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Fauna and distribution of house dust mites in residential areas of Ilam town, western Iran

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A B S T R A C T

Introduction: A study was undertaken to investigate the presence of house dust mites in Ilam town and their climate-induced variability between January and June 2017.

Materials & Methods: In this cross-sectional investigation, a total of fifty houses located in five different residential areas of Ilam town were selected using a cluster random sampling method. Dust samples, collected from mattresses, pillows, and carpets, were obtained from each house utilizing a portable vacuum cleaner. Each sample was then transferred into 70% alcohol solution, with an amount equivalent to 200mg preserved for further analysis. Under a stereomicroscope, mites were carefully isolated from the samples using micro-dissecting needles. Subsequently, these specimens underwent clearing processes before being mounted on Hoyer media for preservation purposes. The identification process involved employing standard taxonomic keys to determine the species of each specimen. Furthermore, statistical analyses provided both mean values as well as confidence intervals (CI) for the mite populations collected for every identified species. Additionally, binomial tests served to assess the distribution patterns across these species.

Findings: Out of a grand total of 208 mite specimens analyzed during this investigation phase, seven distinct species namely *Haemolaelaps glasgowi* (24.52%), *Echinolaelaps echidninus* (12.02%), *Laelaps nuttalli* (11.06%), *Androlaelaps setosus* (13.94%), *Neoeucheyla iranica* (10.10%), *Cheyletus malaccensis* (14.90%), and *Ornithonyssus bacoti* (13.46%) were successfully identified. The distribution of all species displayed a significant statistical value ($P < 0.01$). Furthermore, an astonishing 80% of the visited households were infested with mites.

Conclusion: This particular study has shed light on the presence of a remarkably diverse array of house dust mite species. The prevalence of certain rodent-related mites suggests that rodents either inhabit or frequent residential homes, prompting the need for further investigation.

Keywords: House dust mites, Fauna, Allergens, Iran, Ilam

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Introduction

The notorious "domestic mites," recognized for their capacity to elicit allergies, encompass both house dust mites (HDM) and storage mites (1). Within this class of minuscule arachnids, there exist around 150 different species, approximately 20 of which exhibit allergenic properties (2). These exceedingly small creatures measure between 240–435µm in length and weigh 3.5–13.0µg. They ubiquitously inhabit households, colonizing dust and accumulating in carpets, bedding, fabrics, and furniture. The very household environment that sustains these diminutive arthropods also provides them with abundant sustenance (3).

Numerous studies over time have extensively examined the correlation between exposure to HDM in one's surroundings and the sensitization to specific allergic diseases (4, 5, 6). Humans spend roughly one-third of their lives in their beds, making the presence of HDM within mattresses, bedding, and pillows a pivotal factor in overall HDM exposure levels (7). As current medical advancements do not offer prospects for an asthma cure, modifying the surrounding environment stands as society's most promising endeavor to alleviate the burden that this respiratory condition imposes on individuals (6).

Among the diverse components present in household dust, house dust mites reign supreme as potent allergens due to heavy contamination with fecal pellets and cast skins. Thriving on dander—skin scales originating from human and pet activities—these minuscule creatures foster an ecosystem conducive to allergic reactions (8). House dust mites have been identified as culprits responsible for up to 80 percent of asthmatic cases, numerous instances of hay fever, eczema, and various other allergies—even in regions characterized by low relative humidity levels (9, 10). Climatic conditions, such as relative humidity exceeding 50 percent combined with temperatures ranging between 23-30 ℃, significantly influence house dust mite populations. Consequently, one is likely to observe seasonal fluctuations in these microscopic organisms (11,12).

Considering that mites constitute the most prevalent allergens found in household dust, possessing knowledge about the specific species dominating a particular region is imperative. This understanding is crucial for both diagnostic and therapeutic purposes. The town of Ilam, situated in the north-western part of Ilam province in western Iran, lacked valid data concerning its own house dust mite population. Consequently, a comprehensive study was undertaken to determine various factors, such as prevalence rates, seasonal variations, the number of mite species present, and contamination levels within houses during the period from January to July 2017.

Materials and Methods

Study area

Situated amidst mountainous terrain in a moderate climate zone, Ilam town is located at an altitude of 1382.59 meters above sea level (latitude 33˚ 38′ N and longitude 46˚25′ E). With an approximate population of 172,000, annual maximum and minimum temperatures of up to 39°C and -3°C, respectively, are experienced by the residents. The region observes an average annual precipitation rate of around 240 mm, coupled with a

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relative humidity of approximately 22% during the summer.

