







Parental Perspectives on the Implementation of House Dust Mite Avoidance Measures for Children with House Dust Mite Sensitization

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ABSTRACT

Objective: The avoidance of house dust mite (HDM) is crucial in the management of HDM allergies. We aimed to demonstrate the implementation and perspective of the parents whose children had HDM allergy/sensitization to HDM avoidance measures.

Materials and Methods: Parents of the patients with HDM sensitization were interviewed via telephone questionnaires.

Results: One hundred and three patients with asthma (73.8%), allergic rhinitis (AR) (77.7%) and/or atopic dermatitis (AD) (29.1%) aged four to 18 years were included in the study. Seventy-one patients had multiple allergic diseases (68.9%). Of the parents, 39.8% fully adhered to HDM avoidance measures, and their education status was as follows: 41.5% illiterate/elementary/middle school, 31.7% high school, and 26.8% associate's degree/university. In addition, 32.2% of the mothers who were partially adherent (n=62) were illiterate or had graduated from elementary/middle school, 33.9% had graduated from high school, and 33.9% had an associate's degree or had graduated from university. Forty-one (39.8%) mothers were working, and most of them (61%) had graduated from university or had an associate's degree. Nearly half of the mothers who were partially adherent to HDM measures were working (n=32). In the multivariate analysis, the risk factors for partial adherence to measures was to be a working mother [OR:4.072, 95%CI: 1.350-12.882, p=0.013] and to have the belief that the measures were useless [OR:4.886, 95%CI: 1.499-15.923, p=0.008]. However, no relationship was shown between adherence to the measures and the severity of AR or AD, asthma control status and having multiple allergic diseases.

Conclusion: Full adherence to HDM avoidance measures was considerably dependent on the mothers' working status and belief in the ineffectiveness of the measures whereas there was no relationship to the severity of allergic diseases. This study also revealed how the education status of the mothers affected the adherence to allergen avoidance measures in real life.

Keywords: Children, *Dermatophagoides pteronyssinus*, *Dermatophagoides farinae*, house dust mites, avoidance measures, parents, pediatrics, questionnaire

INTRODUCTION

House dust mites (HDM) are among the most important allergens that trigger allergic diseases, and the most important allergenic product of HDM is their stools. These products are 20-25 µm in size and affect the eyes, upper and lower respiratory system, and the skin (1,2). The most important allergenic HDM include *Dermatophagoides pteronyssinus* (*D. pteronyssinus*), *Dermatophagoides farinae* (*D. farinae*), *Euroglyphus maynei*, and *Blomia tropicalis*, which is actually a storage

mite (3); and the most common mite sensitizations in Turkish children are with *D. pteronyssinus* and *D. farinae* (4).

The foods for HDM are fungi, bacteria, yeasts, and the shed skin cells of warm-blooded animals. HDM are found in locations where there are plenty of shed skin cells such as carpets, beds, and sofas which are suitable environments in terms of humidity, temperature, and the nutrient required for mites (5). Therefore, the first and the most important step in the management of HDM allergy

is protection from mites (6). In order to avoid HDM, selecting appropriate materials for bedding, comforters, and pillows; humidity control; cleaning floors and carpets, and using vacuum cleaners with High Efficiency Particulate Air (HEPA filters) are important (6). In allergy outpatient clinics, HDM avoidance measures are routinely explained to the parents of the patients with HDM sensitization; however, in practice, it is not always possible to implement these measures. Determination of the causes of patients' adherence to HDM avoidance measures is crucial in increasing the success of treatment. In this study, we aimed to demonstrate the implementation and perspective of the parents whose children had HDM allergy to HDM avoidance measures.

MATERIALS and METHODS

Patients

The study was conducted in May 2020 with the enrollment of children who were sensitized to HDM. A questionnaire was administered by telephone to the parents of the children with *D. pteronyssinus* and/or *D. farinae* sensitization. The files of a total of 118 patients with HDM sensitization were located, and 103 (87.3%) parents were contacted by telephone; all of the contacted parents agreed to participate in the study and answer the questions. Children aged four to 18 years with *D. pteronyssinus* and *D. farinae* allergies were included in the study.

