Conference Paper

The Correlation Between the Oviposition of Aedes Sp. and the Features of a House

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Abstract.
Aedes aegypti mosquitoes exhibit specific behavior when choosing their nest. This study was conducted on April 2021 and aimed to assess the correlation between the oviposition habit of female *Aedes* sp. and the features of a house in 34 adjacent houses in the Tamansari area. Ovitraps were placed indoors and outdoors at each house. The number of mosquitoes that laid eggs were estimated by dividing the number of eggs found in the ovitrap by the average number of eggs produced by female mosquitoes. Data about the features of the houses were obtained by observing the houses and interviewing the house owners. Results showed that 79.41% of the houses had the *Aedes* sp.'s egg in an ovitrap. There was a correlation between the number of indoor oviposition mosquitoes and the number of occupants (p=0.04; r=0.35). There was also a correlation between the number of outdoor oviposition mosquitoes and the ratio of the house's area (m2) per number of occupants (p=0.03; r=0.36). We conclude that mosquitoes prefer to nest inside a house with a lot of occupants and prefer to nest outside a house that is spacious and has few residents.

Keywords: aedes, house, oviposition

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1. INTRODUCTION

The Aedes sp. mosquito is a vector of Dengue Hemorrhagic Fever (DHF) which is still a health problem in Indonesia [1]. Aedes sp., which include *Aedes aegypti* and *Aedes albopictus* are also vectors of Chikungunya, Zica and Yellow Fever [2]. The government is trying to involve community in eradication of Aedes sp as an effort to stop the transmission and reduce the incidence of this mosquito-borne disease. The government promotes 3 M, a program which is aimed for eradication of mosquito nests and breaks chain of the mosquito's life cycle. The 3M asks people to drain and clean water reservoirs every week, close the water reservoirs, and burry used goods that can hold water [1]. However, until recently, Aedes sp. cannot be eliminated, even in areas with good hygiene levels with a low container index or in area which is larvae are rarely found in water containers, adult Aedes sp. mosquitoes can still be found [3].

Aedes aegypti is commonly found indoors and in urban areas, while *Aedes albopictus* mosquitoes are mostly found outdoors and in rural areas [4,5]. The flight distance of this mosquito ranges from 50-100 meters [3,6,7]. This mosquito needs rest to continue its flight. Hanging clothes, chairs made of cloth, or plants are often becoming the resting place of the mosquitos [3].

The source of energy for these mosquitoes is plant nectar. However, female mosquitoes need blood for egg development, therefore female Aedes sp mosquitoes suck blood [3]. High CO_2 levels are a sign for mosquitoes to find a host to be sucked [8,9]. These mosquitoes suck blood during the day, especially at 8-9 o'clock in the morning and 4-5 o'clock in the afternoon [10]. Aedes sp mosquitoes lays their eggs or nesting in clean water, such as water in resident's water containers or used goods that collect rainwater. An Aedes sp. Females can lay 50-100 eggs at a time.

These mosquitos lay eggs every three days and can lay about ten times in its lifetime [3]. Aedes sp. prefer to lay their eggs on water in a humid place [11]. Previous studies have shown that the density of houses and the location of breeding sites affected the ovipositioning of Aedes sp. Eggs in ovitrap were found more at terraced housing than high density housing and eggs in ovitraps placed outdoor were more than indoor. Characteristics of houses favored by mosquitoes for nesting need to be known to be aware of the presence of mosquito nests and ovitrap is an effective tool for Aedes surveillance [12]. This study aims to analyze the correlation between oviposition of Aedes sp. and the characteristics of the house, namely the ratio of the area of the house per number of occupants, the number of occupants, the area of the house, and the presence of chairs made of cloth.

2. METHODS

This research is an observational analytic study with a cross-sectional design which was carried out in April 2021 on 34 participants who lived in adjacent houses in the Tamansari area of Bandung city. The area chosen is an area with a low container index (0.05) but has the highest incidence of dengue fever in the Tamansari area this year. The houses involved in this study were houses with no larvae in their water reservoirs, no use of insecticides, no ram wire in the house's ventilation. The ovitrap that we used was a small black bucket with a diameter of 18 cm. It was filled with well water, and filter paper was placed on the walls of the bucket. The mosquito eggs which placed on the surface of the water will stick to the filter paper and can be counted. One ovitrap was placed inside and outside each house. Ovitraps were stored for five days, then filter paper was

taken and dried, the number of eggs were counted. The oviposition habit of Aedes was measured by estimating number of indoor and outdoor nesting mosquitoes. Number of mosquitos was estimated by dividing the number of eggs found in the ovitrap by the minimum average number of eggs produced by female mosquitoes (50 eggs). The data of the house characteristics were obtained by observing the houses and interviewing the house owners. The data were processed by spearman and chi square tests.

