BMJ Open

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Journal:	*BMJ Open*
Manuscript ID	bmjopen-2024-085905
Article Type:	Original research
Date Submitted by the Author:	29-Feb-2024
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Keywords:	PAEDIATRICS, Cross-Sectional Studies, Immunity

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Parents' knowledge, attitude, and practice toward the prevention and treatment of dust mite allergy

Running title: KAP of dust mite allergy

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Abstract

Objective: This cross-sectional study aimed to evaluate parents' knowledge, attitudes, and practices (KAP) concerning the prevention and treatment of dust mite allergy in children.

Design: Conducted between September and December 2022, this cross-sectional study involved multiple healthcare facilities, including primary and secondary care settings, ensuring a comprehensive representation of the target population.

Participants: A total of 503 parents of children with dust mite allergies participated, with 253 parents having children undergoing desensitization treatment and 250 parents whose children did not. Selection criteria were carefully defined to include parents directly responsible for the care of children with dust mite allergies.

Interventions: Two distinct questionnaires were administered to parents, tailored for those with and without children undergoing desensitization treatment. These questionnaires covered demographic information, allergy diagnosis, treatment details, and KAP related to dust mite allergy.

Primary and secondary outcome measures: Primary outcomes included parents' scores on knowledge, attitudes, and practices regarding dust mite allergy prevention and treatment. Secondary outcomes involved analyzing the interaction between these factors using pathway analysis.

Results: Parents of children undergoing desensitization treatment exhibited higher levels of knowledge, attitude, and overall practice scores compared to those without desensitization therapy. Pathway analysis revealed varying influences of knowledge and attitude on practice between the two groups.

Conclusions: The study highlighted differing levels of KAP among parents of children with dust mite allergies, influenced by desensitization therapy status. While attitudes tended to be favorable, practices were suboptimal, particularly among parents whose children did not

receive desensitization treatment. These findings emphasize the importance of targeted educational interventions to enhance parental awareness and practices regarding dust mite allergy management, especially in cases where desensitization treatment is not pursued. Further research is warranted to explore effective strategies for improving parental engagement and adherence to preventive measures.

Key words: dust mites, house; dust mite allergy; health knowledge, attitudes, practice; desensitization, immunologic; cross-sectional study.

Strengths and limitations of this study

Utilizing separate questionnaires for parents of children with and without desensitization treatment allowed for targeted exploration of relevant factors, enhancing the study's specificity.

Incorporating six dimensions in the questionnaire ensured a thorough examination of parents' knowledge, attitudes, and practices, providing a holistic understanding of their KAP towards dust mite allergy prevention and treatment.

With 503 participants, the study's sample size is sufficiently large to provide reliable statistical analysis and meaningful insights into parental perceptions and behaviors related to dust mite allergy management.

Conducting the study at Shengjing Hospital Affiliated to China Medical University ensures consistency in data collection procedures and minimizes potential confounding variables related to healthcare settings, enhancing the internal validity of the findings.

1 INTRODUCTION

House dust mites mainly include *Dermatophagoides pteronyssinus*, *Dermatophagoides farinae*, and *Euroglyphus maynei* (1). They are non-parasitic microscopic bugs that live on desquamated dead skin cells from humans and pets. They prefer warm and moist environments and are found in bedding, linens, carpets, and furniture (2-4). Although the mite's exoskeleton can contribute to the allergic reaction, the main allergens are found in the mite's fecal pellets (5, 6). Each mite produces about 20 pellets daily, each the size and weight of a pollen grain (5, 6). Therefore, they are easily inhaled and can cause sensitization of the respiratory tract mucosa, leading to epithelial permeability and the movement of the mite's antigens to antigen-presenting dendritic cells (5, 6). Dust mite allergy affects about 20 million people in the United States of America (USA) alone (2). Dust mite allergy contributes to the development of allergic rhinitis and asthma, affecting 800 million people worldwide (1, 5, 7, 8). The prevalence of asthma in children in the USA is 8.3% (9). Therefore, dust mites represent a serious public health problem. The most effective management method for dust mite allergy is allergen avoidance (e.g., frequently washing bedding, removing carpets, room air cleaners, and humidity control) (5, 10-12). Over-the-counter medications (antihistamines, nasal corticosteroids, leukotriene receptor antagonists, cromolyn sodium, and decongestants) and allergen immunotherapy can also help (5, 10).

Since allergen avoidance involves specific lifestyle habits (5, 10-12), parents' proper knowledge, attitudes, and practice (KAP) toward dust mites are essential to managing the allergic symptoms in their children. KAP surveys are tools that provide quantitative and qualitative data about a specific subject in a specific population (13, 14). They can be used to identify gaps and design tailored teaching and training activities (13, 14). It is known that parents who visited an allergist demonstrated higher dust mite KAP (15). Generally, parents display very high KAP toward food allergies in their children (16-18), mainly because several

of these allergies can be fatal, which is not the case with dust mite allergy. Studies revealed poor parental KAP for allergic rhinitis (19, 20) and poor KAP regarding allergic disorders in general (21), including in parents of asthmatic children (22). Still, the KAP of parents toward dust mites is poorly known, especially in China.

Therefore, this study aimed to evaluate the KAP of parents toward preventing and treating dust mite allergy and to examine the differences between the parents of children who were treated with desensitization treatment and the parents of children who were not. Parents are the primary actors in house cleaning and management, and evaluating their KAP toward house mite allergy should help design future teaching activities.

2 MATERIALS AND METHODS

2.1 Study design and participants

This cross-sectional study survey was conducted from September to December 2022 at Shengjing Hospital Affiliated to China Medical University. The participants were the parents of children with dust mite allergies. The study was approved by the Medical Ethics Committee of Shengjing Hospital Affiliated to China Medical University (approval #2022PS935K). Informed consent was obtained from the participants before completing the survey.

The inclusion criteria were 1) parents of children who tested positive for dust mite-specific serum IgE (measured by Phadia ImmunoCAP) and 2) voluntarily completed the questionnaire. The participants were grouped according to whether the children were treated with desensitization treatment or not.

2.2 Questionnaires

The questionnaire was designed by two senior experts in allergy with reference to the literature (15, 23, 24). The final questionnaire had two versions: one for the parents of children who did not undergo desensitization treatment (Questionnaire A) and one for the parents of children

who underwent desensitization treatment (Questionnaire B). Thirty parents were randomly selected to complete the questionnaire to test its reliability. Cronbach's α was 0.726 for Questionnaire A and 0.702 for Questionnaire B.

The questionnaire contained six dimensions: demographic information of the parents, demographic information of the child, diagnosis and treatment information related to dust mite allergy in children, knowledge dimension, attitude dimension, and practice dimension. The specific questions and scoring instructions for both questionnaire versions can be found in the Supplementary Materials. The data were collected by on-site inquiry and questionnaire when the parents visited the hospital.

2.3 Statistical analysis

The continuous variables were expressed as means ± standard deviations (SD) and analyzed using Student's t-test or ANOVA. The categorical data were expressed as n (%) and analyzed using the chi-square test. All statistical analyses were performed using two-sided tests, and P-values <0.05 were considered statistically significant. Pathway analysis was constructed, and the hypotheses were 1) knowledge has direct effects on attitude, 2) attitude has direct effects on practice, and 3) knowledge has direct effects on practice. By analyzing the influencing factors of good practice through multiple factors, define it as 70% of the highest possible score for practice. STATA 17.0 (Stata Corporation, College Station, TX, USA) was used for statistical analysis.

2.4 Patient and public involvement

No patient involved

3 RESULTS

3.1 Characteristics of the participants

A total of 503 participants completed the questionnaires: 250 in the non-desensitization group and 253 in the desensitization group. Most participants were women (81.91%), most participants had a bachelor's degree or higher education, and only a small proportion had a history of dust mite allergy. There were more fathers in the desensitization group (25.69% vs. 9.20%, P<0.001), and the mothers' education was higher in the non-desensitization group (P=0.028) (Table 1). There were no differences between the children of the two groups, except for the residence area (P=0.001) and means of transportation to the hospital (P=0.003) (Supplementary Table S1). Compared with the non-desensitization group, the children in the desensitization group had higher proportions of dust mite allergy diagnosis (P=0.009), less rhinitis (P=0.004), and shorter rhinitis attacks (P<0.001) (Supplementary Table S1).

Table 1. Characteristics of the parents, n (%)

	Without desensitization	With desensitization	P
Total	250 (49.70)	253 (50.30)	
Parental relationship			<0.001
Father	23 (9.20)	65 (25.69)	
Mother	223 (89.20)	184 (72.73)	
Other family members	4 (1.60)	4 (1.58)	
Father's education			0.167
Primary school and below	19 (7.60)	13 (5.14)	
Middle school	28 (11.20)	44 (17.39)	
High school/technical secondary school	33 (13.20)	41 (16.21)	
Bachelor's degree/junior college	131 (52.40)	128 (50.59)	
Master's degree	30 (12.00)	20 (7.91)	
Doctorate	9 (3.60)	7 (2.77)	
Mother's education			0.028
Primary school and below	1 (0.40)	3 (1.19)	
Middle school	22 (8.80)	39 (15.42)	
High school/technical secondary school	32 (12.80)	44 (17.39)	
Bachelor's degree/junior college	154 (61.60)	143 (56.52)	
Master's degree	35 (14.00)	21 (8.30)	
Doctorate	6 (2.40)	3 (1.19)	
Annual household income (RMB)			0.379
<30,000	18 (7.20)	24 (9.49)	
30,000-50,000	29 (11.60)	43 (17.00)	
50,000-100,000	76 (30.40)	73 (28.85)	
100,000-200,000	61 (24.40)	61 (24.11)	
200,000-300,000	32 (12.80)	26 (10.28)	

>300,000	34 (13.60)	26 (10.28)	
Are the parents allergic to dust mites?			0.373
None	102 (40.80)	126 (49.80)	
Father only	21 (8.40)	18 (7.11)	
Mother only	24 (9.60)	19 (7.51)	
Both	6 (2.40)	6 (2.37)	
Unclear	97 (38.80)	84 (33.20)	
Ways to learn about allergies [multiple choice]			-
Newspaper & Books	49 (19.60)	19 (7.51)	
Radio & TV	36 (14.40)	21 (8.30)	
Web Search	104 (41.60)	82 (32.41)	
Short videos	76 (30.40)	40 (15.81)	
Doctor's guidance during the consultation	164 (65.60)	228 (90.12)	
Never knew about it	26 (10.40)	8 (3.16)	

3.2 Knowledge, attitudes, and practice

For the items common to the two questionnaires, compared with the non-desensitization group, the desensitization group showed higher correct response rates about dust mites, the complications of dust mite allergies, the source of dust mites, and how to manage dust mite populations (all $P<0.05$) (Supplementary Table S2). Both groups showed relatively poor knowledge regarding the group-specific items (Supplementary Table S3).

About half of the participants cannot stand dust mites in their homes. More participants in the desensitization group were very worried about the possible health risks of dust mites in children ($P<0.001$). More participants in the desensitization group remained worried after following the doctors' advice to decrease dust mites ($P=0.016$). Most participants in the two groups agree that it is necessary to remove dust mites regularly ($P=0.053$) (Supplementary Table S4). The participants in the non-desensitization group are willing to undergo treatments, but cost appears to be a barrier, while most participants in the desensitization group have a favorable attitude toward treatment (Supplementary Table S5).

Compared with the non-desensitization group, subjects in the desensitization group displayed higher rates of positive behavior regarding all practice items (all $P\leq0.001$), except for the

weekly cleaning of bedding and daily vacuuming (P=0.345 and P=0.142) (Supplementary Table S6). There were no significant differences between the two groups regarding the pillow and bedding materials (Supplementary Table S7).

3.3 Pathway analysis

The root mean square error of approximation (RMSEA, P<0.001), comparative fit index (CFI, P=1.000), Tucker-Lewis index (TLI, P=1.000), and standardized root mean square residual (SRMR, P<0.001) all indicated that the model fit was acceptable. In the non-desensitization group, knowledge directly affected attitude (β=0.22, P<0.001), and attitude directly affected practice (β=0.16, P<0.001, Table 2), but the knowledge did not affect practice (β=-0.01, 0.06, P<0.001). In the desensitization group, knowledge directly affected attitude (β=0.13, P=0.028), but the practice was not affected by attitude (β=0.08, P<0.001) or knowledge (β=0.03, 0.12, P<0.001).

Table 2. Estimates of hypothesis paths of KAP

	β (95% CI)	P-value
Without desensitization		
K -> A	0.22 (0.10, 0.35)	<0.001
A -> P	0.16 (0.09, 0.22)	<0.001
K -> P	-0.01 (-0.07, 0.06)	0.871
Desensitization		
K -> A	0.13 (0.01, 0.25)	0.028
A -> P	0.08 (-0.01, 0.17)	0.095
K -> P	0.03 (-0.05, 0.12)	0.439

CI: confidence interval; K: knowledge; A: attitude; P: practice.

3.4 Factors influencing practice among parents of children who underwent desensitization treatment

Among parents of children who underwent desensitization treatment, bachelor's degree or above (OR=3.816, 95%CI: 1.483-9.818, P=0.005), suspected dust allergy based on symptoms (OR=4.299, 95%CI: 1.429-12.929, P=0.009), and children having rhinitis (OR=0.352, 95%CI: 0.170-0.272, P=0.005) were associated with the parents' practice (Table 3).

Table 3. The factors influencing good practices (n=44 parents with good practice) among parents of children who have undergone desensitization treatment (n=253)

	Univariate		Multivariate	
	95%CI	P	95%CI	P
Knowledge	0.966 (0.846-1.102)	0.604		
Attitude	1.16 (0.99-1.36)	0.067		
Parental relationship				
Mother	REF			
Father/ Other family members	0.449 (0.19-1.061)	0.068		
Father's education				
Junior college or below	REF			
Bachelor's degree or above	1.44 (0.721-2.877)	0.302		
Mother's education				
Junior college or below	REF		REF	
Bachelor's degree or above	3.928 (1.589-9.709)	0.003	3.816 (1.483-9.818)	0.005
Annual household income (RMB)				
<100,000	REF			
≥100,000	1.297 (0.676-2.487)	0.434		
Are the parents allergic to dust mites?				
None	REF			
One of the parents/Both	1.83 (0.814-4.112)	0.144		
Unclear	0.639 (0.286-1.428)	0.275		
Learned about allergies				
No	REF			

Yes	0.621 (0.121-3.182)	0.567		
Pre-visit knowledge of child's dust mite allergy				
Unaware	REF		REF	
Aware	1.81 (0.887-3.694)	0.103	1.679 (0.792-3.561)	0.176
Suspected based on symptoms	3.08 (1.118-8.481)	0.03	4.299 (1.429-12.929)	0.009
Child's sex				
Male	REF			
Female	1.111 (0.564-2.187)	0.761		
Child's age	0.855 (0.738-0.992)	0.039	0.895 (0.764-1.049)	0.17
Only child				
Yes	0.552 (0.286-1.065)	0.076		
No	REF			
Child's Diagnosed Conditions:				
Rhinitis	0.432 (0.222-0.841)	0.013	0.352 (0.17-0.727)	0.005
Bronchial Asthma	0.87 (0.428-1.767)	0.699		
Cough-Variant Asthma	0.833 (0.362-1.921)	0.669		
Allergic Cough	1.01 (0.521-1.957)	0.977		

4 DISCUSSION

This study investigated parents' KAP regarding the prevention and treatment of dust mite allergy and examined the differences between the parents of children who were treated with desensitization treatment and those of children who were not. The results showed that the parents of children with dust mite allergy had relatively good KAP regarding dust mites. The parents of children who did not undergo desensitization therapy had poor knowledge, favorable attitudes, and poor practice regarding dust mites, while the parents of children who underwent desensitization therapy had good knowledge, favorable attitudes, and poor practice.

Although dust mite allergy is bothersome for the patients and can evolve into allergic rhinitis and asthma, the condition is not as dangerous as food allergies, probably explaining why the KAP toward food allergies is very high in parents of food-allergic children (16-18) but lower in parents of children with dust mite allergy, as observed in the present study. Indeed, the relatively low KAP observed here is supported by previous studies on allergic rhinitis (19, 20) and allergies in general (21). Even parents of children with chronic asthma (in whom allergens can be triggers for asthma attacks) have a poor KAP toward allergies (22). A study covering 29 Chinese cities showed that the KAP of parents toward allergic rhinitis was low (25). In the present study, the total KAP scores and knowledge scores were higher in the desensitization group than in the non-desensitization group, as supported by Callahan et al. (15), who reported higher KAP in the parents who met an allergist compared with those who did not (to receive desensitization treatment, all patients must consult an allergist in China). Still, in the present study, the non-desensitization group included parents of children newly diagnosed with dust mite allergy and parents of children with known dust mite allergy who did not receive or did not yet receive desensitization treatment. The attitude scores were relatively high in both groups, but the practice scores were low. These results indicate that although the willingness to take measures against house dust mites to improve their child's health was high, the actual application of these measures was low. Indeed, for example, vacuuming each day is time-consuming, boring, and bothersome. The same goes for changing and laundering sheets more often. Since house dust mite allergy is not a serious condition, many parents do not feel the need to perform all those tasks.

This study showed significantly better scores for several knowledge areas, such as the dust mite species causing allergies, the diseases that can be due to dust mite allergies, the objects in which dust mites are more likely to thrive, methods to eliminate dust mites, and whether cleaning can completely eliminate dust mites. It is probable that the parents who opted for desensitization

therapy in their children obtained more information from the physicians or other sources when discussing the treatment options or by themselves to understand better what they were getting into. Indeed, a study showed that the parents of children with life-threatening illnesses were actively seeking information about the illness (26); although dust mite allergy is far from being life-threatening, a similar protective behavior could be involved. Furthermore, parents of children with allergies are actively seeking information from different sources (27). Desensitization therapy is relatively expensive, and parents might fear some adverse effects on their children, encouraging them to take more information. Compared with the non-desensitization group, the parents in the desensitization group also reported a more worried attitude toward the possible health risks related to dust mites in their children and more worries toward dust mites despite active measures taken to decrease them. These worries could come from a better knowledge of the diseases and complications related to dust mite allergies. Regarding the practice items, compared with the non-sensitization group, the parents in the desensitization group declared more efforts being taken to gain knowledge about dust mites (which could relate to the knowledge scores), as previously suggested (27) and reported a higher use of mite-proof bedding and pillowcase and a lower use of dust mite-prone decoration, which could be related to a better knowledge of the sources of dust mites. Still, both groups reported poor practice regarding washing bedding weekly and vacuuming every day. In the desensitization group and higher education, suspected dust mite allergy based on symptoms (suggesting a higher knowledge of dust allergy) were independently and positively associated with the practice. On the other hand, rhinitis was independently and negatively associated with practice.

The pathway analysis showed different patterns of association among the KAP dimensions between the non-desensitization and desensitization groups. Indeed, in the non-desensitization group, knowledge affected attitude, which in turn affected practice, while in the desensitization

group, only knowledge affected attitude. It is possibly because the parents in the desensitization group had already taken action for their children's condition. Still, these differences should be investigated more in-depth to tailor future interventions to the specific target populations. In addition, pathway analyses are only statistical surrogates for causality (28, 29), and the results should be confirmed.

Nevertheless, the present study provides clues for designing teaching brochures, videos, podcasts, or activities to increase the KAP of parents toward dust mites. In particular, the knowledge about the dust mites themselves and the methods to kill them was low. The practice of minimizing the living habitats of dust mites and using actual means to get rid of them should be emphasized.

This study had limitations. It was performed at a single center, and the sample size is relatively small. In addition, because the two subpopulations of participants (i.e., with children with or without desensitization treatments) had two different KAP questionnaires, a direct comparison of the KAP scores was not possible between the two groups. Furthermore, as for all KAP surveys, the data represent the situation of a specific population at a specific point in time (13, 14). In addition, KAP surveys are subject to a social acceptability bias, i.e., the participants can be tempted to answer what they should do instead of what they really do (13, 14). Nevertheless, the present study might provide a comparator point to evaluate the KAP in a similar population after an intervention to increase health literacy on house dust mites.

5 CONCLUSIONS

In conclusion, the parents of children who did not undergo desensitization therapy had poor knowledge, favorable attitudes, and poor practices regarding dust mites, while the parents of children who underwent desensitization therapy had good knowledge, favorable attitudes, and poor practices. Still, the practice was generally poor in all participants, highlighting the need

to emphasize the importance of decreasing the house dust mite to maintain the children's health. There is still a need to spread awareness and educate the general population about the importance of controlling house dust mites.

List of abbreviations

KAP: knowledge, attitudes, and practices

SD: standard deviations

Declarations

Ethics approval and consent to participate

The research was carried out in accordance with the Declaration of Helsinki. The study was approved by the Medical Ethics Committee of Shengjing Hospital Affiliated to China Medical University (approval #2022PS935K). Informed consent by electronic questionnaire was obtained from the participants before completing the survey.

Consent for publication

Not applicable.

Data Availability Statement

All data generated or analyzed during this study are included in this published article [and its supplementary information files].

Conflict of Interest

The authors declare that the research was conducted in the absence of any commercial or financial relationships that could be construed as a potential conflict of interest.

Funding

This work was supported by the Basic Scientific Research Project of Colleges and Universities of Liaoning Province (Key Program, No. LJKZ0746) and the Basic Scientific Research Project of Colleges and Universities of Liaoning Province (General Program, No. LJKZ0746).

Authors' contributions

Conceptualization, Si Liu and Qianlan Zhou; Methodology, Bing Dai; Software, Li Chen; Validation, Qinzhen Zhang; Formal Analysis, Lina Han; Investigation, Xiaowen Li; Resources, Wenxin Shen; Data Curation, Si Liu; Writing – Original Draft Preparation, Si Liu; Writing – Review & Editing, Qianlan Zhou; Visualization, Qianlan Zhou; Supervision, Lishen Shan; Project Administration, Lishen Shan; Funding Acquisition, Lishen Shan.

Acknowledgments

Not applicable.

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Figure Legends

Figure 1. Pathway analysis. (A) Without desensitization. (B) With desensitization.

