

The Effects of Rumah Panggung Environment, Social Culture, and Behavior on Malaria Incidence in Kori Village, Indonesia

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Abstract—Malaria is an infectious disease that still cannot be solved in Kori village, West Nusa Tenggara, Indonesia, where the most of people live in rumah panggung (Stilts House). The purpose of this study was to know whether there were the effects of rumah panggung environment, social culture, and behavior on malaria incidence in the Kori village. A cross-sectional study was performed to explore the effects of rumah panggung environment, social culture and behavior on malaria incidence. This study recruited 280 respondents, who live in the rumah panggung, permanent residents in Kori village, were age above 17 years old, and suffered from malaria in the past year. The collected data were analyzed with path analysis. The results of this study showed that the environment of rumah panggung and behavior have a direct effect on the incidence of malaria ($p < 0.05$). It could be concluded that improvement of environmental conditions of rumah panggung, sociocultural, and behavioral changes to maintain a healthy environment are needed to reduce the malaria incidence.

Keywords—*Rumah panggung*, socio cultural, behavior, malaria.

I. INTRODUCTION

MALARIA is a disease of global concern in the world because it can cause extraordinary events. This has an impact on quality of life, economy, and can lead to death. The population at risk of malaria is about 2.3 billion or 41% of the world's population [1]. It is estimated that 35% of the world's population live in areas at risk of transmission of *Plasmodium falciparum*, and about 1 billion people live in low-risk areas and still have malaria transmission [2]. According to data from the World Health Organization (WHO) estimates, the incidence of malaria in the world reaches 215 million cases and among those infected with plasmodium parasites are around 655 thousand. WHO 2014 recorded 198 million cases of malaria globally. In 2013, malaria deaths were 584,000/10,000. The number of deaths due to malaria in Africa reaches 700,000 - 2.7 million each year, 75% of them are children [3].

Malaria is a contagious disease re-emerging in the public. This is caused by the global warming that occurs due to human-caused pollution that produces emissions and greenhouse gases, such as CO₂, CFC, CH₃, NO, perfluorocarbon and carbon tetrafluoride. These conditions cause the earth's atmosphere to heat up and damage the ozone layer. The

damaged ozone layer causes more solar radiation to enter the earth so that the earth's temperature heats up and global warming occurs [4].

Malaria is an infectious disease caused by a parasite (*Plasmodium*) that is transmitted by the bite of an infected mosquito (vector borne disease). Malaria in humans can be caused by *P. malaria*, *P. vivax*, and *P. oval*. In the human body, the parasite divides and multiplies in the liver and then infects the red blood cells [5]. Malaria infections are common in tropical and sub-tropical areas where there are symptoms such as fever with regular temperature fluctuations, lack of blood, enlarged spleen and pigment in tissues. The endemic areas in Southeast Asia are: Bangladesh, Bhutan, India, Indonesia, Maldives, Myanmar, Nepal, Sri Lanka, and Thailand. In Indonesia malaria, is found to be widespread on all islands with varying degrees and weight of infections. It is estimated that every year malaria cases amount to 30 million in Indonesia [6]. The factors influence these incidents are development that is not environmentally sound, the population mobility from malaria endemic areas, the presence of vector mosquito resistance against the insecticides used and also the increasingly widespread malaria drug resistance. The prevalence of malaria in 2013 in Indonesia was 6.0%. The five provinces with the highest incidence and prevalence were Papua (9.8% and 28.6%), East Nusa Tenggara (6.8% and 23.3%), West Papua (6.7% and 19.4%), Central Sulawesi (5.1% and 12.5%), and Maluku (3.8% and 10.7%). Nusa Tenggara Timur (NTT) ranks the second of Malaria prevalence in Indonesia [5].

Malaria infects humans in endemic areas because of the geographical environment that supports the growing of *Anopheles* sp. It is therefore necessary to control malaria in every region in Indonesia with a comprehensive approach, not only focusing on the disease but also considering the environmental aspects. Almost 90% of villages in East Nusa Tenggara (NTT) province are malaria endemic villages with morbidity 4,354 in 2016. Malaria endemic areas are generally located in remote areas with poor environmental conditions, difficult transportation and communication means, poor access to health services, low education levels and socioeconomic conditions, and unhealthy community behavior towards healthy habits [7].

The people of Kori Village, located in Sumba district, NTT mostly live in *rumah panggung* made of bamboo, roofed of reed that blends with cattle enclosures like cows, buffaloes, pigs, and other animals [8]. Livestock that blend with the home

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is one factor causing the high incidence of malaria. The environment is one of the factors causing malaria incidence associated with resting place and breeding place for mosquitoes [9].

