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Species Identification and Prevalence of House Dust Mites as Respiratory Allergen in Kindergartens of the Bandar Abbas City

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ABSTRACT

The aim of this study was to identify the species and prevalence of house dust mites (HDMs) in kindergartens in Bandar Abbas, south of Iran.

In this study 10 kindergartens were selected randomly in five areas of Bandar Abbas. Two dust samples were collected from each sampling place with a vacuum cleaner. Mites were isolated and mounted in Hoyer's medium and identified using a morphology-based key.

In total, 1758 mites were collected and identified, which consisted of five species: *Dermatophagoides pteronyssinus* (31.06%), *D. evansi* (23.49%), *D. farinae* (17.75%), *Ornithonyssus bacoti* (19.45%), and *Cheyletus malaccensis* (8.25%). Two main allergenic dust mite species *D. pteronyssinus* and *D. farinae*, coinhabited and were collected from all of kindergartens.

Results of this study have revealed that *D. pteronyssinus* is the most prevalent HDMs in Bandar Abbas Kindergartens and all studied areas are contaminated by more than one dust mite. Regarding the high prevalence of HDMs in Bandar Abbas kindergartens, implementation of strict control measures is necessary for reduction of mite population and prevention of children respiratory diseases and other allergic disorders in this city.

Keywords: Bandar Abbas; Hose dust mite; Iran; Kindergarten

INTRODUCTION

Allergy is a global disease induced by indoor and

outdoor environmental allergens.¹ House dust mites (HDM) are one of the main sources of allergens in human indoor environments, causing allergic diseases

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such as rhinitis, asthma, and atopic dermatitis.^{1,2} Respiratory allergies, particularly allergic rhinitis, are among the most common allergies within various populations all over the world.¹ The prevalence of allergic respiratory conditions is increasing worldwide and may be as high as 40% in children in some developed countries.^{3,4}

Among aeroallergens, indoor allergens have a great role in allergic sensitization. For example, in the very warm seaport of Bandar Abbas people spend most of their time indoors and several studies have shown that sensitization to indoor allergens correlates well with indoor allergen exposure.^{5,6}

HDM, animal dander, cockroach and moulds are the main sources of indoor allergens.⁷ Among these allergens, HDMs have been considered as the major source of allergens and are associated with more than 50% of allergic diseases in clinics.⁸ Many studies around the world have documented their role in the sensitization and development of allergic symptoms, particularly in asthma and rhinitis and it has been reported that 60-100% of asthmatic subjects have hypersensitivity to HDMs allergens.¹

HDMs are cosmopolitan and live in human habitats; however, there are differences in their numbers, allergens and condensation in different locations.⁹ They inhabit areas and items of the house, as well as the workplace, which comply with their survival requirements.⁸ Mites are seen in bedding, carpets, soft furnishings, soft toys, books, and clothing. They feed mainly on skin scales shed by humans and their pets, which are colonized by fungi, yeasts and bacteria, although they may also take advantage of other organic detritus that accumulate in houses.⁸⁻¹⁰

HDMs have been recognized in the past 30 years as one the most important source of allergens in human.^{11,12} The severity of allergic reactions may depend on factors such as the number of mites and their concentrations.¹³ Typically, there are 300 mites per 1 gram of house dust and 5,000 mites can be found in just 1 gram of mattress dust under ideal breeding conditions. Above 100 mites per g are weighed as a risk factor for sensitization to allergies.⁹

The most common dust mite species around the world include *Dermatophagoides pteronyssinus*, *Dermatophagoides farinae*, *Euroglyphus maynei* and *Blomia tropicalis*.⁸ Two species of *D. pteronyssinus* and *D. farinae*, are associated with allergic diseases, such as bronchial asthma, rhinitis and atopic

dermatitis.¹¹ There is little information about the HDMs in Iran but studies have shown that *D. pteronyssinus* is the most prevalent species.¹⁴⁻¹⁶

Many factors including temperature, humidity, and altitude may influence mites' growth and prevalence.¹⁷ Bandar Abbas is a seaport in the south of Iran with subtropical climate with relative humidity and average annual temperature of 64.4% and 21.5°C, respectively. Such situations are favorable for reproduction of HDMs.⁸ Hence; this study was carried out to determine the species composition and prevalence of HDMs in Bandar Abbas kindergartens.