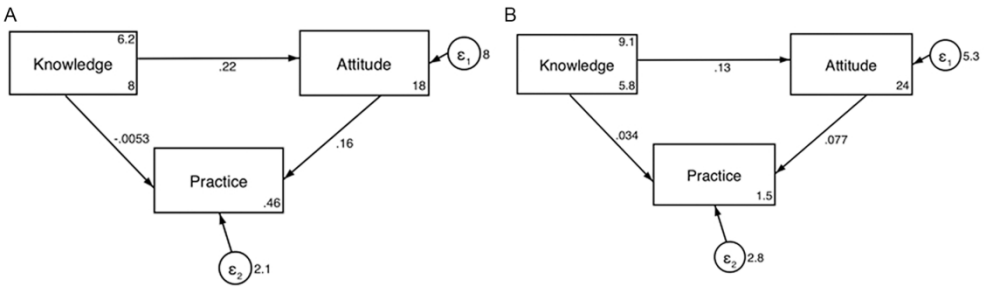

Figure 1. Pathway analysis. (A) Without desensitization. (B) With desensitization.

170x51mm (300 x 300 DPI)

Supplementary Table S1. Medical characteristics of the children, n (%)

	Without desensitization (n=250)	Desensitization (n=253)	P
Gender			0.304
Male	153 (61.20)	166 (65.61)	
Female	97 (38.80)	87 (34.39)	
Age, mean±SD	6.37±3.13	8.80±2.36	-
Ethnicity			0.934
the Han nationality	180 (72.00)	183 (72.33)	
Minorities	70 (28.00)	70 (27.67)	
Yes	147 (58.80)	-	
No	103 (41.20)	-	
Knowing your child's dust mite allergy before going to the doctor			0.009
Know	58 (23.20)	79 (31.23)	
Don't know	150	152 (60.08)	

	(60.00)		
Suspected dust mite allergy in the child based on him/her symptoms	42 (16.80)	22 (8.70)	
Season when rhinitis is more likely to occur			0.004
Without rhinitis	68 (27.20)	33 (13.04)	
Spring	27 (10.80)	41 (16.21)	
Summer	10 (4.00)	12 (4.74)	
Autumn	66 (26.40)	72 (28.46)	
Winter	24 (9.60)	26 (10.28)	
All year round	55 (22.00)	69 (27.27)	
Duration of rhinitis attack			<0.001
Without rhinitis	77 (30.80)	40 (15.81)	
The duration of symptoms <4 days/week, or <4 consecutive weeks	89 (35.60)	121 (47.83)	
The duration of symptoms ≥4 days/week, or ≥4 consecutive weeks	84 (33.60)	92 (36.36)	

Frequency of desensitization treatments		-
First medication	-	16 (6.32)
Within 3 months	-	49 (19.37)
3 months to 6 months	-	22 (8.70)
6 months to 1 year	-	38 (15.02)
More than 1 year	-	128 (50.59)
Outcome of desensitization treatment		-
First medication	-	27 (10.67)
Significant improvement (no symptoms or close to normal)	-	61 (24.11)
Improvement (few or occasional mild symptoms)	-	70 (27.67)
Remission (fewer symptoms and less frequent recurrences)	-	55 (21.74)
Effective (all symptoms still present but less frequent recurrences)	-	34 (13.44)
Ineffective (hardly any improvement and worse symptoms)	-	6 (2.37)
Time for desensitization to complete initial treatment		-
Initial treatment has not been	-	71 (28.06)

completed		
14 weeks	-	95 (37.55)
15-20 weeks	-	45 (17.79)
21-28 weeks	-	10 (3.95)
More than 28 weeks	-	32 (12.65)
Adverse reactions during desensitization treatment		-
No	-	98 (38.74)
Only redness and swelling at the injection site	-	146 (57.71)
Large area urticaria throughout the body	-	6 (2.37)
Severe allergic reaction (difficulty breathing, shock, etc.)	-	3 (1.19)
Frequency of adverse reactions during desensitization		-
None	-	105 (41.50)
1 - 2 times	-	64 (25.30)
3 - 5 times	-	34 (13.44)
Often	-	35 (13.83)
Every time	-	15 (5.93)

Supplementary Table S2. Knowledge dimension, n (%)

	Correct rate		P
	Without desensitization	Desensitization	
Q1. Which of the following species of dust mite can cause an allergic reaction?	148 (59.20)	216 (85.38)	<0.001
Q2. Only live dust mites can act as allergens to cause allergic reactions.	105 (42.00)	119 (47.04)	0.256
Q3. Which of the following diseases can be caused by dust mite allergy?	153 (61.20)	187 (73.91)	<0.001
Q4. Dust mites in the house mainly breed in bed sheets and bedding; carpets and curtains are not prone to breeding dust mites.	171 (68.40)	192 (75.89)	0.061
Q5. Plush toys are prone to breeding dust mites.	226 (90.40)	245 (96.84)	0.003
Q6. UV light can kill dust mites.	68 (27.20)	54 (21.34)	0.126
Q7. Freezing the plush toys or	44	68 (26.88)	0.012

pillowcases in the refrigerator overnight can kill dust mites.	(17.60)		
Q8. How many degrees of hot water for washing bed sheets will be most effective in removing dust mites?	127 (50.80)	151 (59.68)	0.045
Q9. Indoor dust mites can be completely eliminated with a good job of cleaning.	185 (74.00)	215 (84.98)	0.002

Supplementary Table S3. The distribution of the remaining problems in the knowledge dimension, n (%)

Questionnaire A Without desensitization treatment	Correct	Wrong	Don't know
Q10. There is no cure for a child with dust mite allergy, but keep the house as hygienic as possible to avoid dust mites	43 (17.20)	139 (55.60)	68 (27.20)
Q11. Dust mite allergy will heal itself as the child grows up	39 (15.60)	119 (47.60)	92 (36.80)
	Haven't heard of it	Have heard of it but don't know the details	Understand the process and procedure of it
Q12. Have you heard of or know about desensitization treatment for dust mites?	91 (36.40)	126 (50.40)	33 (13.20)
Questionnaire B Desensitization treatment			
Q10. The desensitization treatment for dust mite allergy usually takes 3-5 years	231 (91.30)	4 (1.58)	18 (7.11)

Q11. The medications of nasal spray hormone therapy for rhinitis or nebulized hormone therapy for asthma can be stopped during desensitization treatment	78 (30.83)	116 (45.85)	59 (23.32)
Q12. There is no need to pay attention to removing and avoiding dust mites during desensitization treatment	9 (3.56)	231 (91.30)	13 (5.14)
Q13. The desensitization of dust mites can treat rhinitis caused by dust mite allergy, but it can't prevent rhinitis from developing into asthma	65 (25.69)	104 (41.11)	84 (33.20)
	Itching of the palms of the hands and feet. Itchy scalp. Flushed skin all over the body.	Immediate shock (altered mental state. Cold and clammy skin. The Decrease in blood	Difficulty breathing. Rapid breathing. Hoarseness and other symptoms

	appearance of pressure urticaria		
Q14. Those adverse reactions in desensitization treatment that require attention are (Multiple choice)	212 (83.79)	42 (57.71)	195 (77.08)

Supplementary Table S4. Attitude dimension, n (%)

	Without desensitization	Desensitization	P
You can't stand dust mites infesting your home			0.481
Strongly agree	111 (44.40)	122 (48.22)	
Agree	95 (38.00)	98 (38.74)	
Unsure/Don't know	35 (14.00)	28 (11.07)	
Disagree	9 (3.60)	5 (1.98)	
What is your attitude towards the possible health risks of dust mite infestation in children			0.001

Very worried	137 (54.80)	177 (69.96)	
Worried	92 (36.80)	70 (27.67)	
Unsure/Don't know	20 (8.00)	5 (1.98)	
Not worried at all	1 (0.40)	1 (0.40)	
Even though you have followed the doctor's advice to reduce your child's exposure to dust mites by mite removal in the house, you are still worried about the dust mite allergy			0.016
Strongly agree	101 (40.40)	114 (45.06)	
Agree	105 (42.00)	118 (46.64)	

Unsure/Don’t know	39 (15.60)	17 (6.72)	
Strongly disagree	5 (2.00)	4 (1.58)	
Do you think it is necessary to remove mites from your home regularly			0.053
Very necessary	182 (72.80)	188 (74.31)	
Possibly necessary	55 (22.00)	54 (21.34)	
Unsure	13 (5.20)	6 (2.37)	
Unnecessary	0	5 (1.98)	

Supplementary Table S5. The distribution of the remaining questions in the attitude dimension, n (%)

Questionnaire A Without desensitization treatment	Very necessary	Possibly necessary	Unsure	Unnecessary
Q14.2. If there have a therapy to make your child non-allergic to dust mites, do you think it is necessary to undergo it	159 (63.60)	71 (28.40)	19 (7.60)	1 (0.40)
	More than 1000 CNY/month	500-1000 CNY/month	100-500 CNY/month	Less than 100 CNY/month
Q14.3. How much do you think is acceptable to spend for your child on the prevention and treatment of dust mite allergy (RMB)	47 (18.80)	81 (32.40)	82 (32.80)	40 (16.00)

Questionnaire B Desensitization treatment	Yes	Probably	Don't know/Unsure	No

Q16.2. Do you think that desensitization treatment is an effective option for your child's rhinitis/asthma	211 (83.40)	31 (12.25)	10 (3.95)	1 (0.40)
	Very needed	Needed	Don't know	Don't need
Q16.3. Do you think desensitization treatment needs to be carried out strictly according to medical advice (e.g., Follow up consultation on time)	217 (85.77)	36 (14.23)	0	0
	Persist	May persist, depending on the situation	May give up	Definitely give up
Q16.4. If your child has a relatively obvious reaction to the treatment, such as severe redness at the injection site or a rash around the	108 (42.69)	123 (48.62)	18 (7.11)	4 (1.58)

body, or even anaphylaxis, will you continue with the Desensitization treatment

Supplementary Table S6. Practice dimension, n (%)

	Positive behavior		P
	Without desensitization	Desensitization	
P1. Due to your child's dust mite allergy, have you and your family made a special effort to learn about relevant knowledge (including dust mites. dust mite allergy and desensitization treatment, etc.)	154 (61.60)	216 (85.38)	<0.001
P2. Does your child use mite-proof bedding such as mite-proof pillowcases and bedclothes	94 (37.60)	105 (41.50)	<0.001
P3. Do you use a dust mite controller to remove mites in your home	162 (64.80)	162 (64.03)	<0.001
P4. Do you use instruments such as dehumidifier/air-conditioning, air cleaner, etc., to remove mites in your home	115 (46.00)	85 (33.60)	<0.001
P5. Do you use decoration prone to mites, such as carpet in your home	20 (8.00)	4 (1.58)	0.001

P6. Do you or your family weekly wash your pillowcases and bedclothes	161 (64.40)	173 (68.38)	0.345
P7. Do you or your family use a vacuum cleaner to clean your house every day	114 (45.60)	99 (39.13)	0.142

Supplementary Table S7. Material of the bedding items, n (%)

	Without desensitization	Desensitization	P
Your child is currently using a pillow with the content material of			0.700
Latex	123 (49.20)	122 (48.22)	
Down	1 (0.40)	1 (0.40)	
Artificial fiber	24 (9.60)	30 (11.86)	
Buckwheat hulls	75 (30.00)	82 (32.41)	
Cotton	17 (6.80)	10 (3.95)	
Other	10 (4.00)	8 (3.16)	
Your child is currently using bedding with the content material of			0.830
Latex	5 (2.00)	5 (1.98)	
Down	9 (3.60)	10 (3.95)	

Artificial fiber	39 (15.60)	38 (15.02)
Silk	138 (55.20)	135 (53.36)
Cotton	50 (20.00)	60 (23.72)
Other	9 (3.60)	5 (1.98)

Questionnaire A

Dear Parents:

Hello!

We are researchers at Shengjing Hospital of China Medical University and we thank you for participating in our research! This study is conducted to collect information to understand the knowledge, attitudes and practice of parents toward the prevention and treatment of dust mite allergy, and aims to provide a basis for the development of scientific intervention strategies for the disease, which may help more people in the future and improve their condition. Your participation in this study is voluntary and this study has been approved by the Ethics Approval Committee. If you agree to participate in this study, please refer to the following instructions and complete the questionnaire patiently by **circling the corresponding symbol**.

1. There are no certain correct or wrong answers, you just need to fill in the questionnaire according to your actual situation, any questions during the answering process can be asked to us, after finishing, please submit it in time.
2. This study is only a simple questionnaire and will not harm your physical or psychological condition, but may involve some privacy questions, such as your gender, age, etc. We will keep your information strictly confidential and will not disclose your information, the results will be derived from the overall statistical analysis of the data and will not involve any personal privacy, please feel free to fill in.
3. As a participant, you can be kept informed of information and research progress related to this study. If you decide to withdraw from the study, please let us know and your data will not be included in the results of this study.

Finally, we sincerely thank you for taking time out of your busy schedule to support our scientific research!

□I have been informed of and agree to the use of the data collected for scientific research.

Participation date: Year Mouth Day

Questionnaire A on the prevention and treatment of dust mite allergy (for patients without desensitization treatment)

I. Please fill in your basic information：

1. Your relationship with your child is？

a. Father

b. Mother

c. Other family member

2. Father's education：

a. Primary school and below

b. Middle school

c. High school/Technical secondary school

d. Bachelor's degree/Junior college

e. Master's degree

f. Doctorate

3. Mother's education：

a. Primary school and below

b. Middle school

c. High school/Technical secondary school

d. Bachelor's degree/Junior college

e. Master's degree

f. Doctorate

4. Annual household income（CNY）：

a. ＜30,000

b. 30,000-50,000
c. 50,000-100,000
d. 100,000-200,000
e. 200,000-300,000
f. ＞300,000

5. Are the parents allergic to dust mites?
a. None
b. Father only
c. Mother only
d. Both allergic to dust mites
e. Haven't followed it, don't know yet

6. You learn about allergies through：
a. Newspaper & Books
b. Radio & TV
c. Web Search
d. Short videos (Tiktok)
e. Doctor's guidance during consultation
f. Never knew about it

II. Please fill in your child's basic information：
1. Name：

2. Age：

3. Gender：

4. Ethnicity：

5. Whether your child is the only-child?
a. Yes
b. No

6. The exercises your children usually enjoy to do (Multiple choice)：
a. Outdoor running and walking
b. Playing basketball
c. Swimming
d. Taekwondo
e. Indoor dancing
f. Cycling
g. Other

7. The floor your child live on：
a. Single-storey house
b. First floor
c. Floor 2-10
d. Floor 10-20
e. Floor 21 and above
f. Top Floor

8. Your child's residence is：
a. Within Shenyang City
b. Rural areas of Shenyang
c. Towns of Shenyang
d. City of Liaoning Province (except Shenyang)
e. Rural areas within Liaoning Province (except Shenyang)
f. Towns within Liaoning Province (except Shenyang)
g. Outside Liaoning Province

9. The transportation to visit a doctor：
a. On foot
b. Bus
c. Metro
d. High-speed Rail
e. Long distance bus
f. Private Car
g. Other

III. Please fill in your child's medical information：

1. The doctor has diagnosed your child with (multiple choice)：
a. Rhinitis
b. Bronchial asthma
c. Cough variant asthma
d. Allergic cough

2. Has your child visits to a paediatric allergist in the past?
a. Yes
b. No

3. Were you aware of your child's dust mite allergy before you brought him/her to the paediatric allergy u
a. Know
b. Don't know
c. Suspected dust mite allergy in child based on him/her symptoms

4. Which season your child's rhinitis is more likely to occur?
a. No rhinitis
b. Spring
c. Summer
d. Autumn
e. Winter
f. All year round

5. What is the duration of your child's rhinitis attack?
a. No rhinitis
b. The duration of symptoms <4 days/week, or <4 consecutive weeks
c. The duration of symptoms ≥4 days/week, or ≥4 consecutive weeks

6. Does your child's rhinitis affect his/her study, cultural & sports activities, and sleep?
a. Without rhinitis
b. Without significant effect
c. Have significant or severe effects

7. Which season your child's asthma is more likely to occur?
a. No asthma
b. Spring
c. Summer
d. Autumn
e. Winter
f. All year round

8. The times of your child's asthma attack in the last six months is:
a. No asthma
b. No acute asthma
c. 1-2 times
d. 3-5 times
e. ≥6 times

IV. Please choose the appropriate options for the following questions (the following are the knowledge dimension)

1. Which of the following species of dust mite can cause an allergic reaction: (assign 0 points for ab, 1 point for c, 0 points for d):
a. House dust mite only
b. Dermatophagoides farinae only
c. Both house dust mite and dermatophagoides farinae

d. Don't know

2. Only live dust mites can act as allergens to causing allergic reactions：（assign 0 points for a, 1 point for b, 0 points for c）
a. Correct
b. Wrong
c. Don't know

3. Which of the following diseases can be caused by dust mite allergy：（assign 0.5 points for abcd, 1 point for e, 0 points for f）
a. Eczema
b. Allergic conjunctivitis
c. Rhinitis d. Asthma
d. All of them
e. Don't know

4. Dust mites in the house mainly breed in bed sheets and bedding, carpets and curtains are not prone to breeding dust mites：（assign 0 points for a, 1 point for b, 0 points for c）
a. Correct
b. Wrong
c. Don't know

5. Plush toys are prone to breeding dust mites：（assign 1 point for a, 0 points for b, 0 points for c）
a.Correct b.Wrong c.Don't know

6. UV light can kill dust mites：（assign 0 points for a, 1 point for b, 0 points for c）
a. Correct
b. Wrong

c. Don't know

7. Freezing the plush toys or pillowcases in the refrigerator overnight can kill dust mites：（assign 1 point for a, 0 points for b, 0 points for c）
a. Correct
b. Wrong
c. Don't know

8. How many degrees hot water for washing bed sheets will be most effective in removing dust mites：（assign 0 points for abc, 1 point for d, 0 points for e）
a. 25℃
b. 35℃
c. 45℃
d. 55℃
e. Don't know

9. Indoor dust mites can be completely eliminated with a good job cleaning：（assign 0 points for a, 1 point for b, 0 points for c）
a. Correct
b. Wrong
c. Don't know

10. There is no cure for a child with dust mite allergy but to keep the house as hygienic as possible to avoid dust mites：（assign 0 points for a, 1 point for b, 0 points for c）
a. Correct
b. Wrong
c. Don't know

11. Dust mite allergy will heal itself as the child grows up：（assign 0 points for a, 1 point for b, 0 points for c）
a. Correct
b. Wrong
c. Don't know

12. Have you heard of or know about desensitization treatment for dust mites?：（assign 0 points for a, 0 point for b, 1 point for c）
a. Haven't heard of it
b. Have heard of it but don’t know the details
c. Understand the process and procedure of it

V. Please choose the appropriate options for the following questions
（the following are the attitude dimension， assign 4 points for a, 3 points for b, 2 points for c, 1 point for d）
13. Your concerns about dust mite infestation and dust mite allergy
13.1 You can't stand dust mites infesting your home：
a. Strongly agree
b. Agree
c. Unsure/Don't know
d. Strongly disagree

13.2 What is your attitude towards the possible health risks of dust mite infestation in children?：
a. Very worried
b. Worried
c. Unsure/Don't know
d. Not worried at all

13.3 Even though you have follow the doctor's advice to reduced your child's exposure to dust mites by mite removal in the house, you are still worried about the dust mite allergy.：

a. Strongly agree

b. Agree

c. Unsure/Don't know

d. Strongly disagree

14. Your attitude to mite removal and desensitization treatment

14.1 Do you think it is necessary to regularly remove mites from your home：

a.Very necessary b.Possibly necessary c.Unsure d.Unnecessary

14.2 If there have a therapy to make your child non-allergic to dust mites, do you think it is necessary to undergo it：

a. Very necessary

b. Possibly necessary

c. Unsure/Don't know

d. Unnecessary

14.3 How much do you think is acceptable to spend for your child on prevention and treatment of dust mite allergy：(CNY)

a. More than 1000 CNY/month；

b. 500-1000 CNY/month；

c. 100-500 CNY/month；

d. Less than 100 CNY/month;

VI. Please choose the appropriate options for the following questions (the following are the practice dimension)

15. Targeted practice

15.1Due to your child's dust mite allergy, have you and your family made a special effort to learn about relevant knowledge (including dust mites. dust mite allergy and desensitization treatment, etc.)（assign 1 point for Yes, 0 points for No）:
a. Yes
b. No

15.2 Does your child use mite-proof bedding such as mite proof pillowcases and bedclothes（assign 1 point for Yes, 0.5 points for intend to purchase, 0 points for a.not intend to purchase）:
a. Yes
b. Previously test showed dust mite allergy but not used
c. Recent test show dust mite allergy and intend to purchase
d. Recent test show dust mite allergy but not intend to purchase

15.3 Your child is currently using a pillow with a content material of (No points for this question):
a. Latex
b. Down
c. Artificial fibre
d. Buckwheat hulls
e. Cotton

15.4 Your child is currently using a bedding with a content material of (No points for this question):
a. Latex
b. Down
c. Cotton
d. Silk
e. Artificial fibre

15.5 Do you use Dust Mite Controller to remove mites in your home（assign 1 point for Yes, 0.5 points for intend to purchase, 0 points for a.not intend to purchase）：
a.Yes
b. Previously test showed dust mite allergy but not used
c. Recent test show dust mite allergy and intend to purchase
d. Recent test show dust mite allergy but not intend to purchase

15.6 Do you use instruments such as dehumidifier/air-conditioning, air cleaner, and etc. to remove mites in your home（assign 1 point for Yes, 0.5 points for intend to purchase, 0 points for a.not intend to purchase）：
a.Yes
b. Previously test showed dust mite allergy but not used
c. Recent test show dust mite allergy and intend to purchase
d. Recent test show dust mite allergy but not intend to purchase

15.7 Do you use the decoration which prone to mites such as carpet in your home（assign 0 points for Yes, 1 point for No, 0 points for Don't know）：
a.Yes
b. No
c. Don't know

15.8 Do you or your family weekly wash your pillowcases and bedclothes（assign 1 point for Yes, 0 points for No, 0 points for Don't know）：
a.Yes
b. No
c. Don't know

15.9 Do you or your family use vacuum cleaner to clean your house every day（assign 1 point for Yes, 0 points for No, 0 points for Don't know）：

a.Yes
b. No
c. Don't know

Questionnaire B

Dear Parents:

Hello!