Patients with chronic disorders other than allergic diseases were excluded from the study. Data on the allergic diseases (asthma, allergic rhinitis, atopic dermatitis) of the patients were collected from the patients' medical files. The diagnosis and classification of the severity of asthma, allergic rhinitis, and atopic dermatitis were done according to international guidelines (7-10). Parents were asked about the symptoms and severity of the allergic diseases of the patients; atopy in the family; drug usage for the allergic diseases; the educational level of the mother and father; the working status of the mother; the materials of the mattress, pillow, comforter, and cover of the bedlinen that the patient used; the curtains and carpets in the patient's room; the cleaning of the house; the dusting of the furniture; the presence of stuffed toys; use of a High Efficiency Particulate Air (HEPA) filter vacuum cleaner and/or an air purifier and humidifier; dampness in the house; the heating system of the house; individuals smoking in the home; aggravation of the allergy symptoms of the patient after coming from school; and information about HDM avoidance measures

and opinion about the usefulness of these measures. The working hours of the mothers were recorded according to the annual data published by the Turkish Statistical Institute (TurkStat) on their web pages (11) and the web page of <https://www.calismasaati.net> (12). There were 16 multiple choice or yes/no questions for the parents about the HDM measures. We could not find a scale to assess the adherence of the parents to the allergen avoidance measures for the questionnaire. Therefore, parents who mostly (75-100% according to the questions) applied the measures in their daily life were accepted as fully adherent while parents who sometimes applied the measures in their daily lives (50% to 75% and <50% according to the questions) were accepted as partially and non-adherent, respectively (13).

Two tests, The Childhood Asthma Control Test (C-ACT) and the Asthma Control Test (ACT) were implemented. The C-ACT, for children four to 11 years (14), includes seven questions: the first four questions asked to the children and last three questions asked to the parents; the ACT, for children 12 to 18 years old was administered to children + parents and children (15), respectively, to reveal the asthma control status of children (>20: well-controlled, 19-16; not-well controlled, <15; poorly controlled) (16). We asked the parents and adolescents about nocturnal and daily symptoms and checked the spirometry measurements of the patients in their medical files (17). Parents were also asked their opinion about the effectiveness of HDM control measures regarding controlling their children's allergic diseases, and the answers were categorized as completely useless, partially useful, and totally useful.

The age of the patient, the age of the patient at the time of HDM sensitization, the follow-up period of the patient, accompanying allergen sensitization, total immunoglobulin E (IgE) level, skin prick test (SPT) results, eosinophil absolute numbers, and spirometry measurements (Forced Expiratory Volume in one second, FEV1%, forced expiratory flow at 25-75% of the pulmonary volume, FEF25-75%, Forced Expiratory Volume in one second/Forced Vital Capacity, FEV1/FVC%) at the last visit were recorded from the medical files of the patients. The study was performed in accordance with the protocol approved by the local ethics committee (Hacettepe University, GO 20/510). The authors declare that research and publication ethics were complied with. All parents were informed about the study and provided oral informed consent.

Skin Prick Test

Skin prick tests (SPTs) were performed with *Alternaria alternata*, *D. pteronyssinus*, *D. farinae*, grass pollen mixture (*Avena sativa*, *Dactylis glomerata*, *Festuca pratensis*, *Lolium perenne*, *Phleum pratense*, *Poa pratensis*), tree pollen mixture (*Betula alba*, *Corylus avellana*, *Olea europaea*, *Quercus robur*, *Populus alba*, *Platanus vulgaris*, *Salix caprea*, *Ulmus campestris*), weed pollen mixture (*Artemisia vulgaris*, *Chenopodium alba*, *Plantago*, *Parietaria judaica*, *Salsola kali*), cat and dog fur, and cockroach allergen extracts (*ALK-Abelló, Copenhagen, Denmark); and positive (10 mg/mL histamine) and negative controls (0.9% serum physiological) on the upper back and volar face of the forearms of the patients who were under two years and above two years of age, respectively. SPTs were evaluated 15-20 minutes after the application, and a wheal diameter ≥ 3 mm was considered as positive (18).

Statistical Analyses

Statistical analyses were performed using the SPSS Version 22.0 statistical software package (IBM SPSS Statistics Chicago, Ill). Categorical values were not normally distributed; thus, the data are given as median

and interquartile ranges (IQR). The chi-square and Fisher exact tests were used to analyze differences between the groups in categorical variables. Non-parametrical continuous variables were analyzed using the Mann-Whitney U test and a Kruskal-Wallis analysis for two and more than two groups, respectively. A p-value of <0.05 was considered significant. Odds ratios (ORs) with relevant 95% confidence intervals (CIs) were calculated by univariate and multivariate analyses to reveal the predictors for partial adherence to HDM avoidance measures. Variables were selected if the p value was less than 0.20 in the univariate analysis and included in the multivariate analysis. A p-value of <0.05 was considered the risk factor in the multivariate analysis.

RESULTS

A total of 103 children (56.3% male) with a median age of 10.0 (6.8-13.2) years sensitized to *D. pteronyssinus* and/or *D. farinae* participated in the study. The questionnaire consisted of 38 questions, and all the parents were interviewed by telephone. The questions were mostly answered by the mothers because the mother (n=100, 97.1%) was generally reported as the primary caregiver.