MATERIALS AND METHODS

Study Areas

This study was carried out in Bandar Abbas, capital city of Hormozgan province, south of Iran. It is the largest seaport in Iran and situated at an altitude of 10 m in a coastal area. The city has an area of 45 km² and is located between latitudes 26°53'-27°31' N and longitudes 54°53'-56°03' E with a population of approximately 449000 in 2016 (Figure. 1). Bandar Abbas city has a warm and humid climate with mean annual temperature of 26.6°C ranging from 15.7 to 33.6°C. The annual average of rainfall in October-April has been 293.5 mm during 2014–2015. The annual averages of minimum and maximum relative humidity are 51% in November and 72% in August (Figure 2).

Sampling and Identification of Mites

To calculate the sample size, the maximum variability was assumed to be 50% ($p=0.5$). With 95% confidence level and $\pm 5\%$ precision, the minimum number of HDMs determined using the formula ($n=z^2pq/d^2$) was 384. Based on the number and distribution of kindergartens the study area was divided to five sampling regions (Figure 1). In each sampling region 2 kindergartens were randomly selected. Two dust samples were collected from each kindergarten. Mite sample was collected at different times in 2014.

Dust was collected from 1 m² of the surface of each sampling place in 2 min with a vacuum cleaner. A cellulose filter was located inside the vacuum cleaner and after vacuuming, filters were placed in a plastic bag. Dust samples were immediately frozen to avoid mite reproduction. Samples were transferred to the laboratory for isolation and identification of mites. In the laboratory, dust samples were weighed and

Species Identification and Prevalence of House Dust Mites as a Respiratory Allergen



Figure 1. Map of Iran showing Hormozgan province, Bandar Abbas city, and regions in which the species and prevalence of house dust mites were evaluated in kindergartens

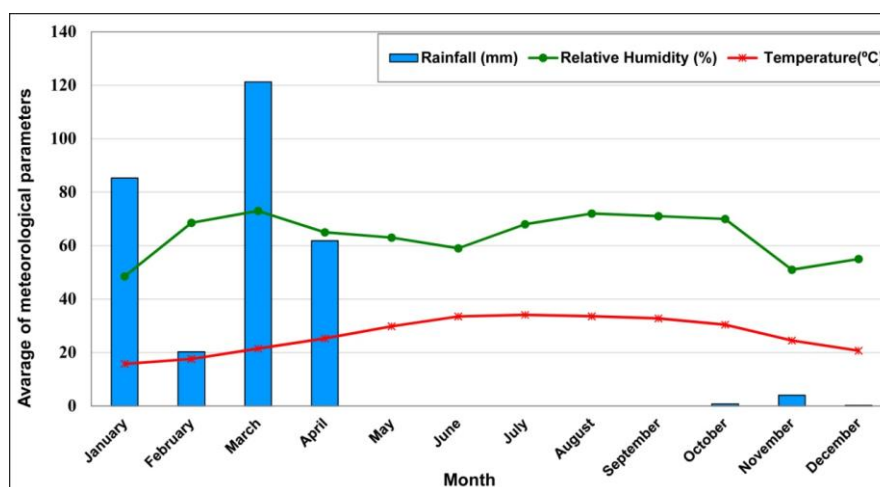


Figure 2. Average of meteorological parameters affecting prevalence of mites including rainfall, temperature and humidity during 2014-2015 in Bandar Abbas, southeast of Iran

separated into 50 to 100 mg aliquots. To isolate the mites, ten mL of 90% lactic acid was added to 100-250 mg of the dust sample. This mixture was heated until boiling and diluted with 90 mL distilled water. Individual mites were removed

using a fine needle under a stereomicroscope and identified under a compound microscope. The mites were then placed into 2 drops of Hoyer's medium in order to prepare permanent slides. Prepared slides were incubated for 24-48 hours. Finally; mites were counted and identified according to Colloff & Spieksma.¹⁸

RESULTS

In this study, a total of 40 dust samples were collected from 10 kindergartens in different areas of Bandar Abbas. Mites were detected in 37/40 samples (92.5%) and in all of kindergartens. 1758 mites including 1271 HDMs were collected and identified according to their morphological characteristics. Collected mites were classified into five species and three genera including *Dermatophagoides pteronyssinus*, *D. farinea*, *D. evansi*, *Ornithonyssus bacoti*, and *Cheyletus malaccensis*.

Dermatophagoides pteronyssinus of the Pyroglyphidae family was the main species and present

in all mite-positive samples. *D. evansi* and *D. farinea*, another species of the Pyroglyphidae family with 23.49% and 17.75% were respectively the second and the third most frequent species (Table 1). *Ornithonyssus bacoti* of the Macronyssidae family and *Cheyletus malaccensis* of the Cheyletidae family were the next frequent species (Table 1).