This study aims to determine the effect of stilt house environment, socio-cultural and behavior toward the incidence of malaria in the village of Kori NTT. The results of this study are useful to improve the quality of life in the prevention of risk factors for malaria events.

II. MATERIAL AND METHOD

The study was conducted in Kori Village, located in Southwest Sumba District, East Nusa Tenggara. Malaria incident in Kori Village was highest in East Sumba Regency East Nusa Tenggara (NTT). The population in the study amounted to 932 people living in 233 *rumah panggung*.

This study used a cross-sectional survey using structured questionnaires, observation sheets and checklists. The first part of the questionnaire includes sociodemographic characteristics, including sex, age, education level and occupation. The second part has questions about the home environment of the *rumah panggung* including the condition of the *rumah panggung*, ventilation, cattle stables and home yard stage. The third part of the questionnaire is the socio-cultural environment, the habit of being outdoors, the use of mosquito nets, the use of long-sleeved clothing, the use of anti-mosquito drugs, cleaning the enclosure and the environment.

The questionnaires were distributed to 300 selected people based on criteria that resided on stage, a permanent resident in the village of Kori, over 17 years old and suffering from malaria in the past year. The study was conducted between January and February in 2018. As many as 20 out of 300 people were excluded as respondents because they only stayed 3 weeks in Kori Village and the distance from their stage houses was difficult to reach.

The study was approved by the ethical clearance committee of the Public Health Department, Universitas Negeri Semarang. Before the survey, meetings with community and government leaders were held where the survey objectives were clearly explained. Informed consent was obtained from each study participant. All participants are actively involved and no one refused to complete the interview.

The analysis was performed using the Path technique with SPSS version 20. The level of significance was also determined by using 95% confidence interval and p-value.

III. RESULTS AND DISCUSSION

The spread of malaria plasmodium differs according to geography and climate. *Plasmodium falciparum* is commonly found in a tropical climate. *Plasmodium vivax* is widely found in the area cold climates, sub tropics to the tropics and *Plasmodium ovale* is commonly found Africa and western Pacific [10].

The most common species in Indonesia are *Plasmodium palciparum* and *Plasmodium vivax* whereas *Plasmodium ovale* has been found in Papua and East Nusa Tenggara. Malaria can

result in lower health status and work ability of the population and become an important barrier to social and economic development. The people who are at risk for malaria are toddlers, pregnant women and non-immune people who visit malaria endemic areas such as migrant workers (especially forestry, agriculture, mining), refugees, transmigrants and tourists.

Based on the Basic Health Research in Indonesia 2013 [5], by age characteristics, the highest point prevalence was at age 5-9 years (0.9%), then in the age group 1-4 years (0.8%) and lowest on age < 1 year (0.3%). Meanwhile, according to the prevalence period, the highest prevalence was in the age group > 15 years (10.8%), the second highest in the age group 1-4 years (10.7%) and the lowest remained at <1 year (8.2%). From the Riskesdes data, it appears that the trend of high-risk groups affected by malaria shifted from age > 15 years to age 1-4 years [5].

For the characteristics of sex, shelter, education and employment, prevalence points and the prevalence period are almost identical. At the prevalence point, the prevalence in men is the same as for women (0.6%), in rural (0.8%) twice the prevalence in urban areas (0.4%). The education group did not complete primary school (0.7%) and never attended school (0.8%) were the two groups with the highest prevalence and the group graduated was the lowest prevalence group (0.2%). The "school" and farmer/fisherman/laborer groups were the highest prevalence of occupations (0.7% each) while the lowest were the Employees/TNI/POLRI (0.3%) [3].

In this study, population characteristics are shown in Table I. The number of male (51.10%) is more than female (48.90%). The uneducated group was the largest (63.90%) compared with the educated. Approximately 43.55% of respondents are farmers and ranchers. Based on the age group, 17-44 years is highest infected with malaria (75.36%) compared to other age groups.

TABLE I
 SOCIO-DEMOGRAPHIC CHARACTERISTIC OF MALARIA INCIDENCE (N = 280)

	n	%
Sex		
Male	143	51,10
Female	137	48,90
Age, years		
17-44	211	75,36
45-64	45	16,07
≥ 65	24	8,57
Education		
No Education	179	63,90
Elementary	34	12,10
Junior High School	39	13,90
Senior High School	28	10,10
Occupation		
Ranches	122	43,55
Farmer	122	43,55
Non-Government Employee	33	11,80
Government Employee	3	1,10

Based on the results of the analysis, shown in Table II, the

rumah panggung environment and social culture affected the behavior (p-value < 0.05).