We are researchers at Shengjing Hospital of China Medical University and we thank you for participating in our research! This study is conducted to collect information to understand the knowledge, attitudes and practice of parents toward the prevention and treatment of dust mite allergy, and aims to provide a basis for the development of scientific intervention strategies for the disease, which may help more people in the future and improve their condition. Your participation in this study is voluntary and this study has been approved by the Ethics Approval Committee. If you agree to participate in this study, please refer to the following instructions and complete the questionnaire patiently by **circling the corresponding symbol**.

1. There are no certain correct or wrong answers, you just need to fill in the questionnaire according to your actual situation, any questions during the answering process can be asked to us, after finishing, please submit it in time.

2. This study is only a simple questionnaire and will not harm your physical or psychological condition, but may involve some privacy questions, such as your gender, age, etc. We will keep your information strictly confidential and will not disclose your information, the results will be derived from the overall statistical analysis of the data and will not involve any personal privacy, please feel free to fill in.

3. As a participant, you can be kept informed of information and research progress related to this study. If you decide to withdraw from the study, please let us know and your data will not be included in the results of this study.

Finally, we sincerely thank you for taking time out of your busy schedule to support our scientific research!

□I have been informed of and agree to the use of the data collected for scientific research.

Participation date: Year Mouth Day

Questionnaire B on the prevention and treatment of dust mite allergy (for patients treated with hypodermic desensitization)

I. Please fill in your basic information：

1. Your relationship with your child is？

a. Father

b. Mother

c. Other family member

2. Father's education：

a. Primary school and below

b. Middle school

c. High school/Technical secondary school

d. Bachelor's degree/Junior college

e. Master's degree

f. Doctorate

3. Mother's education：

a. Primary school and below

b. Middle school

c. High school/Technical secondary school

d. Bachelor's degree/Junior college

e. Master's degree

f. Doctorate

4. Annual household income（CNY）：

a. ＜30,000

b. 30,000-50,000

c. 50,000-100,000

d. 100,000-200,000

e. 200,000-300,000
f. ＞300,000

5. Are the parents allergic to dust mites?
a. None
b. Father only
c. Mother only
d. Both allergic to dust mites
e. Haven't followed it, don't know yet

6. You learn about allergies through：
a. Newspaper & Books
b. Radio & TV
c. Web Search
d. Short videos (Tiktok)
e. Doctor's guidance during consultation
f. Never knew about it

II. Please fill in your child's basic information：

1. Name：

2. Age：

3. Gender：

4. Ethnicity：

6. Whether your child is the only-child?

c. Yes
d. No

6. The exercises your children usually enjoy to do (Multiple choice):
a. Outdoor running and walking
b. Playing basketball
c. Swimming
d. Taekwondo
e. Indoor dancing
f. Cycling
g. Other

7. The floor your child live on:
a. Single-storey house
b. First floor
c. Floor 2-10
d. Floor 10-20
e. Floor 21 and above
f. Top Floor

8. Your child's residence is:
a. Within Shenyang City
b. Rural areas of Shenyang
c. Towns of Shenyang
d. City of Liaoning Province (except Shenyang)
e. Rural areas within Liaoning Province (except Shenyang)
f. Towns within Liaoning Province (except Shenyang)
g. Outside Liaoning Province

10. The transportation to visit a doctor：
h. On foot
i. Bus
j. Metro
k. High-speed Rail
l. Long distance bus
m. Private Car
n. Other

III. Please fill in your child's medical information：

1. The diagnose of your child (multiple choice)：
a. Rhinitis
b. Bronchial asthma
c. Cough variant asthma
d. Allergic cough

2. Were you aware of your child's dust mite allergy before you brought him/her to the paediatric allergy unit?
a. Know
b. Don't know
c. Suspected dust mite allergy in child based on him/her symptoms

3. Which season your child’s rhinitis is more likely to occur?
a. No rhinitis
b. Spring
c. Summer
d. Autumn
e. Winter
f. All year round

4. What is the duration of your child's rhinitis attack?
a. No rhinitis
b. The duration of symptoms <4 days/week, or <4 consecutive weeks
c. The duration of symptoms ≥4 days/week, or ≥4 consecutive weeks

5. Does your child's rhinitis affect his/her study, cultural & sports activities, and sleep?
a. No rhinitis
b. No significant effect
c. Have significant or severe effects

6. Which season your child's asthma is more likely to occur?
a. No asthma
b. Spring
c. Summer
d. Autumn
e. Winter
f. All year round

7. The times of your child's asthma attack in the last six months is：
a. No asthma
b. No acute asthma
c. 1-2 times
d. 3-5 times
e. ≥6 times

8. The time your child has been receiving desensitization treatment is:
a. First medication
b. Within 3 months
c. 3 months to 6 months

d. 6 months to 1 year
e. More than 1 year

9. Your current evaluation for the outcome of desensitization treatment on your child is:
a. First medication
b. Significant improvement (no symptoms or close to normal)
c. Improvement (few or occasional mild symptoms)
d. Remission (fewer symptoms and less frequent recurrences)
e. Effective (all symptoms still present but less frequent recurrences)
f. Ineffective (hardly any improvement and worse symptoms)

10. How long have your child been stopped the use of inhaled or nasal spray hormones after desensitization treatment?
a. Still on medication
b. Within 3 months
c. 3 months to 6 months
d. 6 months to 1 year
e. More than 1 year

11. How many weeks desensitization take your child to complete initial treatment?
a. Initial treatment has not been completed
b. 14 weeks
c. 15-20 weeks
d. 21-28 weeks
e. More than 28 weeks

12.Has your child had any adverse reactions during desensitization treatment?
a. No
b. Yes, but not serious (only redness and swelling at injection site)
c. Experienced a large area urticaria throughout the body

d. Experienced a severe allergic reaction (Difficulty breathing, Shock, and etc.)

13. Frequency of adverse reactions：
a. None
b. 1 - 2 times
c. 3 - 5 times
d. Often
e. Every time

IV. Please choose the appropriate options for the following questions (the following are the knowledge dimension)

1. Which of the following species of dust mite can cause an allergic reaction: (assign 0 points for ab, 1 point for c, 0 points for d):
a. House dust mite only
b. Dermatophagoides farinae only
c. Both house dust mite and dermatophagoides farinae
d. Don't know

2. Only live dust mites can act as allergens to causing allergic reactions：（assign 0 points for a, 1 point for b, 0 points for c）
a. Correct
b. Wrong
c. Don't know

3. Which of the following diseases can be caused by dust mite allergy：（assign 0.5 points for abcd, 1 point for e, 0 points for f）
a. Eczema
b. Allergic conjunctivitis
c. Rhinitis d. Asthma
d. All of them
e. Don't know

4. Dust mites in the house mainly breed in bed sheets and bedding, carpets and curtains are not prone to breeding dust mites：（assign 0 points for a, 1 point for b, 0 points for c）
a. Correct
b. Wrong
c. Don't know

5. Plush toys are prone to breeding dust mites：（assign 1 point for a, 0 points for b, 0 points for c）
a. Correct
b. Wrong
c. Don't know

6. UV light can kill dust mites：（assign 0 points for a, 1 point for b, 0 points for c）
a. Correct
b. Wrong
c. Don't know

7. Freezing the plush toys or pillowcases in the refrigerator overnight can kill dust mites：（assign 1 point for a, 0 points for b, 0 points for c）
a. Correct
b. Wrong
c. Don't know

8. How many degrees hot water for washing bed sheets will be most effective in removing dust mites：（assign 0 points for abc, 1 point for d, 0 points for e）
a. 25℃
b. 35℃
c. 45℃
d. 55℃
e. Don't know

9. Indoor dust mites can be completely eliminated with a good job cleaning：（assign 0 points for a, 1 point for b, 0 points for c）
a. Correct
b. Wrong
c. Don't know

10. The desensitization treatment for dust mite allergy usually takes 3-5 years：（assign 1 point for a, 0 points for b, 0 points for c）
a. Correct
b. Wrong
c. Don't know

11. The medications of nasal spray hormone therapy for rhinitis or nebulised hormone therapy for asthma can be stopped during desensitization treatment：（assign 0 points for a, 1 point for b, 0 points for c）
a. Correct
b. Wrong
c. Don't know

12. There is no need to pay attention to removing and avoiding dust mites during desensitization treatment：（assign 0 points for a, 1 point for b, 0 points for c）
a. Correct
b. Wrong
c. Don't know

13. The desensitization of dust mite can treat rhinitis caused by dust mite allergy, but it can't prevent rhinitis from developing into asthma：（assign 0 points for a, 1 point for b, 0 points for c）
a. Correct
b. Wrong
c. Don't know

14.Those adverse reactions in desensitization treatment that require attention are（Multiple choice）：（assign 0.2 points for each option）

a. Itching of the palms of the hands and feet. Itchy scalp. Flushed skin all over the body. The appearance of urticaria
b. Immediate shock (altered mental state. Cold and clammy skin. Decrease in blood pressure)
c. Difficulty breathing. Rapid breathing. Hoarseness and other symptoms
d. Abdominal pain. Nausea. Vomiting. Urinary incontinence
e. Loss of consciousness. Loss of respiration. Loss of carotid artery pulsation

V. Please choose the appropriate options for the following questions
（the following are the attitude dimension，assign 4 points for a, 3 points for b, 2 points for c, 1 point for d）
15. Your concerns about dust mite infestation and dust mite allergy
15.1 You can't stand dust mites infesting your home：
a. Strongly agree
b. Agree
c. Unsure/Don't know
d. Strongly disagree

15.2 What is your attitude towards the possible health risks of dust mite infestation in children：
a. Very worried
b. Worried
c. Unsure/Don't know
d. Not worried at all

15.3 Even though you have follow the doctor's advice to reduced your child's exposure to dust mites by house dust mites removal, you are still worried about the dust mite allergy.：
a. Strongly agree
b. Agree
c. Unsure/Don't know
d. Strongly disagree

16. Your attitude to mite removal and desensitization treatment

16.1 Do you think it is necessary to regularly remove mites from your home：

e. Very necessary

f. Possibly necessary

g. Unsure/Don't know

h. Unnecessary

16.2 Do you think that desensitization treatment is an effective option for your child's rhinitis/asthma：

a. Yes

b. Probably yes

c. Don't know /Unsure

d. No

16.3 Do you think desensitization treatment needs to be carried out strictly according to medical advice (e.g. follow up consultation on time)：

a. Very needed

b. Needed

c. Don't know

d. Don't need

16.4 If your child has a relatively obvious reaction to the treatment, such as severe redness at the injection site or a rash around the body or even anaphylaxis, will you continue with the Desensitization treatment：

a. Persist

b. May persist, depending on the situation

c. May give up

d. Definitely give up

VI. Please choose the appropriate options for the following questions (the following are the practice dimension)

17. Targeted practice

17.1 Due to your child's dust mite allergy, have you and your family made a special effort to learn about relevant knowledge (including dust mites. dust mite allergy and desensitization treatment, etc.)（assign 1 point for Yes, 0 points for No）:
a. Yes
b. No

17.2Does your child use mite-proof bedding such as mite proof pillowcases and bedclothes（assign 1 point for Yes, 0 points for No, 0 points for Don't know）:
a.Yes
b. No
c. Don't know

17.3 Your child is currently using a pillow with a content material of (No points for this question):
a. Latex
b. Down
c. Artificial fibre
d. Buckwheat hulls
e. Cotton

17.4 Your child is currently using a bedding with a content material of (No points for this question):
a. Latex
b. Down
c. Cotton
d. Silk
e. Artificial fibre

17.5 Do you use dust mite controller to remove mites in your home（assign 1 point for Yes, 0 points for No, 0 points for Don't know）:
a.Yes
b. No
c. Don't know

17.6 Do you use instruments such as dehumidifier/air-conditioning, air cleaner, and etc. to remove mites in your home（assign 1 point for Yes, 0 points for No, 0 points for Don't know）:
a.Yes
b. No
c. Don't know

17.7 Do you use the decoration which prone to mites such as carpet in your home（assign 0 points for Yes, 1 point for No, 0 points for Don't know）:
a.Yes
b. No
c. Don't know

17.8 Do you or your family weekly wash your pillowcases and bedclothes（assign 1 point for Yes, 0 points for No, 0 points for Don't know）:
a.Yes b.No c.Don't know

17.9 Do you or your family use vacuum cleaner to clean your house every day（assign 1 point for Yes, 0 points for No, 0 points for Don't know）:
a.Yes
b. No
c. Don't know

17.10 Has your child had a delay in injections for some reason that caused treatment to be restarted or follow-up injections to be cancelled（assign 1 point for a, 0 points for b, 0 points for c）:
a. Never
b. Once or twice before
c. Frequently postponed

BMJ Open

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Journal:	*BMJ Open*
Manuscript ID	bmjopen-2024-085905.R1
Article Type:	Original research
Date Submitted by the Author:	15-Oct-2024
Complete List of Authors:	Liu, Si; Shengjing Hospital of China Medical University, Department of Pediatrics Zhou, Qianlan; Shengjing Hospital of China Medical University, Department of Pediatrics Dai, Bing; Shengjing Hospital of China Medical University, Department of Pediatrics Chen, Li; Shengjing Hospital of China Medical University, Department of Pediatrics Zhang, Qinzhen; Shengjing Hospital of China Medical University, Department of Pediatrics Han, Lina; Shengjing Hospital of China Medical University, Department of Pediatrics Li, Xiaowen; Shengjing Hospital of China Medical University, Department of Pediatrics Shen, Wenxin; Shengjing Hospital of China Medical University, Department of Pediatrics Shan, Lishen; Shengjing Hospital of China Medical University, Department of Pediatrics
Primary Subject Heading:	Paediatrics
Secondary Subject Heading:	Paediatrics
Keywords:	PAEDIATRICS, Cross-Sectional Studies, Immunity

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Parents' knowledge, attitude, and practice toward the prevention and treatment of dust mite allergy: A cross-sectional study in Shenyang (China)

Running title: KAP of dust mite allergy

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Abstract

Objective: This cross-sectional study aimed to evaluate parents' knowledge, attitudes, and practices (KAP) concerning the prevention and treatment of dust mite allergy in children.

Design: Conducted between September and December 2022, this cross-sectional study involved multiple healthcare facilities, including primary and secondary care settings, ensuring a comprehensive representation of the target population.

Participants: A total of 503 parents of children with dust mite allergies participated, with 253 parents having children undergoing desensitization treatment and 250 parents whose children did not. Selection criteria were carefully defined to include parents directly responsible for the care of children with dust mite allergies.

Primary and secondary outcome measures: Two distinct questionnaires were administered to parents, tailored for those with and without children undergoing desensitization treatment. These questionnaires covered demographic information, allergy diagnosis, treatment details, and KAP related to dust mite allergy. Primary outcomes included parents' scores on knowledge, attitudes, and practices regarding dust mite allergy prevention and treatment. Secondary outcomes involved analyzing the interaction between these factors using pathway analysis.

Results: Parents of children undergoing desensitization treatment exhibited higher scores for all items of knowledge, attitude, and overall practice compared to those without desensitization therapy (all $P<0.05$). The pathway analyses revealed that in the non-desensitization group, knowledge directly affected attitude ($\beta=0.22$, $P<0.001$), and attitude directly affected practice ($\beta=0.16$, $P<0.001$), but the knowledge did not affect practice ($\beta=-0.01$, 0.06, $P<0.001$). In the desensitization group, knowledge directly affected attitude ($\beta=0.13$, $P=0.028$), but the practice was not affected by attitude ($\beta=0.08$, $P<0.001$) or knowledge ($\beta=0.03$, 0.12, $P<0.001$).

Conclusions: The study highlighted differing levels of KAP among parents of children with dust mite allergies. The KAP was influenced by desensitization therapy status. While attitudes tended to be favorable, practices were suboptimal, particularly among parents whose children did not receive desensitization treatment. These findings emphasize the importance of targeted educational interventions to enhance parental awareness and practices regarding dust mite allergy management, especially in cases where desensitization treatment is not pursued. Further research is warranted to explore effective strategies for improving parental engagement and adherence to preventive measures.

Keywords: dust mites, house; dust mite allergy; health knowledge, attitudes, practice; desensitization, immunologic; cross-sectional study.

Strengths and limitations of this study

Based on the provided article, here are the summarized strengths and limitations of the methods section:

Strengths:

1. Use of a Validated Questionnaire: The study used two versions of a questionnaire that were designed by senior experts and pre-tested for reliability (Cronbach's $\alpha > 0.7$ for both versions).

2. Cross-Sectional Design: The study was able to capture a snapshot of the parental knowledge, attitudes, and practices (KAP) across a broad sample, making the results relevant for understanding the current state of parental awareness and behavior.

3. Hypothesis-Driven Analysis: The statistical methods included pathway analysis to explore relationships between KAP dimensions, adding depth to the interpretation of the data.

Limitations:

1. Single-Center Study: The study was conducted at a single hospital, which limits generalizability to other regions or hospitals.

2. Potential Bias in Self-Reported Data: KAP surveys are prone to social desirability bias, where participants may provide responses they believe are expected rather than their true behaviors.

1 INTRODUCTION

House dust mites mainly include *Dermatophagoides pteronyssinus*, *Dermatophagoides farinae*, and *Euroglyphus maynei* [1]. They are non-parasitic microscopic bugs that live on desquamated dead skin cells from humans and pets. They prefer warm and moist environments and are found in bedding, linens, carpets, and furniture [2-4]. Although the mite's exoskeleton can contribute to the allergic reaction, the main allergens are found in the mite's fecal pellets [5, 6]. Each mite produces about 20 pellets daily, each the size and weight of a pollen grain [5, 6]. Therefore, they are easily inhaled and can cause sensitization of the respiratory tract mucosa, leading to epithelial permeability and the movement of the mite's antigens to antigen-presenting dendritic cells [5, 6]. The prevalence of dust mite allergy varies from 11.21% in Northeast China to 40.79% in South China [7]. Dust mite allergy contributes to the development of allergic rhinitis and asthma, affecting 800 million people worldwide [1, 5, 8, 9]. The prevalence of asthma in children in the Third National Health Survey in China was 3.02%, showing a 52.8% increase from 2001 to 2013 [10]. Therefore, dust mites represent a serious public health problem.

The most effective management method for dust mite allergy is allergen avoidance (e.g., frequently washing bedding, removing carpets, room air cleaners, and humidity control) [5, 12-14]. Over-the-counter medications (antihistamines, nasal corticosteroids, leukotriene receptor antagonists, cromolyn sodium, and decongestants) and allergen immunotherapy can also help [5, 12].

Since allergen avoidance involves specific lifestyle habits [5, 12-14], parents' proper knowledge, attitudes, and practice (KAP) toward dust mites are essential to managing the allergic symptoms in their children. KAP surveys are tools that provide quantitative and qualitative data about a specific subject in a specific population [15, 16]. They can be used to identify gaps and design tailored teaching and training activities [15, 16]. It is known that parents who visited an allergist demonstrated higher dust mite KAP [17]. Generally, parents display very high KAP

toward food allergies in their children [18-20], mainly because several of these allergies can be fatal, which is not the case with dust mite allergy. Studies revealed poor parental KAP for allergic rhinitis [21, 22] and poor KAP regarding allergic disorders in general [23], including in parents of asthmatic children [24]. the KAP toward dust mite allergy in the general population in China is mostly unknown. Therefore, even if the children display symptoms of dust mite allergy, many parents will not consult at all or will consult when the symptoms are exacerbated. Some patients testing positive for dust mite allergy will receive desensitization therapy, but many parents will refuse treatments. All parents receive the same information package when their children test positive for dust mite allergy, and the parents are free to consult all sources of information and to ask questions. Nevertheless, differences can be present between those who decide on desensitization therapy and those who refuse. It was hypothesized that differences in KAP could explain, at least in part, the parents' decision.

Therefore, this study aimed to evaluate the KAP of parents toward preventing and treating dust mite allergy and to examine the differences between the parents of children who were treated with desensitization treatment and the parents of children who were not. Parents are the primary actors in house cleaning and management, and evaluating their KAP toward house mite allergy should help design future teaching activities.

2 MATERIALS AND METHODS

2.1 Study design and participants

This cross-sectional study survey was conducted from September to December 2022 at Shengjing Hospital, Affiliated with China Medical University. The participants were the parents of children with dust mite allergies. The study was approved by the Medical Ethics Committee of Shengjing Hospital, Affiliated with China Medical University (approval #2022PS935K). Informed consent was obtained from the participants before completing the

survey. All participants were enrolled at the outpatient clinic of Shengjing Hospital, Affiliated to China Medical University, when their children had an appointment.

The inclusion criteria were 1) parents of children who tested positive for dust mite-specific serum IgE (measured by Phadia ImmunoCAP) and 2) voluntarily completed the questionnaire. The participants were grouped according to whether the children were treated with desensitization treatment or not.

2.2 Questionnaires

The questionnaire was designed by two senior experts in allergy with reference to the literature [17, 25, 26]. The final questionnaire had two versions: one for the parents of children who did not undergo desensitization treatment (Questionnaire A) and one for the parents of children who underwent desensitization treatment (Questionnaire B). Thirty parents were randomly selected to complete the questionnaire to test its reliability. Cronbach's α was 0.726 for Questionnaire A and 0.702 for Questionnaire B.

The questionnaire contained six dimensions: demographic information of the parents, demographic information of the child, diagnosis and treatment information related to dust mite allergy in children, knowledge dimension, attitude dimension, and practice dimension. The specific questions and scoring instructions for both questionnaire versions can be found in the Supplementary Materials. The data were collected by on-site inquiry and questionnaire when the parents visited the hospital.

