

HOUSE DUST MITES - WHAT MIGHT A MITE DO?

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Summary

House dust mites are very tiny arachnids that inhabit our houses, live in our beds and living rooms and feed on our sloughed skin scales. They thrive in warm and humid atmosphere. They never cause disease by themselves; however they excrete faecal pellets rich in proteolytic enzymes. These faecal pellets are very allergenic to humans. They are the main cause of the indoor allergies. It is very difficult to get rid of dust mites or to avoid their antigens at houses. Recommended measures are described to avoid exposure to the mite's allergens. These measures focus mainly on decreasing humidity to less than 50% to kill mites. Dust control is also important by keeping the house clean through the use of vacuum cleaners with HEPA filters, encasing bed mattress, pillows in dust-proof covers, regular washing of bed linen and covers,

removing carpets or replacing them with easy to clean small ones.

1. Introduction

As soon as you put your head on your pillow, don't ever think that you are alone. Tiny invisible, unfelt and uninvited small creatures are with you in bed and on your pillow. These organisms are the house dust mites.

The term "house dust mites" has been applied to a large number of mites found in association with dust in dwellings. There is not a house without them, but some houses contain huge numbers and other houses contain almost very few. This does not only depend on cleanliness, but depends very much on the amount of moisture in the house. Dry houses in very cold climates or on high mountains have few mites, but houses in temperate climates and normal altitudes have more.

Humans knew houses after living in caves and shelters for centuries. The first known permanent human settlement was in the village of Zawi Chenui in houses made of mud and reeds at the Turkish- Iranian borders 9000 years before Christianity. In the 17th century, scientists became interested in the dust of houses. In the year 1694, mites were observed in dust, and in 1964, the association of house dust mites with allergies was demonstrated. Since then studies have been carried out to highlight the role of house dust mites in relation to the indoor asthma and allergy.

2. Taxonomy and Natural History of House Dust Mites

Acarology is the science of mites which are members of the Class: Arachnida (relatives of scorpions, spiders and ticks). There are about 16 genera and 46 species of dust mites. The most prevalent in the dust environment are members of the family Pyroglyphidae. The most common members associated with allergy are:

- *Dermatophagoides pteronyssinus*.
- *Dermatophagoides farinae*.
- *Dermatophagoides microceras*.
- *Euroglyphus maynei*.

Dust mites are cosmopolitan in distribution. *Dermatophagoides pteronyssinus* and *Euroglyphus maynei* are more common in Europe, while *Dermatophagoides farinae* is especially common in North America. Other species are usually regarded as storage mites and may also occur in houses. *Blomia tropicalis*, found in house dust in the tropical or semitropical areas, is not easily classified as either a storage mite or Pyroglyphid. They are especially important as they occur in large quantities in houses and their extracts can elicit allergic skin reactions.

3. Morphology of Dust Mites

A mite has a tiny oval or globular body (0.2-0.4 mm. in size). It has a bilaterally symmetrical body, covered with tough translucent, white to light tan colored cuticle. This cuticle has deep striations and long setae (hairs) extending from the outer margins

of the body and shorter setae on the rest of the body. It is blind, with no wings and no antennae. It has four pairs of legs, each ends with a pair of claws and its mouth parts are protruded anteriorly in the form of a capitulum armed with chelicerae. Although the dust mites are closely related to insects, they are easily distinguished from them by having eight legs instead of six in their adult stages. Also, a little trace of body segmentation could be elicited in mites in contrast to the obvious head, thorax and abdomen in insects.