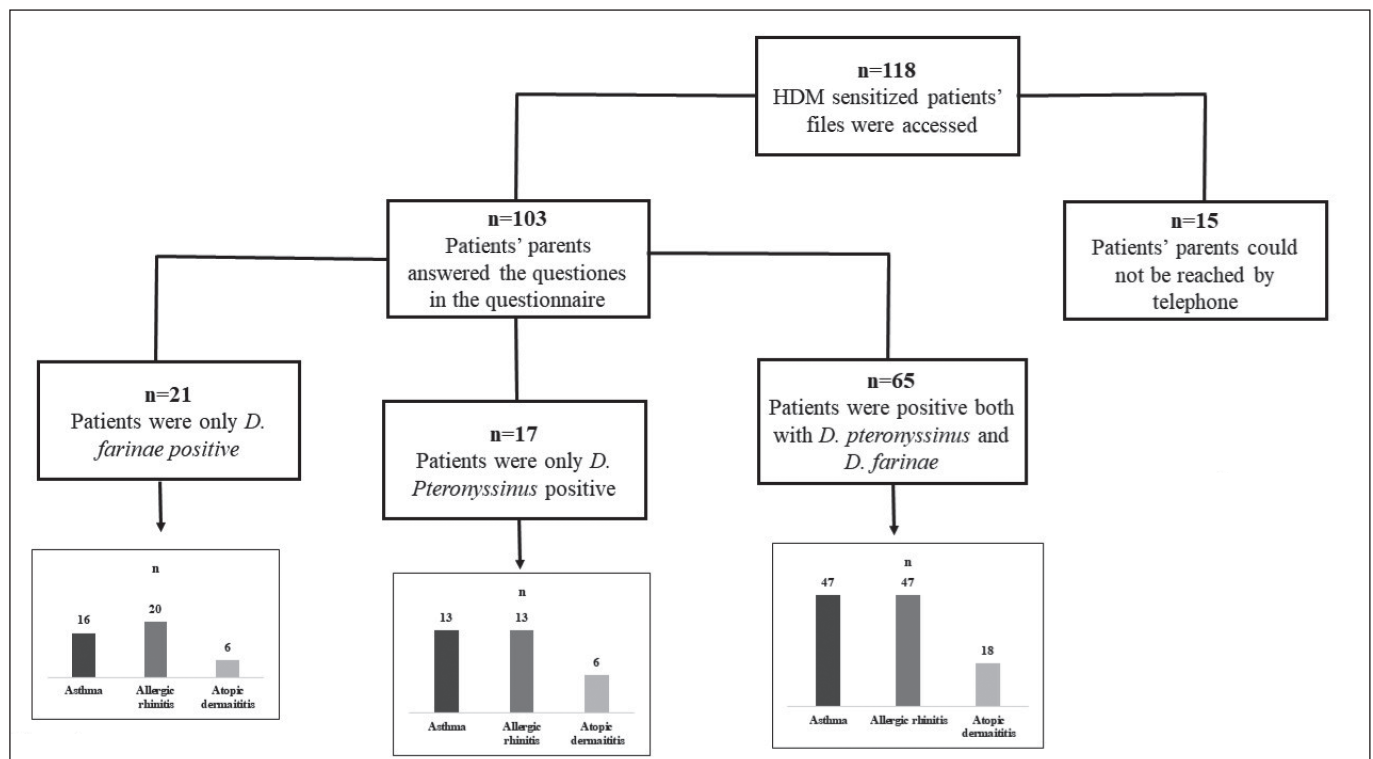


Figure 1. General characteristics of the study population.

Of the patients, 65 (63.1%) were sensitized to both *D. pteronyssinus* and *D. farinae*, and 38 (36.9%) were sensitized to either *D. pteronyssinus* or *D. farinae* (Figure 1). Almost half of the patients (n=52, 50.5%) also had sensitization to foods (7.7%), animal furs (25%), and aeroallergens other than HDM (69.2%). Eighty patients (77.7%) had allergic rhinitis, 76 (73.8%) had asthma, and 30 (29.1%) had atopic dermatitis. Of the patients, 57 (55.3%) had a family history of atopy. Of the patients with asthma, 57 (75%) were undergoing regular asthma treatment, 29 with low dose ICS (28.2%), four with low dose ICS+LABA (3.8%), 20 with medium dose ICS (19.4%),

and with medium dose ICS+LABA (3.8%). Twenty-six (of the 76 patients with asthma, 34.2%) patients with asthma were administered the ACT and 50 (65.8%) patients with asthma were administered the C-ACT to check the asthma control status of the patients (Table I). Of the patients who were administered the ACT and C-ACT tests, 9.2% (n=7) had not well-controlled asthma, 2.6% (n=2) had poorly controlled asthma, and 88.2% (n=67) had well-controlled asthma (Table I). The poorly/not-well controlled asthma group had worse spirometry results than the well-controlled (p<0.001 for FEV1%, p<0.001 for FEV1/FVC, p=0.012 for FEF25/75%) group. Spirometry