2.3 Statistical analysis

The continuous variables were expressed as means ± standard deviations (SD) and analyzed using Student's t-test or ANOVA. The categorical data were expressed as n (%) and analyzed using the chi-square test. All statistical analyses were performed using two-sided tests, and P-values <0.05 were considered statistically significant. Pathway analysis was constructed, and the hypotheses were 1) knowledge has direct effects on attitude, 2) attitude has direct effects

on practice, and 3) knowledge has direct effects on practice. Good practice was defined as a score ≥70% of the highest possible score for practice. STATA 17.0 (Stata Corporation, College Station, TX, USA) was used for statistical analysis.

2.4 Patient and public involvement

No patient involved

3 RESULTS

3.1 Characteristics of the participants

All the patients with dust mite allergy who attended the Pediatric Respiratory Clinic of Shengjing Hospital from September to December 2022 were invited to participate, of whom 189 refused to fill in the questionnaire due to concern about privacy, lack of time, or disinterest. A total of 668 people were surveyed, of which 165 questionnaires were invalid and excluded (135 had missing questions, 27 had contradictory options, and three were filled with all the same options). Therefore, 503 valid questionnaires were included in the analyses: 250 from non-desensitized patients and 253 from desensitized patients.

Most participants were women (81.91%), most participants had a bachelor's degree or higher education, and only a small proportion had a history of dust mite allergy. There were more fathers in the desensitization group (25.69% vs. 9.20%, P<0.001), and the mothers' education was higher in the non-desensitization group (P=0.028) (Table 1). There were no differences between the children of the two groups, except for the residence area (P=0.001) and means of transportation to the hospital (P=0.003) (Supplementary Table S1). Compared with the non-desensitization group, the children in the desensitization group had higher proportions of dust mite allergy diagnosis (P=0.009), less rhinitis (P=0.004), and shorter rhinitis attacks (P<0.001) (Supplementary Table S1).

Table 1. Characteristics of the parents, n (%)

	Without desensitization	With desensitization	P
Total	250 (49.70)	253 (50.30)	
Parental relationship			<0.001
Father	23 (9.20)	65 (25.69)	
Mother	223 (89.20)	184 (72.73)	
Other family members	4 (1.60)	4 (1.58)	
Father's education			0.167
Primary school and below	19 (7.60)	13 (5.14)	
Middle school	28 (11.20)	44 (17.39)	
High school/technical secondary school	33 (13.20)	41 (16.21)	
Bachelor's degree/junior college	131 (52.40)	128 (50.59)	
Master's degree	30 (12.00)	20 (7.91)	
Doctorate	9 (3.60)	7 (2.77)	
Mother's education			0.028
Primary school and below	1 (0.40)	3 (1.19)	
Middle school	22 (8.80)	39 (15.42)	
High school/technical secondary school	32 (12.80)	44 (17.39)	
Bachelor's degree/junior college	154 (61.60)	143 (56.52)	
Master's degree	35 (14.00)	21 (8.30)	
Doctorate	6 (2.40)	3 (1.19)	
Annual household income (RMB)			0.379
<30,000	18 (7.20)	24 (9.49)	
30,000-50,000	29 (11.60)	43 (17.00)	
50,000-100,000	76 (30.40)	73 (28.85)	
100,000-200,000	61 (24.40)	61 (24.11)	
200,000-300,000	32 (12.80)	26 (10.28)	
>300,000	34 (13.60)	26 (10.28)	
Are the parents allergic to dust mites?			0.373
None	102 (40.80)	126 (49.80)	
Father only	21 (8.40)	18 (7.11)	
Mother only	24 (9.60)	19 (7.51)	
Both	6 (2.40)	6 (2.37)	
Unclear	97 (38.80)	84 (33.20)	
Ways to learn about allergies [multiple choice]			-
Newspaper & Books	49 (19.60)	19 (7.51)	
Radio & TV	36 (14.40)	21 (8.30)	
Web Search	104 (41.60)	82 (32.41)	
Short videos	76 (30.40)	40 (15.81)	
Doctor's guidance during the consultation	164 (65.60)	228 (90.12)	
Never knew about it	26 (10.40)	8 (3.16)	

3.2 Knowledge, attitudes, and practice

For the items common to the two questionnaires, compared with the non-desensitization group, the desensitization group showed higher correct response rates about dust mites, the complications of dust mite allergies, the source of dust mites, and how to manage dust mite populations (all P<0.05) (Table 2). Both groups showed relatively poor knowledge regarding the group-specific items (Supplementary Table S2).

Table 2. Knowledge dimension, n (%)

	Correct rate		P
	Without desensitization	Desensitization	
Q1. Which of the following species of dust mite can cause an allergic reaction?	148 (59.20)	216 (85.38)	<0.001
Q2. Only live dust mites can act as allergens that cause allergic reactions.	105 (42.00)	119 (47.04)	0.256
Q3. Which of the following diseases can be caused by dust mite allergy?	153 (61.20)	187 (73.91)	<0.001
Q4. Dust mites in the house mainly breed in bed sheets and bedding; carpets and curtains are not prone to breeding dust mites.	171 (68.40)	192 (75.89)	0.061
Q5. Plush toys are prone to breeding dust mites.	226 (90.40)	245 (96.84)	0.003
Q6. UV light can kill dust mites.	68 (27.20)	54 (21.34)	0.126
Q7. Freezing the plush toys or pillowcases in the refrigerator overnight can kill dust mites.	44 (17.60)	68 (26.88)	0.012
Q8. Which temperature of hot water will be the most effective in removing dust mites when washing bed sheets?	127 (50.80)	151 (59.68)	0.045
Q9. Indoor dust mites can be completely eliminated with a good job of cleaning.	185 (74.00)	215 (84.98)	0.002

About half of the participants cannot stand dust mites in their homes. More participants in the desensitization group were very worried about the possible health risks of dust mites in children (P<0.001). More participants in the desensitization group remained worried after following the doctors' advice to decrease dust mites (P=0.016). Most participants in the two groups agree that it is necessary to remove dust mites regularly (P=0.053) (Table 3). The participants in the non-desensitization group are willing to undergo treatments, but cost appears to be a barrier,

while most participants in the desensitization group have a favorable attitude toward treatment (Supplementary Table S3).

Table 3. Attitude dimension, n (%)

	Without desensitization	Desensitization	P
You can't stand dust mites infesting your home.			0.481
Strongly agree	111 (44.40)	122 (48.22)	
Agree	95 (38.00)	98 (38.74)	
Unsure/Don't know	35 (14.00)	28 (11.07)	
Disagree	9 (3.60)	5 (1.98)	
What is your attitude towards the possible health risks of dust mite infestation in children?			0.001
Very worried	137 (54.80)	177 (69.96)	
Worried	92 (36.80)	70 (27.67)	
Unsure/Don't know	20 (8.00)	5 (1.98)	
Not worried at all	1 (0.40)	1 (0.40)	
Even though you have followed the doctor's advice to reduce your child's exposure to dust mites by mite removal in the house, you are			0.016

still worried about the dust mite allergy.			
Strongly agree	101 (40.40)	114 (45.06)	
Agree	105 (42.00)	118 (46.64)	
Unsure/Don't know	39 (15.60)	17 (6.72)	
Strongly disagree	5 (2.00)	4 (1.58)	
Do you think it is necessary to remove mites from your home regularly?			0.053
Very necessary	182 (72.80)	188 (74.31)	
Possibly necessary	55 (22.00)	54 (21.34)	
Unsure	13 (5.20)	6 (2.37)	
Unnecessary	0	5 (1.98)	

Compared with the non-desensitization group, subjects in the desensitization group displayed higher rates of positive behavior regarding all practice items (all P≤0.001), except for the weekly cleaning of bedding and daily vacuuming (P=0.345 and P=0.142) (Table 4). There were no significant differences between the two groups regarding the pillow and bedding materials (Supplementary Table S4).

Table 4. Practice dimension, n (%)

	Positive behavior		P
	Without desensitization	Desensitization	

P1. Due to your child's dust mite allergy, have you and your family made a special effort to learn about relevant knowledge (including dust mites. dust mite allergy and desensitization treatment, etc.)	154 (61.60)	216 (85.38)	<0.001
P2. Does your child use mite-proof bedding such as mite-proof pillowcases and bedclothes	94 (37.60)	105 (41.50)	<0.001
P3. Do you use a dust mite controller to remove mites in your home	162 (64.80)	162 (64.03)	<0.001
P4. Do you use instruments such as dehumidifier/air-conditioning, air cleaner, etc., to remove mites in your home	115 (46.00)	85 (33.60)	<0.001
P5. Do you use decoration prone to mites, such as carpet in your home	20 (8.00)	4 (1.58)	0.001
P6. Do you or your family weekly wash your pillowcases and bedclothes	161 (64.40)	173 (68.38)	0.345
P7. Do you or your family use a vacuum cleaner to clean your house every day	114 (45.60)	99 (39.13)	0.142

3.3 Pathway analysis

The root mean square error of approximation (RMSEA, P<0.001), comparative fit index (CFI, P=1.000), Tucker-Lewis index (TLI, P=1.000), and standardized root mean square residual

(SRMR, P<0.001) all indicated that the model fit was acceptable. In the non-desensitization group, knowledge directly affected attitude (β=0.22, P<0.001), and attitude directly affected practice (β=0.16, P<0.001) (Table 5), but the knowledge did not affect practice (β=-0.01, 0.06, P<0.001). In the desensitization group, knowledge directly affected attitude (β=0.13, P=0.028), but the practice was not affected by attitude (β=0.08, P<0.001) or knowledge (β=0.03, 0.12, P<0.001) (Figure 1).

Table 5. Estimates of hypothesis paths of KAP

	β (95% CI)	P-value
Without desensitization		
K -> A	0.22 (0.10, 0.35)	<0.001
A -> P	0.16 (0.09, 0.22)	<0.001
K -> P	-0.01 (-0.07, 0.06)	0.871
Desensitization		
K -> A	0.13 (0.01, 0.25)	0.028
A -> P	0.08 (-0.01, 0.17)	0.095
K -> P	0.03 (-0.05, 0.12)	0.439

CI: confidence interval; K: knowledge; A: attitude; P: practice.

3.4 Factors influencing practice among parents of children who underwent desensitization treatment

Among parents of children who underwent desensitization treatment, bachelor's degree or above (OR=3.816, 95%CI: 1.483-9.818, P=0.005), suspected dust allergy based on symptoms (OR=4.299, 95%CI: 1.429-12.929, P=0.009), and children having rhinitis (OR=0.352, 95%CI: 0.170-0.272, P=0.005) were associated with the parents' practice (Table 6).

Table 6. The factors influencing good practices (n=44 parents with good practice) among parents of children who have undergone desensitization treatment (n=253)

	Univariate 95%CI	P	Multivariate 95%CI	P
Knowledge	0.966 (0.846-1.102)	0.604		
Attitude	1.16 (0.99-1.36)	0.067		
Parental relationship				
Mother	REF			
Father/ Other family members	0.449 (0.19-1.061)	0.068		
Father's education				
Junior college or below	REF			
Bachelor's degree or above	1.44 (0.721-2.877)	0.302		
Mother's education				
Junior college or below	REF		REF	
Bachelor's degree or above	3.928 (1.589-9.709)	0.003	3.816 (1.483-9.818)	0.005
Annual household income (RMB)				
<100,000	REF			
≥100,000	1.297 (0.676-2.487)	0.434		
Are the parents allergic to dust mites?				
None	REF			
One of the parents/Both	1.83 (0.814-4.112)	0.144		
Unclear	0.639 (0.286-1.428)	0.275		
Learned about allergies				
No	REF			
Yes	0.621 (0.121-3.182)	0.567		
Pre-visit knowledge of child's dust mite allergy				
Unaware	REF		REF	
Aware	1.81 (0.887-3.694)	0.103	1.679 (0.792-3.561)	0.176
Suspected based on symptoms	3.08 (1.118-8.481)	0.03	4.299 (1.429-12.929)	0.009
Child's sex				
Male	REF			

Female	1.111	(0.564-2.187)	0.761			
Child's age	0.855	(0.738-0.992)	0.039	0.895	(0.764-1.049)	0.17
Only child						
Yes	0.552	(0.286-1.065)	0.076			
No	REF					
Child's Diagnosed Conditions:						
Rhinitis	0.432	(0.222-0.841)	0.013	0.352	(0.17-0.727)	0.005
Bronchial Asthma	0.87	(0.428-1.767)	0.699			
Cough-Variant Asthma	0.833	(0.362-1.921)	0.669			
Allergic Cough	1.01	(0.521-1.957)	0.977			

4 DISCUSSION

This study investigated parents' KAP regarding the prevention and treatment of dust mite allergy and examined the differences between the parents of children who were treated with desensitization treatment and those of children who were not. The results showed that the parents of children with dust mite allergy had relatively good KAP regarding dust mites. The parents of children who did not undergo desensitization therapy had poor knowledge, favorable attitudes, and poor practice regarding dust mites, while the parents of children who underwent desensitization therapy had good knowledge, favorable attitudes, and poor practice.

Although dust mite allergy is bothersome for the patients and can evolve into allergic rhinitis and asthma, the condition is not as dangerous as food allergies, probably explaining why the KAP toward food allergies is very high in parents of food-allergic children [18-20] but lower in parents of children with dust mite allergy, as observed in the present study. Indeed, the relatively low KAP observed here is supported by previous studies on allergic rhinitis [21, 22] and allergies in general [23]. Even parents of children with chronic asthma (in whom allergens can be triggers for asthma attacks) have a poor KAP toward allergies [24]. A study covering 29 Chinese

cities showed that the KAP of parents toward allergic rhinitis was low [27]. In the present study, the total KAP scores and knowledge scores were higher in the desensitization group than in the non-desensitization group, as supported by Callahan et al. [17], who reported higher KAP in the parents who met an allergist compared with those who did not (to receive desensitization treatment, all patients must consult an allergist in China). Still, in the present study, the non-desensitization group included parents of children newly diagnosed with dust mite allergy and parents of children with known dust mite allergy who did not receive or did not yet receive desensitization treatment. The attitude scores were relatively high in both groups, but the practice scores were low. These results indicate that although the willingness to take measures against house dust mites to improve their child's health was high, the actual application of these measures was low. Indeed, for example, vacuuming each day is time-consuming, boring, and bothersome. The same goes for changing and laundering sheets more often. Since house dust mite allergy is not a serious condition, many parents do not feel the need to perform all those tasks.

This study showed significantly better scores for several knowledge areas, such as the dust mite species causing allergies, the diseases that can be due to dust mite allergies, the objects in which dust mites are more likely to thrive, methods to eliminate dust mites, and whether cleaning can completely eliminate dust mites. It is probable that the parents who opted for desensitization therapy in their children obtained more information from the physicians or other sources when discussing the treatment options or by themselves to understand better what they were getting into. Indeed, a study showed that the parents of children with life-threatening illnesses were actively seeking information about the illness [28]; although dust mite allergy is far from being life-threatening, a similar protective behavior could be involved. Furthermore, parents of children with allergies are actively seeking information from different sources [29]. Desensitization therapy is relatively expensive, and parents might fear some adverse effects on

their children, encouraging them to take more information. Compared with the non-desensitization group, the parents in the desensitization group also reported a more worried attitude toward the possible health risks related to dust mites in their children and more worries toward dust mites despite active measures taken to decrease them. These worries could come from a better knowledge of the diseases and complications related to dust mite allergies. Regarding the practice items, compared with the non-sensitization group, the parents in the desensitization group declared more efforts being taken to gain knowledge about dust mites (which could relate to the knowledge scores), as previously suggested [29] and reported a higher use of mite-proof bedding and pillowcase and a lower use of dust mite-prone decoration, which could be related to a better knowledge of the sources of dust mites. Still, both groups reported poor practice regarding washing bedding weekly and vacuuming every day. In the desensitization group and higher education, suspected dust mite allergy based on symptoms (suggesting a higher knowledge of dust allergy) were independently and positively associated with the practice. On the other hand, rhinitis was independently and negatively associated with practice.

The pathway analysis showed different patterns of association among the KAP dimensions between the non-desensitization and desensitization groups. Indeed, in the non-desensitization group, knowledge affected attitude, which in turn affected practice, while in the desensitization group, only knowledge affected attitude. It may be because the parents in the desensitization group had already taken action to address their children's condition. Still, these differences should be investigated more in-depth to tailor future interventions to the specific target populations. In addition, pathway analyses are only statistical surrogates for causality [30, 31], and the results should be confirmed.

In the present study, it was hypothesized that differences in KAP could explain, at least in part, the parents' decision for desensitization therapy for children with dust mite allergy. The results

support the hypothesis and may provide ideas and directions to guide and educate the parents in the clinic. Nevertheless, although the parents of children receiving desensitization treatment had a higher KAP, there were still many gaps in knowledge, suggesting that we should strengthen the education and management of these patients in addition to drug desensitization treatment. The present study provides insights for designing teaching brochures, videos, podcasts, or activities to increase the KAP of parents toward dust mites. In particular, the knowledge about the dust mites themselves and the methods to kill them was poor. The practice of minimizing the living habitats of dust mites and using actual means to get rid of them should be emphasized. An intervention based on the results of the present study is being developed and will be investigated in a future study.

This study had limitations. It was performed at a single center, and the sample size is relatively small. In addition, because the two subpopulations of participants (i.e., with children with or without desensitization treatments) had two different KAP questionnaires, a direct comparison of the KAP scores was not possible between the two groups. Furthermore, as for all KAP surveys, the data represent the situation of a specific population at a specific point in time [15, 16]. In addition, KAP surveys are subject to a social acceptability bias, i.e., the participants can be tempted to answer what they should do instead of what they really do [15, 16]. Nevertheless, the present study might provide a comparator point to evaluate the KAP in a similar population after an intervention to increase health literacy on house dust mites.

5 CONCLUSIONS

In conclusion, the parents who did not decide on desensitization therapy for their children had poor knowledge, favorable attitudes, and poor practices regarding dust mites. On the other hand, the parents of children who underwent desensitization therapy had good knowledge, favorable attitudes, and poor practices. The poor practice scores highlight the need to emphasize the

importance of dust mite control for the children's health. There is a need to educate the general population about the importance of controlling house dust mites.

List of abbreviations

KAP: knowledge, attitudes, and practices

SD: standard deviations

Declarations

Ethics approval and consent to participate

The research was carried out in accordance with the Declaration of Helsinki. The study was approved by the Medical Ethics Committee of Shengjing Hospital, Affiliated with China Medical University (approval #2022PS935K). Informed consent by electronic questionnaire was obtained from the participants before completing the survey.

Consent for publication

Not applicable.

Data Availability Statement

All data generated or analyzed during this study are included in this published article [and its supplementary information files].

Conflict of Interest

The authors declare that the research was conducted in the absence of any commercial or financial relationships that could be construed as a potential conflict of interest.

Funding

This work was supported by the Basic Scientific Research Project of Colleges and Universities of Liaoning Province (Key Program, No. LJKZ0746) and the Basic Scientific Research Project of Colleges and Universities of Liaoning Province (General Program, No. LJKZ0746).

Authors' contributions

Conceptualization, Si Liu and Qianlan Zhou; Methodology, Bing Dai; Software, Li Chen; Validation, Qinzhen Zhang; Formal Analysis, Lina Han; Investigation, Xiaowen Li; Resources,

Wenxin Shen; Data Curation, Si Liu; Writing – Original Draft Preparation, Si Liu; Writing – Review & Editing, Qianlan Zhou; Visualization, Qianlan Zhou; Supervision, Lishen Shan; Project Administration, Lishen Shan; Funding Acquisition, Lishen Shan. Guarantor is Lishen Shan.

Acknowledgments

Not applicable.

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Figure Legends

Figure 1. Pathway analysis. (A) Without desensitization. (B) With desensitization.

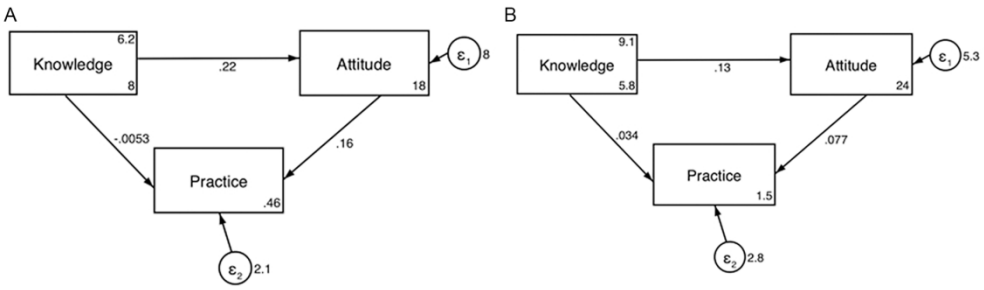

Figure 1. Pathway analysis. (A) Without desensitization. (B) With desensitization.

