ORIGINAL ARTICLE

Relationship of House Dust Mite Density in Student Dormitories on Allergy Risk and Eosinophil Levels

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ABSTRACT

Introduction: House dust mites (HDM) are prevalent aeroallergens worldwide, encompassing various species and found in nearly all regions. They commonly inhabit household items like mattresses, upholstered furniture, carpets, surfaces of cabinets, and room corners. When present in significant concentrations, HDM can induce allergic reactions in humans. Therefore, this study aims to analyze the relationship between HDM density in student dormitories on allergy risk and eosinophil levels. **Methods:** The study was conducted from March to May 2024 in the Parasitology and Hematology Laboratories of the Faculty of Health Sciences at Jenderal Achmad Yani University. It employed a cross-sectional design, where allergy risk was evaluated using a questionnaire. House dust mite (HDM) density was microscopically analyzed from dust collected from mattresses in 44 student dormitories near the university in Cimahi, using purposive technique sampling. Eosinophil levels were assessed through counts performed on peripheral blood smears. The data was analyzed statistically by Chi-Square. **Result:** Analysis of the 44 participants revealed that all dust samples were 100% positive for HDM, primarily of the Dermatophagoides spp., with an average density of 93 mites per gram. Seventeen participants had elevated eosinophil levels. Statistical analysis using the chi-square test showed no significant association between HDM density and allergy risk ($p = 0.07$) or between HDM density and eosinophil levels ($p = 0.22$). **Conclusion:** This study found that although all sampled student dormitories were positive for house dust mite (HDM) presence, there was no statistically significant relationship between HDM density and eosinophil levels among the students.
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INTRODUCTION

Allergies, or hypersensitivity reaction, refers to an abnormal or excessive immune response to a specific antigen (1). Allergic reactions can affect nearly every tissue and organ in the body, resulting in clinical symptoms that vary depending on the individual (2). Up to 90% of asthma patients are also diagnosed with allergic rhinitis (AR)(3,4). Atopic dermatitis has risen in prevalence over the past decade, affecting 15–30% of children and 2–10% of adults (5). House dust mites (HDM) are considered the common aeroallergens in the community.

HDM consists of various species, with the main species being Dermatophagoides spp. HDM is typically present in household items such as mattresses, chairs, carpets, atop cabinets, and room corners (6). Bedrooms tend to have higher populations of HDM, as they accumulate human skin epithelial cells, which serve as a food source for the mites. Bedrooms are often less frequently cleaned, further promoting conditions that support the life cycle of HDM (7,8). On average, people spend 6 to 8 hours sleeping each night, shedding about 0.5 to 1 gram of skin epithelial cells during this time. The higher humidity levels typically found in bedrooms further support the reproductive and respiratory functions of house dust mites, creating an environment conducive to their growth and reproduction (9,10). Student dormitories fulfill these conditions as well since students spend significant amounts of time in their dormitory rooms, particularly on mattresses, which are ideal breeding grounds for HDM.

Allergy diagnosis is based on a history of symptoms and possible allergic triggers. If there is any uncertainty, additional tests should be conducted, such as a leukocyte count, to assess the eosinophil levels (11). Eosinophils increase during allergic inflammation as

they are released to help regulate the immune response to allergens. Eosinophils are part of the body's defense system, playing a role in protecting the body from various infections (12).

Leczano's study showed that the mean densities of mites per gram of dust on mattresses were 3.577 mites per gram of dust and 6.273 mites per gram of dust, respectively (13). The presence of house dust mite (HDM) populations in bedrooms, with the density of Dermatophagoides species in mattress dust samples ranging from 4.50 to 13.80 mites per gram of dust (14). However, neither of these studies analyzed eosinophil levels as indicators of allergic reactions caused by HDM. Consequently, this study aims to investigate the relationship between HDM density as a risk factor for allergies and eosinophil levels among student dormitory residents in Cimahi, Indonesia.

MATERIALS AND METHODS

Design

This study was a cross-sectional study with questionnaire completion by the student dormitory residents who will participate in the study as an initial step of the research. Following this the laboratory examination was carried out, dust samples were collected from the mattresses, and blood samples were taken for eosinophil examination. The examination continues in the laboratory to analyze dust density and eosinophil levels using peripheral blood smears. The study was conducted from March to May 2024 in student dormitories near the campus of Jenderal Achmad Yani University, Cimahi. The laboratory research was conducted at the Parasitology Laboratory and the Hematology Laboratory of the Faculty of Health Sciences, Jenderal Achmad Yani University.

Sample

The sample involved in the study consisted of a population of 80, and after calculation using the Slovin formula, a sample size of 44 student dormitories and their residents was obtained, using purposive technique sampling. The inclusion criteria for this study were students with allergy risk who had provided informed consent. The participants met the inclusion criteria, which included spending more than 6 hours a day in bed and not currently suffering from any infections.

