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The Control over the Population of *Dermatophagoides* Mites based on the Internal Environment Arrangement of Residences for Respiratory Tract Allergy Patients in Surabaya Indonesia

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Abstract. **This research aimed to find path model for various factors of internal environment of residences of respiratory tract allergy patients which can be used as guidance in reducing the population of *Dermatophagoides* mites in house dust. *Dermatophagoides* mites produce allergen liquid which can trigger respiratory tract allergic reaction. This current research has found path model among a number of internal environment factors which can be used to conclude that the population of *Dermatophagoides* mites has direct and indirect correlations with internal environment of respiratory tract allergy patients' residences. Internal environment factor which has direct correlation with the mite population is the protein level of dust particles; while other factors have indirect correlation. There are two internal environment factors which do not correlate with the mite population, namely pH level and water level in house dust. Through empirical interpretation of the path model, five strategies to control *Dermatophagoides* mite population are proposed.**

Keywords: dermatophagoides, allergen

INTRODUCTION

Allergen in house dust is produced by the feces of *Dermatophagoides* mites, which mix with allergen liquid [1], [2], [3]. The body part of mite, which produces liquid allergen is the digestion tracts called *midgut posterior* and *hindgut anterior* [4]. When mite excretes, the residual liquid from both digestion tracts mixes with feces resulting in allergenic feces. The feces spread into house dust particles causing house dust to turn into allergenic. Allergenic house dust floats in the air through performing house chores such as carpet dusting, floor cleaning, curtain cleaning, and such, which in turn causing the dust to be inhaled into respiratory tract along with breathing the air [4]-[5]. When an individual is exposed to allergen, the allergen triggers hypersensitivity reaction at the respiratory tract, causing symptoms of rhinitis allergy or respiratory tract allergy [5]-[6].

Inhaling dust containing allergen results in respiratory tract allergic disease. The followings are the symptoms of which: unremitting sneezing, itchy nose, clogged and runny nose, itchy and watery eyes, shallow breathing, and asthma [6]. One amidst a number of preventions against respiratory tract allergic disease is the control over the population of *Dermatophagoides* mites by means of house environment arrangement. It is of urgency as the control over such mites potentially reduces the risk of inhaling the air containing inhalant allergen [4]-[5].

METHOD

This current research is conducted by using cross-sectional design by means of an analytical approach. The research population unit is residences in an urban area in Surabaya of which residents (minimum 1 person) are identified with respiratory tract allergy, which includes bronchial asthma, chronic cough, and rhinitis and are getting treatment from RSUD Dr. Soetomo, Surabaya.

The variables of residence's internal environment involve bio-chemical environment and physical environment factors. Bio-chemical environment factor includes seven variables; while physical environment factors similarly consist of seven variables. The main variable is the population of *Dermatophagoides* mites (see Table 1). The data analysis technique employed path analysis.

RESULT

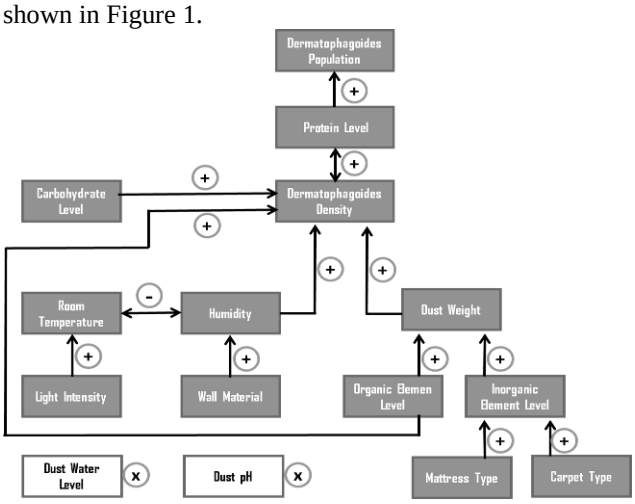
The results from data sampling of residences' internal environment factor variables are presented on Table 1 in the form of mean values from each variable taken from the total 80 research samples. The result of mean value calculation of the mite population is 26.02 mites/gram of dust with variations of bio-chemical condition factor and physical environment as presented in Table 1.

