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Types and density of dust mites found among different habitats in houses in North Sulawesi Province, Indonesia

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Abstract

House dust mites (HDM) are the main source of allergens in house dust. The purpose of this study was to determine the type and density of HDM among different habitats in houses in North Sulawesi Province, Indonesia. The present study was an observational analysis, conducted by sampling house dust in some habitats in houses. Microscopic examination conducted on the mites that have been isolated and preserved with Hoyer's medium. The density of HDM was calculated and then analyzed. The results showed the presence of various types of mites, like *Dermatophagoides pteronyssinus*, *Dermatophagoides farinae*, *Blomia tropicalis*, *Austroglycyphagus*, *Tyrophagus sp*, *Suidasia sp* et cetera. Data analysis showed that there was no significant difference on the average density of HDMs and the total mites between foam mattress and spring bed mattress ($p > 0.05$), but there were significant differences on the average density of HDMs between spring bed mattress and floor tiles ($P < 0.05$)

Keywords: Dust mites, *D. pteronyssinus*, *D. farinae*, *B. tropicalis*. North Sulawesi

1. Introduction

Global warming can have a wide impact on the environment. Data from some research found an increase of average temperatures in the last 7 years in the city of Manado, which is an increase of 0.3 °C annually [1]. Increased temperature can cause a rise in air pollutants, such as dust. Dust in homes contains components that are allergens to sensitive people; among them are house dust mites (HDM). HDM is an important allergen in houses [2, 3].

House dust mites belong to the phylum Arthropoda, subphylum Chelicerata, class Arachnida, order Acari, suborder Astigmata, and family Pyroglyphidae [4, 5]. The use of the term HDM, traditionally refers to mites of the family Pyroglyphidae, although house dust mites can also be found in the family Glycyphagidae and Acaridae [4]. Most of 49 species of the family Pyroglyphidae are nest dwellers or feather-associates of birds, only 13 species recorded can be found in house dust. Five species have been recorded in this habitat repeatedly and throughout the world, which are *Dermatophagoides pteronyssinus*, *Dermatophagoides farinae*, *Hirstia domicola*, *Malayoglyphus intermedius* and *Euroglyphus maynei* [4]. Three species are the main sources of dust mite allergen, ie *D. pteronyssinus*, *D. farinae* and *E. maynei* [6-7]. Many studies found that dust mites can be found in a variety of habitats such as on a mattress [8-12], the bedroom floor [8, 9, 12], carpet [12-13], sofa [12, 14], curtain [14], tapestry [12]. HDM can also be found on the blanket, pillow or fabric material in houses [12, 15].

The present study aims to determine the types of HDM, and other mites found in dust from a variety of habitats, and whether there are differences in the density in habitat such as foam mattress, spring bed mattress, tile floor, cement floor, fabrics sofa which were collected in the city of Manado and Tomohon, North Sulawesi Province, Indonesia.

2. Material and methods

2.1 Dust collection

The study was conducted with the method of observational analysis. Sampling was done from December 2014 to January 2016. Dust samples were collected from several villages in the city of Manado (Malalayang 1, Malalayang 2, Kleak, Batu Kota, West Mahakeret, Tumumpa) and one village in Tomohon (Matani) using 2 sets of 400watt vacuum cleaners. Permission for the research was asked to the local government before the research was done.

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The sampling was done purposively with the help of the headman and the local community.

From every house visited, at least two habitats were chosen, according to the house owner. The habitats for the sampling were mattress, floor, sofa, and shelf. On each sampling, a piece of siphon fabric sized 20 x 20 cm was inserted on the tube of the vacuum cleaner. The vacuum cleaner was cleaned every time a sampling was done; therefore 2 sets of the same vacuum cleaner were used in turns. In every sampling, the humidity and temperature of the room were measured.

