

Diversity and Activities of Mosquito in Yogyakarta Special Region Province, Indonesia, a Non Filariasis Endemic Area

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Abstract. According to data from the Ministry of Health of the Republic of Indonesia in 2018, there were 37 cases of Elephantiasis in Yogyakarta, even though Yogyakarta is not an endemic area of filariasis. This preliminary study was carried out to evaluate the diversity of species, relative abundance, frequency and dominance of mosquitoes in Yogyakarta and to determine the role of mosquitoes as a vector of filariasis. A cross-sectional study was used involving 3 hamlets with elephantiasis cases found in April 2019 in Yogyakarta. Mosquitoes around the house inhabited by the patient with elephantiasis were collected for 12 hours starting from 6:00 p.m. until 6:00 a.m. Mosquitoes were dissected under a dissection microscope and the presence of filaria larvae was observed. A total of 9 mosquitoes species were found. They were *Culex vishnui*, *Culex tritaenorrhynchus*, *Armigeres kesseli*, *Aedes albopictus*, *Culex quinquefasciatus*, *Culex bitaenorrhynchus*, *Anopheles vagus*, *Anopheles subpictus*, *Aedes aegypti*. The highest diversity, frequency, and dominance was *Culex vishnui*, while the lowest was *Culex quinquefasciatus*. There was no filarial larva found during the study.

Keywords: diversity, activity, mosquito, filariasis, Yogyakarta.

1 Introduction

Filariasis is an infectious disease caused by Nematode worm infections and is transmitted by mosquitoes. Filarial worms live in the lymphatic system, causing inflammation of the lymphatic channels and glands in the form of lymphangitis and lymphadenitis, as well as disorders of lymph flow causing an obstruction that continues into edema. Acute filariasis occurs beginning with recurrent fever, retrograde lymphangitis, and lymphadenitis. Furthermore, it can continue to become chronic filariasis in the form of edema, which is initially reversible, but at the later stages becomes irreversible due to tissue fibrosis [1].

Until now filariasis is still a health problem in Indonesia. Filariasis does not cause death, but the advanced stage of the disease causes permanent disability in the form of enlargement, namely elephantiasis, of the legs, arms, breasts, and genitals. Elephantiasis raises social and economic problems. Patient productivity has decreased to be a problem for patients and their families. State-borne health costs are also large [2]. Three species of lymphatic filarial worms are known, namely *Wuchereria bancrofti*, *Brugia malayi* and *Brugia timori*, and all three are found in Indonesia [3].

Filariasis is transmitted by mosquitoes. Various mosquitoes have been found to act as filariasis vectors, namely *Anopheles*, *Culex*, *Mansonia*, *Aedes* and

Armigeres [4]. There are 23 species of mosquitoes from the 5 genera known to act as filariasis vectors. Eradication of this disease cannot ignore vector control. Vector control activities must be carried out properly so that vector densities can be suppressed. Therefore, it is necessary to know vector bionomic which includes mosquito breeding sites, feeding behavior, and resting behavior.

In Indonesia, in 2017 there was 12,677 chronic filariasis (elephantiasis) cases spread in 34 provinces. This figure is lower than the data in 2016, which were 13,009, because of reported deaths. The provinces with the most chronic filariasis cases in 2017 are Papua with 3,047 cases, while in the Special Region of Yogyakarta there are 37 chronic cases. Nevertheless, the Special Region of Yogyakarta is not a filariasis endemic area with no cases of microfilaremia found in the Special Region of Yogyakarta [3]. There is no data yet why in Yogyakarta there was no transmission of filariasis, although 37 cases of elephantiasis were found.

The purpose of this study was to determine the diversity of species, relative abundance, frequency and dominance of mosquitoes captured in non-endemic filariasis areas in Yogyakarta.

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2 Materials and Methods

2.1 Study Area

This observational study was designed to cross-sectional, carried out in 3 hamlets, namely 2 hamlets in Bantul Regency (Pandak and Sedayu sub-districts) and 1 hamlet (Ngaglik sub-district) in Sleman Regency in February 2019. Site selection is based on the presence of elephantiasis cases. This type of research is descriptive, describing the diversity of mosquitoes that have the potential to be a vector of filariasis.

2.2 Mosquito collecting

Collecting mosquitoes is done by mosquito catching volunteers using aspirators for 12 hours, starting at 6:00 p.m. until 6:00 a.m. inside and outside the home of the elephantiasis case and two houses in the vicinity. Each volunteer acts as a human bite and a collector. Volunteers wear closed clothes except for the lower limbs. The landed mosquitoes were captured using an aspirator, and inserted to labeled paper cups according to collection time and location.

Catching mosquitoes is carried out by the following procedure.

2.2.1. Human landing collection was performed for 40 minutes each hour inside and outside the houses

2.2.2. The resting collection was performed for 10 minutes post-human collection inside the house (walls, mosquito nets, curtains, hanging clothes) and outside the house (outside walls, drum walls, leaves), in 3 different houses

2.2.3. The identification of breeding places is carried out by observing the area around catching mosquitoes. Larvae were detected in puddles found.