Table 1 Measurement Result of Each Internal Environment Factor as Research Variable

Variables	Measurement mean value	Measurement
1. Total mite population	26.02	mites/gram of dust
2. Bio-chemical Environment Factors		
a. Mite density	52.90	mites/m^2
b. Level of dust protein	0.16	gram*
c. Level of dust carbohydrate	1.87	gram*
d. Level of dust inorganic elements	12.22	gram*
e. Level of dust organic elements	13.67	gram*
f. Water level	1.28	gram*
g. pH level	7.01	-
3. Physical Environment Factors:		
a. Room temperature	33.65	^{0}C
b. Humidity	54.75	%
c. Light intensity	3.58	Luxmeter
d. Mattress sheet's type	2.20	(1) Spring bed; (3) Cotton
e. Carpet type	1.23	(1) non-carpet; (3) carpet
f. Weight of dust	26.43	Gram
g. (Additional) wall material	1.72	(1) wall; (3) carpet and wood

* per dust weight concentrated in a residence

The following step was conducting path analysis on the data which consisted of 80 samples. The analysis process was performed after all variables were deemed to meet with the prerequisites of assumption test. There were alternative path models based on the relationship between variables, but the path model with the scientifically and statistically highest significance was worthy of being selected. The selected path model is shown in Figure 1.



Based on path model in Figure 1, it can be concluded that the total population of *Dermatophagoides* mites in house dust of respiratory tract allergy patients' residences has shown significant direct and indirect correlations with the internal environment factor of the residence. The environment factor that correlates directly is the protein level of dust particles; while the other factors have indirect correlation. There are two environment factors that do not significantly correlate, namely pH level and water level in house dust, and therefore, the two factors will not be discussed. The model empirically consists of three main paths which describe the causality of internal environment factors with the population of mites in the dust. Through the path model, the empirical interpretation of depopulating *Dermatophagoides* mites in house dust can be acquired. Figure 1. Path model between variables of each internal environmental factor of residences with the path end of *Dermatophagoides* mite population.

The first path correlates the population of *Dermatophogoides* mites with the dust protein level factor. Referring to the path, it can be said that the population of *Dermatophogoides* mites is influenced by the house dust protein level. The higher the level of protein in the dust, the bigger the population of mites present in the residence of respiratory tract allergy patients [2]-[7]. The presence of protein in the dust highly influences the existence of mites because protein is the source of food important for development and multiplication functions. Protein is crucial for the mite's weight growth and is also important in increasing the resistance to the extreme environment [4]. In reproduction function, protein is needed as the component which helps develop the female's eggs. By looking at this path, it can also be concluded that the population of mites can be reduced by limiting the production of protein in the house dust.

The second path correlates the protein level with the density of *Dermatophagoides* mites. Through this path, it can be postulated that the protein level correlates with the density of mites in the house dust. It can be said that the two factors correlate and the level of mite density possesses synergy with the habitat high in protein level. Correlating the second path with the first path, it can be empirically formulated that the depopulation of *Dermatophagoides* mites can be done by reducing the protein level and minimizing the population of mites in the house dust.

The third path correlates the density of *Dermatophagoides* mites with four environmental factors, namely: carbohydrate level, organic element level, humidity, and weight of dust accumulated in the house. This path has asual relationship so that it can be interpreted that the mite density factor is influenced by the four factors. The carbohydrate level factor influences the mite density in a way that it serves as food source within the mite's habitat. The existence of carbohydrate is assumed coming from various host activities related to eating habits, such as: rice eating habit, snacking, and other activities which cause crumbs to scatter in the floor, carpet, mattress, pillow, and sofa. When mixed with house dust, they can thrive as mite habitat. For mites, carbohydrate serves as the source of energy for mobility, migration, and distribution in order to survive alongside humans. Through the third path, it can be empirically formulated that in order to minimize the density of mites, the control over the carbohydrate level in the house dust needs to be performed. This can be done by improving living and eating habit by eating in the dining room so that crumbs do not scatter around floor, carpet, mattress, pillows, and sofa. By making sweeping floor and cleaning carpet, mattress, pillows, and sofa habits, the density of mites can be reduced.

From the third path, it can be concluded that the density of *Dermatophagoides* mites can be influenced by the level of organic elements in the house dust. The presence of organic elements is caused by the resident's

skin squama which naturally flakes off or as a result of scratching. House residents can be human or animals with furs such as cat, dog, or bird. In a day, the accumulation of human skin scales is at 5 mg/day [4]-[5]. Skin squama mixed into house dust provides protein for mites. Therefore, the more densely populated the house, the more skin squama is produced and mixed with house dust and thus making the protein level in the dust and the mite population increase. It is advised that the number of inhabitants in a house is not over four individuals/100 m^2 where children below 12 years old are not over 2 children/100 m^2 [1]-[5].