Table I: Demographical Features of the Study Population

Patients (n=103)	n	%	
Gender, male	58	56.3	
Age at diagnosis of house dust mite allergy (years)*	5.5 (4.0-7.4)		
Total IgE (kU/L)*	266.0 (101.0-415.0)		
Eosinophil count (absolute) (/mm ³)*	300 (200-500)		
Only DF positivity	21	20.4	
Only DP positivity	17	16.5	
DF and DP positivity	65	63.1	
Patients with polysensitization	52	50.5	
Pollen (grass, weed, tree)	35	67.3	
Mold	7	13.5	
Animal furs	13	25.0	
Cockroach	32	61.5	
Foods	4	7.7	
Asthma	76	73.8	
Spirometry measurements	FEV1%*	FEV1/FVC%*	FEF25-75%*
Poorly controlled/Not-well controlled (n=9)	78.5 (75.0-79.7)	79.5 (76.5-81.0)	79.0 (77.2-82.2)
Well controlled (n=67; 19 of them did not take regular asthma treatment)	94.0 (87.0-101.0)	94.5 (91.0-98.0)	103.0 (86.0-126.0)
Asthma Control Tests	<15 (poorly controlled)	16-19 (not well-controlled)	>20 (well-controlled)
C-ACT (n=50)	2	6	42
ACT (n=26)	0	1	25
Allergic rhinitis	80		77.7
Atopy in the family	57		55.3
Cough, shortness of breath upon exposure to house dust mite	61		59.2
Itchy, stuffy, and/or runny nose, sneezing upon exposure to house dust mite	74		71.8
Itching of the skin upon exposure to house dust mite	41		39.8

*: Median, Interquartile range, ACT: Asthma Control Test, C-ACT: Childhood-Asthma Control Test, DF: Dermatophagoides farinae, DP: Dermatophagoides pteronyssinus, FEV1%: Forced Expiratory Volume in one second, FEF25-75%: forced expiratory flow at 25-75% of the pulmonary volume, FEV1/FVC%: Forced Expiratory Volume in one second/Forced Vital Capacity, ICS: Inhaler corticosteroid treatment, IgE: Immunoglobulin E, LABA: Long-acting beta agonist.

measurements were similar between the well-controlled group under regular asthma treatment and patients with well-controlled asthma status without regular asthma treatment, except the FEV1 % results ($p=0.017$). Six of 76 patients with asthma had suffered an asthma attack during past four weeks, 26 (34.2%) had suffered an asthma attack in the previous 12 months, and seven of those 26 patients (26.9%) were given oral corticosteroid treatment for those asthma attacks. None of the patients had been hospitalized due to an asthma attack in the past year (Table I). Additionally, seven of the patients with AR ($n=80$) had moderate to severe persistent AR (7 of 80, 8.8%), and five of the patients with AD ($n=30$) had moderate to severe AD (five of 30, 16.7%).

The mother of two patients was illiterate (1.9%), the mother of 26 patients had graduated from elementary school (25.2%), the mother of nine patients had graduated from middle school (8.7%), the mother of 34 patients had graduated from high school in 34 (33.0%), and the mother of 32 patients had an associate's degree or was a university graduate (31.1%). Of the fathers, 14 (13.6%) had graduated from elementary school, 13 (12.6%) had graduated from middle school, 26 (25.3%) had graduated from high school, and 50 (48.5%) had an associate's degree or had graduated from university. Mothers of 41 patients (39.8%) were working, and most of them had graduated from university or had an associate's degree (25, 61%). The parents of ninety (87.4%) patients had information about HDM avoidance measures whereas the rest of the study population ($n=13$, 12.6%) did not know about HDM reduction strategies. For the parents of 61 (67.7%) patients, the source of information about the measures was physicians; for the parents of 19 (21.1%) patients, physicians and the internet were their sources of information, for the parents of seven (7.7%) patients, the internet was the only source of information, and for the parents of three (3.3%) patients, they obtained information from other sources (Table II).

No relationship was found between having multiple allergic diseases ($p=0.234$), having polysensitization ($p=0.778$) and full adherence to HDM avoidance measures. However, in patients with multiple allergic diseases ($n=71$), only *D. farinae* positivity ($p=0.046$), asthma ($p<0.001$), and allergic rhinitis ($p<0.001$) were common whereas both *D. pteronyssinus* and *D. farinae* positivity ($p=0.022$), smoking at home ($p=0.016$), and feeding pets with fur at home ($p=0.007$) were seen frequently in patients with

single allergic diseases. Conversely, the parents of the patients with polysensitization significantly avoided smoking compared to the parents of the patients with monosensitization (sensitization only to HDM) ($p=0.012$).