170x51mm (300 x 300 DPI)

Supplementary Table S1. Medical characteristics of the children, n (%)

	Without desensitization (n=250)	Desensitization (n=253)	P
Gender			0.304
Male	153 (61.20)	166 (65.61)	
Female	97 (38.80)	87 (34.39)	
Age, mean±SD	6.37±3.13	8.80±2.36	-
Ethnicity			0.934
the Han nationality	180 (72.00)	183 (72.33)	
Minorities	70 (28.00)	70 (27.67)	
Yes	147 (58.80)	-	
No	103 (41.20)	-	
Knowing your child's dust mite allergy before going to the doctor			0.009
Know	58 (23.20)	79 (31.23)	
Don't know	150 (60.00)	152 (60.08)	
Suspected dust mite allergy in the child based on him/her symptoms	42 (16.80)	22 (8.70)	
Season when rhinitis is more likely to occur			0.004
Without rhinitis	68 (27.20)	33 (13.04)	
Spring	27 (10.80)	41 (16.21)	
Summer	10 (4.00)	12 (4.74)	
Autumn	66 (26.40)	72 (28.46)	

Winter	24 (9.60)	26 (10.28)	
All year round	55 (22.00)	69 (27.27)	
Duration of rhinitis attack			<0.001
Without rhinitis	77 (30.80)	40 (15.81)	
The duration of symptoms <4 days/week, or <4 consecutive weeks	89 (35.60)	121 (47.83)	
The duration of symptoms ≥4 days/week, or ≥4 consecutive weeks	84 (33.60)	92 (36.36)	
Frequency of desensitization treatments			-
First medication	-	16 (6.32)	
Within 3 months	-	49 (19.37)	
3 months to 6 months	-	22 (8.70)	
6 months to 1 year	-	38 (15.02)	
More than 1 year	-	128 (50.59)	
Outcome of desensitization treatment			-
First medication	-	27 (10.67)	
Significant improvement (no symptoms or close to normal)	-	61 (24.11)	
Improvement (few or occasional mild symptoms)	-	70 (27.67)	
Remission (fewer symptoms and less frequent recurrences)	-	55 (21.74)	
Effective (all symptoms still present but less frequent recurrences)	-	34 (13.44)	
Ineffective (hardly any improvement	-	6 (2.37)	

and worse symptoms)			
Time for desensitization to complete initial treatment			-
Initial treatment has not been completed	-	71 (28.06)	
14 weeks	-	95 (37.55)	
15-20 weeks	-	45 (17.79)	
21-28 weeks	-	10 (3.95)	
More than 28 weeks	-	32 (12.65)	
Adverse reactions during desensitization treatment			-
No	-	98 (38.74)	
Only redness and swelling at the injection site	-	146 (57.71)	
Large area urticaria throughout the body	-	6 (2.37)	
Severe allergic reaction (difficulty breathing, shock, etc.)	-	3 (1.19)	
Frequency of adverse reactions during desensitization			-
None	-	105 (41.50)	
1 - 2 times	-	64 (25.30)	
3 - 5 times	-	34 (13.44)	
Often	-	35 (13.83)	
Every time	-	15 (5.93)	

Supplementary Table S2. The distribution of the remaining problems in the knowledge dimension, n (%)

Questionnaire A Without desensitization treatment	Correct	Wrong	Don't know
Q10. There is no cure for a child with dust mite allergy, but keep the house as hygienic as possible to avoid dust mites	43 (17.20)	139 (55.60)	68 (27.20)
Q11. Dust mite allergy will heal itself as the child grows up	39 (15.60)	119 (47.60)	92 (36.80)
	Haven't heard of it	Have heard of it but don't know the details	Understand the process and procedure of it
Q12. Have you heard of or know about desensitization treatment for dust mites?	91 (36.40)	126 (50.40)	33 (13.20)
Questionnaire B Desensitization treatment			
Q10. The desensitization treatment for dust mite allergy usually takes 3-5 years	231 (91.30)	4 (1.58)	18 (7.11)

Q11. The medications of nasal spray hormone therapy for rhinitis or nebulized hormone therapy for asthma can be stopped during desensitization treatment	78 (30.83)	116 (45.85)	59 (23.32)
Q12. There is no need to pay attention to removing and avoiding dust mites during desensitization treatment	9 (3.56)	231 (91.30)	13 (5.14)
Q13. The desensitization of dust mites can treat rhinitis caused by dust mite allergy, but it can't prevent rhinitis from developing into asthma	65 (25.69)	104 (41.10)	84 (33.20)
	Itching of the palms of the hands and feet. Itchy scalp. Flushed skin all over the body. The appearance of urticaria	Immediate shock (altered mental state. Cold and clammy skin. Decrease in blood pressure)	Difficulty breathing. Rapid breathing. Hoarseness and other symptoms

Q14. Those adverse reactions in desensitization treatment that require attention are (Multiple choice)	212 (83.79)	146 (57.70)	195 (77.08)

Supplementary Table S3. The distribution of the remaining questions in the attitude dimension, n (%)

Questionnaire A Without desensitization treatment	Very necessary	Possibly necessary	Unsure	Unnecessary
Q14.2. If there have a therapy to make your child non-allergic to dust mites, do you think it is necessary to undergo it	159 (63.60)	71 (28.40)	19 (7.60)	1 (0.40)
	More than 1000 CNY/month	500-1000 CNY/month	100-500 CNY/month	Less than 100 CNY/month
Q14.3. How much do you think is acceptable to spend for your child on the prevention and treatment of dust mite allergy (RMB)	47 (18.80)	81 (32.40)	82 (32.80)	40 (16.00)
Questionnaire B Desensitization treatment	Yes	Probably	Don't know/Unsure	No
Q16.2. Do you think that desensitization treatment is an effective option for	211 (83.40)	31 (12.25)	10 (3.95)	1 (0.40)

your child's rhinitis/asthma				
	Very needed	Needed	Don't know	Don't need
Q16.3. Do you think desensitization treatment needs to be carried out strictly according to medical advice (e.g., Follow up consultation on time)	217 (85.77)	36 (14.23)	0	0
	Persist	May persist depending on the situation	May give up	Definitely give up
Q16.4. If your child has a relatively obvious reaction to the treatment, such as severe redness at the injection site or a rash around the body, or even anaphylaxis, will you continue with the Desensitization treatment	108 (2.69)	123 (8.62)	18 (7.11)	4 (1.58)

Supplementary Table S4. Material of the bedding items, n (%)

	Without desensitization	Desensitization	P
Your child is currently using a pillow with the content material of			0.700
Latex	123 (49.20)	122 (48.22)	
Down	1 (0.40)	1 (0.40)	
Artificial fiber	24 (9.60)	30 (11.86)	
Buckwheat hulls	75 (30.00)	82 (32.41)	
Cotton	17 (6.80)	10 (3.95)	
Other	10 (4.00)	8 (3.16)	
Your child is currently using bedding with the content material of			0.830
Latex	5 (2.00)	5 (1.98)	
Down	9 (3.60)	10 (3.95)	

Artificial fiber	39 (15.60)	38 (15.02)
Silk	138 (55.20)	135 (53.36)
Cotton	50 (20.00)	60 (23.72)
Other	9 (3.60)	5 (1.98)

Questionnaire A

Dear Parents:

Hello!

We are researchers at Shengjing Hospital of China Medical University and we thank you for participating in our research! This study is conducted to collect information to understand the knowledge, attitudes and practice of parents toward the prevention and treatment of dust mite allergy, and aims to provide a basis for the development of scientific intervention strategies for the disease, which may help more people in the future and improve their condition. Your participation in this study is voluntary and this study has been approved by the Ethics Approval Committee. If you agree to participate in this study, please refer to the following instructions and complete the questionnaire patiently by **circling the corresponding symbol**.

1. There are no certain correct or wrong answers, you just need to fill in the questionnaire according to your actual situation, any questions during the answering process can be asked to us, after finishing, please submit it in time.
2. This study is only a simple questionnaire and will not harm your physical or psychological condition, but may involve some privacy questions, such as your gender, age, etc. We will keep your information strictly confidential and will not disclose your information, the results will be derived from the overall statistical analysis of the data and will not involve any personal privacy, please feel free to fill in.
3. As a participant, you can be kept informed of information and research progress related to this study. If you decide to withdraw from the study, please let us know and your data will not be included in the results of this study.

Finally, we sincerely thank you for taking time out of your busy schedule to support our scientific research!

□I have been informed of and agree to the use of the data collected for scientific research.

Participation date: Year Mouth Day

Questionnaire A on the prevention and treatment of dust mite allergy (for patients without desensitization treatment)

I. Please fill in your basic information：

1. Your relationship with your child is？

a. Father

b. Mother

c. Other family member

2. Father's education：

a. Primary school and below

b. Middle school

c. High school/Technical secondary school

d. Bachelor's degree/Junior college

e. Master's degree

f. Doctorate

3. Mother's education：

a. Primary school and below

b. Middle school

c. High school/Technical secondary school

d. Bachelor's degree/Junior college

e. Master's degree

f. Doctorate

4. Annual household income（CNY）：

a. ＜30,000

b. 30,000-50,000
c. 50,000-100,000
d. 100,000-200,000
e. 200,000-300,000
f. ＞300,000

5. Are the parents allergic to dust mites?
a. None
b. Father only
c. Mother only
d. Both allergic to dust mites
e. Haven't followed it, don't know yet

6. You learn about allergies through：
a. Newspaper & Books
b. Radio & TV
c. Web Search
d. Short videos (Tiktok)
e. Doctor's guidance during consultation
f. Never knew about it

II. Please fill in your child's basic information：
1. Name：

2. Age：

3. Gender：

4. Ethnicity：

5. Whether your child is the only-child?
a. Yes
b. No

6. The exercises your children usually enjoy to do (Multiple choice)：
a. Outdoor running and walking
b. Playing basketball
c. Swimming
d. Taekwondo
e. Indoor dancing
f. Cycling
g. Other

7. The floor your child live on：
a. Single-storey house
b. First floor
c. Floor 2-10
d. Floor 10-20
e. Floor 21 and above
f. Top Floor

8. Your child's residence is：
a. Within Shenyang City
b. Rural areas of Shenyang
c. Towns of Shenyang
d. City of Liaoning Province (except Shenyang)
e. Rural areas within Liaoning Province (except Shenyang)
f. Towns within Liaoning Province (except Shenyang)
g. Outside Liaoning Province

9. The transportation to visit a doctor：
a. On foot
b. Bus
c. Metro
d. High-speed Rail
e. Long distance bus
f. Private Car
g. Other

III. Please fill in your child's medical information：
1. The doctor has diagnosed your child with (multiple choice)：
a. Rhinitis
b. Bronchial asthma
c. Cough variant asthma
d. Allergic cough

2. Has your child visits to a paediatric allergist in the past?
a. Yes
b. No

3. Were you aware of your child's dust mite allergy before you brought him/her to the paediatric allergy u
a. Know
b. Don't know
c. Suspected dust mite allergy in child based on him/her symptoms

4. Which season your child's rhinitis is more likely to occur?
a. No rhinitis
b. Spring
c. Summer
d. Autumn
e. Winter
f. All year round

5. What is the duration of your child's rhinitis attack?
a. No rhinitis
b. The duration of symptoms <4 days/week, or <4 consecutive weeks
c. The duration of symptoms ≥4 days/week, or ≥4 consecutive weeks

6. Does your child's rhinitis affect his/her study, cultural & sports activities, and sleep?
a. Without rhinitis
b. Without significant effect
c. Have significant or severe effects

7. Which season your child's asthma is more likely to occur?
a. No asthma
b. Spring
c. Summer
d. Autumn
e. Winter
f. All year round

8. The times of your child's asthma attack in the last six months is:
a. No asthma
b. No acute asthma
c. 1-2 times
d. 3-5 times
e. ≥6 times

IV. Please choose the appropriate options for the following questions (the following are the knowledge dimension)

1. Which of the following species of dust mite can cause an allergic reaction: (assign 0 points for ab, 1 point for c, 0 points for d):
a. House dust mite only
b. Dermatophagoides farinae only
c. Both house dust mite and dermatophagoides farinae

d. Don't know

2. Only live dust mites can act as allergens to causing allergic reactions：（assign 0 points for a, 1 point for b, 0 points for c）
a. Correct
b. Wrong
c. Don't know

3. Which of the following diseases can be caused by dust mite allergy：（assign 0.5 points for abcd, 1 point for e, 0 points for f）
a. Eczema
b. Allergic conjunctivitis
c. Rhinitis d. Asthma
d. All of them
e. Don't know

4. Dust mites in the house mainly breed in bed sheets and bedding, carpets and curtains are not prone to breeding dust mites：（assign 0 points for a, 1 point for b, 0 points for c）
a. Correct
b. Wrong
c. Don't know

5. Plush toys are prone to breeding dust mites：（assign 1 point for a, 0 points for b, 0 points for c）
a.Correct b.Wrong c.Don't know

6. UV light can kill dust mites：（assign 0 points for a, 1 point for b, 0 points for c）
a. Correct
b. Wrong

c. Don't know

7. Freezing the plush toys or pillowcases in the refrigerator overnight can kill dust mites：（assign 1 point for a, 0 points for b, 0 points for c）
a. Correct
b. Wrong
c. Don't know

8. How many degrees hot water for washing bed sheets will be most effective in removing dust mites：（assign 0 points for abc, 1 point for d, 0 points for e）
a. 25℃
b. 35℃
c. 45℃
d. 55℃
e. Don't know

9. Indoor dust mites can be completely eliminated with a good job cleaning：（assign 0 points for a, 1 point for b, 0 points for c）
a. Correct
b. Wrong
c. Don't know

10. There is no cure for a child with dust mite allergy but to keep the house as hygienic as possible to avoid dust mites：（assign 0 points for a, 1 point for b, 0 points for c）
a. Correct
b. Wrong
c. Don't know

11. Dust mite allergy will heal itself as the child grows up：（assign 0 points for a, 1 point for b, 0 points for c）
a. Correct
b. Wrong
c. Don't know

12. Have you heard of or know about desensitization treatment for dust mites?：（assign 0 points for a, 0 points for b, 1 point for c）
a. Haven't heard of it
b. Have heard of it but don’t know the details
c. Understand the process and procedure of it

V. Please choose the appropriate options for the following questions
（the following are the attitude dimension， assign 4 points for a, 3 points for b, 2 points for c, 1 point for d）
13. Your concerns about dust mite infestation and dust mite allergy
13.1 You can't stand dust mites infesting your home：
a. Strongly agree
b. Agree
c. Unsure/Don't know
d. Strongly disagree

13.2 What is your attitude towards the possible health risks of dust mite infestation in children?：
a. Very worried
b. Worried
c. Unsure/Don't know
d. Not worried at all

13.3 Even though you have follow the doctor's advice to reduced your child's exposure to dust mites by mite removal in the house, you are still worried about the dust mite allergy.：

a. Strongly agree

b. Agree

c. Unsure/Don't know

d. Strongly disagree

14. Your attitude to mite removal and desensitization treatment

14.1 Do you think it is necessary to regularly remove mites from your home：

a.Very necessary b.Possibly necessary c.Unsure d.Unnecessary

14.2 If there have a therapy to make your child non-allergic to dust mites, do you think it is necessary to undergo it：

a. Very necessary

b. Possibly necessary

c. Unsure/Don't know

d. Unnecessary

14.3 How much do you think is acceptable to spend for your child on prevention and treatment of dust mite allergy：(CNY)

a. More than 1000 CNY/month；

b. 500-1000 CNY/month；

c. 100-500 CNY/month；

d. Less than 100 CNY/month;

VI. Please choose the appropriate options for the following questions (the following are the practice dimension)

15. Targeted practice

15.1Due to your child's dust mite allergy, have you and your family made a special effort to learn about relevant knowledge (including dust mites. dust mite allergy and desensitization treatment, etc.)（assign 1 point for Yes, 0 points for No）:
a. Yes
b. No

15.2 Does your child use mite-proof bedding such as mite proof pillowcases and bedclothes（assign 1 point for Yes, 0.5 points for intend to purchase, 0 points for a.not intend to purchase）:
a. Yes
b. Previously test showed dust mite allergy but not used
c. Recent test show dust mite allergy and intend to purchase
d. Recent test show dust mite allergy but not intend to purchase

15.3 Your child is currently using a pillow with a content material of (No points for this question):
a. Latex
b. Down
c. Artificial fibre
d. Buckwheat hulls
e. Cotton

15.4 Your child is currently using a bedding with a content material of (No points for this question):
a. Latex
b. Down
c. Cotton
d. Silk
e. Artificial fibre

15.5 Do you use Dust Mite Controller to remove mites in your home（assign 1 point for Yes, 0.5 points for intend to purchase, 0 points for a.not intend to purchase）:
a.Yes
b. Previously test showed dust mite allergy but not used
c. Recent test show dust mite allergy and intend to purchase
d. Recent test show dust mite allergy but not intend to purchase

15.6 Do you use instruments such as dehumidifier/air-conditioning, air cleaner, and etc. to remove mites in your home（assign 1 point for Yes, 0.5 points for intend to purchase, 0 points for a.not intend to purchase）:
a.Yes
b. Previously test showed dust mite allergy but not used
c. Recent test show dust mite allergy and intend to purchase
d. Recent test show dust mite allergy but not intend to purchase

15.7 Do you use the decoration which prone to mites such as carpet in your home（assign 0 points for Yes, 1 point for No, 0 points for Don't know）:
a.Yes
b. No
c. Don't know

15.8 Do you or your family weekly wash your pillowcases and bedclothes（assign 1 point for Yes, 0 points for No, 0 points for Don't know）:
a.Yes
b. No
c. Don't know

15.9 Do you or your family use vacuum cleaner to clean your house every day（assign 1 point for Yes, 0 points for No, 0 points for Don't know）:

a.Yes
b. No
c. Don't know

Questionnaire B

Dear Parents:

Hello!

We are researchers at Shengjing Hospital of China Medical University and we thank you for participating in our research! This study is conducted to collect information to understand the knowledge, attitudes and practice of parents toward the prevention and treatment of dust mite allergy, and aims to provide a basis for the development of scientific intervention strategies for the disease, which may help more people in the future and improve their condition. Your participation in this study is voluntary and this study has been approved by the Ethics Approval Committee. If you agree to participate in this study, please refer to the following instructions and complete the questionnaire patiently by **circling the corresponding symbol**.

1. There are no certain correct or wrong answers, you just need to fill in the questionnaire according to your actual situation, any questions during the answering process can be asked to us, after finishing, please submit it in time.

2. This study is only a simple questionnaire and will not harm your physical or psychological condition, but may involve some privacy questions, such as your gender, age, etc. We will keep your information strictly confidential and will not disclose your information, the results will be derived from the overall statistical analysis of the data and will not involve any personal privacy, please feel free to fill in.

3. As a participant, you can be kept informed of information and research progress related to this study. If you decide to withdraw from the study, please let us know and your data will not be included in the results of this study.

Finally, we sincerely thank you for taking time out of your busy schedule to support our scientific research!

□I have been informed of and agree to the use of the data collected for scientific research.

Participation date: Year Mouth Day

Questionnaire B on the prevention and treatment of dust mite allergy (for patients treated with hypodermic desensitization)

I. Please fill in your basic information：

1. Your relationship with your child is？

a. Father

b. Mother

c. Other family member

2. Father's education：

a. Primary school and below

b. Middle school

c. High school/Technical secondary school

d. Bachelor's degree/Junior college

e. Master's degree

f. Doctorate

3. Mother's education：

a. Primary school and below

b. Middle school

c. High school/Technical secondary school

d. Bachelor's degree/Junior college

e. Master's degree

f. Doctorate

4. Annual household income（CNY）：

a. ＜30,000

b. 30,000-50,000

c. 50,000-100,000

d. 100,000-200,000

e. 200,000-300,000
f. ＞300,000

5. Are the parents allergic to dust mites?
a. None
b. Father only
c. Mother only
d. Both allergic to dust mites
e. Haven't followed it, don't know yet

6. You learn about allergies through：
a. Newspaper & Books
b. Radio & TV
c. Web Search
d. Short videos (Tiktok)
e. Doctor's guidance during consultation
f. Never knew about it

II. Please fill in your child's basic information：

1. Name：

2. Age：

3. Gender：

4. Ethnicity：

6. Whether your child is the only-child?

c. Yes
d. No

6. The exercises your children usually enjoy to do (Multiple choice):
a. Outdoor running and walking
b. Playing basketball
c. Swimming
d. Taekwondo
e. Indoor dancing
f. Cycling
g. Other

7. The floor your child live on:
a. Single-storey house
b. First floor
c. Floor 2-10
d. Floor 10-20
e. Floor 21 and above
f. Top Floor

8. Your child's residence is:
a. Within Shenyang City
b. Rural areas of Shenyang
c. Towns of Shenyang
d. City of Liaoning Province (except Shenyang)
e. Rural areas within Liaoning Province (except Shenyang)
f. Towns within Liaoning Province (except Shenyang)
g. Outside Liaoning Province

10. The transportation to visit a doctor：
h. On foot
i. Bus
j. Metro
k. High-speed Rail
l. Long distance bus
m. Private Car
n. Other

III. Please fill in your child's medical information：

1. The diagnose of your child (multiple choice)：
a. Rhinitis
b. Bronchial asthma
c. Cough variant asthma
d. Allergic cough

2. Were you aware of your child's dust mite allergy before you brought him/her to the paediatric allergy unit?
a. Know
b. Don't know
c. Suspected dust mite allergy in child based on him/her symptoms

3. Which season your child's rhinitis is more likely to occur?
a. No rhinitis
b. Spring
c. Summer
d. Autumn
e. Winter
f. All year round

4. What is the duration of your child's rhinitis attack?
a. No rhinitis
b. The duration of symptoms <4 days/week, or <4 consecutive weeks
c. The duration of symptoms ≥4 days/week, or ≥4 consecutive weeks

5. Does your child's rhinitis affect his/her study, cultural & sports activities, and sleep?
a. No rhinitis
b. No significant effect
c. Have significant or severe effects

6. Which season your child's asthma is more likely to occur?
a. No asthma
b. Spring
c. Summer
d. Autumn
e. Winter
f. All year round

7. The times of your child's asthma attack in the last six months is:
a. No asthma
b. No acute asthma
c. 1-2 times
d. 3-5 times
e. ≥6 times

8. The time your child has been receiving desensitization treatment is:
a. First medication
b. Within 3 months
c. 3 months to 6 months

d. 6 months to 1 year
e. More than 1 year

9. Your current evaluation for the outcome of desensitization treatment on your child is:
a. First medication
b. Significant improvement (no symptoms or close to normal)
c. Improvement (few or occasional mild symptoms)
d. Remission (fewer symptoms and less frequent recurrences)
e. Effective (all symptoms still present but less frequent recurrences)
f. Ineffective (hardly any improvement and worse symptoms)

10. How long have your child been stopped the use of inhaled or nasal spray hormones after desensitization treatment?
a. Still on medication
b. Within 3 months
c. 3 months to 6 months
d. 6 months to 1 year
e. More than 1 year

11. How many weeks desensitization take your child to complete initial treatment?
a. Initial treatment has not been completed
b. 14 weeks
c. 15-20 weeks
d. 21-28 weeks
e. More than 28 weeks

12.Has your child had any adverse reactions during desensitization treatment?
a. No
b. Yes, but not serious (only redness and swelling at injection site)
c. Experienced a large area urticaria throughout the body

d. Experienced a severe allergic reaction (Difficulty breathing, Shock, and etc.)

