

ORIGINAL RESEARCH

Malaria Incidence in East Kutai, East Kalimantan, Indonesia 2016: an Epidemiology Study

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ABSTRACT

Background: Malaria is endemic in Indonesia and knowing the factors that are involved in malaria infection will help the development of surveillance, prevention, and disease control. **Objective:** This study aimed to identify the profile of malaria infection and the vectors known in East Kutai Regency, Indonesia, in 2016. **Material and Method:** This research was a descriptive observational study with a cross-sectional design. The sample used was taken from the 2016 annual report of The Health Office, East Kutai Regency. We evaluated malaria indicators, disease distribution, incidence (age, sex, and occupation), plasmodium species found and known vectors. **Result:** In 2016, there were 55 confirmed cases of malaria infection in East Kutai. The Annual Parasite Index was 0.16 per 1,000. Malaria patients were dominated by males (85.5%), aged between 25-34 years old with a mean age of 29.56 years. Most of the patients lived in Rantau Pulung (41.8%). Most of the patients had work that had high contact with forest areas (70.9%). Most of the patients were infected with *Plasmodium vivax* (58.2%). Identified vectors were *Anopheles balabacensis* which was found in Kaliorang District. **Conclusion:** The East Kutai Regency was classified as Low Case Incidence Area with most cases found in males of 24 to 34 years old whose work had high contact with forest areas. The identified plasmodium species were *Plasmodium vivax* and *Plasmodium falciparum* while the identified vector was *Anopheles balabacensis*.

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BACKGROUND

Malaria is still a major world problem, causing more than 211 million cases each year and 430,000 deaths every year. Most malaria cases are found in developing countries, while other cases are usually imported from those countries. Indonesia is not an exception, with approximately more than 1 million

cases each year. Death caused by malaria in Indonesia is surprisingly low with only 150 to 300 deaths reported each year (WHO, 2016).

The Annual Parasite Index (API) shows how many cases are found in a certain area. Indonesia has an API of 0.85 for every 100,000 population. It means that Indonesia has 85 cases for every 10 million people living in Indonesia. However, these numbers apply to a nation. Eastern Indonesia still had an API of around 31 per 100,000 population (The Ministry of Health, Republic of Indonesia, 2016).

About 26% of Indonesian still live in endemic malaria regions, while others (74%) live in malaria-free regions. This seemingly low-risk population makes malaria a neglected disease in most regions because malaria is not widely infected people. However, we should remember that API does not spread evenly. Those populations living along the borderline have a very high risk of getting malaria (The Ministry of Health, Republic of Indonesia, 2016).

Eliminating malaria in a low case incidence area is another problem, especially for a region with wide coverage that includes forests and fields while they do not have too many populations like in East Kutai, East Kalimantan. Having 35 million kilometers wide territory with only 300 thousand population makes East Kutai a great example of how a low-case incidence area could become a problem (Health Office, East Kutai, 2016).

Topography in East Kutai is quite diverse, ranging from beaches, lowland, highland, forest, swamps, and mountains. East Kutai also has high rainfall ranging from 2000–4000 mm/year with 130–150 days of rain each year. This condition makes East Kutai a perfect place for vector growth and increases the chance of malaria infection (Regional Development Planning Agency, East Kutai, 2016).

OBJECTIVE

This study was intended to describe the distribution of malaria cases in East Kutai Regency in 2016 based on patients' age, sex, occupation, and districts, and to identified the vectors that caused malaria infection.

MATERIAL AND METHOD

This study was an observational descriptive study with a cross-sectional design. The study was conducted in East Kutai Regency from December 2017 to January 2018. This study evaluated malaria indicators using Annual Parasite Index (API), disease distribution based in East Kutai, incidence (age, sex, and occupation), Plasmodium species based on laboratory results, and vectors recorded in the area. The population studied were all malaria patients in East Kutai Regency in 2016. This study used secondary data that was taken from the 2016 annual report of the Local Governmental Health Agency. The *Plasmodium* species was identified using thick and thin blood smears using Giemsa staining methods in the local health care services. The sample size of the study was 55 samples. The sampling technique used was non-random sampling of consecutive sampling method.