Questionnaire

The participants completed two questionnaires. The first questionnaire was about their allergy history, and the second focused on the cleanliness of their bedrooms. The questionnaire used in this study was a self-developed instrument designed to address specific objectives that could not be adequately captured by existing standardized questionnaires. This personal questionnaire was chosen for its flexibility and contextual relevance, making it more suitable for the nature of this research.

House Dust Mite Density Examination

Dust from the mattress was collected using a vacuum cleaner for approximately 2 minutes across all areas of the mattress to ensure that the dust sample was representative and included a variety of particles and microorganisms present on the mattress. The collected dust was then placed into a Ziplock bag. The dust was filtered, and the filtered material was placed into a vial bottle. A 5-10 drop of 10% KOH was added to the dust, and it was homogenized. The supernatant was then dropped onto a glass slide, covered with a cover slip, and observed under a microscope with 10x and 40x magnification. The number of house dust mites was counted in 0.1 grams of dust and multiplied by the total weight of the dust divided by 0.1 to determine the dust mite density. A dust mite density of 100-500 mites per gram of dust is considered a risk factor for allergic reactions (9).

Eosinophil Count

Blood samples were prepared as peripheral blood smears and stained with Giemsa. The slide was then examined under a microscope with 100x magnification. The number of eosinophils was counted in 100 leukocytes, and the result was expressed as a percentage, with a normal range of 1-6%.

Data Analysis

Statistical analysis was performed using SPSS version 29 with chi-square analysis to compare dust mite density with allergy history and dust mite density with eosinophil count. A p-value of less than 0,05 was considered significant, indicating a meaningful relationship between the categorical variables and the strength of their association.

Ethical Clearance

This research was approved by the Ethics Committee in Fakultas Ilmu dan Teknologi Kesehatan Universitas Jenderal Achmad Yani Cimahi with number registration: 012/KEPK/FITKes-UNJANI/III/2024.

RESULTS

The study results included 44 dust and blood samples from student dormitory residents, both allergic and non-allergic. The dust collected was from the mattresses. Information regarding the participants' data is presented in Table I.

In this study, samples were taken from the mattress in the bedroom. All dust samples tested were found to be 100% positive for HDM. The microscopic results showed that HDM was predominantly composed of Dermatophagoides spp. (Fig. 1). From the dust collected from student dormitories, the density was calculated, resulting in an average of 93 mites per gram of dust on the mattress, with a total weight of 22.5 grams, as shown in Table II.

Table I. Participant Questionnaire Result (n=44)

	Number	Percentage
Type of Allergy		
Asthma	3	6
Allergic Rhinitis	13	30
Atopic Dermatitis	6	14
Non-Allergic	22	50
Cleaning Habits		
Cleaning the room at least once a week	20	45
Cleaning the room more than a week	24	55

Fig. 1: Dermatophagoides found in the dust sample under 400x magnification

Table II. Average HDM Density

Description	Quantity
Total Mites	803
Total Dust Weight (grams)	22.5 grams
Average HDM Density	93 mites per gram of dust

After determining the HDM density, an eosinophil examination was performed. The findings indicated that in the >6% eosinophil level category, there were 17 individuals with an average eosinophil level of 10%. In the ≤6% eosinophil level category, there were 27 individuals with an average eosinophil level of 3%.

Statistical testing was then performed using the chi-square test, and the results are shown in Table III. Based on the chi-square test statistics, there was no significant relationship between HDM density and allergy symptoms or eosinophils level, as the p-values obtained were 0.07 for allergies and 0.22 for eosinophils level.

Table III. Relationship Between HDM Density, Allergy Risk, and Eosinophils Counts

Variable	P-value Chi-Square	Description
Allergy	0.07	Not Significant
Eosinophils	0.22	Not Significant

DISCUSSION

Based on the research conducted with 44 student respondents, it was found that 22 students did not have allergies, while 22 students had allergies such as asthma, allergic rhinitis, and atopic dermatitis. This finding aligns with the questionnaire results, where 73.6% of the students had not been diagnosed with allergies by a doctor but experienced allergy symptoms as described in the questionnaire, while 26.4% of the students had already been diagnosed with allergies by a doctor.

House dust mites (HDM) can survive and reproduce under optimal temperature and humidity conditions. Allergic reactions can occur due to exposure to HDM densities between 100 and 500 mites per gram of dust. HDM can cause allergic reactions such as atopic dermatitis, allergic rhinitis, and asthma (15). Based on this study, it was observed that all 44 dust samples from student mattresses were 100% positive for HDM, with population densities ranging from 24 to 234 mites per gram, with an average of 93 mites per gram of dust. This density is still below the HDM threshold and is considered a risk factor for triggering allergies. Levels of 100–500 mites per gram of dust or an allergen concentration of 2 micrograms per gram of dust can trigger allergies in sensitive individuals. The risk of asthma increases if the concentration reaches ten micrograms per gram of dust. The primary sources of allergens are proteins found in mite feces and dead mite bodies, which are commonly present in bedding and carpets (16).