The parents of a total of 41 patients (39.8%) stated that they were fully adherent to HDM avoidance measures; the rest of the study population ($n=62$, 60.2%) could only partially adhere to the measures for a variety of reasons (Figure 2), and none of the parents were non-adherent.

Table II: House Dust Mite Avoidance Measures of the Parents

	n	%
Anti-allergy comforter/pillow for the child	16	15.5
HEPA filter vacuum cleaner	48	46.6
Carpet on the floor of the child's bedroom		
Nothing on the floor	17	16.5
Carpet/rug	75	72.8
Anti-allergy carpet/rug	11	10.7
Frequency of vacuuming/mopping of the floors		
Every day	26	25.2
More than once a week	74	71.8
Less than once a week	3	3.0
Frequency of dusting the furniture		
Every day	30	29.1
More than once a week	70	67.9
Less than once a week	3	3.0
Dampness at home	15	14.6
Feeding pets with fur at home at present	12	11.7
Smoking at home	40	38.8
The source of the information about house dust mite avoidance measures	90	
Physician	61	67.7
Physician+Internet	19	21.1
Internet	7	7.7
Other	3	3.3
Implementation of house dust mite avoidance measures		
Full adherence	41	39.8
Partial adherence	62	60.2
Non-adherence	0	0
The usefulness of house dust mite avoidance measures		
Absolutely useful	62	60.2
Partially useful	33	32.0
Completely useless	8	7.8

HEPA filter: High Efficiency Particulate Air filter vacuum cleaner

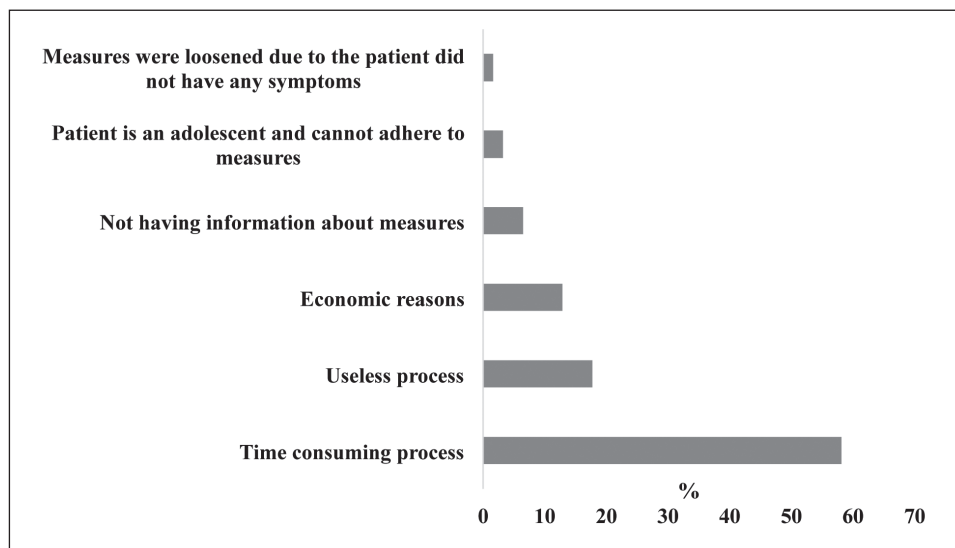


Figure 2. The reasons of partial adherence of the parents (n=62) to the HDM avoidance measures.

One of the reasons for the adherence levels of the parents was having the belief that HDM avoidance measures are a time-consuming process (n=36, 58.1%). This was followed by the belief in the measures being a useless process (n=11, 17.7%), economic reasons (n=8, 12.9%), not having information about the measures (n=4, 6.5%), being an adolescent patient (n=2, 3.2%), and loosening the measures because the patient had no symptoms (n=1, 1.6%). Furthermore, the parents of 62 patients (60.2%) thought that avoidance measures for HDM allergy were absolutely useful, parents of 33 (32.0%) patients thought that the measures were partially useful, and parents of eight (7.8%) of the patients thought that HDM avoidance measures were completely useless.

Of the mothers who were fully adherent to HDM avoidance measures, 17 (17 of 41, 41.5%) were illiterate or had graduated from elementary and middle school, 13 (13 of 41, 31.7%) had graduated from high school, and 11 (11 of 41, 26.8%) had graduated from university or had an associate’s degree. Twenty (20 of 62, 32.2%) of the mothers who could not fully apply measures were illiterate or had graduated from elementary and middle school, 21 of these mothers (21 of 62, 33.9%) had graduated from high school, and 21 of these mothers (21 of 62, 33.9%) had graduated from university or had an associate’s degree.

