Mass Blood Survey Followed by Active Case Detection Success to Eradicate Malaria in Batunampar Village, Jerowaru Subdistrict, East Lombok, West Nusa Tenggara, Indonesia

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ABSTRACT
Malaria is an endemic that often occurs in the coastal areas of East Lombok, West Nusa Tenggara. One of the most common ways of spreading this parasite is through asymptomatic malaria. Therefore, mass blood surveys and active case detection are needed to identify parasitemia and eradicate malaria in Batunampar village, Jerowaru subdistrict, East Lombok, West Nusa Tenggara, Indonesia. Mass blood survey was conducted on all residents of the research location through Rapid Diagnostic Tests, microscopic examination, and therapy. Furthermore, active case detection and evaluation were carried out for 5 consecutive years in collaboration with the Public Health Center in East Lombok. In the mass blood survey, 3,038 people (61%) were examined from a total of 5,017 residents. The Rapid Diagnostic Test (RDT) result showed that 15 people were positive for malaria, out of which 4 (27%) showed fever symptoms. Similarly, in the first year of active case detection, 296 residents suffered fever, with an Annual Parasite Incidence (API) decline below 1 per 10,000 population. The incidence of asymptomatic malaria in Batunampar village is 73%, which is relatively high. However, due to the successful detection of the associated parasite that causes this infection, it is easier to detect and treat sufferers, thereby reducing the rate of transmission. Detection of asymptomatic and symptomatic malaria and appropriate treatment are the keys to successfully eradicating malaria in Batunampar village, East Lombok.

Keywords: *Active case detection, Annual Parasite Incidence, Malaria, Mass blood survey*.

1. INTRODUCTION

Malaria, tuberculosis (TB), and HIV/AIDS are major public health problems in poor and underdeveloped countries. These infections lead to spontaneous abortion, low birth weight babies, death of newborns, and direct/indirect cause of maternal death in pregnant women. According to research, approximately 90% of malaria-related deaths in South Africa and the Sahara occur mostly in children every 30 seconds [1]. Survivors are likely to suffer irreparable brain damage. The World Health Organization stated that malaria is found in tropical and subtropical regions with a yearly death rate of 1 million people and more than 300 million sufferers [1].

The 2001 Household Health Survey (SKRT) in Indonesia estimated that approximately 70 million people live in malaria-endemic areas with 15 million clinical cases. From this total number, 56.3 million live in moderate to high-risk areas. In 2003, malaria spread to 6,053 villages in 226 regencies and 30 provinces, a significant increase from the 1997 survey. This indicates that Indonesia is a tropical country with a suitable environment for mosquitoes to lay eggs and breed, therefore, it acts as a reservoir of plasmodium [2,3].

Malaria is one of the main public health problems in West Nusa Tenggara, with some endemic areas. Based on a report from the Provincial Health Office, this area experienced an annual malaria increase of 20.5 per 1000 population in 2005. This means that the incidence of malaria has been continuously decreased since 1998. However, in some areas, there are frequent outbreaks, thereby leading to continuous transmission [2,3]. For example, in East Lombok from October to December 2005, a total death rate of 14 people was recorded with 1,443 clinical cases at a positive rate of 39.9% [4] .

Several malaria controls programs, such as house spraying, biological vector control, larvicides, environmental management, and installation of mosquito nets, have been implemented in West Nusa Tenggara for decades. Meanwhile, the strategies used in malaria detection differ with regions. For instance, in Java and Bali, it is carried out by active and passive case detection (ACD, PCD), mass fever survey (MFS), epidemiological investigation (Epid), survey, and follow-up of population migration, while in West Nusa Tenggara only PCD and malariometric survey are utilized [2,4].

The malaria control program in West Nusa Tenggara is also associated with different problems compared to other areas. This is because its surrounding environment is generally an ideal place for mosquitoes to lay eggs and breed. Therefore, the residents of this area have a greater chance of spreading the virus because the percentage of working as laborers in other parts of Indonesia or abroad is more significant. This program, with its many problems, requires the cooperation of various stakeholders with an integrated approach to control vectors, humans, and their environment through early diagnosis and appropriate treatment [4].