3. RESULTS

We found positive ovitrap in 27 of 34 houses (79.41%). The range number of mosquitoes that nesting in ovitraps is 0-7 mosquitoes per household. The average number of mosquitoes that nesting in ovitraps is two female mosquitoes per household. The average number of mosquitoes that nesting outside of the house is approximately the same as inside of the house. As we see at Table 1, the average number of mosquitos that nesting inside of the house is 1.01 with confidence interval 0.4235. We do round off as there is no 1.01 of mosquito, so the average number of mosquitos that nesting inside of the house is one mosquito. The average number of mosquitos that nesting outside the house also about one mosquito.

TABLE 1: The average number of egg laying mosquitos.

Place	Average	Standard deviation	Confidence Interval
Inside of the house	1.01	1.26	$\mu = 1.01 \pm 0.4235$
Outside of the house	0.94	1.19	$\mu = 0.94 \pm 0.4$
Total	1.95	1.80	$\mu = 1.95 \pm 0.605$

We analyzed the correlation between the number mosquitoes that nesting in ovitraps which placed inside and outside the house with the characteristics of the residents' houses. There was a correlation between the number of indoor nesting mosquitoes and the number of occupants (p=0.04) with a low-level positive correlation (r=0.35). There was also a correlation between the number of outdoor nesting mosquitoes and the ratio of house area (m2) per number of occupants (p=0.03) with a low-level positive correlation (r=0.36). However, there were no correlation between indoor nesting mosquitoes and the presence of a cloth chair in the house since p=0.08 (Table 2 and Table 3).

Table 2: Correlation between the number of nesting mosquitoes and house characteristic.

Correlation	p	r
Correlation n between the number of indoor nesting mosquitoes and the number of occupants	0.04	0.35
Correlation n between the number of indoor nesting mosquitoes and house size	0.50	0.12
Correlation between the number of indoor nesting mosquitoes and the ratio of house area (m2) per number of occupants	0.09	0.29
Correlation n between the number of outside eggs laying mosquitoes and the number of occupants	0.08	0.30
Correlation n between the number of outdoor nesting mosquitoes and house size	0.65	0.08
Correlation n between the number of outdoor nesting mosquitoes and the ratio of house area (m2) per number of occupants	0.03	0.36

Table 3: Relationship between indoor nesting mosquitoes and the presence of a cloth chair.

Presence	Indoor nesting mosquitoes	No indoor nesting mosquitoes	p
Cloth chair	9	7	0.08
No cloth chair	11	7	

4. DISCUSSION

In this study, we found 79.41% house with ovitraps positive. It describes even there were no mosquito nests in the house of all participants beside ovitraps, there were still mosquitoes in the participants' house and nested there. A house which is clean from mosquito nests does not mean free from mosquitoes. Mosquitoes can fly 50-100 m, so mosquitoes can visit our homes from other places [3,6,7]. Puddles of water in house gutters, used goods and garbage that can accommodate rainwater, water storage containers in public places such as mosques, schools, or public buildings are places that mosquito can lay eggs and can act as sources of mosquitoes for the environment [3,13-15]. Therefore, care for the cleanliness of the environment and neighbors must also be considered in addition to the cleanliness of the house.

The average number of nesting mosquitoes in the ovitrap of each house is about two, with the average number of nesting mosquitoes inside and outside the house is approximately the same, namely one. The absence of mosquito rams causes mosquitoes to freely enter and exit the house so that the average number of nesting mosquitoes in the ovitrap inside and outside is approximately the same. We found that the number of indoor nesting mosquitoes had correlation with the number of occupants. The more occupants of a house made more mosquitoes laid eggs in the ovitrap inside the house.

We also found that the number of outdoor nesting mosquitoes had correlation with the ratio of house area (m^2) per number of occupants. Mosquitoes prefer to lay their eggs in the ovitrap outside the house at bigger house or fewer the number of occupants. This is in accordance with the nature of mosquitoes that are attracted to the environment with high CO_2 levels as a sign of the presence of host that can be sucked blood. Mosquitoes need blood for the process of maturation of their eggs so that mosquitoes look for hosts to suck blood. About three days after the female mosquito sucks blood, she will lay her eggs. Aedes mosquitoes do not fly far, they only fly 50-100 meters during their lifetime, even research in Peru states that Aedes only move about 30 meters, so after sucking blood, mosquitoes tend to lay eggs inside the house [3,6,7,18,19].