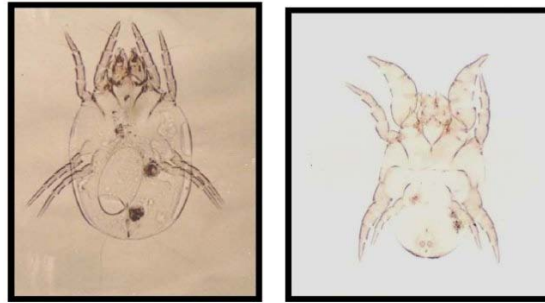


Figure 1. Male and female *Dermatophagoides farinae*

4. Life Stages of Dust Mites

The development of *Dermatophagoides* species from eggs to adults usually takes from 19 to 33 days at favorable conditions of temperatures between 22°C and 32°C and about 75% humidity. The adults live up to 6 weeks, during which they can mate one to three times. House dust mites go through five major life stages in an incomplete metamorphosis. These stages are: egg, larva, protonymph, tritonymph and adult. Between these stages the mite molts shedding its old chitinous skin. A male may attach itself to a second stage nymph female and mate when it reaches the adult stage. Mated females live about two months. *D. farinae* lays an egg /day, over 30 days. *D. pteronyssinus* lays about 80 eggs singly or in small groups of three to five, over a 45 days period.

5. Ecology and Habits

The Dust mite avoids light, burrows into the fabric to find darkness. It clings strongly with its claws to the fibers of furniture, so can not be inhaled. It has a thin permeable skin that makes it sensitive to water loss by the low humidity. That is why it requires 60 - 80% relative humidity and a temperature about 25°C to survive. Mites lack respiratory organs and spiracles for ventilation. They exchange gases through their cuticles.

5.1. Feeding Habits

House dust mites do not sting or bite and do not transmit any disease causing pathogen. The name *Dermatophagoides* is a good description of the nature of these mites (in Greek: *derma* means: skin, and *phagein*: means to eat), so primarily these mites are skin eaters. Dust mites consume minute food particles. Human and animal dander (shed skin

scales) constitute the main food, plus fine crumbs of food eaten in bed.

Scientists estimated that human shed about 1/5 ounce of dander (dead skin) /week. In a life time, man may shed up to 40 pounds of skin flakes. About 80% of the material seen floating in a sunbeam in a room is actually skin flakes. Dust mites are also more abundant in the areas where pets sleep as they are rich in animal dander.

Dust mites have a rudimentary alimentary tract without a stomach. Skin flakes are fatty and too dry for mites to ingest, so a previous preparation of food is essential. This is achieved by the help of a fungus: *Aspergillus repens* that makes these newly shed skin scales softer and perfect for the mite's nutritional needs by taking out fat and adding water.

5.2. Excretion of Faecal Pellets

The house dust mites are known to partially digest food and produce faecal pellets rich in protein. They re-chew their partially digested faecal pellets up to six times until they almost extract all their nutrients. When these faecal pellets are finally excreted, they will be full of very allergenic proteolytic enzymes. A dust mite may produce 20 faecal pellets/day. That is 200 times its own weight in faeces during its short life time. It has been estimated that a gram of house dust (~ 1/2 of a tea spoon) contains as 1000 dust mites plus up to 250 000 faecal pellets. These faecal pellets contain very strong allergenic substances responsible for human illness, besides allergens contained in their secretions and cast chitinous skin shed during their growth and molting. Dust mites are capable of the production of 10 identified groups of allergens responsible for production of allergy. Other mites e.g. storage mites produce similar antigens which may be responsible for similar symptoms in humans.

5.3. Hosts

Dust mites live in the vicinity of houses of man and habitat of other mammals. They are also common in the resting places of pets, nests of birds, and occasionally in bee hives.

6. Effect on Health

Over the past 20-30 years, the number of dust mites has dramatically increased in homes. The modern central heating, loft, soft furnishings, wall to wall carpets especially the high pile varieties and the energy-saving measures such as double glazing, wall insulation and others are important causes associated with this dramatic increase in the mite population indoors. Besides, it is noteworthy that many houses are small with smaller rooms and lower ceilings; this may reduce ventilation inside the houses, trap dust, provide darkness and encourage warm and moist conditions needed by mites.

Exposure to the antigens of mites occurs mainly indoors, and this is usually shown in the appearance of signs and symptoms of asthma or allergy. The idle style of life recently led by many people, spending longer time watching TV, video or using computers rather than carrying out outdoor physical activities as walking, running, cycling or gardening, increases the chance for exposure to the indoor allergens of dust

mites.