13. Frequency of adverse reactions：
a. None
b. 1 - 2 times
c. 3 - 5 times
d. Often
e. Every time

IV. Please choose the appropriate options for the following questions (the following are the knowledge dimension)
1. Which of the following species of dust mite can cause an allergic reaction: (assign 0 points for ab, 1 point for c, 0 points for d):
a. House dust mite only
b. Dermatophagoides farinae only
c. Both house dust mite and dermatophagoides farinae
d. Don't know

2. Only live dust mites can act as allergens to causing allergic reactions：（assign 0 points for a, 1 point for b, 0 points for c）
a. Correct
b. Wrong
c. Don't know

3. Which of the following diseases can be caused by dust mite allergy：（assign 0.5 points for abcd, 1 point for e, 0 points for f）
a. Eczema
b. Allergic conjunctivitis
c. Rhinitis d. Asthma
d. All of them
e. Don't know

4. Dust mites in the house mainly breed in bed sheets and bedding, carpets and curtains are not prone to breeding dust mites：（assign 0 points for a, 1 point for b, 0 points for c）
a. Correct
b. Wrong
c. Don't know

5. Plush toys are prone to breeding dust mites：（assign 1 point for a, 0 points for b, 0 points for c）
a. Correct
b. Wrong
c. Don't know

6. UV light can kill dust mites：（assign 0 points for a, 1 point for b, 0 points for c）
a. Correct
b. Wrong
c. Don't know

7. Freezing the plush toys or pillowcases in the refrigerator overnight can kill dust mites：（assign 1 point for a, 0 points for b, 0 points for c）
a. Correct
b. Wrong
c. Don't know

8. How many degrees hot water for washing bed sheets will be most effective in removing dust mites：（assign 0 points for abc, 1 point for d, 0 points for e）
a. 25℃
b. 35℃
c. 45℃
d. 55℃
e. Don't know

9. Indoor dust mites can be completely eliminated with a good job cleaning：（assign 0 points for a, 1 point for b, 0 points for c）
a. Correct
b. Wrong
c. Don't know

10. The desensitization treatment for dust mite allergy usually takes 3-5 years：（assign 1 point for a, 0 points for b, 0 points for c）
a. Correct
b. Wrong
c. Don't know

11. The medications of nasal spray hormone therapy for rhinitis or nebulised hormone therapy for asthma can be stopped during desensitization treatment：（assign 0 points for a, 1 point for b, 0 points for c）
a. Correct
b. Wrong
c. Don't know

12. There is no need to pay attention to removing and avoiding dust mites during desensitization treatment：（assign 0 points for a, 1 point for b, 0 points for c）
a. Correct
b. Wrong
c. Don't know

13. The desensitization of dust mite can treat rhinitis caused by dust mite allergy, but it can't prevent rhinitis from developing into asthma：（assign 0 points for a, 1 point for b, 0 points for c）
a. Correct
b. Wrong
c. Don't know

14.Those adverse reactions in desensitization treatment that require attention are（Multiple choice）：（assign 0.2 points for each option）

a. Itching of the palms of the hands and feet. Itchy scalp. Flushed skin all over the body. The appearance of urticaria
b. Immediate shock (altered mental state. Cold and clammy skin. Decrease in blood pressure)
c. Difficulty breathing. Rapid breathing. Hoarseness and other symptoms
d. Abdominal pain. Nausea. Vomiting. Urinary incontinence
e. Loss of consciousness. Loss of respiration. Loss of carotid artery pulsation

V. Please choose the appropriate options for the following questions
（the following are the attitude dimension，assign 4 points for a, 3 points for b, 2 points for c, 1 point for d）
15. Your concerns about dust mite infestation and dust mite allergy
15.1 You can't stand dust mites infesting your home：
a. Strongly agree
b. Agree
c. Unsure/Don't know
d. Strongly disagree

15.2 What is your attitude towards the possible health risks of dust mite infestation in children：
a. Very worried
b. Worried
c. Unsure/Don't know
d. Not worried at all

15.3 Even though you have follow the doctor's advice to reduced your child's exposure to dust mites by house dust mites removal, you are still worried about the dust mite allergy.：
a. Strongly agree
b. Agree
c. Unsure/Don't know
d. Strongly disagree

16. Your attitude to mite removal and desensitization treatment

16.1 Do you think it is necessary to regularly remove mites from your home：

e. Very necessary
f. Possibly necessary
g. Unsure/Don't know
h. Unnecessary

16.2 Do you think that desensitization treatment is an effective option for your child's rhinitis/asthma：

a. Yes
b. Probably yes
c. Don't know /Unsure
d. No

16.3 Do you think desensitization treatment needs to be carried out strictly according to medical advice (eg. follow up consultation on time)：

a. Very needed
b. Needed
c. Don't know
d. Don't need

16.4 If your child has a relatively obvious reaction to the treatment, such as severe redness at the injection site or a rash around the body or even anaphylaxis, will you continue with the Desensitization treatment：

a. Persist
b. May persist, depending on the situation
c. May give up
d. Definitely give up

VI. Please choose the appropriate options for the following questions (the following are the practice dimension)

17. Targeted practice

17.1 Due to your child's dust mite allergy, have you and your family made a special effort to learn about relevant knowledge (including dust mites. dust mite allergy and desensitization treatment, etc.)（assign 1 point for Yes, 0 points for No）:
a. Yes
b. No

17.2Does your child use mite-proof bedding such as mite proof pillowcases and bedclothes（assign 1 point for Yes, 0 points for No, 0 points for Don't know）:
a.Yes
b. No
c. Don't know

17.3 Your child is currently using a pillow with a content material of (No points for this question):
a. Latex
b. Down
c. Artificial fibre
d. Buckwheat hulls
e. Cotton

17.4 Your child is currently using a bedding with a content material of (No points for this question):
a. Latex
b. Down
c. Cotton
d. Silk
e. Artificial fibre

17.5 Do you use dust mite controller to remove mites in your home（assign 1 point for Yes, 0 points for No, 0 points for Don't know）:
a.Yes
b. No
c. Don't know

17.6 Do you use instruments such as dehumidifier/air-conditioning, air cleaner, and etc. to remove mites in your home（assign 1 point for Yes, 0 points for No, 0 points for Don't know）:
a.Yes
b. No
c. Don't know

17.7 Do you use the decoration which prone to mites such as carpet in your home（assign 0 points for Yes, 1 point for No, 0 points for Don't know）:
a.Yes
b. No
c. Don't know

17.8 Do you or your family weekly wash your pillowcases and bedclothes（assign 1 point for Yes, 0 points for No, 0 points for Don't know）:
a.Yes b.No c.Don't know

17.9 Do you or your family use vacuum cleaner to clean your house every day（assign 1 point for Yes, 0 points for No, 0 points for Don't know）:
a.Yes
b. No
c. Don't know

17.10 Has your child had a delay in injections for some reason that caused treatment to be restarted or follow-up injections to be cancelled（assign 1 point for a, 0 points for b, 0 points for c）:
a. Never
b. Once or twice before
c. Frequently postponed

BMJ Open

Parents' knowledge, attitude, and practice toward the prevention and treatment of dust mite allergy: A cross-sectional study in Shenyang (China)

Journal:	*BMJ Open*
Manuscript ID	bmjopen-2024-085905.R2
Article Type:	Original research
Date Submitted by the Author:	11-Nov-2024
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Primary Subject Heading:	Paediatrics
Secondary Subject Heading:	Paediatrics
Keywords:	PAEDIATRICS, Cross-Sectional Studies, Immunity

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Parents' knowledge, attitude, and practice toward the prevention and treatment of dust mite allergy: A cross-sectional study in Shenyang (China)

Running title: KAP of dust mite allergy

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Abstract

Objective: This cross-sectional study aimed to evaluate parents' knowledge, attitudes, and practices (KAP) concerning the prevention and treatment of dust mite allergy in children.

Design: This cross-sectional study survey was conducted from September to December 2022 at Shengjing Hospital, Affiliated with China Medical University.

Participants: A total of 503 parents of children with dust mite allergies participated, with 253 parents having children undergoing desensitization treatment and 250 parents whose children did not. Selection criteria were carefully defined to include parents directly responsible for caring for children with dust mite allergies.

Primary and secondary outcome measures: Two distinct questionnaires were administered to parents, tailored for those with and without children undergoing desensitization treatment. These questionnaires covered demographic information, allergy diagnosis, treatment details, and KAP related to dust mite allergy. Primary outcomes included parents' scores on knowledge, attitudes, and practices regarding dust mite allergy prevention and treatment. Secondary outcomes involved analyzing the interaction between these factors using pathway analysis.

Results: Parents of children undergoing desensitization treatment exhibited higher scores for all items of knowledge, attitude, and overall practice than those without desensitization therapy (all $P<0.05$). The pathway analyses revealed that in the non-desensitization group, knowledge directly affected attitude ($\beta=0.22$, $P<0.001$), and attitude directly affected practice ($\beta=0.16$, $P<0.001$), but the knowledge did not affect practice ($\beta=-0.01$, 0.06, $P<0.001$). In the desensitization group, knowledge directly affected attitude ($\beta=0.13$, $P=0.028$), but the practice was not affected by attitude ($\beta=0.08$, $P<0.001$) or knowledge ($\beta=0.03$, 0.12, $P<0.001$).

Conclusions: The study highlighted differing levels of KAP among parents of children with dust mite allergies. The KAP was influenced by desensitization therapy status. While attitudes tended to be favorable, practices were suboptimal, particularly among parents whose children

did not receive desensitization treatment. These findings emphasize the importance of targeted educational interventions to enhance parental awareness and practices regarding dust mite allergy management, especially in cases where desensitization treatment is not pursued. Further research is warranted to explore effective strategies for improving parental engagement and adherence to preventive measures.

Keywords: dust mites, house; dust mite allergy; health knowledge, attitudes, practice; desensitization, immunologic; cross-sectional study.

Strengths and limitations of this study

Based on the provided article, here are the summarized strengths and limitations of the methods section:

Strengths:

1. Use of a Validated Questionnaire: The study used two versions of a questionnaire designed by senior experts and pre-tested for reliability (Cronbach's $\alpha > 0.7$ for both versions).

2. Hypothesis-Driven Analysis: The statistical methods included pathway analysis to explore relationships between KAP dimensions, adding depth to the interpretation of the data.

Limitations:

1. Single-Center Study: The study was conducted at a single hospital, which limits generalizability to other regions or hospitals.

2. Potential Bias in Self-Reported Data: knowledge, attitudes, and practices (KAP) surveys are prone to social desirability bias, where participants may provide responses they believe are expected rather than their true behaviors.

3. Cross-Sectional Design: Although the study captured a snapshot of the parental KAP across a broad sample, the temporal relationship is unknown.

1 INTRODUCTION

House dust mites mainly include *Dermatophagoides pteronyssinus*, *Dermatophagoides farinae*, and *Euroglyphus maynei* [1]. They are non-parasitic microscopic bugs that live on desquamated dead skin cells from humans and pets. They prefer warm and moist environments and are found in bedding, linens, carpets, and furniture [2-4]. Although the mite's exoskeleton can contribute to the allergic reaction, the main allergens are found in the mite's fecal pellets [5, 6]. Each mite produces about 20 pellets daily, each the size and weight of a pollen grain [5, 6]. Therefore, they are easily inhaled and can cause sensitization of the respiratory tract mucosa, leading to epithelial permeability and the movement of the mite's antigens to antigen-presenting dendritic cells [5, 6]. The prevalence of dust mite allergy varies from 11.21% in Northeast China to 40.79% in South China [7]. Dust mite allergy contributes to the development of allergic rhinitis and asthma, affecting 800 million people worldwide [1, 5, 8, 9]. The prevalence of asthma in children in the Third National Health Survey in China was 3.02%, showing a 52.8% increase from 2001 to 2013 [10]. Therefore, dust mites represent a serious public health problem.

The most effective management method for dust mite allergy is allergen avoidance (e.g., frequently washing bedding, removing carpets, room air cleaners, and humidity control) [5, 11-13]. Over-the-counter medications (antihistamines, nasal corticosteroids, leukotriene receptor antagonists, cromolyn sodium, and decongestants) and allergen immunotherapy can also help [5, 11].

Since allergen avoidance involves specific lifestyle habits [5, 11-13], parents' proper knowledge, attitudes, and practice (KAP) toward dust mites are essential to managing the allergic symptoms in their children. KAP surveys provide quantitative and qualitative data about a specific subject in a specific population [14, 15]. They can identify gaps and design tailored teaching and training activities [14, 15]. It is known that parents who visited an allergist demonstrated higher dust mite KAP [16]. Generally, parents display very high KAP toward

food allergies in their children [17-19], mainly because several of these allergies can be fatal, which is not the case with dust mite allergy. Studies revealed poor parental KAP for allergic rhinitis [20, 21] and poor KAP regarding allergic disorders in general [22], including in parents of asthmatic children [23]. The KAP toward dust mite allergy remains unknown in the general population of China. Therefore, many parents do not consult when their children display dust mite allergy symptoms or delay consultation when the symptoms exacerbate. Some patients testing positive for dust mite allergy will receive desensitization therapy, but many parents refuse treatments. All parents receive the same information package when their children test positive for dust mite allergy, and the parents are free to consult all sources of information and to ask questions. Nevertheless, differences can be present between those who decide on desensitization therapy and those who refuse. It was hypothesized that differences in KAP could explain, at least in part, the parents' decision.

Therefore, this study aimed to evaluate the KAP of parents toward preventing and treating dust mite allergy and to examine the differences between the parents of children who were treated with desensitization treatment and those of children who were not. Parents are the primary actors in house cleaning and management, and evaluating their KAP toward house mite allergy should help design future teaching activities.

2 MATERIALS AND METHODS

2.1 Study design and participants

This cross-sectional study survey was conducted from September to December 2022 at Shengjing Hospital, Affiliated with China Medical University. The participants were the parents of children with dust mite allergies. The study was approved by the Medical Ethics Committee of Shengjing Hospital, Affiliated with China Medical University (approval #2022PS935K). Informed consent was obtained from the participants before completing the

survey. All participants were enrolled at the outpatient clinic of Shengjing Hospital, Affiliated to China Medical University when their children had an appointment.

The inclusion criteria were 1) parents of children who tested positive for dust mite-specific serum IgE (measured by Phadia ImmunoCAP) and 2) voluntarily completed the questionnaire. The participants were grouped according to whether the children were treated with desensitization treatment or not.

2.2 Questionnaires

Two senior experts in allergy designed the questionnaire with reference to the literature [16, 24, 25]. The final questionnaire had two versions: one for the parents of children who did not undergo desensitization treatment (Questionnaire A) and one for the parents of children who underwent desensitization treatment (Questionnaire B). Thirty parents were randomly selected to complete the questionnaire to test its reliability. Cronbach's α was 0.726 for Questionnaire A and 0.702 for Questionnaire B.

The questionnaire contained six dimensions: demographic information of the parents, demographic information of the child, diagnosis and treatment information related to dust mite allergy in children, knowledge dimension, attitude dimension, and practice dimension. The specific questions and scoring instructions for both questionnaire versions can be found in the Supplementary Materials. The data were collected by on-site inquiry and questionnaire when the parents visited the hospital.

2.3 Statistical analysis

The continuous variables were expressed as means ± standard deviations (SD) and analyzed using Student's t-test or ANOVA. The categorical data were expressed as n (%) and analyzed using the chi-square test. All statistical analyses were performed using two-sided tests, and P-values <0.05 were considered statistically significant. Pathway analysis was constructed, and the hypotheses were 1) knowledge has direct effects on attitude, 2) attitude has direct effects

on practice, and 3) knowledge has direct effects on practice. Good practice was defined as a score ≥70% of the highest possible score for practice. STATA 17.0 (Stata Corporation, College Station, TX, USA) was used for statistical analysis.

2.4 Patient and public involvement

No patient involved

3 RESULTS

3.1 Characteristics of the participants

All the patients with dust mite allergy who attended the Pediatric Respiratory Clinic of Shengjing Hospital from September to December 2022 were invited to participate, of whom 189 refused to fill in the questionnaire due to concern about privacy, lack of time, or disinterest. A total of 668 people were surveyed, of which 165 questionnaires were invalid and excluded (135 had missing questions, 27 had contradictory options, and three were filled with all the same options). Therefore, 503 valid questionnaires were included in the analyses: 250 from non-desensitized patients and 253 from desensitized patients.

The majority of the participants were women (81.91%) and had a bachelor's degree or higher education, but only a small proportion had a history of dust mite allergy. There were more fathers in the desensitization group (25.69% vs. 9.20%, P<0.001), and the mothers' education was higher in the non-desensitization group (P=0.028) (Table 1). There were no differences between the children of the two groups, except for the residence area (P=0.001) and means of transportation to the hospital (P=0.003) (Supplementary Table S1). Compared with the non-desensitization group, the children in the desensitization group had higher proportions of dust mite allergy diagnosis (P=0.009), less rhinitis (P=0.004), and shorter rhinitis attacks (P<0.001) (Supplementary Table S1).

Table 1. Characteristics of the parents, n (%)

	Without desensitization	With desensitization	P
Total	250 (49.70)	253 (50.30)	
Parental relationship			<0.001
Father	23 (9.20)	65 (25.69)	
Mother	223 (89.20)	184 (72.73)	
Other family members	4 (1.60)	4 (1.58)	
Father's education			0.167
Primary school and below	19 (7.60)	13 (5.14)	
Middle school	28 (11.20)	44 (17.39)	
High school/technical secondary school	33 (13.20)	41 (16.21)	
Bachelor's degree/junior college	131 (52.40)	128 (50.59)	
Master's degree	30 (12.00)	20 (7.91)	
Doctorate	9 (3.60)	7 (2.77)	
Mother's education			0.028
Primary school and below	1 (0.40)	3 (1.19)	
Middle school	22 (8.80)	39 (15.42)	
High school/technical secondary school	32 (12.80)	44 (17.39)	
Bachelor's degree/junior college	154 (61.60)	143 (56.52)	
Master's degree	35 (14.00)	21 (8.30)	
Doctorate	6 (2.40)	3 (1.19)	
Annual household income (RMB)			0.379
<30,000	18 (7.20)	24 (9.49)	
30,000-50,000	29 (11.60)	43 (17.00)	
50,000-100,000	76 (30.40)	73 (28.85)	
100,000-200,000	61 (24.40)	61 (24.11)	
200,000-300,000	32 (12.80)	26 (10.28)	
>300,000	34 (13.60)	26 (10.28)	
Are the parents allergic to dust mites?			0.373
None	102 (40.80)	126 (49.80)	
Father only	21 (8.40)	18 (7.11)	
Mother only	24 (9.60)	19 (7.51)	
Both	6 (2.40)	6 (2.37)	
Unclear	97 (38.80)	84 (33.20)	
Ways to learn about allergies [multiple choice]			-
Newspaper & Books	49 (19.60)	19 (7.51)	
Radio & TV	36 (14.40)	21 (8.30)	
Web Search	104 (41.60)	82 (32.41)	
Short videos	76 (30.40)	40 (15.81)	
Doctor's guidance during the consultation	164 (65.60)	228 (90.12)	
Never knew about it	26 (10.40)	8 (3.16)	

3.2 Knowledge, attitudes, and practice

For the items common to the two questionnaires, compared with the non-desensitization group, the desensitization group showed higher correct response rates about dust mites, the

complications of dust mite allergies, the source of dust mites, and how to manage dust mite populations (all P<0.05) (Table 2). Both groups showed relatively poor knowledge regarding the group-specific items (Supplementary Table S2).

Table 2. Knowledge dimension, n (%)

	Correct rate		P
	Without desensitization	Desensitization	
Q1. Which of the following species of dust mite can cause an allergic reaction?	148 (59.20)	216 (85.38)	<0.001
Q2. Only live dust mites can act as allergens that cause allergic reactions.	105 (42.00)	119 (47.04)	0.256
Q3. Which of the following diseases can be caused by dust mite allergy?	153 (61.20)	187 (73.91)	<0.001
Q4. Dust mites in the house mainly breed in bed sheets and bedding; carpets and curtains are not prone to breeding dust mites.	171 (68.40)	192 (75.89)	0.061
Q5. Plush toys are prone to breeding dust mites.	226 (90.40)	245 (96.84)	0.003
Q6. UV light can kill dust mites.	68 (27.20)	54 (21.34)	0.126
Q7. Freezing the plush toys or pillowcases in the refrigerator overnight can kill dust mites.	44 (17.60)	68 (26.88)	0.012
Q8. Which hot water temperature will most effectively remove dust mites when washing bed sheets?	127 (50.80)	151 (59.68)	0.045
Q9. Indoor dust mites can be completely eliminated with a good job of cleaning.	185 (74.00)	215 (84.98)	0.002

About half of the participants cannot stand dust mites in their homes. More participants in the desensitization group were very worried about the possible health risks of dust mites in children (P<0.001). More participants in the desensitization group remained worried after following the doctors' advice to decrease dust mites (P=0.016). Most participants in the two groups agree that it is necessary to remove dust mites regularly (P=0.053) (Table 3). The participants in the non-desensitization group are willing to undergo treatments, but cost appears to be a barrier, while most participants in the desensitization group have a favorable attitude toward treatment (Supplementary Table S3).

Table 3. Attitude dimension, n (%)

	Without	Desensitization	P

	desensitization		
You can't stand dust mites infesting your home.			0.481
Strongly agree	111 (44.40)	122 (48.22)	
Agree	95 (38.00)	98 (38.74)	
Unsure/Don't know	35 (14.00)	28 (11.07)	
Disagree	9 (3.60)	5 (1.98)	
What is your attitude towards the possible health risks of dust mite infestation in children?			0.001
Very worried	137 (54.80)	177 (69.96)	
Worried	92 (36.80)	70 (27.67)	
Unsure/Don't know	20 (8.00)	5 (1.98)	
Not worried at all	1 (0.40)	1 (0.40)	
Even though you have followed the doctor's advice to reduce your child's exposure to dust mites by mite removal in the house, you are still worried about the dust mite allergy.			0.016
Strongly agree	101 (40.40)	114 (45.06)	
Agree	105 (42.00)	118 (46.64)	
Unsure/Don't know	39 (15.60)	17 (6.72)	
Strongly disagree	5 (2.00)	4 (1.58)	
Do you think it is necessary to remove mites from your home regularly?			0.053
Very necessary	182 (72.80)	188 (74.31)	
Possibly necessary	55 (22.00)	54 (21.34)	
Unsure	13 (5.20)	6 (2.37)	
Unnecessary	0	5 (1.98)	

Compared with the non-desensitization group, subjects in the desensitization group displayed higher rates of positive behavior regarding all practice items (all P≤0.001), except for the weekly cleaning of bedding and daily vacuuming (P=0.345 and P=0.142) (Table 4). There were no significant differences between the two groups regarding the pillow and bedding materials (Supplementary Table S4).