2.2 Mites isolation and microscopic identification

Obtained dust samples were collected into a plastic container and then taken to the laboratory of Parasitology, Faculty of Medicine, Sam Ratulangi University (UNSRAT). Each dust samples were filtered, weighed and placed on a petri dish for direct isolation. Petri dishes containing dust was stored at room temperature until it was isolated. Isolation was cultivated to be done immediately. Each petri dish placed under stereoscopy microscope, then every mite caught directly with mite needle and placed on a glass object that has been given Hoyers medium and then covered with a glass cover, ready for identification. Microscopic examination was performed to identify the type of mite using binocular microscope Olympus CX 21. Identification of the mites were used pictorial key from Colloff^[4, 16], Fain and Philips^[17].

2.3 Mites Density

Dust samples were filtered and weighed before direct isolation done. The number of mites was counted during direct isolation. Mite density was calculated by the total of

mites divided by dust weight in grams.

2.4 Data Analysis

All data collections were processed by computer. Data of mites identified on each habitat, were processed descriptively with the help of the Excel program and SPSS version 22. Ratio of the average density between 2 habitats was analyzed with T independent test with the help of the program SPSS version 22.

3. Results and Discussion

A total of 319 dust samples from 150 homes were collected from several villages in the city of Manado (Malalayang 1, Malalayang 2, Kleak, Batu Kota, West Mahakeret, Tumumpa) and one village in Tomohon (Matani). Most of the location of that which was located in Manado are at an altitude < 240 m above sea level and only one location, namely in Tomohon situated at an altitude of 600-700 m above sea level. At the time of the study, the temperature in the city of Manado ranged from 28-34 °C with an average temperature 31.1 °C, while the temperature in Tomohon ranged between 24-31 °C. Air humidity in Manado city ranged between 48-85% with an average humidity of 68.5%, while the relative humidity in Tomohon > 80%.

Types of mites that were found at various sampling locations is given in Table 1. From this table it appears that mites were found on all sampling sites (7 sites) are *D. pteronyssinus* and *B. tropicalis*. Mites of the family Acaridae (*Tyrophagus sp*) and family Tarsonemidae (*Tarsonemus sp*) were found only in the Tumumpa.

Table 1: Distribution of types of mites based on the sampling location

Types of mites	Sampling location						
	West Mahakeret (%)	Malala-yang 1 (%)	Malala-yang 2 (%)	Kleak (%)	Tumumpa (%)	Batu Kota (%)	Tomohon (%)
Pyroglyphidae :							
<i>Dermatophagoides pteronyssinus</i>	50	74	59	40	73	55	8.9
<i>Dermatophagoides farina</i>	0.63	9.77	2.25	-	2.33	31.3	-
Pyroglyphidae unidentified	-	-	0.3	-	0.4	3.9	
Echymiopodidae							
<i>Blomia tropicalis</i>	22.2	10.5	19.7	38.3	18.3	4.69	68.9
Glycyphagidae							
<i>Lepideglyphus destructor</i>	-	0.75	0.56	4.68	-	1.56	-
<i>Gohiera fusca</i>	0.63	-	9.3	0.58	0.44	-	8.9
Chortoglyphidae	0.6	0.8	0.6	-	-	-	-
Aeroglyphidae, <i>Austroglycyphagus</i>	14	0.8	0.6	8.2	-	0.8	-
Acaridae							
<i>Tyrophagus sp.</i>	-	-	-	-	1.2	-	-
<i>Acarus sp.</i>	-	0.8	-	1.2	-	-	-
Suidasiidae							
<i>Suidasia sp.</i>	4.4	-	1.7	2.3	3	0.8	2.2
Cheyletidae	5.7	0.75	2.25	4.09	0.89	-	6.6
Tarsonemidae	-	-	-	-	0.3	-	-
Mesostigmata mite	0.6	-	-	-	0.3	1.6	-
Oribatida mite	-	0.8	-	-	-	-	-
Hard to identified	1.336	0.75	3.1	4.09	-		4.4

Table 1 shows that HDM (*D. pteronyssinus*) was found in all research sites, both in Manado (West Mahakeret, Malalayang 1, Malalayang 2, Kleak, Tumumpa, Batu Kota) and in Tomohon, although the percentage of *D. pteronyssinus* in Tomohon was less (8.9%) compared to *B. tropicalis* mites (68.9%). Tomohon town located in the mountainous area, had a lower air temperature and higher humidity than the city of Manado. The existence of *B. tropicalis* was much more

common in high humidity season (November-January) as reported by Mariana *et al* in Malaysia^[18]. *B. tropicalis* allergy reported more prevalent in tropical region of South Africa^[19]. Dust samples were collected from the bed mattress, floor and sofa. Various types of habitat have been selected based on the consent of house owners, which was foam mattress (14.1%), the spring bed mattress (19.3%), cotton mattress (1.3%), tile floor (19.3%), cement floor (1.6%), wood floor (1.3%), carpet