The collected mosquitoes were identified using a guide to the Rampa Rattanirithikul Mosquito Identification Key Book [5,6,7].

2.2.4. Parameter

The parameters analyzed were mosquito density expressed in Man Hour Density (MHD), relative abundance, frequency and dominance numbers as described by previous researchers Indonesia [8] as follows.

MHD is a certain number of mosquitoes that land on people legs per hour in a certain time.

$$\text{MHD} = \frac{\text{number of mosquito in one species}}{\text{collector number} \times \frac{40}{60} \times \text{time of catching}}$$

$$\text{Relative abundance} = \frac{\text{number of mosquito in one species}}{\text{number of all species of mosquito}} \times 100$$

Species frequency numbers are comparisons between the number of mosquitoes of certain species captured with one type of catch with all mosquitoes captured with all types of arrests.

Frequency = (mosquito number of one method)/(total mosquito number of all method)

The species dominance is the result of multiplication between relative abundance and the number of frequencies of certain types of mosquitoes caught.

Dominance number = relative abundance x Frequency.

3 Results and Discussion

3.1 Mosquito Collection

The number of mosquitoes obtained from 3 collecting areas for 12 hours was 209 adult mosquitoes. The identification results showed as many as 9 species. They are *Cx. vishnui*, *Cx. tritaeniorhynchus*, *Ar. kesseli*, *Ae. albopictus*, *Cx. quinquefasciatus*, *Cx. bitaeniorhynchus*, *An. vagus*, *An. subpictus*, *Ae. aegypti*. The density of mosquitoes caught in humans (MHD) is presented in Table 1.

Table 1. Man Hour Density of mosquito collected by Human Landing collection method in 3 hamlets in Sleman Regency and Bantul Regency, Yogyakarta Special Region Province, at February 2019.

Species	MHD
<i>Cx.vishnui</i>	2,15
<i>Cx.tritaeniorhynchus</i>	0,33
<i>Ar.kesseli</i>	0,25
<i>Ae.albopictus</i>	0,19
<i>Cx.quinquefasciatus</i>	0,17
<i>Cx.bitaeiorhynchus</i>	0,06
<i>An.vagus</i>	0,04
<i>An.subpictus</i>	0,04
<i>Ae.aegypti</i>	0,02

MHD: Man Hour Density, mosquito/time (hour)/man

The relative abundance, frequency, and dominancy of mosquitoes captured by people's bait: indoor human landing collection (IHLC) and outdoor human landing collection (OHLC) and mosquitoes resting collection: indoor resting collection (IRC) and outdoor resting collection (ORC) are presented in Table 2.

Fluctuations of mosquito landing activity that occur every hour can be seen in Figure 1. The highest landing activity of mosquitoes is at 02.00 – 03.00 am by the *Cx. vishnui* mosquito.

Table 2. Relative abundance, frequency and dominance number of mosquito collected by Human Landing collection method and resting mosquito collection method inside and outside houses in 3 hamlets in Sleman Regency and Bantul Regency, Yogyakarta Special Region Province, at February 2019.

Species	IHLC			IRM			OHLC			ORM		
	RA	Freq	Dom	RA	Freq	Dom	RA	Freq	Dom	RA	Freq	Dom
<i>Cx.^a</i>	73,21	0,20	14,36	37,50	0,10	3,77	62,63	0,30	18,58	42,86	0,04	1,85
<i>Cx.^b</i>	8,93	0,02	0,21	1,79	0,00	0,01	11,11	0,05	0,58	9,52	0,01	0,09
<i>Cx.^c</i>	12,50	0,03	0,42	5,36	0,01	0,08	1,01	0,00	0,00	0,00	0,00	0,00
<i>Cx.^d</i>	0,00	0,00	0,00	1,79	0,00	0,01	3,03	0,01	0,04	4,76	0,00	0,02
<i>Ar.^e</i>	0,00	0,00	0,00	3,57	0,01	0,03	12,12	0,06	0,70	9,52	0,01	0,09
<i>An.^f</i>	0,00	0,00	0,00	1,79	0,00	0,01	2,02	0,01	0,02	9,52	0,01	0,09
<i>An.^g</i>	3,57	0,01	0,03	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00
<i>Ae.^h</i>	0,00	0,00	0,00	3,57	0,01	0,03	8,08	0,04	0,31	19,05	0,02	0,36
<i>Ae.ⁱ</i>	1,79	0,00	0,01	3,57	0,01	0,03	0,00	0,00	0,00	4,76	0,00	0,02

^a *Cx.vishnui*, ^b *Cx.tritaeniorhynchus*, ^c *Cx.quinquefasciatus*, ^d *Cx.bitaeiorhynchus*, ^e *Ar.kesseli*, ^f *An.vagus*, ^g *An.subpictus*, ^h *Ae.albopictus*, ⁱ *Ae.aegypti*.

IHLC: Inside Human Landing Collection; IRC: Inside Resting collection
 OHLC: Outside Human Landing Collection ORC: Outside Resting Collection
 RA: Relative Abundance (%); Freq: Frequency; Dom: Dominancy (%).