As shown in Figure 2, the most abundant species of Pyroglyphidae family were *D. pteronyssinus* (42.9%), *D. evansi* (32.5%), and *D. farinea* (24.6%), which together accounted for 72.3% of the total collected mites. In this study all of kindergartens were infected with more than one species of mites.

Table 1. Species identification and prevalence of mites in different kindergartens of Bandar Abbas districts, south of Iran, in 2014

Mites	Kindergartens in each district of Bandar Abbas											
	Amirabad		Syed-kamel		Azadegan		Ziba-shahr		Gol-shahr		Total	
	No.	%	No.	%	No.	%	No.	%	No.	%	No.	%
Pyroglyphidae												
<i>D. pteronyssinus</i>	211	38.6	130	23.8	77	14.1	73	13.4	55	10.1	546	31.06
<i>D. evansi</i>	197	47.7	128	31.0	52	12.6	28	6.8	8	1.9	413	23.49
<i>D. farinea</i>	98	31.4	70	22.4	48	15.4	46	14.7	50	16.1	312	17.75
Macronyssidae												
<i>O. baccoti</i>	71	20.8	49	14.3	137	40.1	52	15.2	33	9.6	342	19.45
Cheyletidae												
<i>C. malaccensis</i>	44	30.3	34	23.4	21	14.5	25	17.2	20	13.8	145	8.25
Total	621	35.3	411	23.4	335	19.1	225	12.8	166	9.4	1758	100

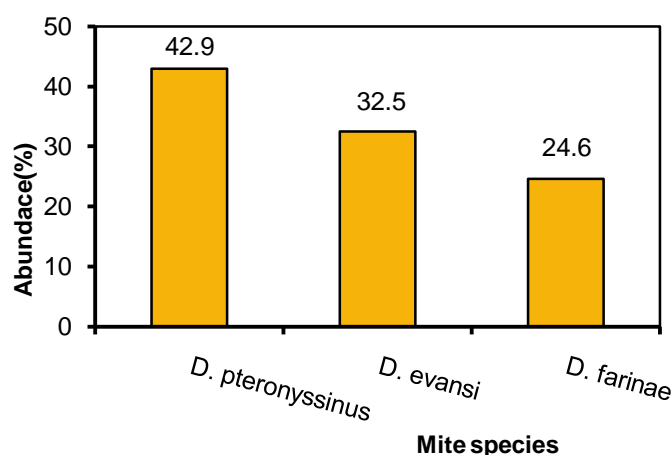


Figure 2. Species composition and prevalence of pyroglyphid mites in Bandar Abbas Kindergartens, south of Iran, in 2014

DISCUSSION

The present results confirm that HDMs are prevalent in Bandar-Abbas Kindergartens.

In this study, *Dermatophagoides pteronyssinus* was the most dominant species with frequency of 42.9% of the pyroglyphid mites and 31.06% of the total mites' population. Similarly, in a study in the residential areas in Iran, this species was reported as the dominant species with a relative frequency of 90%.¹⁴ In two recent studies conducted in hotels and residential areas in Bandar Abbas, 86% and 63.1% of the collected mites belonged to *D. pteronyssinus* species.^{15,16} Results of a study in Williamsburg, Virginia, United States also showed high prevalence of *D. pteronyssinus* species in residential areas.¹⁹ Moreover, it has been reported that *D. pteronyssinus* is the most commonly dust mite found in houses in Europe.²⁰ Similar findings were also reported from coastal and subtropical areas including Saudi Arabia, Taiwan, and Hong Kong.²¹⁻²³

Dermatophagoides pteronyssinus is inevitably found in every house, predominantly in the areas of the world with high relative humidity (>45%) and warm temperatures, from 65 to 85°F.²⁴ A probable reason for high density of *D. pteronyssinus* in our study area is high relative humidity and temperature, because this area is located on the north shore of the Persian Gulf and has a humid subtropical climate.

According to the results, *Dermatophagoides evansi*, another species of pyroglyphid mites was the second frequent species with a frequency of 23.49% and collected from all of kindergartens. Results of different studies in Iran show low prevalence of this species in residential areas. For the first time

Amoli and Cunnington reported small numbers of *D. evansi* in different parts of Iran.¹⁴ In a recent study conducted in residential areas of Bandar Abbas, only 4.1% of the collected mites were *D. evansi*.¹⁶ It has also been reported in other countries such as Russia, the Baltic States, Poland and Bulgaria.²¹ *Dermatophagoides evansi* has been reported to be associated mostly with poultry.²⁵ The presence of this species in the studied kindergartens may be due to the fact that neighbors keep poultries in their homes.

