



Fauna Nyamuk Aedes dan Kemungkinan Perannya dalam Penularan Demam Berdarah Dengue di Banjar Graha Kerti dan Banjar Kerta Petasikan, Denpasar

The Fauna of Aedes Mosquito and Its Potential Role in the Transmission of Dengue Hemorrhagic Fever in the Hamlet of Graha Kerti and Kerta Petasikan, Denpasar

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KATA KUNCI KEYWORDS

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ABSTRAK

Indonesia, seperti banyak negara di wilayah tropis dan subtropis lainnya, merupakan wilayah endemik penyakit Demam Berdarah Dengue (DHF). Di Kodya Denpasar, kasus DHF terus meningkat dari tahun ke tahun selama kurun 2002 -2008. Penelitian cross sectional ini dilakukan di di Banjar Graha Kerti dan Banjar Kerta Petasikan, Kelurahan Sidakarya, Denpasar, dengan tujuan untuk mengetahui adanya larva nyamuk Aedes dan tingkat kepadatannya di rumah penduduk di kedua lokasi tsb. Semua rumah di kedua Banjar tsb diikutkan sebagai sampel penelitian. Semua tempat air yang ditemukan di dalam rumah diperiksa untuk kemungkinan adanya larva nyamuk dan ditetapkan spesiesnya (Aedes, Culex dan Anopheles). Dari 262 rumah, didapatkan sebanyak 869 tempat air tergenang dan 68 di antaranya mengandung larva Aedes, terdiri dari 37 Aedes aegypti, 14 A. albopictus, dan campuran A. aegypti dan A. albopictus. House Index untuk Aedes adalah 17.2% dan Bruteau Index untuk Aedes adalah 20.6%, yang menunjukkan bahwa Aedes di Br Graha Kerti dan Banjar Kerta Petasikan mempunyai potensi untuk menularkan kasus-kasus DHF. Disarankan agar pelaksana program pengendalian kasus DHF di Kota Denpasar mengenali sifat-sifat biologis dari Aedes, termasuk lokasinya dalam tempat-tempat air di rumah tangga.

ABSTRACT

Indonesia, like many other tropical and subtropical countries in the world, is an endemic area for Dengue Hemorrhagic Fever (DHF). In the city of Denpasar, the number of DHF cases has been increasing during the years 2002-2008. A cross sectional study was done in Banjar Graha Kerti and Banjar Kerta Petasikan, Sidakarya Village, Denpasar, with an objective of assessing the presence of Aedes larvae in water containers in the houses and their rate of density. All houses in the two banjars (hamlets) were included as the study samples, in which the number of water containers were identified and examined for the presence of mosquito larvae (Aedes, Culex, Anopheles). From 262 houses, 869 standing water containers were identified, from which 68 were confirmed to

have Aedes larvae, consisting of 37 Aedes aegypti, 14 A. albopictus, and the combination of A. aegypti and A. albopictus. House Index of the Aedes larvae was 17.2% and the Bruteau Index of the Aedes larvae was 20.6%, which indicated that Aedes mosquitos were potential vectors for DHF transmission in Banjar Graha Kerti and Banjar Kerta Petasikan. It is recommended that the authority responsible for the control program of DHF in Denpasar should know the biological characteristics of the Aedes larvae and their predominant locations of water containers in the houses.

Dengue fever (DF) is an acute febrile viral disease characterized by sudden onset, fever, intense headache, myalgia, retro-orbital pain, anorexia, gastrointestinal disturbance, and rash. Dengue Hemorrhagic Fever (DHF) and Dengue Shock Syndrome (DSS) are considered as a severe clinical manifestation of DF. The disease is mosquito-borne, of which female of *Aedes* spp. has been confirmed as the vector.

Approximately 1.3 billion of the total 1.5 billion inhabitants of South-East Asian countries live in areas with high risk of acquiring DF or DHF. Currently, DHF is the leading cause of hospital admissions and deaths among children in the region (Setiati *et al.*, 2006). WHO (2012) has stated that around 100 countries are endemic with DHF and about 40% of the world's population (2.5 billion) in tropical and sub-tropical countries are at risk. According to the estimate, there are over 50 million infections with about 400,000 DHF cases reported annually, which constitute the leading cause of childhood mortality in several Asian countries.