According to the questionnaire results, 20 students regularly cleaned their bedrooms, swept, and mopped the floors; however, the other 24 students rarely dried their mattresses, pillows, and bolsters. This was likely due to a busy schedule with academic tasks and other activities or limited space, which prevented them from drying their bedding. As a result, the mattresses became damp. Although regular cleaning of the bedroom floors helps reduce dust, house dust mites can still be present as they can spread to various places in the home. Furthermore, HDM reproduces quickly in damp environments, which leads to higher population densities and allows them to thrive (17,18).

Based on the eosinophil examination, it was found that of the 44 samples, 17 individuals had eosinophil levels >6%, and 27 individuals had eosinophil levels ≤6%. In this study, eosinophils were measured through differential white blood cell counts using standard microscopic cytology with Giemsa-Romanowsky staining. Allergies occur when a patient is exposed to an antigen, which then undergoes a sensitization process and stimulates histamine H1 receptors that influence eosinophil accumulation in allergic individuals (19). In this study, the average eosinophil count in allergic individuals was higher than the average, at 10%, because eosinophils regulate immune response and local inflammation. Eosinophils in individuals with allergy symptoms can strengthen allergic inflammation by directing the recruitment of T-helper type 2 (Th2) cells and interacting with dendritic cells. Eosinophils can then release Th2 cytokines such as IL-4 and IL-13, which have been pre-formed, further amplifying the allergic response (11).

This study shows the results of the chi-square test between HDM density and allergy risk, with a p-value of 0.07, and eosinophils, with a p-value of 0.22. Statistically, this indicates that there is no relationship between HDM density and allergy risk or eosinophils levels as an allergy marker. This is because the HDM levels in student dormitories are still below the threshold that can trigger allergies. Although this study found 100% positivity for HDM, this can be attributed to the fact that the immune system of each student is highly complex and subjective. Furthermore, eosinophil count and eosinophil granule protein levels in peripheral blood increase in most people with allergies and correlate with the activity of other diseases. This is because some individuals show normal eosinophil counts even when they have active allergies, and an additional allergic condition may cause an increase in eosinophil count (20). Several factors that may exacerbate the impact of house dust mites (HDM) and increase the risk of allergic sensitization include high indoor humidity, the presence of carpets and fabric-covered surfaces, infrequent washing of bedding, poor ventilation, inadequate environmental sanitation, the presence of domestic pets, as well as exposure to cigarette smoke and other indoor pollutants (21).

In this study, the student dormitories conditions were relatively humid due to poor lighting and suboptimal ventilation. However, the students selected as samples frequently washed their room furnishings, which may explain why eosinophil levels did not increase despite all samples testing positive for the presence of house dust mites (HDM). Another possible explanation is the absence of exposure to cigarette smoke in the boarding environment (22). Additionally, there were no pets such as cats or dogs—factors known to significantly contribute to elevated eosinophil levels as allergy indicators. Cats and dogs are recognized as potential carriers of parasites that can infect humans and increase eosinophil counts (23). Since HDM was the sole factor present without the contribution of other known eosinophil-elevating variables, the statistical analysis revealed no significant association.

In this study, the number of eosinophils increased in participants who frequently experienced atopic dermatitis and allergic rhinitis. Eosinophils may play an important role in asthma and rhinitis, but they also play a significant role in skin lesions in atopic dermatitis. As mediators of allergies, eosinophils are considered to have a protective role in the pathogenesis of allergic diseases. The presence of inflammation can activate various cells that are normally found in the bloodstream, such as leukocytes (24,25).

Theoretically, the density of house dust mites is significantly related to allergies. However, allergies are also strongly linked to genetic factors. Based on the results from the questionnaire, 34.5% of students had family members who suffered from allergies. If a family has a history of allergies, the likelihood of other members having a higher risk of developing allergies is increased due to the genetic factors that are inherited. Atopic history is an example of a genetic factor that can be passed down through families, potentially affecting allergic reactions and symptoms such as asthma, dermatitis, and rhinitis. Therefore, even though the density of house dust mites is not directly related to the risk of allergies, house dust mites have the potential to trigger allergic reactions in humans (26).

Although this study did not find a statistically significant relationship between house dust mite density, allergy risk, and eosinophils, this does not mean that maintaining cleanliness at home is not important. Keeping the home clean is a crucial step in protecting health. Maintaining a clean environment can help reduce exposure to certain allergens, such as house dust mites, which can trigger allergies or worsen symptoms in individuals who already have allergies.

CONCLUSION

This study found that although all sampled student dormitories were positive for house dust mite (HDM) presence, there was no statistically significant relationship between HDM density and eosinophil levels among the students. This may be attributed to other environmental factors—such as frequent room cleaning, absence of pets, and lack of exposure to cigarette smoke—which may have mitigated the allergic response. Therefore, while HDM presence is a known allergen, its impact on eosinophil levels may be influenced by the presence or absence of additional risk factors in the living environment.

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