Bust the Dust-Mite Myth
Bust the Dust-Mite Myth Outline

Mites
  - Classifications
  - Places found
  - Effects on the environment, including indoor air quality and occupant health
Dust Mites
  - Life cycle and habits
  - Mite myths
Mite Controls
  - What works and what doesn’t work
Other Mite Species
  - Allergy testing
Microarthropods/Mites
  - Visible evidence of infestation
Questions and Answers
Mighty Mites

Arthropod Phylum include three classes:

Chelicerates (such as spiders, mites, ticks)
Crustaceans (such as lobsters, crabs, and shrimp)
Uniramians (millipedes, centipedes, and insects)
Note On Mites in the Ecosystem:

There are over 40,000 named species.

They are essential soil organisms.

Up to 250,000/m² in upper 10 cm.

Some species eat nematodes that attack plant roots.

Other species eat fungal plant pathogens.
Most Common House-Dust-Mite Species:

*Dermatophagoides pteronyssinus*

*Dermatophagoides farinae*

*Euroglyphus maynei*

*Blomia tropicalis* (tropical areas)
MITES: House Dust Mites
(Dermatophagoides species)
Ann Allergy Asthma Immunol 111 (2013) 465-507

Environmental assessment and exposure control of dust mites: a practice parameter
House Dust Mite Life Cycle

Five Life Stages: takes 23 to 30 days at proper conditions about 23°C, 75% RH

- Egg
- Larva
- Protonymph
- Tritonymph
- Adult

Female is inseminated (gravid)
House Dust Mites

Life Cycle

Gravid female lays up to 80 eggs over about 5 weeks

In a 10-week life span, a house dust mite will produce approximately 2,000 fecal pellets
House Dust Mites

Skin scales

75-micron mite egg from a pillow

D. Farinae with egg in reproductive tract

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House Dust Mites

Prevalence of dust mites depends on mean outdoor relative humidity:

Cincinnati, Memphis, New Orleans almost 100% homes are mite positive (as high as 18,000 mites per gram of dust)

Denver and higher (drier) elevations, fewer than 10% of homes are mite positive and counts are well below 100 mites/gram dust.

Mite counts vary with seasons, lowest in winter

Carpeted floors have much higher counts than solid floors

Airborne Allergens; Arlian, L. Biology and Ecology of House Dust Mites
What is the relative humidity (RH) indoors?

Depends on where you measure it!

No matter how high your throne, you still sit on your rump!

RH under covers can be ambient
Under rump is a different story!
House Dust Mites

Mite allergen is primarily in fecal pellets

Half life of allergen in mattress estimated at 10 years

Mite-fecal dogma: 25-microns!

Variety of sizes

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20 fecal pellets per day

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Mite fecal pellets contain digestive enzymes

The main mite allergens are proteases (to digest protein)

Dermatophagoides pteronyssinus Der p 1, Der p 2
Dermatophagoides farinae Der f 1

About 80% of mite allergen is carried on particles >4.7 microns

However, a small but important proportion of airborne Der p 2 (20.6%) was associated with small particles (1.1–4.7 µm).

Dust mite allergens are carried on not only large particles. Adnan Custovic, Hannah Woodcock, Mark Craven, Rebecca Hassall, Elizabeth Hadley, Angela Simpson, Ashley Woodcock First published: 04 January 2002
Mite Allergens

mite feces in 15 (40.5%) of the dust samples from the foam mattresses without covers and 18 (26.3%) of the foam mattresses with covers.

Only three (12.5%) of the spring mattresses contained detectable amounts of feces.

the risk of finding mite feces was four times higher in foam compared to spring mattresses (odds ratio 4.0, 95% confidence interval (CI) 1.1–15.1), and eight times higher for the foam mattresses without cover (OR 8.1, 95% CI 1.8–36.9).

Conclusion: A simple replacement of foam mattresses with spring mattresses may reduce the exposure to house-dust-mite allergens.

RH<< ~70% mites seek harborage, remain clustered and motionless to conserve moisture.
House Dust Mites

“The weight of the average mattress doubles after ten years due to dust mite infestation, and the weight of the average pillow increases 10% after one year.” ([https://www.achooallergy.com/learning/dust-mites-fact-sheet/](https://www.achooallergy.com/learning/dust-mites-fact-sheet/))

Not enough food!

Lose about 1 gram/day of skin; max of .3g at night
For max of about .25 lb per year but most of this goes into pajamas and sheets.
House Dust Mites

Infestation is not that common

Dust mite infestation not common in arid areas

Less than a third of the mattresses I test have significant infestation

Skin scales are the largest component of house dust
Skin scales!

Headband in detergent water before stirring

Headband in detergent water after stirring

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Skin Scales [acid fuchsin stain]

with melanin crystals

with makeup pigment

Skin scales vary in size 25-40 microns
Bacteria digesting a skin scale 4,000x

Skin is protein food.

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Dust mites look quite formidable with a scanning electron microscope (SEM).

In reality, dust mites are fragile “bags of water.”
Dust Mites

“How do you kill dust mites in mattresses? An old mattress can hold millions of dust mites and their fecal matter. One way to reduce the number of dust mites in a mattress is to spread baking soda on the mattress. This will help soak up excess moisture. Vacuum it up using a vacuum with a HEPA.”

(filter.https://fightingdustmites.com/dust-mites-facts/)

Baking soda is not hydroscopic!!

Dampness comes from body moisture
Dust Mites

“... and use Venetian blinds rather than fabric drapes. Dust mites take refuge in carpets but can’t live on hard surfaces like wood floors or plastic.”