The Faculty of Medicine, the University of Mataram in collaboration with the University of Bukkyo, Kyoto, Japan, the Hepatitis Laboratory of West Nusa Tenggara, and the Health Office of East Lombok Regency held a malaria control program centered on Keruak and Jerowaru sub-districts from December 2006 to February 2008. These areas were chosen because of the high malaria incidence and unique socio-economic background, closeness to the beach, significant population mobility, and strong religious figures. One of the programs carried out in this collaboration is a mass blood survey [5].

Annual Malaria Incidence (AMI) in Batunampar Village and Jerowaru Sub-District are high at 40.6 and 17.78 per 1000 population. These areas geographically consist of beaches and dams that act as breeding places for mosquitoes. The major outbreak of malaria occurred in 1997, resulting in the deaths of more than 10 people [4,5].

Therefore, a mass blood survey is needed to determine the incidence of malaria and its actual rate in all residents of Batunampar Village. This is because determining the incidence of malaria helps in breaking the chain of transmission. In line with this, the main goal is to reduce malaria incidence, specifically in Batunampar Village and East Lombok in general.

2. RESEARCH METHOD

2.1 Place and time of implementation

This Mass Blood Survey took place in Batunampar Village, Jerowaru Sub-District, East Lombok, from Thursday 1 to February 28, 2007. Also, the examinations were carried out daily from 08:30 am to 05:00 pm, including during holidays and Sundays.

Batunampar is one of the villages in Jerowaru Sub-District, East Lombok Regency, West Nusa Tenggara Province, consisting of equal land and water areas. It has a mass of approximately 924 km2 with 5,017 residents. Furthermore, this area consists of 5 hamlets, with an average population of 1,000 people per hamlet. The common occupation of the residents is fishing and farming. The village consists of numerous reservoirs, such as small artificial lakes used to hold water, specifically during the rainy season. [4,5].

2.2 Mass Blood Survey

The socialization process was carried out at the Batunampar village office on January 28, 2007, in preparation for the smooth running of the mass blood survey. This activity, which was accompanied by counseling about malaria, was attended by all village officials, religious and community leaders, NGOs, and representatives. This was also used to explain the procedure for the mass blood survey and the daily schedule of activities. Furthermore, the collection of mass is submitted to each Head of the Hamlet.

After signing the informed consent, capillary blood was taken from all residents' fingertips/earlobe/heel irrespective of their symptoms of malaria. Some of the blood collected with a microcapillary tube had thick/thin smears, while others were examined for malaria parasites using RDT.

Malaria parasite examination was carried out using RDT (West Nusa Tenggara Hepatitis Laboratory) and confirmed by microscopic analysis. Blood smears were collected start from the morning till the afternoon at the Village Malaria Post (Public Health Center Assistant) and then taken to the Hepatitis Laboratory of West Nusa Tenggara to be examined. Microscopic examination was carried out by 2 malaria technicians with more than 15 years of experience. However, a third reader is employed when there are discrepancies in the results.

2.3 Active Case Detection

Active case detection is a continuation technique carried out from March 1, 2007, to February 29, 2008, after completing the mass blood survey. This technique used blood tests to detect malaria, specifically in residents who showed symptoms, such as fever and chills. In Batunampar Village, 2 alert officers were provided with malaria drugs to assist sick residents. Those with fever and chills are asked to experience a blood test with a RDT. The malaria-positive population will be treated according to the Ministry of Health guidelines. Approximately 2 ccs of venous blood are taken from patients with positive results for confirmation examination at the Hepatitis Laboratory of West Nusa Tenggara with a microscope. One special officer is tasked with bringing blood samples from Batunampar Village to the Hepatitis Laboratory, Mataram.

The Active Case Detection (ACD) program, which is a collaboration between the Medical Faculty of Mataram University and the East Lombok Health Office, was carried out till 2012. This program involved 3 health centers located around Batunampar village, namely Sukaraja, Keruak, and Jerowaru. After the collaboration program ended, the local Health Center continued the active case detection program under the supervision of the East Lombok Health Office. API was also used as a parameter to assess the incidence of malaria.