(2.6%), fabrics sofa (36.3%), leather sofa (2.0%), wooden chair (1.3%) and wooden rack (1%). Sampling on the floor was done on the bedroom floor. The distribution of habitats was uneven due to various factors such as the house owner

does not allow to getting samples at certain places, and less use of certain types of habitat such as a cotton mattress. Distribution of mites in various habitats is given in Table 2.

Table 2: Distribution of mites in various habitats

Type of mites	Mites percentage in various habitats										
	1	2	3	4	5	6	7	8	9	10	11
I. Astigmata mites											
1. Pyroglyphidae											
<i>D. pteronyssinus</i>	66,8	73,2	80,0	36,6	28	0	8	65,7	11,1	14,3	0
<i>D. farinae</i>	5.4	5.2	0	0.8	8	0	0	5	0	0	0
Hard to identify	1	0	0	0	8	0	2	0.2	11.1	0	0
2. Echymiopodidae											
<i>Blomia tropicalis</i>	18.5	14.9	0	38.9	32	87	68	16	11.1	28.6	43
3. Glycyphagidae											
<i>L. destructor</i>	0	0.6	0	3.1	0	0	0	0.5	0	0	0
<i>Gohiera fusca</i>	0	2.6	0	5.3	4	0	2	2.5	0	0	0
4. Aeroglyphidae											
<i>Austroglyphagus</i>	0.5	0.6	20	5.3	12	0	2	1.4	55.6	57.1	0
5. Chortoglyphidae	0	0.3	0	0	0	0	2	0.2	0	0	0
6. Family Acaridae											
<i>Acarus</i> sp	0	0	0	0	0	0	0	0	0	0	0
<i>Tyrophagus</i> sp	0	0	0	0.8	0	0	0	1.3	0	0	0
6. Suidasiidae											
<i>Suidasia</i> sp.	1	0.6	0	1.5	0	0	0	4.1	0	0	0
II. Prostigmata mites											
Cheyletidae	3.4	0.6	0	1.5	4.3	0	8	1.6	11.1	0	57
Tarsonemidae	1.5	0.6	0	0.8	0	0	0	0.6	0	0	0
III. Mesostigmata mites, Macrochelidae	0	0	0	0	4	0	2	0	0	0	0
Oribatida mites	0.5	0	0	0	0	0	0	0	0	0	0
Hard to be identified	1.5	0.9	0	5.3	0	13	6	0.8	0	0	0
Total (%)	100	100	100	100	100	100	100	100	100	100	100

Note: 1. Foam mattress 2. Springbed mattress 3. Cotton mattress 4. Tile floor 5. Cement floor 6. Carpet 7. Fabrics sofa 8. Leather sofa 9. Wooden chair 10. Wooden floor 11. Wooden rack

The type of house dust mites found in various habitats come from families Pyroglyphidae (*D. pteronyssinus*, *D. farinae*), Echymiopodidae (*Blomia tropicalis*), Glycyphagidae (*Lepidoglyphus destructor*, *Gohiera fusca*), Chortoglyphidae (*Chortoglyphus* sp) Aeroglyphidae (*Austroglyphagus*), Acaridae (*Tyrophagus* sp, *Acarus* sp.), Suidasiidae (*Suidasia* sp.) Cheyletidae, Tarsonemidae, Macrochelidae and Oribatida mites. Astigmata mite, which were *D. pteronyssinus* (Family Pyroglyphidae) and *B. tropicalis* (Family Octopodidae) were found almost in all habitats.