In the comparison of the education levels of the mothers and the house dust mite avoidance measure parameters, the frequency of cleaning the curtains (p=0.021), having a HEPA filter vacuum cleaner (p<0.001), having a tufted carpet or rug on the floor of the child’s bedroom (p=0.030),

having a carpeted floor at home (p=0.015), having information about house dust mite avoidance measures (p=0.020), the source of the information about house dust mite avoidance measures (p=0.025), and working status (p<0.001) were statistically different between the four groups. When we performed an analysis to discover which group or groups created the difference, we found that parents having an associate’s degree + university caused the difference in almost all of the parameters. Moreover, analysis of the cleaning frequency of the curtains revealed that most who were university graduates or had an associate’s degree cleaned the curtains every three months or less frequently (n=22, 68.8%) whereas the mothers with other education levels (illiterate-elementary school n=16, 57.1%, middle school n=8, 88.9%, high school n=24, 70.6%) mostly cleaned the curtains more than once every three months (p=0.002). Furthermore, mothers who were university graduates or had an associate’s degree preferred HEPA filter vacuum cleaner (75.0%) and untufted carpet or rug for the patients’ bedrooms (87.5%); however, illiterate-elementary school graduate mothers and mothers with a high school degree preferred to use carpets on the floors at home. Most of the mothers who were university graduates or had an associate’s degree had information about HDM avoidance measures compared to the mothers with other education levels. We observed that mothers with an associate’s degree or who were university graduates used the internet to get information about HDM avoidance measures more commonly than the mothers who were illiterate or graduated from elementary school (p=0.006) and mothers graduated from high school (p=0.037). In

addition, most of the mothers with an associate's degree or who were university graduates were working women compared to the mothers with other education levels.

We observed that mothers with an associate's degree or who were university graduates used the internet to get information about HDM measures compared to mothers who were illiterate or graduated from elementary school ($p=0.006$) and mothers graduated from high school ($p=0.037$). Most of the mothers with an associate's degree and university graduate were working women compared to the mothers with other education levels. However, there was no relationship between the fathers' education levels and having information about HDM avoidance measures ($p=0.315$), the thought of usefulness of the measures ($p=0.985$), and adherence to the measures ($p=0.596$).

According to the compliance with HDM avoidance measures in regard to the working status of the mothers, 62.9% of non-working mothers changed the bedlinen of the patient once a week whereas 43.9% and 41.5% of the working mothers changed them weekly and twice a week, respectively ($p=0.001$). Of the non-working mothers, 54.8% cleaned the curtains once a month; however, 31.7% of working mothers cleaned them every three months and only 34.1% of them once a month. Although 51.6% and 32.3% of non-working mothers cleaned the floors of the house twice a week or every day, respectively, 43.9% of the working mothers cleaned the floors twice a week and 34.1% once a week ($p=0.002$). Of the non-working mothers, 51.6% dusted the furniture twice a week and 33.9% dusted every day, 41.5% of the working mothers dusted twice a week, and 29.3% dusted once a week ($p=0.013$). Moreover, 51.6% of the non-working mothers fully complied with HDM avoidance measures while this ratio was only 22% for the working mothers ($p=0.002$). Although there was no statistical difference, working mothers frequently used the HEPA filter vacuum cleaner ($p=0.085$, 56.1% vs., 40.3%). Nevertheless, the ratio of usage of anti-allergy comforter/pillow (17.7% vs., 12.2%, $p=0.319$), or carpets (8.6% vs., 15.5%, $p=0.265$) was similar between working and non-working mothers.

Seven of the working mothers (7/41, 17%) were working four to six hours a day, 24 (58.5%) were working six to eight hours a day, and 10 (24.5%) were working eight to 12 hours a day. In the comparison of the HDM avoidance measures according to mothers' working hours, none of the mothers who were working eight to 12 hours a day had

pets with fur at home (four and three mothers who were working four to six and six to eight hours a day had pets with fur at home, $p=0.006$), and only mothers who were working eight to 12 hours a day used carpeted floors at home (none of the mothers who were working four to six and six to eight hours a day used carpeted floors at home).

Patients with an asthma attack in the previous 12 months had pets with fur at home before the determination of *D. pteronyssinus* and/or *D. farinae* sensitivity (20.4%) more frequently compared to the patients with no asthma attacks in the previous 12 months (3.8%) ($p=0.047$). The usage of an air purifier ($p=0.019$) and anti-allergy carpets ($p=0.014$) was frequent in patients who were given oral corticosteroid treatment in the previous 12 months. In the comparison of the patients with not-well ($n=7$)/poorly controlled ($n=2$) asthma (totally $n=9$, according to ACT scoring) with well-controlled asthma ($n=67$), we found that air purifier usage was significantly common in poorly/not-well controlled asthma group (22.5% vs 1.5%, $p=0.036$). Comparison of the ICS dosage (low, medium, high dose of ICS) and HDM avoidance measures revealed no difference. Moreover, no discrepancy was found regarding the belief in the usefulness of HDM avoidance measures, adherence to the measures and ICS dose, and the asthma control status of the patients. When the patients with asthma and without asthma groups were compared, having pets with fur at home ($n=4/76$, 5.3% in patients with asthma, vs. $n=8/27$, 29.6% in patients without asthma; $p=0.002$) and having anti-allergy carpets ($n=11/76$, 14.5% in patients with asthma, vs. none of the patients without asthma, $p=0.017$) were significantly different between these two groups. Parents of the patients with asthma significantly thought that HDM avoidance measures were completely useful ($n=51/76$, 67.1%) compared to the parents of the patients without asthma ($n=11/27$, 40.7%) ($p=0.032$). No relationship was found between the severity of AR ($p=0.900$), AD ($p=0.669$) and adherence to HDM measures and all other HDM avoidance measures. In addition, we found no relationship between adherence to HDM avoidance measures, age of the patient ($p=0.544$), and time of follow-up for HDM allergy ($p=0.215$).