3. RESULTS

3.1 Mass Blood Survey and Active Case Detection

The mass blood survey was carried out in Batunampar Village from 1st to February 28, 2007. It was carried out by visiting the 5 hamlets in this region, namely Batunampar, Pene, Sagimateng, Mensah, and Tembere. Some helmets were examined more than once, depending on their size.

In this mass blood survey, 3,038 people (61%) of the 5,017 residents registered at the Village office were successfully examined using RDT. The result found that 15 people had malaria, 10 and 4 had falciparum and vivax malaria, and 1 person was positive for falciparum and vivax malaria. The youngest patient was 2 years old and suffered from Plasmodium vivax, while the oldest was 49 years old with plasmodium falciparum. In this situation, API in February 2007 in Batunampar Village was 3.0 per 1000 population.

Table 1. The number of malaria sufferers by type of plasmodium and their symptoms.

No	Types of Plasmodia	Fever Symptoms (%)	Without Fever Symptoms (%)	Total
1	Plasmodium falciparum	4 (40)	6 (60)	10 (100)
2	Plasmodium vivax	0	4	4
3	Mixture of Plasmodium falciparum and Plasmodium vivax	0	1	1
	Total	4 (27 %)	11 (73%)	15 (100%)

Of the 15 people who were positive for malaria, only 4 (27%) showed symptoms of fever. This suggests that healthy people are also prone to contracting malaria and passing it to others. Individuals found to be positive for malaria parasites are immediately treated using treatment procedures issued by the Indonesian Ministry of Health. These include a combination of artesunate, amodiaquine, and primaquine for patients with Malaria falciparum and a combination of chloroquine and primaquine for malaria vivax. The youngest patient by Plasmodium vivax was 2 years old and did not show symptoms.

The program, which was implemented from March 1, 2007, to February 29, 2008, was successfully examined by 296 residents who showed symptoms of malaria, namely fever, and chills. Of all residents who showed symptoms, none was positive for malaria after a blood test using an RDT. However, at the Sukaraja Health Center, there was only 1 positive malaria patient by microscopic examination from Batunampar Village.

3.2 Advanced evaluation of Active Case Detection

Periodic evaluation is carried out to determine the results of the active case detection (ACD) program implementation. Annual Parasite Incidence (API) has continued to decline below 1 per 10,000 population since the program was implemented from 2007 to 2012.

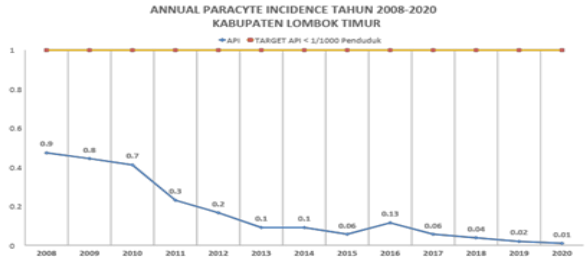

Figure 1. Annual Parasite Incidence in Batunampar Village, East Lombok from 2008 to 2020 [6].

4. DISCUSSION

In the mass blood survey, 3,038 people (61%) of the 5,017 residents were registered at the local village office. The previous survey carried out in 2002 in Purworejo, and Kulon Progo succeeded in examining 78% and 65% of the populations [7]. Mass blood survey in Brazil also succeeded in examining 73,4% or 7 milion of the populations [8]. These inconsistencies in pollution rate during the inspection because many residents were not on-site. Therefore, the inspector had to move from one helmet to another until the process was completed. Also, the geographical condition of the population consisted 5 hamlets scattered between rice fields, hills, and valleys. Consequently, officers could not reach some areas due to their significant distance from the terrain and difficulty to access [4,5].

The RDT examination results found 15 malaria-positive people from 5,017 residents. Therefore, assuming that malaria does not occur in the following month, then in a year, the minimum API in Batunampar Village in 2007 is 3.0 per 1000 population. According to the MOH classification, this includes the criteria for moderate malaria incidence [7] .