The discovery of *Blomia tropicalis* mites, *Gohiera fusca*, *Tyrophagus*, *Suidasia*, *Tarsonemidae* and *Macrochelidae* on dust in the city of Manado and Tomohon was reported for the first time. More than one type of mite can be found at each habitat sample examined. Fabric sofas are the most preferable places for mites to live, in which there were twelve types of mites.

From table 2 it is also can be seen that the mites from the family Pyroglyphidae *D. pteronyssinus* was the predominant mite, found in mattress including foam mattress (68%), spring bed mattress (73.2%) or cotton mattress (80%) as well as on the sofa fabric. Previous research conducted by Koorsgaard (1998) revealed the existence of *Dermatophagoides* sp. amounting to 70% out of all dust mites found in the house,

especially on the mattress [20]. Table 2 showed that *B. tropicalis* was the most common mite on tiled flooring, cement flooring and carpet. On the floor with carpet HDM can still be found, rather than floors without carpets. Mites from superfamily Glycyphagoidea which is *Austroglyphagus*, were seen most often in leather sofas and wood seat. It does need to be investigated and studied further remembering the small number of leather sofas and wooden chairs samples found in this survey.

HDM average density and total mites found in dust (grams) taken from a variety of habitats is given in Table 3. In this table, researcher distinguished between the HDM densities with the total density of mites. HDM density was the number of HDM (*D. pteronyssinus*, *D. farinae*, Pyroglyphidae were difficult to identify) in grams of dust. Table 3 showed that the highest average density of HDM was found in foam mattresses and the lowest density on wooden floors, leather sofa and wooden racks. Although no HDM was found on the wooden floors, leather sofa and wooden racks, there was a high density of other mites. Types of mites that was found on leather sofa, wooden floors and wooden racks were *B. tropicalis*, *Austroglyphagus*, *Cheyletus* sp. (Table 2). The highest density for the total mites was found on the carpet floors.

Table 3: Average density of House Dust Mites and total mites in Various Habitat (in 1 gr of dust)

Type of habitat	Average Density of HDM (/g dust)	Average density of total mites(/g dust)
Foam mattress	402	646
Cotton mattress	234	359
Spring bed mattress	378	640
Tile floor	160	390

Cement floor	201	456
Wooden floor	0	2397
Carpet	42	2590
Fabrics sofa	339	559
Leather sofa	0	625
Wooden chair	200	1250
Wooden rack	0	755

To see if there was a significant difference between the average density in some types of habitats which include between foam mattresses and spring bed and between spring bed mattress and tiled floors then a comparative analysis was performed with independent t-test, and the help of SPSS version 22. Comparison analysis of average density mites from foam mattress and spring bed mattress, also spring bed mattress and tile floor could be seen in Table 4 and Table 5.

Table 4: Analysis for T independent test comparison of average density HDM and total mites between foam mattress and spring bed mattress

Type of habitats	Total mites (/gr dust)	HDM (/gr dust)
Foam mattress	646.4444	402.3333
Spring bed mattress	639.9333	378.8444
Df	79	79
t- value	0.033	0.169
Sig.	$p>0.05$	$p>0.05$

From Table 4, it appears that there is no significant difference on the average density of HDM and the total mites between foam mattress and spring bed mattress ($p> 0.05$)

Table 5: Analysis for T independent test Comparison of average density total mites and HDM between spring bed mattress and tile floor

Type of habitats	Total mites (/g dust)	HDM(/g dust)
Spring bed foam	639.93	591.776
Tile floor	319.96	150.75
Df	99	99
t- value	2.589	2.576
Sig.	$P< 0.05$	$P< 0.05$

Table 5 shows that there are significant differences on the average density of HDM between the spring bed mattress and tiles floor ($P<0.05$), while the total average density of mites between the spring bed mattress and floor tiles does not have significant differences.

The existence of HDM can be found in various habitats, but its density depends on the basic ecological needs, both physical and biological factors. Physical factors such as light, relative humidity, temperature, mechanical disruption, while biological factors such as the presence of predator, parasitism, competition among and interspecies to fulfill the needs of food necessary for growth and proliferation [11].