Sampling technique

Our study, spanning from January to July, encompassed five distinct regions within Ilam town, reflecting our meticulous approach to uncovering relevant information about HDM populations in each investigated area. These districts were deliberately chosen based on their diverse lifestyles, ensuring a certain level of heterogeneity within the sampled socio-economic strata. Ten houses from each district were randomly selected, and detailed inspections were conducted, paying special attention to dust presence on carpets, furniture, bed mattresses, and household appliances. Air and dust samples were collected using a Phillips Minivac 3.6 V model vacuum cleaner with a fine filter, operating for ten minutes. The filter contents were then meticulously transferred into labeled nylon bags for subsequent analysis.

HDM isolation and identification

Examination of the collected bags occurred at the Entomology Laboratory of Ilam UMS in Iran. Each individual dust sample, weighing precisely one hundred milligrams, underwent observation under a stereomicroscope using micro-dissecting needles to identify any HDMs. Specimens found were placed in a solution containing 70% alcohol and a drop of 5% Glycerin, with labels indicating their collection location. Following this, specimens underwent clearing in Hoyer medium and fixation. The classification and identification of HDMs strictly adhered to authorized systematic guidelines or keys designed for this purpose.

Statistical analysis

Both absolute and relative frequencies for each mite species were documented, and the mean and confidence interval of collected mites for each species were calculated. To assess the distribution of different species, a binomial test was conducted, considering a significance level less than 0.05 as statistically significant.

Ethical considerations

The study underwent thorough review and approval by the Research Ethics Committee of Ilam UMS (#EC/93/H/238).

Results

During this research project, a comprehensive examination was conducted on a total of 50 houses situated in various areas within Ilam. This investigation led to the identification of seven distinct mite species spanning three separate families, as outlined in Table 1.

Table 1. Frequency of house dust mites collected in Ilam town's houses, 2017

Order	Family	Genus	Species	Number (RF* %)	95% CI**	P Value
Mesostigmata	Laelaptidae	*Haemolaelaps*	*glasgowi*	51(24.52%)	18.83 to 30.95	<0.001

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Mesostigmata	Laelaptidae	*Echinolaelaps*	*echidninus*	25(12.02%)	7.93 to 17.23	<0.001
Mesostigmata	Laelaptidae	*Laelaps*	*nuttalli*	23(11.06%)	7.14 to 16.13	<0.001
Mesostigmata	Laelaptidae	*Androlaelaps*	*setosus*	29(13.94%)	9.54 to 19.41	<0.001
Prostigmata	Cheyletidae	*Neoeucheyla*	*iranica*	21(10.10%)	6.36 to 15.02	<0.001
Prostigmata	Cheyletidae	*Cheyletus*	*malaccensis*	31(14.90%)	10.36 to 20.48	<0.001
Mesostigmata	Macronyssidae	*Ornithonyssus*	*bacoti*	28(13.46%)	9.14 to 18.86	<0.001
Total				208(100%)		

* RF: Relative Frequency, ** CI: Confidence Interval

Out of the 50 houses that were visited and sampled throughout this study, it was found that 40 (80%) homes were infested with at least one type of mite species. The highest frequency was observed in *Haemolaelaps glasgowi* (24.52%) and *Cheyletus malaccensis* (14.90%), while *Neoeucheyla iranica* had the lowest frequency at only (10.10%). Further examination revealed that four species - *Haemolaelaps glasgowi*, *Echinolaelaps echidninus*, *Laelaps nuttalli*, *Androlaelaps setosus* - belonged to the Laelaptidae family; two other species - *Neoeucheyla iranica* and *Cheyletus malaccensis* - originated from Cheyletidae family; lastly, *Ornithonyssus bacoti* represented Macronyssidae family which consisted of a single reported species. Remarkably enough, *Neoeucheyla iranica* (Acari: Cheyletidae), a predator mite specimen, a new phenomenon once unobserved before, inhabited residential homes within Ilam town, supporting our findings from this particular investigation (Figure 1).

As depicted in Figure 2, the period spanning from January to March exhibits a relative humidity of at least 50%, thus creating favorable climatic conditions for HDMs. These conditions are further enhanced by an optimal indoor temperature. However, upon conducting preliminary sampling, it was determined that these specimens were absent during other months throughout the year.