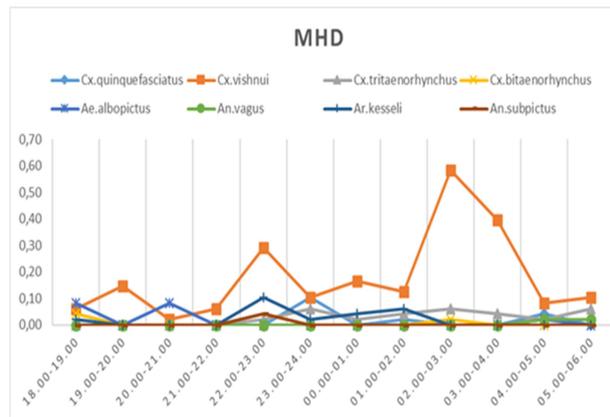


Figure 1. Man hour density of mosquitoes in 3 hamlets of Yogyakarta Special Region, collected at February 2019.

3.2 Breeding Places

It was found many mosquito larvae in the wood bathing pool act as mosquito breeding place in Sleman Yogyakarta Special Region (Figure 2).



Figure 2. Wood bathing pool act as a mosquito breeding place in Sleman, Yogyakarta Special Region.

3.3 Discussion

The mosquito fauna found in non-endemic filariasis areas is in 3 hamlets in Sedayu sub-district and Pandak sub-district, Bantul regency and Ngaglik sub-district in Sleman Regency in February 2019 as many as 9 species. The diversity of mosquito fauna depends on the local geographical conditions. These two sub-districts in Bantul and 1 sub-district in Sleman are plains with altitudes less than 500 m above sea level (9,10). This area includes relatively flat urban areas with both artificial and natural puddles. Artificial puddles such as fish ponds, wood bathing pools and others (Figure 2). These puddles act as mosquito breeding places of *Culex spp.* i.e. *Cx. vishnui* and *Cx. quinquefasciatus*.

The high density of mosquito species in an area is one of the success factors in transmitting vector borne diseases. High mosquito populations are associated with the availability of mosquito breeding sites. Table 1. shows that the dominant species is *Cx. vishnui* with MHD 2.15 mosquitoes per hour per person. Other mosquitoes found with lower densities are *Cx. tritaeniorhynchus*, *Ar. kesseli*, *Ae. albopictus*, *Cx. quinquefasciatus*, *Cx. bitaeiorhynchus*, *An. vagus*, *An. subpictus*, *Ae. aegypti*. Lymphatic filariasis found in Java is an urban type bancrofti filariasis with confirmed vector, namely *Cx. quinquefasciatus*. In this study the density of *Cx. quinquefasciatus* was in level 5, which was 0.17 mosquitoes per hour per man. This finding supports the fact why the Special Region of Yogyakarta is categorized as non filariasis endemic areas. According to Hairston and de Meillon that the occurrence of filariasis transmission is required + 15,000 infective bites, so a high mosquito density is needed [11].

The mosquito biting behavior of the *Cx. quinquefasciatus* species is more dominant indoor than outdoor. Likewise, the resting behavior of the mosquito,

they prefer to rest indoor rather than outdoor. This result is in accordance with previous studies on the biting behavior of *Cx. quinquefasciatus* in other regions [12]. However, relative abundance and frequency of *Cx. quinquefasciatus* is much lower than *Cx. vishnui* mosquitoes. This result supports preliminary data that Yogyakarta Special Region is nonfilariasis endemic area. Dominance numbers of mosquito can describe actual population density. In this study the dominance of *Cx. vishnui* mosquitoes was the highest compared to other species. On the contrary, the dominance of *Cx. quinquefasciatus* was lower.

The results of this study indicate that *Cx. quinquefasciatus* mosquitoes that have low density, low relative abundance, low frequency, and low dominance do not support the occurrence of lymphatic filariasis transmission in the Yogyakarta Special Region. The *Cx. vishnui* mosquito which has high density, high relative abundance, high frequency, and high dominance does not play a role in the transmission of lymphatic filariasis. It is reported that *Cx. vishnui* is one of the vectors of Japanese encephalitis in Indonesia [3]. In the future, research is needed to determine whether mosquitoes captured in the study area have the potential to be vectored by DNA testing and infection testing.

4 Conclusion

The mosquito fauna found in Yogyakarta Special Region consists of 9 species of mosquitoes, namely *Cx. vishnui*, *Cx. tritaeniorhynchus*, *Ar. kesseli*, *Ae. albopictus*, *Cx. quinquefasciatus*, *Cx. bitaeniorhynchus*, *An. vagus*, *An. subpictus*, *Ae. aegypti*. Mosquitoes that have the highest relative abundance and the highest dominance are *Cx. vishnui*, while the *Cx. quinquefasciatus* has a low relative abundance and low dominance. This result supports that there is no potential vector transmission of lymphatic filariasis in the Yogyakarta Special Region.

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