Data were analyzed with descriptive statistics and presented in frequency distribution tables and diagrams. Malaria incidence was counted using Annual Parasite Incidence (API) formula. The mean and mode of age were also determined using Microsoft Office Excel 2010.

RESULT

The total number of samples in this study was 55 patients that were diagnosed with malaria, confirmed and reported in local Health Office Service's annual report. Samples were distributed in 18 Districts in East Kutai Regency.

Table 1. Malaria patient's characteristics in East Kutai Regency.

Characteristics	Frequency
Age (years)	
Mean ± SD	29.56 ± 10.85
Less than 15 years	4 (7.3%)
15 – 24 years	12 (21.8%)
25 – 34 years	22 (40.0%)
35 – 44 years	11 (20.0%)
More than 45 years	6 (10.9%)
Gender:	
Male	47 (85.5%)
Female	8 (14.5%)
Occupation:	
Forest-related Occupation	39(70.9%)
Planters	6 (10.9%)
Farmer	4 (7.2%)
Housewives	3 (5.4%)
Not working/Unknown	3 (5.4%)
Districts:	
Rantau Pulung	23(41.8%)
Muara Wahau	13 (23.6%)
Teluk Pandan	6 (10.9%)
Karangan	5 (9.0%)
Busang	3 (5.4%)
Kongbeng	1 (1.8%)
Long Mesangat	1 (1.8%)
Sandaran	1 (1.8%)
Telen	1 (1.8%)
Batu Ampar	1 (1.8%)
Kaliorang	0 (0%)
Kaubun	0 (0%)
Muara Ancalong	0 (0%)
Muara Bengkal	0 (0%)
Sangatta Selatan	0 (0%)
Sangatta Utara	0 (0%)
Sangkulirang	0 (0%)
Bengalon	0 (0%)
Plasmodium Species:	
P. vivax	32(58.2%)
P. falciparum	16(29.1%)
P. vivax + P. falciparum	7 (12.7%)

The annual report shows that there are 55 malaria patients in East Kutai in 2016 and 357,008 people are living in the regency in the same year. Using the Annual Parasite Incidence formula as follows:

$$\text{Annual Parasite Incidence} = \frac{\text{Number of Positive Slides}}{\text{Total Population}} \times 1000$$

we found that the Annual Parasite Incidence (API) in East Kutai in 2016 was 0.16 per 1,000 residences.

Age characteristics of the patients showed that most of the patients were dominated by 25 to 34 years old age group with the median age being 29.56 years old. The distribution for patients' age was homogenous as the standard deviation value was relatively small. Gender distribution shows that the patients were predominantly male with a percentage of 85.5% while female patients were only 14.5%.

The occupation of the patients was grouped with general designation based on the reports. Most of the malaria patients (70.9%) were working around the forest that could be described as illegal mineworkers, forest loggers or any other work related to natural forest. Other occupations that were found in the report were planters (10.9%), farmers (7.2%), housewives (5.4%) and not working or unknown occupations (5.4%).

Malaria patients were only found in 10 out of 18 districts that reside in East Kutai Regency. Most of the patients were found in Rantau Pulung District with a total of 23 patients (41.8%). Other districts which had several patients were Muara Wahau (23.6%), Teluk Pandan (10.9%), Karangan (9%) and Busang (5.4%). Most of the districts were not adjacent to each other. This showed that malaria distribution in East Kutai was sporadic.

There were two species of *Plasmodium* which infected humans in East Kutai. Those were *Plasmodium vivax* and *Plasmodium falciparum*. Patients were presented by which species infected them. Most of the patients were infected with *P. vivax* (58.2%) rather than *P. falciparum* (29.1%) or mixed infection (12.7%).

DISCUSSION

Malaria Incidence

Several studies about malaria incidence have been conducted in different regions around the world and especially in Indonesia. However, there are not so many studies conducted in East Kalimantan. This study was conducted in East Kutai because the East Kutai regency does not have any studies regarding epidemiology of malaria except for the Annual's Report of The Health Office of local government.