We did not find any relationship between the presence of cloth chairs and the number of indoor nesting mosquitoes. This can be caused because there are many other items that can be used as resting places for mosquitoes such as curtains, hanging clothes, walls, and beds [3,20,21].

5. CONCLUSION

Based on the results of our research, we can conclude that mosquitoes prefer to nest inside the house that have many occupants and mosquitoes prefer to nest outdoor in large houses with few occupants. But there was no correlation between inside eggs laying mosquitoes and the presence of a cloth chair in the house.

References

[1] Pusat Data dan Informasi Kementrian Kesehatan RI, Situasi Demam Berdarah Di Indonesia Tahun 2017. Jakarta. 2018.

[2] Hotez PJ, Murray KO. Dengue, West Nile virus, chikungunya, Zika-and now Mayaro? PLoS Negl Trop Dis. 2017;11.

[3] Global Adult Tobacco Survey: Indonesia Report. World Health Organization. 2011.

[4] Djati AP, Pramestuti N. Indonesian Bulletin of Health Research. 2013;41

[5] Lounibos LP, Kramer LD. Invasiveness of Aedes aegypti and Aedes albopictus and Vectorial Capacity for Chikungunya Virus. J Infect Dis. 2016 Dec;214.

[6] Greenberg JA, DiMenna MA, Hanelt B, Hofkin BV. Analysis of post-blood meal flight distances in mosquitoes utilizing zoo animal blood meals. J Vector Ecol. 2012 Jun;37(1):83–9.

[7] Nirmani MD, Perera K, Galhena GH. Sri Lankan. J Biol. 2019;4.

[8] Lacey ES, Ray A, Cardé RT. Close encounters: contributions of carbon dioxide and human skin odour to finding and landing on a host in *Aedes aegypti*. Physiol Entomol. 2014 Mar;39(1):60–8.

[9] Liu MZ, Vosshall LB. General Visual and Contingent Thermal Cues Interact to Elicit Attraction in Female Aedes aegypti Mosquitoes. Curr Biol. 2019 Jul;29(13):2250–2257.

[10] Syahribulan S, Biu FM, Hassan MS. Indonesian Journal of Health Ecology. 2012;11.

[11] Madeira NG, Macharelli CA, Carvalho LR. Variation of the oviposition preferences of Aedes aegypti in function of substratum and humidity. Mem Inst Oswaldo Cruz. 2002 Apr;97(3):415–20.

[12] Sasmita HI, Neoh KB, Yusmalinar S, Anggraeni T, Chang NT, Bong LJ, et al. Ovitrap surveillance of dengue vector mosquitoes in Bandung City, West Java Province, Indonesia. PLoS Negl Trop Dis. 2021 Oct;15.

[13] Barrera R, Acevedo V, Amador M. Role of Abandoned and Vacant Houses on *Aedes aegypti* Productivity. Am J Trop Med Hyg. 2021 Jan;104(1):145–150.

[14] Gustave J, Fouque F, Cassadou S, Leon L, Anicet G, Ramdini C, et al. Increasing Role of Roof Gutters as *Aedes aegypti* (Diptera: Culicidae) Breeding Sites in Guadeloupe (French West Indies) and Consequences on Dengue Transmission and Vector Control. J Trop Med. 2012;2012:1–3.

[15] Ming LS, Adnan TH, Huck OC, Ibrahim M, Husin D, Abdullah NA, et al. Southeast Asian J Trop Med Public Health. 2018;49.

[16] Satoto TB, Diptyanusa A, Setiawan YD, Alvira N. Jurnal Kedokteran YARSI. 2017;25:41–51.

[17] Lagu AM, Damayati DS, Wardiman M. HIGIENE. Jurnal Kesehatan Lingkungan. 2017;3.

[18] de Moura Rodrigues M, Marques GR, Serpa LL, de Brito Arduino M, Voltolini JC, Barbosa GL, et al. Parasit Vectors. 2015;8:1–9.

[19] Getis A, Morrison AC, Gray K, Scott TW. Perspect. Spat. Data Anal. Springer; 2010.

[20] Perich MJ, Davila G, Turner A, Garcia A, Nelson M. Behavior of resting Aedes aegypti (Culicidae: Diptera) and its relation to ultra-low volume adulticide efficacy in Panama City, Panama. J Med Entomol. 2000 Jul;37(4):541–6.

[21] Diallo D, Diallo M. Resting behavior of Aedes aegypti in southeastern Senegal. Parasit Vectors. 2020;13(1):1–7.