In 1968 the first DHF cases were reported in Jakarta and Surabaya and at present the disease has become endemic with periodic epidemic attacks occurring with a 5 year interval (Samsi, 2001). A report from Denpasar Regional Health Office indicates that in the city of Denpasar DHF cases are found every year; and since 2002 cases have occurred all year round. The report shows a continuous increase of DHF cases in Denpasar during a five year period as

indicated by the occurrence of 1022 cases in 2004, 1651 cases in 2005, 3017 cases in 2006, 3264 cases in 2007, and 2704 cases in 2008 (Dinas Kesehatan Kota Denpasar, 2007).

The geographical distribution of DF/DHF has greatly extended over the last 30 years due to increased breeding potential of the vector *Aedes aegypti*. This has been prompted by demographic explosion and rapid growth of urban centers resulting in strain on public services such as that concerning potable water. This has been augmented by people's practice of discarding unused goods outdoor such as barrels, drums, jars, flower vases, pots, tyres etc that may collect rainwater providing potential mosquito breeding places (WHO, 2006). As a result, DF, DHF, and DSS have emerged as a major public health problem of international concern (WHO, 2006; 2008; 2012).

Until today, no effective medicine and no good protective vaccine are available against dengue virus, hence vector control is the only preventive measure applicable to prevent transmission. A variety of vector control programs have been carried out by Denpasar Health authority, among others in the forms of health education, routine or occasional fumigation, and use of the larvacide temephos. Although control measures have been executed intensively,

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cases of DF/DHF still occur, even continue to increase year by year (Dinas Kesehatan Kota Denpasar, 2007). So far in Bali, particularly in Denpasar municipality, the mosquito vector for DF/DHF has never been completely studied. Therefore, the present study is considered to be important to carry out, especially in relation to the need of having an effective mosquito vector control program for prevention of DF/DHF.

MATERIALS AND METHODS

This cross sectional study was carried out in 2 hamlets, namely Banjar Graha Kerti and Banjar Kerta Petasikan, in the Village of Sidakarya, Denpasar. The objectives of the study were to identify the species of Aedes mosquitoes in both hamlets and to measure their density. The two hamlets were selected based on the record of high number of DHF cases found in the locations in each month during the last several years. Houses were used as the study population and no sampling was done since all houses were selected as the study samples. Species density was determined by calculating the value of their Bruteau Index (BI), Container Index (CI) and House Index (HI). In relation to BI, CI, and HI calculation, all water containers that were considered potential for Aedes breeding places either located outdoor or indoor were observed for the presence of Aedes larvae.

The presence of larvae in the containers was confirmed macroscopically with the help of flashlight or in certain cases with the use of magnifying glass. The larvae in the container were taken out and kept in special containers with label. All larvae found in a container must be taken out, or if it was not possible, the number of larvae taken should be as maximal as possible. Species identification was done directly to prevent larvae from dying.

The values of BI, CI, and HI were calculated by respective formulas: $HI = \frac{\sum \text{number of houses positive with Aedes larvae}}{\sum \text{number of houses examined}} \times 100\%$. $CI = \frac{\sum \text{number of containers positive with Aedes larvae}}{\sum \text{number of container examined}} \times 100\%$. $BI = \frac{\sum \text{number of container positive with Aedes larvae}}{\sum \text{number of houses examined}} \times 100\%$.

The data obtained from the study were analyzed descriptively in both narrative description and in tables presentations.

RESULTS

The total number of the study population was 267 houses, where 162 houses were located in Banjar Kerta Petasikan and 105 houses in Banjar Graha Kerti. Most houses in the two study sites were designed and built by qualified developers, therefore the arrangement of their environment and public facilities were very satisfactory. The local inhabitants generally come from outside Denpasar and almost all of them have permanent jobs in the Municipal City of Denpasar.

Among 267 houses, 262 houses could be observed and 5 houses were considered lost to follow up due to absence of the house occupants at the time of observation. A total of 259 houses were found to have standing water containers, while 3 houses did not have such containers at all. The total number of standing water containers found was 869; this means the average container per house was 3.3. The most prevalent containers found were toilet tank 327 (37.6%), flower pots 171 (19.7%), refrigerator box 72 (8.3%), toilet pail 58 (6.7%), pond 54 (6.2%), container for bird drinking water 50 (5.8%), discarded goods 47 (5.4%), aquarium 33 (3.8%), water barrel 17 (2.0%), unused tire 17 (2.0%), holy water

container 14 (1.6%), and other containers 9 (1.0%) (Table 1).