In this study, we have found that there were a total of 55 cases in 2016 with an API of 0.16 per 1,000 residents. Ministry of Health classified a region based on their API; 1) Malaria free area with API = 0; 2) Low Case Incidence (LCI) area with API <1 per 1,000 population; 3) Medium Case Incidence (MCI) with API 1-5 per 1,000 population; 4) High Case Incidence (HCI) with API >5 per 1,000 population. East Kutai Regency could be classified as low case incidence with API <1 per 1,000 population ([The Ministry of Health, Republic of Indonesia, 2016.](#))

Patient's Characteristics

Several studies about malaria incidence and epidemiology were used to compare the data from this study with others. In this study, the mean age of the sample was 29.56 with most of the samples being in the 25-34 years old age group (40%). Most of the patients were male (85.5%) and working as forest workers (70.9%). These results were almost the same as other malaria epidemiology studies which state that most malaria patients have several risk factors which are male, of productive age (16-45 years old) and have a history of having contact with forest, either working or just doing a visit ([Cotter et al., 2013](#); [Sturrock et al., 2013](#); [Monteiro et al., 2015](#); [Herdiana et al., 2016](#); [Wardani & Arifah, 2016](#); [Ekawati et al., 2020](#)).

Most of the factors could be explained because in East Kutai most of the workers were from the male sex group. They were usually young immigrants that worked in the forest to gather earnings. These facts are also the same in other developing countries or regions and it was said that those risk factors have a 7.9 times higher risk than other occupation that does not have any relation to a forest. In Muara Uya, being a wood logger, gold miner and rubber farmer increases the risk of having malaria compared to other occupations ([Lestari, 2017](#); [Wen, 2017](#)). Forest workers or other workers that frequently visit forests usually increase vector and host contact rates, which could cause a higher risk of malaria infection. Other than that, forest workers might move between endemic and non-endemic areas that may continue sustaining transmission of malaria ([Bertram et al., 1964](#); [Barbieri & Sawyer, 2007](#); [Allotey et al., 2015](#); [Luthi & Schlagenhauf, 2015](#)).

Based on the patient's district, it was found that Rantau Pulung is the district with the most malaria cases found (41.8%). Local government reports said that Rantau Pulung is a district with one-third of its area covered with preserved forest and local illegal logging activity is high ([Regional Development Planning Agency, East Kutai, 2016](#)). Other districts following Rantau Pulung have some common characteristics. For example, Muara Wahau and Teluk Pandan, consecutively in second and third positions after Rantau Pulung, have most of their territories covered in forests, fields, or preserved forests. Those area are the perfect location for *An. balabacensis* spawning ground. From this fact, we could assume the malaria incidence in East Kutai was mostly caused by the high contact rate in the forest ([Walter Reed Biosystematics Unit, 2022](#)).

Two species of *Plasmodium* that were found in East Kutai cases were *Plasmodium vivax* and *Plasmodium falciparum*. Malaria infection in East Kutai was predominantly caused by *P. vivax* species (58.2%) while *P. falciparum* came in second (29.1%) and the rest of the case (12.7%) was caused by

mixed infection (two parasites species in one host). Both species are commonly found in Indonesia with diverse infection rates in every regency or island they inhabit (Surjadjaja, et al., 2016; Rahayu et al., 2020). *P. vivax* infection could become a problem for local Government as this species can turn into a dormant state called *hypnozoite*. This phase gives *P. vivax* the ability to cause a relapse if the host does not take the appropriate medicine. The disease burden caused by this relapse might be another problem if it is not treated properly, thus suggesting the local government to take action against it. It is known that *P. vivax* has the highest degree of virulence, while *P. falciparum* has the highest mortality rate (Fuadzy & Santi, 2012).

CONCLUSION

The East Kutai Regency was classified as Low Case Incidence Area with most cases found in males of 24 to 34 years old whose work had high contact with forest areas. The identified plasmodium species were *Plasmodium vivax* and *Plasmodium falciparum* while the identified vector was *Anopheles balabacensis*.

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Conflict of Interest

All authors have no conflict of interest.

Ethics Consideration

This research has been approved by the ethical committee of Fakultas Kedokteran Universitas Airlangga with ethic certification no. 315/EC/KEPK/FKUA/2017.

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Author Contribution

All authors have contributed to all process in this research, including preparation, data gathering and analysis, drafting and approval for publication of this manuscript.

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