TABLE II
 THE EFFECT OF *RUMAH PANGGUNG* ENVIRONMENT AND SOCIAL CULTURE ON BEHAVIOR

	p-value
<i>Rumah Panggung</i> Environment	0,009*
Social Culture	0.008*

*p-value < 0.05

Rumah panggung environment and behavior have a direct effect on Malaria incidence (p-value < 0.05). In this study, the *rumah panggung* environment has a great influence on Malaria incidence through behavior. Social culture had no effect on malaria incidence as shown in Table III.

TABLE III
 THE EFFECT OF *RUMAH PANGGUNG* ENVIRONMENT AND SOCIAL CULTURE, AND BEHAVIOR ON MALARIA INCIDENCE

	p-value
<i>Rumah Panggung</i> Environment	0,049*
Social Culture	0.808
Behavior	0.046*

*p-value < 0.05

The characteristic of this study was that most of the population was uneducated. The level of education affects a person's ability. This perceptivity will form an attitude. Attitudes that are influenced by the environment will produce a behavior as a reaction [9]. The lack of understanding and knowledge of malaria was the cause of misbehavior against malaria. A person who has good knowledge and behavior will avoid the person from the risk of malaria [12].

Some types of work were risk factors and provide opportunities for contact with mosquitoes, such as farmers, ranchers, and miners. More activity in outdoors without any self-protection, the greater the risk of malaria is [10]. Other studies also show that there was a significant relationship between the types of jobs (farmers, ranchers, fisherman) and the incidence of malaria [14]. In line with this study, those who have a risk of being infected with malaria are mostly farmers.

One's health status is influenced by 4 factors; environment, behavior, health services, and heredity or heredity. Blum concluded that the environment has the greatest impact on health status; then followed by the behavior, health service, and offspring who have the least contribution to health status. These four factors directly affect health. Health status will be achieved optimally if the four factors are together. Each factor must be optimized. If one of the factors is in a state that is not optimal, then the health status will shift to below the optimal. Among these factors, human behavior is the biggest determinant factor and the most difficult to overcome, followed by environmental factors. This is because behavioral factors are more dominant than environmental factors. The human environment is strongly influenced by people's behavior.

Every human being during life must undergo changes. These changes include social norms, organizational behavior, organizational structure, community, power, authority, and

social interaction. Changes that occur in the community are a normal symptom. Social culture is related to changes that occur in society. Culture is a complex that includes knowledge, beliefs, art, morals, laws, customs gained by human beings as members of society. Culture includes everything that people get or learn from as members of the community. Other studies suggest that there is a relationship between social cultures with the incidence of malaria [14], whereas in this study, social culture does not directly affect the incidence of malaria. Malaria incidence is influenced by behavior. Good behavior in preventing malaria will reduce the risk of malaria transmission. The use of mosquito nets during night sleep, the use of mosquito repellent to avoid mosquito bites, mosquito nest eradication is an effort to prevent transmission of malaria [7]. Other studies also suggest that prevention of malaria is done by avoiding mosquito bites by wearing long-sleeved shirts and trousers on the way out of the house, especially at night, reducing mosquito breeding places in the neighborhood, killing larvae and adult mosquitoes [15].

The success of disease prevention and treatment efforts depends on the willingness of the person concerned to implement and maintain healthy behavior. Jullen distinguishes individual behavior over 3 types, namely, ideal behavior, current behavior and expected behavior [16].

The habit of people who do not use mosquito nets is a risk factor for malaria incidence, someone who does not use bed nets during sleep has a bigger chance compared to people who use mosquito net [11]. Some studies have shown that regular use of bed nets at nighttime sleep reduces the incidence of malaria, that there are still many people who do not use mosquito nets and people still use traditional medicine to prevent malaria, knowledge and public awareness of malaria prevention is still lacking [13]. Eco-physiological and eco-phagic vectors will facilitate mosquito bites. The habit of people outside the home at night and not using long sleeves has a relationship with the incidence of malaria [13]. In line with this study, behavior has a direct effect on Malaria.

Larvae habitats are found in large areas but most species prefer clean water. Larvae in *Anopheles* mosquitoes are found in clean water or brackish water that has salinity, mangrove swamps, in paddy fields, grassy ditches, rivers and streams, and rain pools. Many species prefer to live in habitats with plants. Other habitats are more self-contained. Some species prefer the outdoors, the puddles that are exposed to the sun. According to breeding grounds, malaria vectors can be grouped into three types: breeding in paddy fields, hills/forests and beaches/rivers [18].