Of 869 containers observed, 405 were found in Kerta Petasikan and 464 in Graha Kerti. From all containers examined, 68 were positive with mosquito larvae. Microscopically, 12 containers were positive with larvae of *Culex* spp, 2 with *Anopheles* spp, and 54 with *Aedes* spp. Species identification of the *Aedes* larvae found in the containers revealed 37 *Aedes aegypti*, 14 *Aedes albopictus*, and 3 combined *Aedes aegypti* and *Aedes albopictus* (Table 2).

Of the 869 containers with standing water, 405 located in the hamlet of Kerta Petasikan and 464 in Graha Kerti, were examined. Of those, 54 containers were positive with species of *Aedes* larvae either *A. aegypti* or *A. albopictus*. This means that the Container Index (CI) of *Aedes* was 6.2%. Additionally, 12 and 2 containers were positive with larvae of *Culex* and *Anopheles*, respectively (Table 2).

Table 1. The types of containers with standing water found in the hamlet of Kerta Petasikan and Graha Kerti

Type of container	Total	Percentage
Toilet tank	327	37.6
Flower pot	171	19.7
Refrigerator box	72	8.3
Toilet pail	58	6.7
Pond	54	6.2
Container for bird drinking water	50	5.8
Discarded goods	47	5.4
Aquarium	33	3.8
Water barrel	17	2.0
Unused tyre	17	2.0
Holy water container	14	1.6
Others	9	1.0
T o t a l	869	100

Table 2. The distribution of containers positive with mosquito larvae according to species and location

Mosquitoes type Study location	<i>Aedes aegypti</i>	<i>Aedes albopictus</i>	<i>A. aegypti</i> and <i>A. albopictus</i>	<i>Culex</i> spp	<i>Anopheles</i> spp	Total
Kerta Petasikan	20	0	3	3	1	27
Graha Kerti	17	14	0	9	1	41
Total	37	14	3	12	2	68

Out of 262 houses observed, 45 were confirmed to have standing water containers that were positive with *Aedes* larvae, hence the House Index of *Aedes* was 17.2%. As only 54 among 869 standing water containers examined were positive with *Aedes* larvae, of which 40 positive with *Aedes aegypti* and 17 with *Aedes albopictus* (3 containers with mixed infestation), therefore, the Container Index of *Aedes*, *Aedes aegypti*, and *Aedes albopictus* were 6.2%, 4.6%, and 2.0%, respectively. The Bruteau Index was 20.6% for *Aedes*, 15.2% for *Aedes aegypti*, and 2.0% for *Aedes albopictus*.

DISCUSSION

The number of houses observed in the two hamlets was 262, comprising 102 houses in Banjar Kerta Petasikan and 160 houses in Banjar Graha Kerti. As 45 of 262 houses in the two hamlets were found positive with *Aedes* larvae, it means the House Index (HI) was 17.2%. This figure is much lower than that reported in a previous study done in the area of Kuta Selatan and Tuban, in the Regency of Badung, where HI of 40% was found in Kuta Selatan and 33.3% in Tuban (Subagyo *et al.*, 2004).

The number of containers recovered in the two hamlets surveyed was 869 containers, of which 405 were in Br Kerta Petasikan and 464 in Banjar Graha Kerti. Of the total 869 containers examined, 54 were found to have *Aedes* larvae (*A. aegypti* and *A. albopictus*). Therefore, the Container Index (CI) of the two hamlets was 6.2%. Other than *Aedes* larvae, 12 containers were found to have *Culex* larvae and 2 containers with *Anopheles* larvae. Based on the species, the CI of *Aedes aegypti* in the two hamlets surveyed was 4.6% (40 containers positive of 869 examined) and CI of *Aedes albopictus* was 2% (17 containers positive of 869 examined). These two figures are about similar to the previous figures reported from other areas in

Indonesia such as those from Kuta Selatan, Badung, Bali (7.7%), Tuban, Badung, Bali (8.2%), Tangerang, Banten Province (1.3 - 4.1%), and Palu in Central Sulawesi Province (5.25 - 29.93%) (Subagyo *et al.*, 2004; Sasono and Idram, 2004; Garjito *et al.*, 2004).