Discussion

The ubiquity and diversity of house dust mites (HDMs) as common triggers for asthma and allergic rhinitis are well-documented, with variations in predominant species contingent on geographical locations (1). In this specific investigation within Ilam town, seven distinct HDM species from three families were meticulously documented, with *Haemolaelaps glasgowi* and *Cheyletus malaccensis* emerging as the most prevalent (Table 1). A comparative analysis with prior studies in different Iranian locales, such as Sari (10), Guilan province (13), and Bandar-Abbas (14), underscores the distinctiveness of Ilam's HDM fauna. Despite Ilam's prevalent low humidity, this study revealed a diverse array of HDM species, suggesting potential influences from geographical and climatic variations, along with diverse socio-economic circumstances.

The well-established association between HDMs and respiratory

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ailments, particularly *Dermatophagoides* spp (15), is contextualized within this study by the discovery of seven different HDM species within Ilam. Notably, *Dermatophagoides* spp, commonly found in other Iranian regions, was conspicuously absent in Ilam, suggesting a unique ecological composition possibly influenced by the arid and warm climate of the Region (13,25).

This study coincided with a previous investigation in Sarpole-zahab, revealing analogous ectoparasites in rodents, specifically Ornithodoros bacoti and Lealaps nuttalli. The consistent presence of these species in both studies fortifies the reliability of the findings. Parallel studies in Bandar-Abbas (20) and Northern Tehran (21) further underscore the uniform prevalence of specific HDM species across diverse Iranian regions.

The identification of *Neoeucheyla iranica*, a rare predator mite, in Ilam introduces a distinctive element to the study. Initially discovered near Tehran (21), its unexpected presence in a residential home in Ilam suggests potential adaptations to local conditions, possibly linked to the storage of wheat grain, known as storage mites (23).

This study concludes that Ilam's HDM fauna markedly differs from other regions in Iran, characterized by the coexistence of both ecto-parasitic and predatory species. Factors contributing to this diversity include geographical and climatological conditions, lifestyle practices, and potential interactions with storage mites.

In each sampled house, at least one mite species was found, with *Haemolaelaps glasgowi* being the most prevalent, raising concerns about potential rodent activity and associated health risks. These findings, observed during winter, underscore the influence of indoor temperature and humidity conditions on HDM proliferation. Rainfall and warmer temperatures contribute to their growth, emphasizing the need to consider various factors in understanding dust mite populations. These results align with previous studies, highlighting the intricate interplay of factors influencing HDM prevalence (12,17,26).

In this study, a species of mites known as *Neoeucheyla iranica* from the Acari family Cheyletidae was discovered. Notably, these mites possess unique characteristics on their dorsal shield and leg I setae. The dorsal setae are clamshell-like in shape, wider than they are long, reticulate in pattern, uncurved and irregularly shaped. In addition to these features, modified neotrichial setae can be found along the median part of the mite's body; these flattened structures have an irregular shape.

Conclusion

In conclusion, it is widely recognized that domestic mites play a substantial role in the onset of allergic ailments. These minuscule creatures are ubiquitous, inhabiting regions ranging from moderate to tropical climates and flourishing particularly within human dwellings. Consequently, it has become crucial to investigate and comprehend the abundance and variety of these organisms across different settings, territories, and seasons in order to effectively manage allergies.

This investigation imparts valuable insights concerning the prevalence of house mite dust (HDMs) specifically within Ilam town in Iran. Nevertheless,

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it should be mentioned that some prevalent species of HDMs like *Dermatophagoides pteronyssinus* and D. *farinae* were not identified throughout this study; their absence may come as unexpected.

Furthermore, the findings of this study suggest that the abundance and diversity of dust mites in households fluctuate throughout the year, with a notable increase during the rainy season. This indicates a higher likelihood for allergy outbreaks during this specific time period. It is important to consider external factors such as climate change and human behavior, as they have a significant impact on the prevalence of these mites despite their preference for indoor environments.

To summarize, investigating the presence and characteristics of domestic mites plays a vital role in comprehending and managing illnesses related to allergies. By closely examining their distribution patterns across different habitats and regions over an extended period, we can develop effective strategies to alleviate allergic reactions caused by these minuscule organisms.

