.5)	48(14.2)	5(1.5)
16 Need to urinate frequently	231(68.5)	76(22.6)	29(8.6)	1(0.3)
*17 Hands are often dry and warm	1(0.3)	52(15.4)	126(37.4)	158(46.9)
18 Facial flushing	115(34.1)	145(43.0)	66(19.6)	11(3.3)
*19 Falling asleep easily and sleeping well all night	18(5.3)	35(10.4)	91(27.0)	193(57.3)
20 Nightmares	130(38.6)	129(38.3)	30(8.9)	48(14.2)

\* Negatively worded items

Table 3 The results of anxiety manifestations factor analysis in children with asthma

Anxiety manifestations	Item	Factor load	Explained variance (%)
Mental manifestations	20 nightmares, 4 madness, 18 facial flushing, 9 easy to sit, 16 pollakiuria, 2 fear, 17 hands are warm, 1 anxiety, 3 panic, 19 sleep well, 15 stomach upset, 5 It feels good, 13 breathe easy, 11 dizzy, 10 palpitation	0.50~0.82	40.01
Sensory manifestations	7 distress for physical pain and distress, 8 feeling susceptible to weakness and fatigue, 12 a faint feeling	0.68~0.76	13.73
Hand-and-foot manifestations	6 hand and foot tremors 14 hand and foot tingling	0.66~0.82	11.54

Table 4 The relationships between different anxiety manifestations and behavioral abnormalities in the children with asthma

Anxiety manifestations	Behavioral abnormalities				
	N (%)	uOR (95%CI)	P-value	*aOR (95%CI)	P-value
Mental manifestations					
Q1	140(41.5)	1		1	
Q2	123(36.5)	1.38(0.77~2.46)	0.277	1.30(0.72~2.37)	0.388
Q3	74(22.0)	2.54(1.36~4.72)	0.003	2.56(1.32~4.99)	0.006
Sensory manifestations					
Q1	151(44.8)	1		1	
Q2	106(31.5)	1.70(0.98~2.95)	0.061	1.66(0.94~2.92)	0.079
Q3	80(23.7)	1.47(0.77~2.79)	0.240	1.40(0.73~2.67)	0.311
Hand-and-foot manifestations					
Q1	140(41.5)	1		1	
Q2	104(30.9)	1.11(0.62~2.00)	0.727	1.09(0.60~1.98)	0.769
Q3	93(27.6)	1.99(1.09~3.64)	0.025	1.86(1.01~3.43)	0.048

Note: uOR: unadjusted OR; aOR: adjusted OR \*Adjusted sex, age, history of wheezing, marital status of parents

## Figures

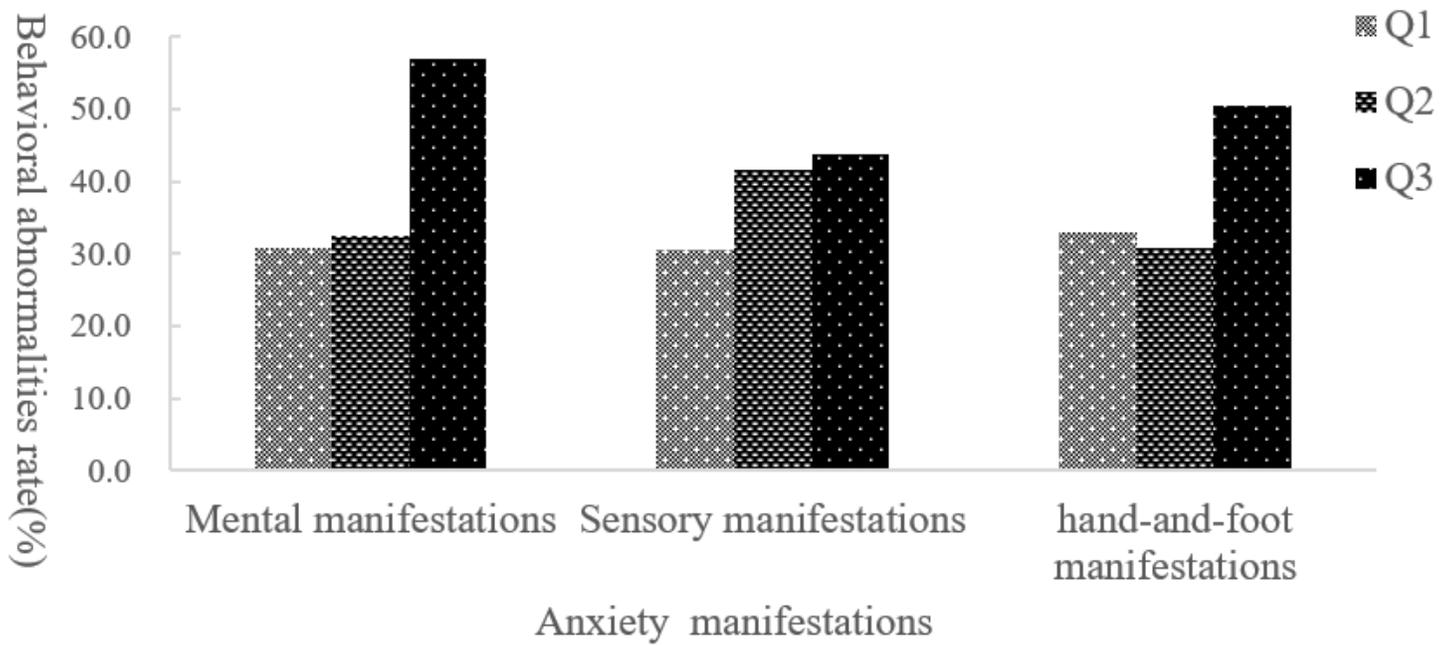


Figure 1

Behavioral abnormalities rate of different anxiety manifestations