Table 4. Practice dimension, n (%)

	Positive behavior		P
	Without desensitization	Desensitization	
P1. Due to your child's dust mite allergy, have you and your family made a special effort to learn about relevant knowledge (including dust mites. dust mite allergy and desensitization treatment, etc.)	154 (61.60)	216 (85.38)	<0.001

P2. Does your child use mite-proof bedding such as mite-proof pillowcases and bedclothes	94 (37.60)	105 (41.50)	<0.001
P3. Do you use a dust mite controller to remove mites in your home	162 (64.80)	162 (64.03)	<0.001
P4. Do you use instruments such as dehumidifier/air-conditioning, air cleaner, etc., to remove mites in your home	115 (46.00)	85 (33.60)	<0.001
P5. Do you use decoration prone to mites, such as carpet in your home	20 (8.00)	4 (1.58)	0.001
P6. Do you or your family weekly wash your pillowcases and bedclothes	161 (64.40)	173 (68.38)	0.345
P7. Do you or your family use a vacuum cleaner to clean your house every day	114 (45.60)	99 (39.13)	0.142

3.3 Pathway analysis

The root mean square error of approximation (RMSEA, P<0.001), comparative fit index (CFI, P=1.000), Tucker-Lewis index (TLI, P=1.000), and standardized root mean square residual (SRMR, P<0.001) all indicated that the model fit was acceptable. In the non-desensitization group, knowledge directly affected attitude (β=0.22, P<0.001), and attitude directly affected practice (β=0.16, P<0.001) (Table 5), but the knowledge did not affect practice (β=-0.01, 0.06, P<0.001). In the desensitization group, knowledge directly affected attitude (β=0.13, P=0.028), but the practice was not affected by attitude (β=0.08, P<0.001) or knowledge (β=0.03, 0.12, P<0.001) (Figure 1).

Table 5. Estimates of hypothesis paths of KAP

	β (95% CI)	P-value
Without desensitization		
K -> A	0.22 (0.10, 0.35)	<0.001
A -> P	0.16 (0.09, 0.22)	<0.001
K -> P	-0.01 (-0.07, 0.06)	0.871
Desensitization		
K -> A	0.13 (0.01, 0.25)	0.028
A -> P	0.08 (-0.01, 0.17)	0.095
K -> P	0.03 (-0.05, 0.12)	0.439

CI: confidence interval; K: knowledge; A: attitude; P: practice.

3.4 Factors influencing practice among parents of children who underwent desensitization treatment

Among parents of children who underwent desensitization treatment, bachelor's degree or above (OR=3.816, 95%CI: 1.483-9.818, P=0.005), suspected dust allergy based on symptoms (OR=4.299, 95%CI: 1.429-12.929, P=0.009), and children having rhinitis (OR=0.352, 95%CI: 0.170-0.272, P=0.005) were associated with the parents' practice (Table 6).

Table 6. The factors influencing good practices (n=44 parents with good practice) among parents of children who have undergone desensitization treatment (n=253)

	Univariate 95%CI	P	Multivariate 95%CI	P
Knowledge	0.966 (0.846-1.102)	0.604		
Attitude	1.16 (0.99-1.36)	0.067		
Parental relationship				
Mother	REF			
Father/ Other family members	0.449 (0.19-1.061)	0.068		
Father's education				
Junior college or below	REF			
Bachelor's degree or above	1.44 (0.721-2.877)	0.302		
Mother's education				
Junior college or below	REF		REF	
Bachelor's degree or above	3.928 (1.589-9.709)	0.003	3.816 (1.483-9.818)	0.005
Annual household income (RMB)				
<100,000	REF			
≥100,000	1.297 (0.676-2.487)	0.434		
Are the parents allergic to dust mites?				
None	REF			
One of the parents/Both	1.83 (0.814-4.112)	0.144		
Unclear	0.639 (0.286-1.428)	0.275		
Learned about allergies				
No	REF			
Yes	0.621 (0.121-3.182)	0.567		
Pre-visit knowledge of child's dust mite allergy				
Unaware	REF		REF	
Aware	1.81 (0.887-3.694)	0.103	1.679 (0.792-3.561)	0.176

Suspected based on symptoms	3.08	(1.118-8.481)	0.03	4.299	(1.429-12.929)	0.009
Child's sex						
Male	REF					
Female	1.111	(0.564-2.187)	0.761			
Child's age	0.855	(0.738-0.992)	0.039	0.895	(0.764-1.049)	0.17
Only child						
Yes	0.552	(0.286-1.065)	0.076			
No	REF					
Child's Diagnosed Conditions:						
Rhinitis	0.432	(0.222-0.841)	0.013	0.352	(0.17-0.727)	0.005
Bronchial Asthma	0.87	(0.428-1.767)	0.699			
Cough-Variant Asthma	0.833	(0.362-1.921)	0.669			
Allergic Cough	1.01	(0.521-1.957)	0.977			

4 DISCUSSION

This study investigated parents' KAP regarding the prevention and treatment of dust mite allergy and examined the differences between the parents of children treated with desensitization and those of children who were not. The results showed that the parents of children with dust mite allergy had relatively good KAP regarding dust mites. The parents of children who did not undergo desensitization therapy had poor knowledge, favorable attitudes, and poor practice regarding dust mites, while the parents of children who underwent desensitization therapy had good knowledge, favorable attitudes, and poor practice.

Although dust mite allergy is bothersome for the patients and can evolve into allergic rhinitis and asthma, the condition is not as dangerous as food allergies, probably explaining why the KAP toward food allergies is very high in parents of food-allergic children [17-19] but lower in parents of children with dust mite allergy, as observed in the present study. Indeed, the relatively low KAP observed here is supported by previous studies on allergic rhinitis [20, 21] and allergies in general [22]. Even parents of children with chronic asthma (in whom allergens

can be triggers for asthma attacks) have a poor KAP toward allergies [23]. A study covering 29 Chinese cities showed that the KAP of parents toward allergic rhinitis was low [26]. In the present study, the total KAP scores and knowledge scores were higher in the desensitization group than in the non-desensitization group, as supported by Callahan et al. [16], who reported higher KAP in the parents who met an allergist compared with those who did not (to receive desensitization treatment, all patients must consult an allergist in China). Still, in the present study, the non-desensitization group included parents of children newly diagnosed with dust mite allergy and parents of children with known dust mite allergy who did not receive or did not yet receive desensitization treatment. The attitude scores were relatively high in both groups, but the practice scores were low. These results indicate that although the willingness to take measures against house dust mites to improve their child's health was high, the actual application of these measures was low. Indeed, for example, vacuuming each day is time-consuming, boring, and bothersome. The same goes for changing and laundering sheets more often. Since house dust mite allergy is not a serious condition, many parents do not feel the need to perform all those tasks.

This study showed significantly better scores for several knowledge areas, such as the dust mite species causing allergies, the diseases that can be due to dust mite allergies, the objects in which dust mites are more likely to thrive, methods to eliminate dust mites, and whether cleaning can completely eliminate dust mites. The parents who opted for desensitization therapy in their children probably obtained more information from the physicians or other sources when discussing the treatment options or by themselves to understand better what they were getting into. Indeed, a study showed that the parents of children with life-threatening illnesses actively sought information about the illness [27]; although dust mite allergy is far from life-threatening, a similar protective behavior could be involved. Furthermore, parents of children with allergies actively seek information from different sources [28]. Desensitization therapy is relatively

expensive, and parents might fear some adverse effects on their children, encouraging them to take more information. Compared with the non-desensitization group, the parents in the desensitization group also reported a more worried attitude toward the possible health risks related to dust mites in their children and more worries toward dust mites despite active measures taken to decrease them. These worries could come from a better knowledge of the diseases and complications related to dust mite allergies. Regarding the practice items, compared with the non-sensitization group, the parents in the desensitization group declared more efforts being taken to gain knowledge about dust mites (which could relate to the knowledge scores), as previously suggested [28] and reported a higher use of mite-proof bedding and pillowcase and a lower use of dust mite-prone decoration, which could be related to a better knowledge of the sources of dust mites. Still, both groups reported poor practice regarding washing bedding weekly and vacuuming daily. In the desensitization group and higher education, suspected dust mite allergy based on symptoms (suggesting a higher knowledge of dust allergy) were independently and positively associated with the practice. On the other hand, rhinitis was independently and negatively associated with practice.

The pathway analysis showed different patterns of association among the KAP dimensions between the non-desensitization and desensitization groups. Indeed, in the non-desensitization group, knowledge affected attitude, which in turn affected practice, while in the desensitization group, only knowledge affected attitude. It may be because the parents in the desensitization group had already taken action to address their children's condition. Still, these differences should be investigated more in-depth to tailor future interventions to the specific target populations. In addition, pathway analyses are only statistical surrogates for causality [29, 30], and the results should be confirmed.

In the present study, it was hypothesized that differences in KAP could explain, at least in part, the parents' decision for desensitization therapy for children with dust mite allergy. The results

support the hypothesis and may provide ideas and directions to guide and educate the parents in the clinic. Nevertheless, although the parents of children receiving desensitization treatment had a higher KAP, there were still many gaps in knowledge, suggesting that we should strengthen the education and management of these patients in addition to drug desensitization treatment. The present study provides insights for designing teaching brochures, videos, podcasts, or activities to increase the KAP of parents toward dust mites. In particular, the knowledge about the dust mites themselves and the methods to kill them was poor. The practice of minimizing the living habitats of dust mites and using actual means to get rid of them should be emphasized. An intervention based on the results of the present study is being developed and will be investigated in a future study.

This study had limitations. It was performed at a single center, and the sample size is relatively small. In addition, because the two subpopulations of participants (i.e., with children with or without desensitization treatments) had two different KAP questionnaires, a direct comparison of the KAP scores was impossible between the two groups. Furthermore, as for all KAP surveys, the data represent the situation of a specific population at a specific point in time [14, 15]. In addition, KAP surveys are subject to a social acceptability bias, i.e., the participants can be tempted to answer what they should do instead of what they really do [14, 15]. Nevertheless, the present study might provide a comparator point to evaluate the KAP in a similar population after an intervention to increase health literacy on house dust mites.

5 CONCLUSIONS

In conclusion, the parents who did not decide on desensitization therapy for their children had poor knowledge, favorable attitudes, and poor practices regarding dust mites. On the other hand, the parents of children who underwent desensitization therapy had good knowledge, favorable attitudes, and poor practices. The poor practice scores highlight the need to emphasize the

importance of dust mite control for the children's health. There is a need to educate the general population about the importance of controlling house dust mites.

List of abbreviations

KAP: knowledge, attitudes, and practices

SD: standard deviations

Declarations

Ethics approval and consent to participate

The research was carried out in accordance with the Declaration of Helsinki. The study was approved by the Medical Ethics Committee of Shengjing Hospital, Affiliated with China Medical University (approval #2022PS935K). Informed consent by electronic questionnaire was obtained from the participants before completing the survey.

Consent for publication

Not applicable.

Data Availability Statement

All data generated or analyzed during this study are included in this published article [and its supplementary information files].

Conflict of Interest

The authors declare that the research was conducted in the absence of any commercial or financial relationships that could be construed as a potential conflict of interest.

Funding

This work was supported by the Basic Scientific Research Project of Colleges and Universities of Liaoning Province (Key Program, No. LJKZ0746) and the Basic Scientific Research Project of Colleges and Universities of Liaoning Province (General Program, No. LJKZ0746).

Authors' contributions

Conceptualization, Si Liu and Qianlan Zhou; Methodology, Bing Dai; Software, Li Chen; Validation, Qinzhen Zhang; Formal Analysis, Lina Han; Investigation, Xiaowen Li; Resources,

Wenxin Shen; Data Curation, Si Liu; Writing – Original Draft Preparation, Si Liu; Writing – Review & Editing, Qianlan Zhou; Visualization, Qianlan Zhou; Supervision, Lishen Shan; Project Administration, Lishen Shan; Funding Acquisition, Lishen Shan. The guarantor is Lishen Shan.

Acknowledgments

Not applicable.

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Figure Legends

Figure 1. Pathway analysis. (A) Without desensitization. (B) With desensitization.

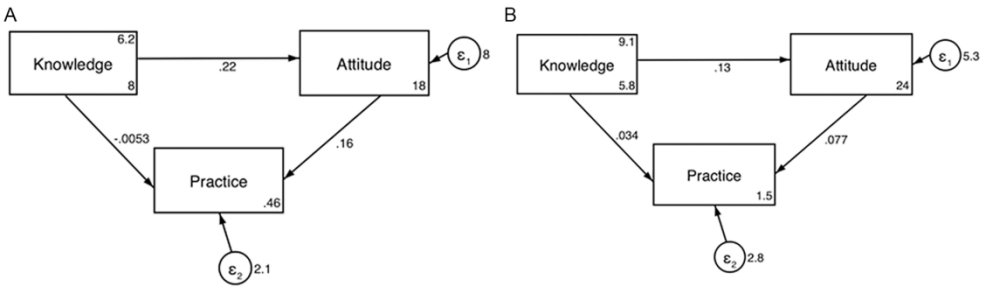

Figure 1. Pathway analysis. (A) Without desensitization. (B) With desensitization.

170x51mm (300 x 300 DPI)

Supplementary Table S1. Medical characteristics of the children, n (%)

	Without desensitization (n=250)	Desensitization (n=253)	P
Gender			0.304
Male	153 (61.20)	166 (65.61)	
Female	97 (38.80)	87 (34.39)	
Age, mean±SD	6.37±3.13	8.80±2.36	-
Ethnicity			0.934
the Han nationality	180 (72.00)	183 (72.33)	
Minorities	70 (28.00)	70 (27.67)	
Yes	147 (58.80)	-	
No	103 (41.20)	-	
Knowing your child's dust mite allergy before going to the doctor			0.009
Know	58 (23.20)	79 (31.23)	
Don't know	150 (60.00)	152 (60.08)	
Suspected dust mite allergy in the child based on him/her symptoms	42 (16.80)	22 (8.70)	
Season when rhinitis is more likely to occur			0.004
Without rhinitis	68 (27.20)	33 (13.04)	
Spring	27 (10.80)	41 (16.21)	
Summer	10 (4.00)	12 (4.74)	
Autumn	66 (26.40)	72 (28.46)	

Winter	24 (9.60)	26 (10.28)	
All year round	55 (22.00)	69 (27.27)	
Duration of rhinitis attack			<0.001
Without rhinitis	77 (30.80)	40 (15.81)	
The duration of symptoms <4 days/week, or <4 consecutive weeks	89 (35.60)	121 (47.83)	
The duration of symptoms ≥4 days/week, or ≥4 consecutive weeks	84 (33.60)	92 (36.36)	
Frequency of desensitization treatments			-
First medication	-	16 (6.32)	
Within 3 months	-	49 (19.37)	
3 months to 6 months	-	22 (8.70)	
6 months to 1 year	-	38 (15.02)	
More than 1 year	-	128 (50.59)	
Outcome of desensitization treatment			-
First medication	-	27 (10.67)	
Significant improvement (no symptoms or close to normal)	-	61 (24.11)	
Improvement (few or occasional mild symptoms)	-	70 (27.67)	
Remission (fewer symptoms and less frequent recurrences)	-	55 (21.74)	
Effective (all symptoms still present but less frequent recurrences)	-	34 (13.44)	
Ineffective (hardly any improvement and	-	6 (2.37)	

worse symptoms)		
Time for desensitization to complete initial treatment		-
Initial treatment has not been completed	-	71 (28.06)
14 weeks	-	95 (37.55)
15-20 weeks	-	45 (17.79)
21-28 weeks	-	10 (3.95)
More than 28 weeks	-	32 (12.65)
Adverse reactions during desensitization treatment		-
No	-	98 (38.74)
Only redness and swelling at the injection site	-	146 (57.71)
Large area urticaria throughout the body	-	6 (2.37)
Severe allergic reaction (difficulty breathing, shock, etc.)	-	3 (1.19)
Frequency of adverse reactions during desensitization		-
None	-	105 (41.50)
1 - 2 times	-	64 (25.30)
3 - 5 times	-	34 (13.44)
Often	-	35 (13.83)
Every time	-	15 (5.93)

Supplementary Table S2. The distribution of the remaining problems in the knowledge dimension, n (%)

Questionnaire A Without desensitization treatment	Correct	Wrong	Don't know
Q10. There is no cure for a child with dust mite allergy, but keep the house as hygienic as possible to avoid dust mites	43 (17.20)	139 (55.60)	68 (27.20)
Q11. Dust mite allergy will heal itself as the child grows up	39 (15.60)	119 (47.60)	92 (36.80)
	Haven't heard of it	Have heard of it but don't know the details	Understand the process and procedure of it
Q12. Have you heard of or know about desensitization treatment for dust mites?	91 (36.40)	126 (50.40)	33 (13.20)
Questionnaire B Desensitization treatment			
Q10. The desensitization treatment for dust mite allergy usually takes 3-5 years	231 (91.30)	4 (1.59)	18 (7.11)
Q11. The medications of nasal spray hormone therapy for rhinitis	78 (30.83)	116 (45.85)	59 (23.32)

or nebulized hormone therapy for asthma can be stopped during desensitization treatment			
Q12. There is no need to pay attention to removing and avoiding dust mites during desensitization treatment	9 (3.56)	231 (91.30)	13 (5.14)
Q13. The desensitization of dust mites can treat rhinitis caused by dust mite allergy, but it can't prevent rhinitis from developing into asthma	65 (25.69)	104 (41.10)	84 (33.20)
	Itching of the palms of the hands and feet. Itchy scalp. Flushed skin all over the body. The appearance of urticaria	Immediate shock (altered mental state. Cold and clammy skin. Decrease in blood pressure)	Difficulty breathing. Rapid breathing. Hoarseness and other symptoms
Q14. Those adverse reactions in desensitization treatment that require attention are (Multiple choice)	212 (83.79)	146 (57.75)	195 (77.08)

Supplementary Table S3. The distribution of the remaining questions in the attitude dimension, n (%)

Questionnaire A Without desensitization treatment	Very necessary	Possibly necessary	Unsure	Unnecessary
Q14.2. If there have a therapy to make your child non-allergic to dust mites, do you think it is necessary to undergo it	159 (63.60)	71 (28.40)	19 (7.60)	1 (0.40)
	More than 1000 CNY/month	500-1000 CNY/month	100-500 CNY/month	Less than 100 CNY/month
Q14.3. How much do you think is acceptable to spend for your child on the prevention and treatment of dust mite allergy (RMB)	47 (18.80)	81 (32.40)	82 (32.80)	40 (16.00)
Questionnaire B Desensitization treatment	Yes	Probably	Don't know/Unsure	No
Q16.2. Do you think that desensitization treatment is an effective option for your child's rhinitis/asthma	211 (83.40)	31 (12.35)	10 (3.95)	1 (0.40)

	Very needed	Needed	Don't know	Don't need
Q16.3. Do you think desensitization treatment needs to be carried out strictly according to medical advice (e.g., Follow up consultation on time)	217 (85.77)	36 (14.23)	0	0
	Persist	May persist depending on situation	May give up	Definitely give up
Q16.4. If your child has a relatively obvious reaction to the treatment, such as severe redness at the injection site or a rash around the body, or even anaphylaxis, will you continue with the Desensitization treatment	108 (2.69)	123 (8.62)	18 (7.11)	4 (1.58)

Supplementary Table S4. Material of the bedding items, n (%)

	Without desensitization	Desensitization	P
Your child is currently using a pillow with the content material of			0.700
Latex	123 (49.20)	122 (48.22)	
Down	1 (0.40)	1 (0.40)	
Artificial fiber	24 (9.60)	30 (11.86)	
Buckwheat hulls	75 (30.00)	82 (32.41)	
Cotton	17 (6.80)	10 (3.95)	
Other	10 (4.00)	8 (3.16)	
Your child is currently using bedding with the content material of			0.830
Latex	5 (2.00)	5 (1.98)	
Down	9 (3.60)	10 (3.95)	
Artificial fiber	39 (15.60)	38 (15.02)	
Silk	138 (55.20)	135 (53.36)	

Cotton	50 (20.00)	60 (23.72)
Other	9 (3.60)	5 (1.98)

Questionnaire A

Dear Parents:

Hello!

We are researchers at Shengjing Hospital of China Medical University and we thank you for participating our research! This study is conducted to collect information to understand the knowledge, attitudes and practice of parents toward the prevention and treatment of dust mite allergy, and aims to provide a basis for the development of scientific intervention strategies for the disease, which may help more people in the future and improve their condition. Your participation in this study is voluntary and this study has been approved by the Ethics Approval Committee. If you agree to participate in this study, please refer to the following instructions and complete the questionnaire patiently by **circling the corresponding symbol**.

1. There are no certain correct or wrong answers, you just need to fill in the questionnaire according to your actual situation, any questions during the answering process can be asked to us, after finishing, please submit it in time.

2. This study is only a simple questionnaire and will not harm your physical or psychological condition, but may involve some privacy questions, such as your gender, age, etc. We will keep your information strictly confidential and will not disclose your information, the results will be derived from the overall statistical analysis of the data and will not involve any personal privacy, please feel free to fill in.

3. As a participant, you can be kept informed of information and research progress related to this study. If you decide to withdraw from the study, please let us know and your data will not be included in the results of this study.

Finally, we sincerely thank you for taking time out of your busy schedule to support our scientific research.

□I have been informed of and agree to the use of the data collected for scientific research.