According to a 2006 report by the Sukaraja Health Center, AMI in Batunampar Village was 40.6 per 1000 population, which was classified in the high category. Based on API 3 per 1000 population, the Malaria Incidence in 2007 was lower than in 2006. This decrease is due to several factors, such as a decrease in its occurrence in 2007. Also, the AMI used to report the incidence of malaria by the number of patients that show clinical symptoms. This is in accordance with the Ministry of Health's regulation report, which stated that Public Health Centers outside Java and Bali report malaria incidence based on AMI [2,4]. Furthermore, the symptoms of malaria, such as fever and chills, are very subjective because it is similar to other infectious diseases. Patients with malaria and those living in malaria-endemic areas are more likely to be infected, increasing the recorded AMI. Meanwhile, in Java and Bali, API reported the number of positive malaria patients through microscopic examination. However, the number of sufferers found in this mass blood survey was not high due to the time used to implement the activity. This mass blood survey is carried out when the rainy season has not yet arrived, whereas malaria incidence is usually high at the beginning of the rainy season [5,7,9,].

Of the 15 people with malaria, only 4 (27%) showed symptoms of fever, which means that the incidence of asymptomatic malaria in Batunampar Village is quite high. The main symptom of malaria as an infectious disease caused by plasmodium is fever. It is suspected that its occurrence is related to the process of schizogony (rupture of merozoites/schizonts) with the clinical symptoms influenced by the type/strain of plasmodium that infects the body's immunity, and the number of infecting parasites. Immunity to malaria is elicited by stimulation from repeated infection of Plasmodium [10,11].

Research carried out in Ghana in 2000 involving 308 samples found 96.8%, asymptomatic malaria patients [12]. Another research in Brazil in 1999 on 1173 samples also found 82% asymptomatic malaria [13]. Yekutiel (1960) summarized 5 major research of asymptomatic malaria at the end of the 1960s. The prevalence ranges from 18.4% in Japan to 90.7% in Taiwan [8]. Patients with asymptomatic malaria are more infectious due to the presence of gametocytes in the blood that can last up to 9 months. This is also because sufferers do not realize they are sick, therefore, they do not take antimalarial drugs [10,14].

In Brazil and China, mass blood surveys were conducted continuously as a malaria control program, also known as aggressive active case detection (AACD). This program succeeded in reducing the incidence of malaria by 20.7% and 40.57% in Brazil and China in 1999 and 1996, respectively. Malaria in the Peruvian, Amazon was successfully reduced until there were no cases due to aggressive active case detection and appropriate treatment [8,15].

According to WHO guidelines, artesunate is the first choice for simple or complicated malaria. It is administered singly or in combination with other drugs. Artesunate can kill all types of plasmodium and is well tolerated by the body [16]. Research in Irian Jaya carried out by comparing Artesunate+sulfadoxine-pyrimethamine with sulfadoxine-pyrimethamine singly found better effectiveness of the artesunate combination than sulfadoxine-pyrimethamine singly. This drug also has the ability to relieve fever symptoms quickly with a low therapeutic failure rate. The combination of drugs used with this drug prevents this resistance from occurring [17]. Artesunate-amodiaquin combination was effective to threat malaria in Madagaskar [18].

Active case detection for one year succeeded in examining 296 people with symptoms of malaria, such as fever and chills, without positive patients. The decrease in malaria incidence is due to mass blood

surveys and active case detection programs, which enable symptomatic and asymptomatic patients to be immediately examined and treated. The mass blood surveys conducted in Peruvian, Amazon regularly eliminated the incidence of malaria until it became non-existent [19]. Likewise, in Vietnam, it succeeded in achieving a significantly low value [20,21]. A mass blood survey and active case detection in Sabang, Aceh also succeeded in controlling malaria cases. This program can effectively decrease malaria cases during a 5-year period [22].

5. CONCLUSION

In conclusion, a mass blood survey followed by active case detection was successfully used to eradicate malaria in Batunampar village, East Lombok. Therefore, detection of asymptomatic and symptomatic malaria and appropriate treatment are the keys to successful malaria eradication.

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