This study discovered that the mite from the group Pyroglyphidae were dominant mite, found in mattresses like foam mattresses, spring bed mattresses, cotton mattresses, also on the fabric sofa. The highest average density of HDM was found in foam mattresses, although the analysis did not reveal any significant difference between the average density of HDM and total mites on the foam mattresses and spring bed mattresses (Table 4). In this study, the number of cotton mattresses were very low causing no further analysis. Comparison of mites density in foam mattress with cotton mattress was studied by Podder *et al* [11]. That study reports that the density of *D. pteronyssinus*, *D. farinae* and *B. tropicalis* were found higher in foam mattress than in cotton

mattress [11]. Different results were reported by Kusumo, stating that the population of HDM is more common in cotton mattress than non-cotton mattress [10]. The difference between the results can be affected by other factors such as the habit of cleaning house (sunning the mattress, using a vacuum cleaner), using air conditioner [21], which is associated with the temperature and humidity required by mites [16]. Of all the influencing factors, air humidity is the most important factor. This is related to the breathing of the HDM, where HDM breathe through the skin, so that HDM need moisture high enough to able to inhibit water loss from the body [22].

The average density of HDM and total mites in spring bed mattress was significantly different ($P<0.05$) when compared to the average density in the tile floor (Table 5). This result is consistent with the study by Van Nes which reported that the density of HDM on a mattress is higher than on the floor [8]. This relates to the physical and biological factors that are required in the growth of mites [11]. The mattress and sofa are places that support the growth of HDM because the surface tends to retain moisture. The mattress and sofa were also places with good food sources for HDM, because there are many dead skin remnants of the human body often located at those places [17].

House dust mites live in microhabitat dominated by three main macromolecular structures which are keratin, cellulose and chitin. Microhabitats in houses are found in fabrics including clothes, soft toys and furniture using fabric. Woven fabric or pile cloths are very good dust traps. House dust consists of leftover human skin (keratin source), fungal hyphae (where chitin is derived, apart from the skin mite itself) and the fibrous material of the fabric (which is a source of cellulose) [16]. Fabrics and fabrics pile found in mattress, carpet, sofa, rug, and curtain can provide food and shelter for HDM [16, 21-23].

From Table 3 it is known that the average density of HDM on wooden floors, wooden chairs and wooden shelves are very low. Wood flooring and other wood materials tend to resist moisture. At the time of the research and sampling on the wooden floor (July-August 2015) the air temperature ranged between 32-34 °C, higher than the annual average temperature in Manado reported in 2013 which is about 26.4 °C. The influence of global warming impacting the increase in average temperature also affects the HDM population. The HDM population while sampling during the summer, in a variety of habitats was very low, even not found. Capacity growth and reproduction of *D. pteronyssinus* and *D. farinae* is well at temperatures of 25 ± 2 °C and a relative humidity of 75 – 80% [24]. The reduced moisture of HDM assumed would hasten death. The influence of climate on HDM population reported by Van Nes that in the winter in the Netherlands, the mite population is very less because the temperature and humidity are not suitable [8]. HDM population data associated with the climate in the tropics has not been widely reported.

4. Conclusion

Types of dust mites found in several habitats in the city of Manado come from families Piroglyohidae (*D. pteronyssinus*, *D. farinae*), Echymiopodidae (*Blomia tropicalis*),

Glycyphagidae (*Lepidoglyphus destructor*, *Gohiera fusca*), Aeroglyphidae (*Austroglyphagus*), Chortoglyphidae (*Chortoglyphus*), Acaridae (*Tyrophagus*, *acarus sp.*), Suidasiidae (*Suidasia*), Cheyletidae, Chortoglyphidae, Tarsonemidae, Macrochelidae and mites Oribatida. *D. pteronyssinus* mite was dominantly found in foam mattresses (68%), on a springbed mattress (73.2%) and on a cotton mattress (80%). *B. tropicalis* is dominant on the tiled floor (38.9%), cement floor (42.1%), wood floor (47.1%), carpets (86.7%) and wooden shelf (42.9%). The HDM density was found highest on foam mattress with *D. pteronyssinus* as the dominant type of mite, but statistically no significant difference ($p > 0.05$) was found between foam mattress and spring bed mattress. But there is a significant difference between the density of HDM and total mites in spring bed mattress compared with tiled floors.

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