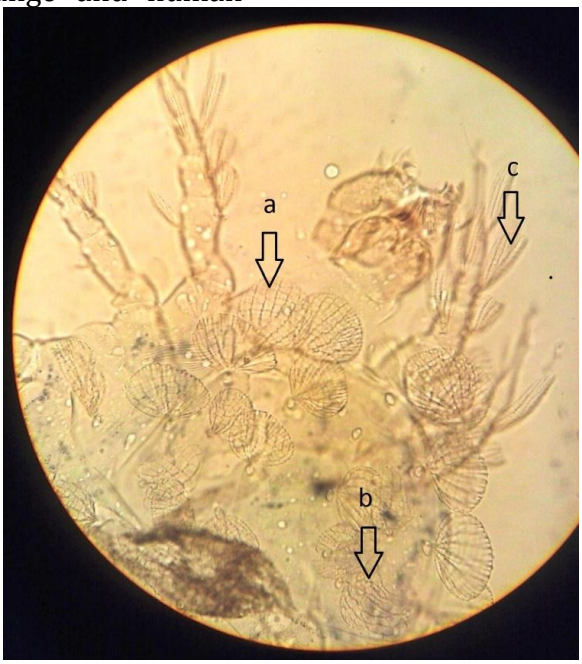


Figure 1. Morphological Features of *Neoeucheyla iranica* (Acari: Cheyletidae) from the Study. **a)** Dorsal shield setae are clamshell-like, wider than long, reticulate, not bent, and irregularly outlined, **b)** Neotrichial modified setae are present in the median part, displaying a flattened and irregular shape, **c)** Leg I feature dorsal flabellate setae.

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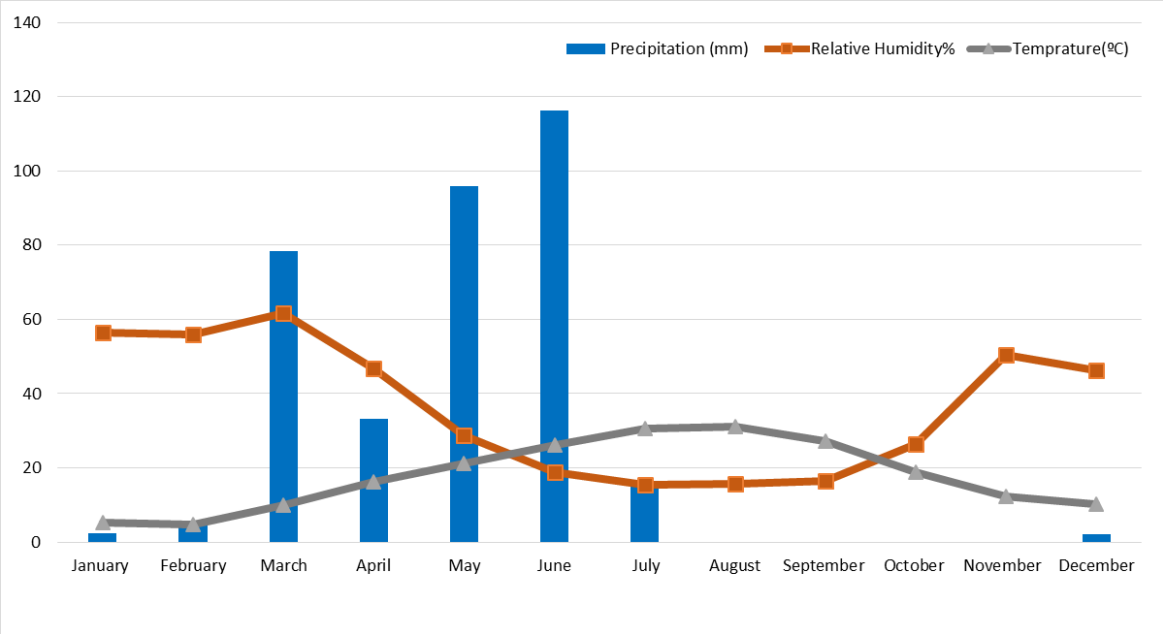


Figure 2. Average Meteorological Parameters (Temperature, Rainfall, and Relative Humidity) in Ilam, Western Iran, for the Year 2017

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Conflict of Interests

All the authors declare that they have no conflicts of interest.

Authors' Contributions

NS and FM: Conceptualization, data curation, formal analysis, funding acquisition, investigation, writing the original draft; AS: Conceptualization, methodology, data validation check, writing the original draft; MHR and AAA: Conceptualization, supervision of the project, data validation check, writing the original draft, review and editing of the manuscript.

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