Malaria vector bite times are at 5 p.m -6 p.m, 8 p.m – 11 p.m, and 12 a.m – 4 a.m. The malaria vector biting at 5 p.m – 6 p.m is *An. tesselatus*, around 8 p.m – 11 p.m is *An. Aconitus*, *An. annularis*, *An. barbirostris*, *An. kochi*, *An. sinensis*, *An. vagus*, and around 12 a.m – 4 a.m is *An. farauti*, *An. koliensis*, *An. leucosphyrosis* and *An. unctullatus*. The behavior of malaria vectors such as breeding grounds and time of biting activity are very important to the decision makers as the basis for consideration to determine interventions in more effective vector control [16].

The physical environment of the *rumah panggung* affects the incidence of malaria. Physical environment that affects the incidence of malaria were the temperature, humidity and the construction of the house [6]. At high humidity, mosquitoes become active and often bite thus increasing malaria transmission. Temperature and humidity also affect the parasite breeding of mosquitoes. Other researchers also stated that the construction of the house with sealed wall allowed the occurrence of malaria transmission in the home. Installation of mosquito gauze in all ventilation in the house and windows is one of the prevention efforts in avoiding the bite of malaria mosquitoes [15]. The ceiling or roof is made from wood, neutral bamboo or woven as a barrier to the entry of mosquitoes into the house. The roof construction is made from straw. In addition, a house with a garden around it is a suitable condition for living or resting mosquitoes. Other researchers also affirm that the vegetation around the houses is closely related to the incidence of malaria [6].

Environmental factors have an enormous effect on the incidence of malaria in an area, if the environmental conditions are in accordance with the mosquito breeding place, then the mosquito grow quickly. The risk of transmission of malaria depends on the flying distance of *Anopheles*. The flight distance of *Anopheles* is approximately 2-3 kilometers. Houses that have a distance of less than 250 meters from the forest and swamps or 200 meters from the garden are at risk of malaria mosquitoes. A poorly maintained house environment, such as an unhealed garden around and a very close range of sluice is suitable for mosquitoes to live or rest. Mosquitoes generally rest in a shady and humid place. The surroundings of the house that need to be noticed in the incidence of malaria is the distance of the house from the place of longing and a resting place that is loved by *Anopheles* mosquitoes such as, vegetation, puddles, and lakes whose water is brackish [17]. *Anopheles sundaicus* grows autonomously in brackish water with salt content of 12-18%, for the growth of *Anopheles sundaicus* mosquito larvae prefer lighting less than 60 Lux. Sufficient lighting is one of the requirements of a healthy home. Giving the chance of sunlight entering with an intensity of approximately 60 Lux will be able to kill pathogenic germs. If the lighting is less than 60 Lux, the room becomes relatively dark and the situation is favored by mosquitoes. For those purposes, ventilation is needed about 10-20% of the floor area. Sunlight is a natural energy that is needed by all living things, which will increase the temperature and reduce the humidity, thus affecting the life of larvae and mosquitoes [18]. Wooden house walls allow more holes for entry of mosquitoes. Most people who suffer from malaria due to traditional houses/huts as bedroom without valance and hole have a higher risk. It indicates that the wall of the house made from wood/board is the risk factor of malaria, so people living in the house with wooden/board walls have a higher risk of malaria than people who have walled walls [17]. The wall is made of rough bamboo or wooden/board that there are holes more than 1.5 mm² will facilitate mosquitoes into the house. The environment is one of the factors causing malaria incidence associated with resting place and breeding place for mosquitoes [8]. Livestock that

blends with the home is one factor causing the high incidence of malaria [5]. The distance of the house with the cattle pen is close; it is triggering the development of mosquitoes [18]. The biological environment includes the existence of bushes and the condition of the cattle pen [19].

IV. CONCLUSION

Rumah Panggung environment and behavior are factors that influence the incidence of malaria. Social culture has no direct effect on malaria incidence. It is suggested that related parties play an active role to mobilize the community in preventing and eradicating malaria, among others by intervening breeding place, mapping the mosquito breeding place for malaria vector control. In addition, health promotion activities are expected to be routinely done by providing a better understanding, emphasized on knowledge, attitude and efforts to prevent malaria. Workers such as farmers and ranchers should be able to protect themselves from the bite of malaria mosquitoes when they are on the job site.

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