There were 54 containers positive for *Aedes* larvae of 262 houses surveyed; therefore the Bruteau Index (BI) of the two hamlets studied was 20.6%. This denotes that in every 100 houses, about 20.6 houses were positive for *Aedes* larvae. Based on the species, the Bruteau Index of *Aedes aegypti* was 15.2% and of *Aedes albopictus* was 6.5%.

The overall Bruteau Index of > 20% in the two hamlets studied indicates a very high potential of DHF transmission in Banjar Kerta Petasikan and Banjar Graha Kerti (WHO, 1994). The above BI (20%) is higher than the figures reported elsewhere in Indonesia in the years 2003-2004, such as that from Tangerang (4.3 - 14.4%), and Tatura Selatan and Baija, Palu (14% and 15%, respectively). However, the figure is lower than those reported from Kuta Selatan and Tuban, both in Badung Regency, Bali (46.7% and 53.3%, respectively). The difference of BI rates in the two hamlets currently studied from that in Kuta Selatan and Tuban might be due to the difference in the sampling methods applied, where in the survey in Kuta Selatan and Tuban, the study samples were selected from those houses around which DHF cases were just reported (Subagyo *et al.*, 2004).

From results of this study we can conclude that the species *Aedes aegypti* and *Aedes albopictus* had great potential of being DHF vectors in Banjar Kerta Petasikan and Banjar Kerti Graha. From the House Index (17.2%), Container Index (6.2%), and Bruteu Index (20.6%), we can conclude that the *Aedes* intensity of the two hamlets studied was high. Specifically, from the viewpoint of the Bruteau Index, the two hamlets can be considered as having a very high potential for

transmitting Dengue Hemorrhagic Fever. In relation with the control program, we recommend that the local health authority should take into consideration the biological characteristics of *Aedes aegypti* and *Aedes albopictus* and the vector intensity should be significantly lowered in order that DHF cases in Banjar Kerta Petasikan and Banjar Kerta Graha Kerti are under control or decreased.

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REFERENCES

- Dinas Kesehatan Kota Denpasar 2007. Profil Kesehatan Kota Denpasar Tahun 2006. (*Health Profiles of Denpasar City, Year 2006*). Available at www.depkes.go.id
- Garjito TA, Rosmini, Wijaya Y, Labatjo Y, Srikandi Y, Samarang, Erlan A, Udin Y, Puryadi 2004. Investigation of *Aedes aegypti* Breeding in 3 Types of DHF Area (Endemic, Sporadic and Non-Endemic) in Palu Municipality, Central Sulawesi Province, Indonesia. Seminar Peringatan Hari Nyamuk IV. Tropical Diseases Center, Universitas Airlangga
- Samsi TK 2001. Demam Berdarah Dengue. Pengamatan Klinik dan Penatalaksanaan di Rumah Sakit Sumber Waras (*Dengue Hemorrhagic Fever. Clinical Observation and Management at Sumber Waras Hospital*). Ebers Papyrus Vol 7 No. 3: 163-76
- Sasono PM and Idram NSI 2004. Dengue Transmission in a Dengue Endemic Area of Tangerang District of Banten Province, Indonesia. Breeding Place Preferences of *Aedes* Sp. Seminar Peringatan Hari Nyamuk IV. Tropical Diseases Center, Universitas Airlangga
- Setiati TE, Jiri FP, Wagenaar, Martijn D, de Kruif, Albert TA, Mairuhu, Eric CM. van Gorp, Agustinus Soemantri 2006. Changing Epidemiology of Dengue Hemorrhagic Fever in Indonesia. *Dengue Bulletin*, Vol 10: 1-13
- Subagyo Y, Dachlan YP, Bendryman SS 2004. Survei Larva *Aedes* di Kecamatan Kuta Selatan dan Tuban, Kabupaten Badung, Bali (*A Survey on Aedes Larvae in the Villages of Kuta Selatan and Tuban, Regency of Badung, Bali*). Seminar Peringatan Hari Nyamuk IV. Tropical Diseases Center, Universitas Airlangga
- WHO 1994. Guidelines for Dengue Surveillance and Mosquito Control. WHO Manila
- WHO Regional Office for South-East Asia 2006. Dengue/DHF. Fact Sheet on Dengue Fever and Dengue Hemorrhagic Fever. Available at www.searo.who.int
- WHO 2008. Environmental Health Perspectives. Volume 116, Number 9, September 2008
- WHO 2012. Dengue and Severe Dengue. Fact Sheet No 117. Available at www.who.int