6.1. Environmental Factors associated with Increasing Sensitivity to Mite Allergens

- The structure and age of the home: The old houses may contain dust, moulds, and fungi and may encourage mites. On the contrary the modern buildings with smooth walls and floors are not favorable for mite's living.
- The system of heating and ventilating: The proper ventilation will decrease humidity indoors depriving mites from an important factor for survival.
- The type of furnishings: The use of fluffy fabrics for furnishings makes a proper hiding site for mites.
- The number of household occupants: The more crowded are the rooms, the better chance for humidity and dust collection.
- The domestic cleaning methods: Most of the conventional cleaning methods depending on dusting and use of ordinary vacuum cleaners allow the mites antigens to become air-borne and increase the allergic manifestations.

7. The Common Sites for House Dust Mites

Dust mite populations are highest in humid regions and lowest in areas of high altitude or dry climates. They have highest densities in hot humid summer and lowest in cold drier winter season.

Mites live in the fine layer of dust that continually settles on household items. They prefer mattresses, pillows, covers, upholstered furniture, carpets, curtains and soft stuffed toys where they can hide. They also may be in clothes, where they can be transmitted to other sites.

8. Exposure to House Dust Mite Allergens

House dust mites share our beds. Beds are the prime habitat for man, where at least one third of man's life is spent and also for mites. Mites prefer warm, moist surroundings such as the inside of a mattress or a pillow when someone is sleeping or setting in bed. Humidity is maintained in beds by perspiration, breathing, saliva and wet hair after a shower.

Some scientists presumed that a typical used mattress may contain from 100,000 to 10 million mites inside. It was estimated that about 10% of the weight of a two years old pillow can be composed of dead mites and their droppings. Studies showed that during one night sleep, most people toss and turn up 60-70 times, making possible for mite droppings to be inhaled.

Routine human activity such as housecleaning, walking, playing on carpeting, or making the bed causes the tiny fecal particles ranging from 1-20 microns in size, to become air-borne and easily inhaled. Crawling and playing of young kids on carpets may result in their exposure to the air-borne mite droppings moved and circulated by their activity.

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Biographical Sketch

Dr. Nadia El-Dib, born in Gharbeya, Egypt in 1947, is a medical graduate, from Alexandria University, branch of Tanta in 1971. She pursued her postgraduate studies and training in Kasr El Ainy Teaching Hospital, which is the main teaching hospital for Cairo University. She was appointed in the Parasitology Department, Cairo University as a Parasitology instructor (1973-1976), Assistant lecturer (1976-1983), Lecturer (1983-1988), Assistant professor (1988-1994) and then was appointed as Professor of Parasitology in 1994.

She worked as a head of Schistosomiasis, Malaria & Public health Laboratories in Taif, KSA (from 1984-1989). In 1997- 2002, became Head of The Diagnostic and Research Unit in the Parasitology Department, Cairo University. Assisted in the establishment of The Parasitology Department in Taibah University, Madinah, KSA in 2002. Worked as the Head of the Parasitology team in a project with the National Institute of Science and Technology, Cairo, Egypt in 1992, and as a principal investigator of a project of Fascioliasis in 1998- 2002, and a Consultant in the Project of Intestinal Capillariasis in Egypt, with the National Academy of Science & Technology, Cairo, Egypt. During her career she was co-author in 4 books, supervised many master and MD thesis and published more than 50 papers in National and International Journals. Shares in teaching the course of: Medicine in Tropics Class for the postgraduate students of The Uniformed Services University, USA, Hosted by NAMRU-3, Cairo. Since 1997.

Prof. El-Dib is a member of the Egyptian Society of the Parasitology, Egyptian Society of Tropical Medicine & Parasitology, Egyptian Society of Hepatology, Paleopathology and The Global Academy of Tropical Health (GATH). She was also Supervisor of the Student's Scientific Society (1996 – 2002), Vice president of the Society of Egyptian Parasitologists United, and associate editor of its journal.