(https://www.nytimes.com/2011/03/05/health/05patient.html)

Most common sources of infestation are frequently used cushioned items (mattresses, pillows, couches) but allergens settles in dust on hard surfaces.
Dust Mites

“How to kill dust mites? There are several ways to kill dust mites naturally and with chemicals. Extreme cold or extreme heat is the easiest ways. **Freeze pillows and stuffed animals for 24 hours.**” (https://fightingdustmites.com/dust-mites-facts/)

Practice parameter does not recommend using chemicals and notes lack of evidence for effectiveness of physical measures. (Freezing works but cold items can have moisture condense in them! A hot dryer will kill mites. Problem with freezing and drying is major sources of infestation such as couches and mattresses cannot be treated.)
Mites: Confusing opinions

Twenty-nine trials (939 patients in the analyses) were included, ... Nine trials assessed chemical methods alone, 15 physical methods alone, and 5 a combination of chemical and physical methods. Overall, there was no statistically significant difference improvement of asthma.

Chemical and physical methods aimed at reducing exposure to house dust mite allergens cannot be recommended. It is doubtful whether further studies, similar to the ones in our review, are worthwhile.

Gøtzsche PC, Johansen HK. House dust mite control measures for asthma. Cochrane Database Syst Rev. 2001;(3):CD001187 (meta study)

WIDELY DISCREDITED META STUDY
The Use of Domestic Steam Cleaning for the Control of House Dust Mites.
Colloff MJ, Taylor C, Merrett

METHODS: A domestic steam cleaner was used to treat carpet squares that had been seeded in the laboratory with known numbers of dust mites (Dermatophagoides pteronyssinus). The number of live mites was monitored for a period of 4 months in eight treated carpet squares and eight controls. Dust samples were taken from 12 standardized areas of carpet in a tenement flat in Glasgow, UK, before and after steam cleaning treatment, and the concentration of allergen Der p 1 was compared with 12 adjacent, control areas.

RESULTS: No live mites were found at any time in the treated carpet squares, whereas in the control squares geometric mean mite population density rose from 11 after 3 days to 39 after 1 month, 66 after 2, 122 after 3 and 185 after 4 months.
Mites: Steam vapor kills mites and can destroy allergens

May, J. “Sampling, Results & Remediation in 300 ‘Sick Homes,’” *Bioaerosols, Fungi and Mycotoxins* (1999), New York Occupational & Environmental Health Center
Environmental Control for Mites: Steam Vapor

<table>
<thead>
<tr>
<th></th>
<th>Before steam vapor</th>
<th>After steam vapor, 30 min.</th>
</tr>
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<tbody>
<tr>
<td>Mite allergen in mattress</td>
<td>37 mcg/gram</td>
<td>.83 mcg/gram</td>
</tr>
<tr>
<td>Dog allergen in pillow</td>
<td>29 mcg/gram</td>
<td>.98 mcg/gram</td>
</tr>
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Some protein allergens are destroyed by heat!
My opinion: Encasing mattresses, box springs and pillows is the most effective preventative measure for beds.

Practice Parameter

“17. Recommend that patients should use mite allergen-proof mattress, box spring, and pillow encasings to decrease exposure to mite allergens. (Strength of recommendation: strong, B evidence.)”
Mites

Four generations of mite encasings

1. All-vinyl; was “crinkly” and “sweaty”

2. Non-woven material (random like Tyvek): porous

3. Woven cotton or polyester with polyurethane liner

4. All woven material, 400 threads per inch; no liner
Mites

Woven encasing (100x)
30 micron x 10 micron gaps

Woven encasing (100x) with polyurethane liner; I highly recommend

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Mites in Dog Beds

Dogs get asthma from dust mites in their beds! (only use folded blankets and wash periodically)

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MITES: Other

Some mites feed on mold; may ingest spores or just insert tube to digest and extract nutrients
The Species of Mites from Homes
Allergists typically only test for two species

A mite foraging in Stachybotrys.

A mite from fiberglass.

A mite egg from a basement covered with Aspergillus spores.

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Allergy testing to mites does not detect allergy to mold-eating mites

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When microarthropods forage, dust appears “splotchy” rather than evenly spread due to presence of fecal pellets.

“Fresh” dust is homogeneous.

“Old” dust is heterogeneous.
Mold-eating microarthropod (possibly mite) fecal pellets full of *Aspergillus* spores

Looks like mold

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Dishwasher Mite Infestation!

Dust-mite fecal pellets in dust

Insulation on dishwasher

Tape sample of dust

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Mite and mite fecal pellets: Client concerned about dust around kitchen-sink rim

(probably *Acarus* mite)
Fecal pellets contain digestive enzymes that are the main mite allergens

Condensation on bulb and insulation, mold on framing

Weather changed from cool to hot and humid

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Mold in exposed, basement fiberglass insulation can be a major source of mold exposure.
Mites and *Penicillium/Aspergillus*-type Spores at 400x in Air Samples from Exposed Basement Ceiling Fiberglass

There is an easy test for invisible mold in fiberglass insulation. Just press a Petri dish against the fibers!

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Silverfish eat mites, and mites eat mites

Silverfish (~.5 inch)

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Cheyletus eruditus (~350 microns)

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Paper damage from silverfish

Cheyletus eruditus attacking a snake mite


It’s an arthropod war out there!
Questions?

May Indoor Air Investigations, Tyngsborough, MA
<www.MayIndoorAir.com>
<www.MyHouseIsKillingMe.com>
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