Other than the organic elements, the population of *Dermatophagoides* mites is also influenced by humidity factor. The higher the humidity level, the higher the density of mites population in the air. Cited from various sources, mites require a high humidity level in order to be able to survive optimally [1], [4], [8], [9]. Humidity level at 65% – 75% is the most optimal level for mites. Physically, the humidity illustrates the amount of water vapor contained in the air inside a room [10]-[11]. High humidity allows the microorganism to flourish in organic elements' fibers. Therefore, humidity provides a positive condition for the availability of various sources of foods for mites and in turn causes the population of mites to increase. Empirically, it can be said that in order to reduce the population of mites, the humidity level of a room needs to be decreased. Based on the path model, humidity correlates negatively with room temperature. High room temperature affects precipitation of water vapor molecules [10]-[11]. The increase in room temperature can reduce the level of water vapor and thus reduce humidity level. Based on the model, increasing room temperature can be done by increasing light intensity inside a room, by means of adding ventilation and allow air circulation by opening curtains and window.

Based on Figure 1, high humidity factor of a room can be reduced by considering the choice of wall materials. Referring to Table 1, house wall covered by carpet is susceptible to high humidity. Empirically proven, carpet is absorbing house dust before being accumulated within the materials. Dust trapped in the carpet for a certain period of time causes the carpet to become the habitat of numerous parasites and microorganisms. Biotic activities lead to water vapor increase inside the room resulting in humidity increase. Accordingly, in effort to reduce room humidity, it is of urgency to consider and avoid the use of carpet to cover up the walls and floor.

The third path has contributed empirical basis that *Dermatophagoides* mite population is much influenced by dust weight. The more dust accumulated inside the house, the more population of mites is evident. Dust is the key determinant factor causing a proper habitat for *Dermatophagoides* mites, making it familiarly referred to as house dust mites. Dust comprises microscopic particles tapped in the diameter of 6 x 10-7 mm or 0.0000006 mm up to 1 mm [4], [12], [13]. A group of house dust sizing similarly or less than 0.1 mm is shown to be easily floating or flying on the air of the room, even triggered by the movement of walking or running residents, or by the wind blowing inside the house [4]. As shown in the path model, dust weight is determined by organic and inorganic elements; consequently, to reduce house dust, it is necessary that those organic and inorganic elements be reduced.

Inorganic elements are nonliving matters in the form of synthetic products, for instance synthetic fibers, wool fibers, paper fibers, and cotton fibers [8]-[13]. The presence of fibers within house dust is the results of residents' activities in which fiber-based materials are chosen to be used as parts of house hold fixtures. Cloth fibers are mainly found in clothes, sleeping mattress, curtains, blankets, carpets, and jackets. Paper fibers exist in house dust, particularly when books, newspapers, and magazines are found in the house. The presence of fibers mixed in house dust multiplies the dust weight so as to benefit the mites to form their habitat and shelter. The habitat is the potential place for them to lay eggs and hatch even more mites. As for suppressing the population of mites, the avoidance of using more fiber-based materials is to be reconsidered. More efforts need to be regularly done, for instance by vacuuming the dust, mopping the floor, and discarding fiber-based materials away from house.

It is highly recommended that house dust issue be handled properly by considering the choice of materials for a sleeping mattress as well as floor and wall covers. Referring to the path model, the types of sleeping mattress and room cover are highly contributing to organic elements. Empirically (shown in Table 1), the sleeping mattress discussed above is the one made of cotton and the room cover is made of carpet or wood. This is due to the fact that house dust accumulates in those fiber-based materials. Another challenge lies on the issue of difficulties of doing house cleaning, in particular for house dust. Accordingly, it could be summed up that the use of fiber-based materials is to be minimized.

CONCLUSION

The population of *Dermatophagoides* mites contained in house dust found in the residences of respiratory tract allergy patients directly and indirectly correlates with internal environment factors. Internal environment factors showing direct correlation are represented by protein level of dust; while the other factors are indirectly correlating. There are two internal environment factors that do not correlate with the population of mites, namely pH and water levels of house dust.

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