In this study, *Dermatophagoides farinae* relative frequency was 17.75%. Results of recent studies in this area showed that the frequency of this species in the hotels and residential areas were 11.6 % and 32.8%, respectively.^{15,16} This finding is in agreement with

results from Turkey, which showed low prevalence of this species with a frequency of 12% of pyroglyphid mites.¹⁷

Dermatophagoides farinae is mostly prevalent in dry continental climates, rare in coastal climates such as the Mediterranean and Black Sea regions of Turkey, the British Isles, absent in Central Africa and Cuba, and is not fully established in terms of prevalence in some geographical areas.^{17,26} Accordingly, low frequency of *D. farinae* in our study area can be attributed to unfavorable environmental conditions such as high level of humidity.

HDMs including *D. pteronyssinus* and *D. farinae*, are the most important mite species in terms of allergenicity and clinical relevance.²⁷ They have two major allergens, Der p 1 and Der f 1, which elicit IgE antibody responses in the majority of patients who are sensitive to pyroglyphid mites.^{6,27}

In some studies carried out on *D. farinae* in the United States, Singapore, and Turkey it was revealed that despite its low density, compared with *D. pteronyssinus*, it can play an important role in the allergy symptoms in sensitive people.^{1,17}

HDMs have been reported as respiratory allergens by different studies in the Middle East region. In this regard Hasnain et al. carried out an investigation on patients from Saudi Arabia, United Arab Emirates, and Sudan with respiratory allergy to explore sensitization to locally prepared allergenic HDM extracts. They found *D. pteronyssinus* followed by *D. farinae* extracts as the main causes of allergenicity in the studied patients.²⁸ Other studies in Iraq, Kuwait, Qatar, Jordan and Palestine have also demonstrated *D. farinae* and *D. pteronyssinus* as the main HDM allergens.²⁹

According to the results of a study in Iran, 19% and 18% of asthmatic patients who referred to a private clinic close to Tehran showed a positive response to *D. pteronyssinus* and *D. farinae*, respectively.³⁰ Moreover, a recent study conducted on 299 allergic patients in the southwest of Iran showed 32.1% and 27.1 % positive skin prick test in the case of exposure to extracts of *D. farinae* and *D. pteronyssinus*, respectively.³¹ According to the results of a similar study in Mashhad, Iran prevalence of positive skin prick test to *D. farinae* and *D. pteronyssinus* was found to be 17.5% and 20.1% , respectively.³²

In addition, results of atopy studies using skin prick test to find most common aeroallergens among allergic patients in several cities of Iran including Shiraz, Yazd,

and Sari revealed *D. farinae* and *D. pteronyssinus* as the main HDM allergens.²⁹

Since common dust mite species including *D. pteronyssinus*, and *D. farinae* feed mainly on skin scales shed by humans and other organic detritus that accumulates in houses, the prevalence of these mites can be controlled by good housekeeping. Moreover, as HDMs satisfy their requirement of water by taking up vapor from the surrounding, maintaining a low humidity indoors is considered as an effective measure to reduce the prevalence of HDMs.¹ Since educational intervention has been reported to be effective in increasing community involvement and reduction of prevalent insect-borne diseases³³, it is important to provide appropriate educational programs directed toward parents, teachers, and students to increase community health awareness about HDMs and related health risks.

Mites can be transferred to public places such as kindergartens on the clothes, skin, or hair, and will form an active population if the new environment provides favorable feeding opportunities, temperature and humidity.³¹ In addition, exposure to HDM allergens may be increased due to spending more time indoors, more insulation, poor ventilation for energy saving causes, and carpeting in kindergartens, making them an ideal habitats for dust mites.¹⁰

In summary, results of this study show that all kindergartens in Bandar Abbas are contaminated with more than one dust mite species. Two main allergenic dust mite species *D. farinae* and *D. pteronyssinus* coinhabited and were the most prevalent species in the studied area.

Regarding the high prevalence of HDMs in the kindergartens, implementation of strict control measures is necessary for reduction of mite population and prevention of pediatric respiratory diseases and other allergic disorders in this city. The control measures should include increasing public awareness, use of fibreless furnishings, proper building maintenance, ventilation, and regular cleaning. Additionally, further studies are needed to identify HDM allergens and their association with the prevalence of different allergic diseases in this area.

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Species Identification and Prevalence of House Dust Mites as a Respiratory Allergen

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