In the multivariate analysis, to be a working mother [OR: 4.072, 95% CI: 1.350-12.882, $p=0.013$] and to have a belief in the ineffectiveness of HDM avoidance measures [OR: 4.886, 95% CI: 1.499-15.923, $p=0.008$] were the risk factors for partial adherence to the measures (Table III).

Table III: Risk Factors for Partial Adherence to House Dust Mite Avoidance Measures

	Univariate			Multivariate		
	OR	95% CI	p [†]	OR	95% CI	p [†]
Time to follow-up for house dust mite allergy (months)	1.105	0.973-1.256	0.125			
Having atopy in the family	0.577	0.257-1.293	0.182			
Not going to school due to an asthma attack in the last year	0.304	0.052-1.771	0.186	0.192	0.026-1.408	0.104
To be a working mother	3.793	1.555-9.250	0.003	4.072	1.350-12.882	0.013
Having thought of the ineffectiveness of house dust mite avoidance measures	3.793	1.555-9.250	0.003	4.886	1.499-15.923	0.008

[†]p should be <0.20, *p should be <0.05

DISCUSSION

This study revealed that working mothers could not fully adhere to HDM avoidance measures. The most important reason for partial adherence to the measures was the belief in HDM avoidance measures being time consuming according to the mothers. The belief in the ineffectiveness of the measures and being a working mother were the other risk factors for the partial adherence to HDM avoidance measures. In patients with multiple allergic diseases, *D. farinae* positivity, asthma, and allergic rhinitis were more common than in the patients with single allergic diseases; however, both *D. pteronyssinus* and *D. farinae* positivity, smoking at home, and having pets with fur at home were significantly higher in patients with a single allergy. Parents of the patients with polysensitization (sensitization to other allergens along with HDM) avoided smoking compared to the parents of the patients with monosensitization.

HDM avoidance measures are recommended and known to be effective in the prevention of allergic diseases in children with HDM sensitization (6). These measures aim to reduce or eliminate the exposure, resources, reservoirs, and factors that facilitate HDM allergies (6). The main point emphasized in these studies in general is that these measures are useful when they are applied in combination (19,20). Most of the studies have shown that using air purifiers (21), using HEPA filter vacuum cleaners (22), using impermeable mattress covers (23), and removal of the pet (24) did not improve pulmonary physiology, asthma control, exacerbations, hospitalization or inhaled steroid usage in case that each measure was applied individually. On the other hand, when parents performed these measures in combination, school absenteeism, asthma symptoms, and allergen levels considerably

improved (25-28). The most effective combination of these measures includes maintaining humidity at between 35% to 50%, washing the bedding regularly, vacuuming the home with a HEPA filter vacuum cleaner, and using mattress covers and pillow cases, (6). Humidity at home and in the living environment has been shown to have a particularly important role and to be risk factor in the aggravation of allergy symptoms (29).

However, full adherence to these measures may be difficult for the families due to the intense pace of real life. We found that working mothers and mothers with an associate's degree or who were university graduates could not fully adhere to HDM avoidance measures. Furthermore, to be a working mother was one of the risk factors for partial adherence to HDM avoidance measures, according to our results. The most important reason for this interesting outcome of our study was that about three out of four of these mothers with this educational level were mostly working, and they frequently stated that they did not have enough time for cleaning, dusting, vacuuming, and washing the mattress covers and pillow cases. This result was contrary to the previous study on HDM avoidance measures (30), which reported that the education level of parents did not influence the compliance with the measures. Additionally, Densen Lino et al. (30) showed that the economic status of the family influenced the purchasing of mite-proof pillowcases and mattress covers. On the other hand, Joseph et al. (13) showed that the cost (71%) and the belief in the time-consuming nature of the process of HDM measures (71%) were the most important reasons for non-adherence to HDM avoidance measures. In our study, economic reasons were the third most common reason (12.9%) whereas the thought of the time-consuming nature of HDM measures was the leading cause of partial adherence (58.1%). Economic reasons have

been emphasized in previous studies (30,31). Considering the socio-economic balances in the society, free or low cost anti-allergy products and HEPA filter vacuum cleaners should be provided for the patients with house dust mite allergy (30).