Participation date： Year Mouth Day

Questionnaire A on the prevention and treatment of dust mite allergy (for patients without desensitization treatment)

I. Please fill in your basic information：

1. Your relationship with your child is？

a. Father

b. Mother

c. Other family member

2. Father's education：

a. Primary school and below

b. Middle school

c. High school/Technical secondary school

d. Bachelor's degree/Junior college

e. Master's degree

f. Doctorate

3. Mother's education：

a. Primary school and below

b. Middle school

c. High school/Technical secondary school

d. Bachelor's degree/Junior college

e. Master's degree

f. Doctorate

4. Annual household income（CNY）：

a. ＜30,000

b. 30,000-50,000

c. 50,000-100,000

d. 100,000-200,000

e. 200,000-300,000

f. ＞300,000

5. Are the parents allergic to dust mites?

a. None

b. Father only

c. Mother only

d. Both allergic to dust mites

e. Haven't followed it, don't know yet

6. You learn about allergies through：

a. Newspaper & Books

b. Radio & TV

c. Web Search

d. Short videos (Tiktok)

e. Doctor's guidance during consultation

f. Never knew about it

II. Please fill in your child's basic information:

1. Name:

2. Age:

3. Gender:

4. Ethnicity:

5. Whether your child is the only-child?

a. Yes

b. No

6. The exercises your children usually enjoy to do (Multiple choice)：

a. Outdoor running and walking

b. Playing basketball

c. Swimming

d. Taekwondo

e. Indoor dancing

f. Cycling

g. Other

7. The floor your child live on：

a. Single-storey house

b. First floor

c. Floor 2-10

d. Floor 10-20

e. Floor 21 and above

f. Top Floor

8. Your child's residence is：

a. Within Shenyang City

b. Rural areas of Shenyang

c. Towns of Shenyang

d. City of Liaoning Province (except Shenyang)

e. Rural areas within Liaoning Province (except Shenyang)

f. Towns within Liaoning Province (except Shenyang)

g. Outside Liaoning Province

9. The transportation to visit a doctor：

a. On foot

b. Bus

c. Metro

d. High-speed Rail

e. Long distance bus

f. Private Car

g. Other

III. Please fill in your child's medical information：

1. The doctor has diagnosed your child with (multiple choice)：

a. Rhinitis

b. Bronchial asthma

c. Cough variant asthma

d. Allergic cough

2. Has your child visits to a paediatric allergist in the past?

a. Yes

b. No

3. Were you aware of your child's dust mite allergy before you brought him/her to the paediatric allergy u

a. Know

b. Don't know

c. Suspected dust mite allergy in child based on him/her symptoms

4. Which season your child’s rhinitis is more likely to occur?

a. No rhinitis

b. Spring

c. Summer

d. Autumn

e. Winter

f. All year round

5. What is the duration of your child's rhinitis attack?

a. No rhinitis

b. The duration of symptoms <4 days/week, or <4 consecutive weeks

c. The duration of symptoms ≥4 days/week, or ≥4 consecutive weeks

6. Does your child's rhinitis affect his/her study, cultural & sports activities, and sleep?

a. Without rhinitis

b. Without significant effect

c. Have significant or severe effects

7. Which season your child’s asthma is more likely to occur?

a. No asthma

b. Spring

c. Summer

d. Autumn

e. Winter

f. All year round

8. The times of your child's asthma attack in the last six months is：

a. No asthma

b. No acute asthma

c. 1-2 times

d. 3-5 times

e. ≥6 times

IV. Please choose the appropriate options for the following questions (the following are the knowledge dimension)

1. Which of the following species of dust mite can cause an allergic reaction: (assign 0 points for ab, 1 point for c, 0 points for d):

a. House dust mite only

b. Dermatophagoides farinae only

c. Both house dust mite and dermatophagoides farinae

d. Don't know

2. Only live dust mites can act as allergens to causing allergic reactions：（assign 0 points for a, 1 point for b, 0 points for c）

a. Correct

b. Wrong

c. Don't know

3. Which of the following diseases can be caused by dust mite allergy：（assign 0.5 points for abcd, 1 point for e, 0 points for f）

a. Eczema

b. Allergic conjunctivitis

c. Rhinitis d. Asthma

d. All of them

e. Don't know

4. Dust mites in the house mainly breed in bed sheets and bedding, carpets and curtains are not prone to breeding dust mites：（assign 0 points for a, 1 point for b, 0 points for c）

a. Correct

b. Wrong

c. Don't know

5. Plush toys are prone to breeding dust mites：（assign 1 point for a, 0 points for b, 0 points for c）

a.Correct b.Wrong c.Don't know

6. UV light can kill dust mites：（assign 0 points for a, 1 point for b, 0 points for c）

a. Correct

b. Wrong

c. Don't know

7. Freezing the plush toys or pillowcases in the refrigerator overnight can kill dust mites：（assign 1 point for a, 0 points for b, 0 points for c）

a. Correct

b. Wrong

c. Don't know

8. How many degrees hot water for washing bed sheets will be most effective in removing dust mites：（assign 0 points for abc, 1 point for d, 0 points for e）

a. 25℃

b. 35℃

c. 45℃

d. 55℃

e. Don't know

9. Indoor dust mites can be completely eliminated with a good job cleaning：（assign 0 points for a, 1 point for b, 0 points for c）

a. Correct

b. Wrong

c. Don't know

10. There is no cure for a child with dust mite allergy but to keep the house as hygienic as possible to avoid dust mites：（assign 0 points for a, 1 point for b, 0 points for c）

a. Correct

b. Wrong

c. Don't know

11. Dust mite allergy will heal itself as the child grows up：（assign 0 points for a, 1 point for b, 0 points for c）

a. Correct

b. Wrong

c. Don't know

12. Have you heard of or know about desensitization treatment for dust mites?：（assign 0 points for a, 0 points for b, 1 point for c）

a. Haven't heard of it

b. Have heard of it but don’t know the details

c. Understand the process and procedure of it

V. Please choose the appropriate options for the following questions

（the following are the attitude dimension， assign 4 points for a, 3 points for b, 2 points for c, 1 point for d）

13. Your concerns about dust mite infestation and dust mite allergy

13.1 You can't stand dust mites infesting your home：

a. Strongly agree

b. Agree

c. Unsure/Don't know

d. Strongly disagree

13.2 What is your attitude towards the possible health risks of dust mite infestation in children?：

a. Very worried

b. Worried

c. Unsure/Don't know

d. Not worried at all

13.3 Even though you have follow the doctor's advice to reduced your child's exposure to dust mites by mite removal in the house, you are still worried about the dust mite allergy.：

a. Strongly agree

b. Agree

c. Unsure/Don't know

d. Strongly disagree

14. Your attitude to mite removal and desensitization treatment

14.1 Do you think it is necessary to regularly remove mites from your home：

a.Very necessary b.Possibly necessary c.Unsure d.Unnecessary

14.2 If there have a therapy to make your child non-allergic to dust mites, do you think it is necessary to undergo it：

a. Very necessary

b. Possibly necessary

c. Unsure/Don't know

d. Unnecessary

14.3 How much do you think is acceptable to spend for your child on prevention and treatment of dust mite allergy：(CNY)

a. More than 1000 CNY/month；

b. 500-1000 CNY/month；

c. 100-500 CNY/month；

d. Less than 100 CNY/month;

VI. Please choose the appropriate options for the following questions (the following are the practice dimension)

15. Targeted practice

15.1Due to your child's dust mite allergy, have you and your family made a special effort to learn about relevant knowledge (including dust mites. dust mite allergy and desensitization treatment, etc.)（assign 1 point for Yes, 0 points for No）:

a. Yes

b. No

15.2 Does your child use mite-proof bedding such as mite proof pillowcases and bedclothes（assign point for Yes, 0.5 points for intend to purchase, 0 points for a.not intend to purchase）:

a. Yes

b. Previously test showed dust mite allergy but not used

c. Recent test show dust mite allergy and intend to purchase

d. Recent test show dust mite allergy but not intend to purchase

15.3 Your child is currently using a pillow with a content material of (No points for this question):

a. Latex

b. Down

c. Artificial fibre

d. Buckwheat hulls

e. Cotton

15.4 Your child is currently using a bedding with a content material of (No points for this question):

a. Latex

b. Down

c. Cotton

d. Silk

e. Artificial fibre

15.5 Do you use Dust Mite Controller to remove mites in your home（assign 1 point for Yes, 0.5 points for intend to purchase, 0 points for a.not intend to purchase）:

a.Yes

b. Previously test showed dust mite allergy but not used

c. Recent test show dust mite allergy and intend to purchase

d. Recent test show dust mite allergy but not intend to purchase

15.6 Do you use instruments such as dehumidifier/air-conditioning, air cleaner, and etc. to remove mites in your home（assign 1 point for Yes, 0.5 points for intend to purchase, 0 points for a.not intend to purchase）:

a.Yes

b. Previously test showed dust mite allergy but not used

c. Recent test show dust mite allergy and intend to purchase

d. Recent test show dust mite allergy but not intend to purchase

15.7 Do you use the decoration which prone to mites such as carpet in your home（assign 0 points for Yes, 1 point for No, 0 points for Don't know）:

a.Yes

b. No

c. Don't know

15.8 Do you or your family weekly wash your pillowcases and bedclothes（assign 1 point for Yes, 0 points for No, 0 points for Don't know）:

a.Yes

b. No

c. Don't know

15.9 Do you or your family use vacuum cleaner to clean your house every day（assign 1 point for Yes, 0 points for No, 0 points for Don't know）:

a.Yes

b. No

c. Don't know

Questionnaire B

Dear Parents:

Hello!

We are researchers at Shengjing Hospital of China Medical University and we thank you for participating our research! This study is conducted to collect information to understand the knowledge, attitudes and practice of parents toward the prevention and treatment of dust mite allergy, and aims to provide a basis for the development of scientific intervention strategies for the disease, which may help more people in the future and improve their condition. Your participation in this study is voluntary and this study has been approved by the Ethics Approval Committee. If you agree to participate in this study, please refer to the following instructions and complete the questionnaire patiently by **circling the corresponding symbol**.

1. There are no certain correct or wrong answers, you just need to fill in the questionnaire according to your actual situation, any questions during the answering process can be asked to us, after finishing, please submit it in time.

2. This study is only a simple questionnaire and will not harm your physical or psychological condition, but may involve some privacy questions, such as your gender, age, etc. We will keep your information strictly confidential and will not disclose your information, the results will be derived from the overall statistical analysis of the data and will not involve any personal privacy, please feel free to fill in.

3. As a participant, you can be kept informed of information and research progress related to this study. If you decide to withdraw from the study, please let us know and your data will not be included in the results of this study.

Finally, we sincerely thank you for taking time out of your busy schedule to support our scientific research.

□I have been informed of and agree to the use of the data collected for scientific research.

Participation date： Year Mouth Day

Questionnaire B on the prevention and treatment of dust mite allergy (for patients treated with hypodermic desensitization)

I. Please fill in your basic information：

1. Your relationship with your child is？

a. Father

b. Mother

c. Other family member

2. Father's education：

a. Primary school and below

b. Middle school

c. High school/Technical secondary school

d. Bachelor's degree/Junior college

e. Master's degree

f. Doctorate

3. Mother's education：

a. Primary school and below

b. Middle school

c. High school/Technical secondary school

d. Bachelor's degree/Junior college

e. Master's degree

f. Doctorate

4. Annual household income（CNY）：

a. ＜30,000

b. 30,000-50,000

c. 50,000-100,000

d. 100,000-200,000

e. 200,000-300,000

f. ＞300,000

5. Are the parents allergic to dust mites?

a. None

b. Father only

c. Mother only

d. Both allergic to dust mites

e. Haven't followed it, don't know yet

6. You learn about allergies through：

a. Newspaper & Books

b. Radio & TV

c. Web Search

d. Short videos (Tiktok)

e. Doctor's guidance during consultation

f. Never knew about it

II. Please fill in your child's basic information：

1. Name：

2. Age：

3. Gender：

4. Ethnicity：

6. Whether your child is the only-child?

c. Yes

d. No

6. The exercises your children usually enjoy to do (Multiple choice)：

a. Outdoor running and walking

b. Playing basketball

c. Swimming

d. Taekwondo

e. Indoor dancing

f. Cycling

g. Other

7. The floor your child live on：

a. Single-storey house

b. First floor

c. Floor 2-10

d. Floor 10-20

e. Floor 21 and above

f. Top Floor

8. Your child's residence is：

a. Within Shenyang City

b. Rural areas of Shenyang

c. Towns of Shenyang

d. City of Liaoning Province (except Shenyang)

e. Rural areas within Liaoning Province (except Shenyang)

f. Towns within Liaoning Province (except Shenyang)

g. Outside Liaoning Province

10. The transportation to visit a doctor：

h. On foot

i. Bus

j. Metro

k. High-speed Rail

l. Long distance bus

m. Private Car

n. Other

III. Please fill in your child's medical information：

1. The diagnose of your child (multiple choice)：

a. Rhinitis

b. Bronchial asthma

c. Cough variant asthma

d. Allergic cough

2. Were you aware of your child's dust mite allergy before you brought him/her to the paediatric allergy unit?

a. Know

b. Don't know

c. Suspected dust mite allergy in child based on him/her symptoms

3. Which season your child’s rhinitis is more likely to occur?

a. No rhinitis

b. Spring

c. Summer

d. Autumn

e. Winter

f. All year round

4. What is the duration of your child's rhinitis attack?

a. No rhinitis

b. The duration of symptoms <4 days/week, or <4 consecutive weeks

c. The duration of symptoms ≥4 days/week, or ≥4 consecutive weeks

5. Does your child's rhinitis affect his/her study, cultural & sports activities, and sleep?

a. No rhinitis

b. No significant effect

c. Have significant or severe effects

6. Which season your child’s asthma is more likely to occur?

a. No asthma

b. Spring

c. Summer

d. Autumn

e. Winter

f. All year round

7. The times of your child's asthma attack in the last six months is：

a. No asthma

b. No acute asthma

c. 1-2 times

d. 3-5 times

e. ≥6 times

8. The time your child has been receiving desensitization treatment is:

a. First medication

b. Within 3 months

c. 3 months to 6 months

d. 6 months to 1 year

e. More than 1 year

9. Your current evaluation for the outcome of desensitization treatment on your child is:

a. First medication

b. Significant improvement (no symptoms or close to normal)

c. Improvement (few or occasional mild symptoms)

d. Remission (fewer symptoms and less frequent recurrences)

e. Effective (all symptoms still present but less frequent recurrences)

f. Ineffective (hardly any improvement and worse symptoms)

10. How long have your child been stopped the use of inhaled or nasal spray hormones after desensitization treatment?

a. Still on medication

b. Within 3 months

c. 3 months to 6 months

d. 6 months to 1 year

e. More than 1 year

11. How many weeks desensitization take your child to complete initial treatment?

a. Initial treatment has not been completed

b. 14 weeks

c. 15-20 weeks

d. 21-28 weeks

e. More than 28 weeks

12.Has your child had any adverse reactions during desensitization treatment?

a. No

b. Yes, but not serious (only redness and swelling at injection site)

c. Experienced a large area urticaria throughout the body

d. Experienced a severe allergic reaction (Difficulty breathing, Shock, and etc.)

13. Frequency of adverse reactions：

a. None

b. 1 - 2 times

c. 3 - 5 times

d. Often

e. Every time

IV. Please choose the appropriate options for the following questions (the following are the knowledge dimension)

1. Which of the following species of dust mite can cause an allergic reaction: (assign 0 points for ab, 1 point for c, 0 points for d):

a. House dust mite only

b. Dermatophagoides farinae only

c. Both house dust mite and dermatophagoides farinae

d. Don't know

2. Only live dust mites can act as allergens to causing allergic reactions：（assign 0 points for a, 1 point for b, 0 points for c）

a. Correct

b. Wrong

c. Don't know

3. Which of the following diseases can be caused by dust mite allergy：（assign 0.5 points for abcd, 1 point for e, 0 points for f）

a. Eczema

b. Allergic conjunctivitis

c. Rhinitis d. Asthma

d. All of them

e. Don't know

4. Dust mites in the house mainly breed in bed sheets and bedding, carpets and curtains are not prone to breeding dust mites：（assign 0 points for a, 1 point for b, 0 points for c）

a. Correct

b. Wrong

c. Don't know

5. Plush toys are prone to breeding dust mites：（assign 1 point for a, 0 points for b, 0 points for c）

a. Correct

b. Wrong

c. Don't know

6. UV light can kill dust mites：（assign 0 points for a, 1 point for b, 0 points for c）

a. Correct

b. Wrong

c. Don't know

7. Freezing the plush toys or pillowcases in the refrigerator overnight can kill dust mites：（assign 1 point for a, 0 points for b, 0 points for c）

a. Correct

b. Wrong

c. Don't know

8. How many degrees hot water for washing bed sheets will be most effective in removing dust mites：（assign 0 points for abc, 1 point for d, 0 points for e）

a. 25℃

b. 35℃

c. 45℃

d. 55℃

e. Don't know

9. Indoor dust mites can be completely eliminated with a good job cleaning：（assign 0 points for a, 1 point for b, 0 points for c）

a. Correct

b. Wrong

c. Don't know

10. The desensitization treatment for dust mite allergy usually takes 3-5 years：（assign 1 point for a, 0 points for b, 0 points for c）

a. Correct

b. Wrong

c. Don't know

11. The medications of nasal spray hormone therapy for rhinitis or nebulised hormone therapy for asthma can be stopped during desensitization treatment：（assign 0 points for a, 1 point for b, 0 points for c）

a. Correct

b. Wrong

c. Don't know

12. There is no need to pay attention to removing and avoiding dust mites during desensitization treatment：（assign 0 points for a, 1 point for b, 0 points for c）

a. Correct

b. Wrong

c. Don't know

13. The desensitization of dust mite can treat rhinitis caused by dust mite allergy, but it can't prevent rhinitis from developing into asthma：（assign 0 points for a, 1 point for b, 0 points for c）

a. Correct

b. Wrong

c. Don't know

14.Those adverse reactions in desensitization treatment that require attention are（Multiple choice）:（assign 0.2 points for each option）

a. Itching of the palms of the hands and feet. Itchy scalp. Flushed skin all over the body. The appearance of urticaria

b. Immediate shock (altered mental state. Cold and clammy skin. Decrease in blood pressure)

c. Difficulty breathing. Rapid breathing. Hoarseness and other symptoms

d. Abdominal pain. Nausea. Vomiting. Urinary incontinence

e. Loss of consciousness. Loss of respiration. Loss of carotid artery pulsation

V. Please choose the appropriate options for the following questions

（the following are the attitude dimension，assign 4 points for a, 3 points for b, 2 points for c, 1 point for d）

15. Your concerns about dust mite infestation and dust mite allergy

15.1 You can't stand dust mites infesting your home：

a. Strongly agree

b. Agree

c. Unsure/Don't know

d. Strongly disagree

15.2 What is your attitude towards the possible health risks of dust mite infestation in children：

a. Very worried

b. Worried

c. Unsure/Don't know

d. Not worried at all

15.3 Even though you have follow the doctor's advice to reduced your child's exposure to dust mites by house dust mites removal, you are still worried about the dust mite allergy.：

a. Strongly agree

b. Agree

c. Unsure/Don't know

d. Strongly disagree

16. Your attitude to mite removal and desensitization treatment

16.1 Do you think it is necessary to regularly remove mites from your home：

e. Very necessary

f. Possibly necessary

g. Unsure/Don't know

h. Unnecessary

16.2 Do you think that desensitization treatment is an effective option for your child's rhinitis/asthma：

a. Yes

b. Probably yes

c. Don't know /Unsure

d. No

16.3 Do you think desensitization treatment needs to be carried out strictly according to medical advice (e.g. follow up consultation on time)：

a. Very needed

b. Needed

c. Don't know

d. Don't need

16.4 If your child has a relatively obvious reaction to the treatment, such as severe redness at the injection site or a rash around the body or even anaphylaxis, will you continue with the Desensitization treatment：

a. Persist

b. May persist, depending on the situation

c. May give up

d. Definitely give up

VI. Please choose the appropriate options for the following questions (the following are the practice dimension)

17. Targeted practice

17.1 Due to your child's dust mite allergy, have you and your family made a special effort to learn about relevant knowledge (including dust mites. dust mite allergy and desensitization treatment, etc.)（assign 1 point for Yes, 0 points for No）:

a. Yes

b. No

17.2Does your child use mite-proof bedding such as mite proof pillowcases and bedclothes (assign 1 point for Yes, 0 points for No, 0 points for Don't know)：

a.Yes

b. No

c. Don't know

17.3 Your child is currently using a pillow with a content material of (No points for this question)：

a. Latex

b. Down

c. Artificial fibre

d. Buckwheat hulls

e. Cotton

17.4 Your child is currently using a bedding with a content material of (No points for this question)：

a. Latex

b. Down

c. Cotton

d. Silk

e. Artificial fibre

17.5 Do you use dust mite controller to remove mites in your home（assign 1 point for Yes, 0 points for No, 0 points for Don't know）：

a.Yes

b. No

c. Don't know

17.6 Do you use instruments such as dehumidifier/air-conditioning, air cleaner, and etc. to remove mites in your home（assign 1 point for Yes, 0 points for No, 0 points for Don't know）：

a.Yes

b. No

c. Don't know

17.7 Do you use the decoration which prone to mites such as carpet in your home（assign 0 points for Yes, 1 point for No, 0 points for Don't know）:

a.Yes

b. No

c. Don't know

17.8 Do you or your family weekly wash your pillowcases and bedclothes（assign 1 point for Yes, 0 points for No, 0 points for Don't know）:

a.Yes b.No c.Don't know

17.9 Do you or your family use vacuum cleaner to clean your house every day（assign 1 point for Yes, 0 points for No, 0 points for Don't know）:

a.Yes

b. No

c. Don't know

17.10 Has your child had a delay in injections for some reason that caused treatment to be restarted or follow-up injections to be cancelled（assign 1 point for a, 0 points for b, 0 points for c）：

a. Never

b. Once or twice before

c. Frequently postponed