The current study population reported the belief in the ineffectiveness of HDM measures as the second most frequent cause of partial adherence to HDM measures (17.7). In fact, some studies have shown the ineffectiveness of HDM avoidance measures (32). Joseph et al. (13) also showed that a disbelief in the health benefits of HDM avoidance measures caused a lack of adherence to HDM measures but as only one of the less frequently reported reasons (4%) contrary to our results. In our study, 6.5% of the parents who could not fully adhere to the measures declared that they had no information about the measures. Joseph et al. (13) showed that 4% of the parents reported not having been told by the doctor to use measures. As reported, there are similarities in the studies in many respects, and the differences may be due to the socio-cultural and socio-economic dynamics of the societies.

In our study, we showed that the most important difference regarding the adherence to HDM measures was due to the mother's working status. When we analyzed whether the working hours of the mothers affected the compliance with HDM measures, the only difference between the groups was seen in having pets with fur and carpeted floors in mothers working eight to 12 hours, and carpeted floors was only seen in eight to 12 hours working mothers. Mothers working four to six hours a day (100%) and six to eight hours a day (58.8%) declared that they thought about the time-consuming process of HDM measures more frequently than the mothers working eight to 12 hours a day. Other than the working hours of the mothers, we observed that, although working mothers more frequently had HEPA filter vacuum cleaners than the non-working mothers, the most frequent partially adherent group was also working mothers. Altogether, we showed that the mothers' working status rather than the mother's working hours mainly affected adherence to the measures.

Most of the parents had information about HDM avoidance measures. While many of them obtained the information from their physicians, mothers with an associate's degree and who were university graduates also accessed the information via the internet. Nowadays, internet usage is widespread and access to internet can be

provided in small towns and even in villages. However, the education status of the parents is a much more important factor in whether the parent searched for the information inquisitively rather than having internet access at home. Indeed, we showed a relationship between the parents' education level and the information accessed on the internet about HDM avoidance measures. As shown in our study, it was emphasized in a previous report that when the education level of pediatric patients' families who applied to allergy clinics increased, internet usage also increased (33). In another study (34), it was shown that, regardless of the level of education, younger parents and parents of younger children had an increased tendency to using the internet for their children's health problems. On the contrary, regardless of the age of the patients, we only found a relationship between educational status of mothers and internet use.

Patients with HDM sensitization commonly experience concomitant allergic rhinitis and asthma over time (35). According to our study, 69% of the study population had multiple allergic diseases. Additionally, *D. farinae* positivity in our patients seems to be related to having multiple allergic diseases. However, we did not find a study associating *D. farinae* positivity with multiple allergies, as shown in our study. In a report conducted in adult patients (36), *D. farinae* positivity was associated with frequent respiratory symptoms and asthma attacks. Since asthma and allergic rhinitis coexistence is common (37), concomitant allergies may be seen in patients with *D. farinae* positivity. Nevertheless, more detailed studies should be conducted on multiple allergic diseases in patients with *D. farinae* positivity. On the other hand, the reason for less smoking and less frequently having pets with fur at home in patients with multiple allergic disease and less smoking in the parents of the patients with polysensitization may be that these patients behave more carefully because their children have many allergic sensitizations and allergic diseases.

In our study population, parents of the patients who were given oral corticosteroid treatment in the previous 12 months used air purifiers and anti-allergy carpets more frequently compared to the other patients. Furthermore, the parents of the patients with not-well/poorly controlled asthma used air purifier more commonly than those of the well-controlled asthma group. This may be because parents with severe asthma attacks try to implement not

only cleaning, washing, or dusting measures, but also all the other measures to completely eliminate HDM. On the other hand, no relationship was found between the severity of AR, AD, asthma status, and adherence behavior to HDM avoidance measures.

An important limitation of the current study is that it was a cross-sectional study, and therefore long-term compliance cannot be evaluated. Another limitation is that, since the study was conducted with a small population, the results cannot be generalized to the entire population of the patients with HDM sensitization. The most important strength of this study is that it showed the adaptability of families to these allergy alleviation measures in real life. The current study is also valuable because it revealed the importance of sociocultural and socioeconomic factors in compliance with HDM avoidance measures.

In conclusion, full adherence with HDM avoidance measures depends considerably on the mothers' working status and the belief in the ineffectiveness of the measures. This study revealed that the education status of the mothers considerably affected adherence to the measures in real life.

CONFLICT of INTEREST

We certify that we have no actual or potential conflicts of interest in relation to this article. The study was performed in accordance with the protocol approved by the local ethics committee (Hacettepe University, GO 20/510).

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