THE EFFECT OF MATERNAL AND ENVIRONMENTAL BEHAVIOUR FACTORS ON THE MALARIA CASE IN CITY OF SABANG, ACEH, INDONESIA

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ABSTRACT

The city of Sabang is an endemic area of malaria with the dominant Plasmodium falciparum. This study aims to determine the effect of maternal and environmental behavioural factors on malaria cases in Sabang. The research design used was an analytic survey with cross-sectional study design. The sampling technique in this study employs cluster random sampling technique, hence the number of samples of 100 mothers from 4 villages in the Sabang area was obtained, namely Beurawang Village, Keuneukai Village, Batee Shok Village, and Iboih Village. Data collection was done by interviewing and examining the environment around the mother's residence. This study provides results, namely the physical, biological and chemical environments significantly influence the incidence of malaria. Furthermore, knowledge, attitudes, and skills of mothers also significantly influence the incidence of malaria. The dominant factor that most influences malaria cases in Sabang are the physical environment, namely mosquito breeding sites (water depth, water temperature, area, clarity, lighting, and water flow).

Keywords*: mother; environmental behavior; malaria; endemic; maternal*

1.0 INTRODUCTION

Malaria is still one of the public health problems that can cause death, especially in high-risk groups, namely infants, toddlers, and pregnant women. In addition, malaria directly causes anemia and can reduce work productivity. The World Health Organization (WHO, 2015) reports that malaria has a negative impact on community health and livelihoods. In 2015 there were 212 million new cases of malaria worldwide (range 148-304 million). The African region accounts for the majority of global malaria cases (90%), followed by the Southeast Asian Region (7%) and the Eastern Mediterranean Region (2%).

WHO (2016b) reports that in 2015 there were an estimated 429,000 deaths from malaria (range 235,000-639,000) worldwide. Most of these deaths occur in the African Region (92%), followed by the Southeast Asian Region (6%) and

the Eastern Mediterranean Region (2%). Most deaths from malaria occur in children under the age of 5 years. Children under five are very vulnerable to malaria, infection, and death (Cullen, 2016). In 2015, malaria killed around 303,000 toddlers worldwide, including 292,000 in the African Region. Between 2010 and 2015, malaria mortality rates in children under 5 years of age decreased by around 35%. Even so, malaria remains is the main killer of toddlers, which causes death in 1 child every 2 minutes (Cibulskis et al., 2016). The issue is not only a health issue, yet a socio-economic problems affecting the community especially the high-risks groups. Hence, socio-economic contexts are so intertwined that they are distinguishable but indivisible (Pillai and Ahamat, 2018)

Clinical malaria cases in Aceh (high fever accompanied by shivering) without examination of blood preparations amounted to 21,993 cases with positive malaria totaling 1,068 cases and the number of API (Annual Parasite Incidence) in Aceh Province in 2012 amounted to 0.2%. Districts/cities in the province of Aceh with the highest malaria cases were Kota Sabang in 2001 with API values reaching 100.9 cases per thousand inhabitants. The government then worked together to eliminate malaria and reduce the number. In 2008 the API in Sabang was successfully reduced to 3.03 cases in the thousand population and at the end of 2012, only 0.1 cases were recorded. Sabang is an area that has a high commitment to eradicate malaria (Dinkes, 2016).

The city of Sabang can be used as a model for malaria elimination programs, based on the prevalence of malaria which is less than 1/1000 of the population. The malaria endemicity level of the city of Sabang until the end of December 2013 was 0,000 per 1000 inhabitants so that Sabang was categorized as a Low Case Incidence. The results of the WHO audit, the City of Sabang has been certified as a Malaria Free Zone, so Sabang is a model for Indonesia in malaria elimination. But now there have been several cases of imported malaria (import cases) and the emergence of new parasitic species and their transmission through long-tailed apes that were not previously present in Sabang. This is closely related to the status of Sabang as a tourist destination both locally, nationally and internationally (Herdiana et al., 2013).

The incidence of malaria in Sabang was previously influenced by climate and non-climate factors. Parham et al. (2015) say that climate factors include air temperature, rainfall, and humidity. Non-climatic factors include vector types, parasite types, environmental development and urbanization,

population movement and migration, immunity to malaria in humans, insecticide resistance to mosquitoes and drug resistance to parasites. But there are other non-physical factors that indirectly influence the incidence of malaria, namely behavioural factors which include knowledge, attitudes, and actions in preventing malaria (Sachs & Malaney, 2002). Based on the facts above, the problem in this paper is to examine the influence of behavioural and environmental factors (physical, biological and chemical) on the incidence of malaria cases in Sabang. To address this, the basic question is to identify the factors that influence the incidence of malaria. While, the overall objective of the study is to determine the influence of maternal and environmental behavioural factors on malaria cases in Sabang City.

2.0 LITERATURE REVIEW

2.1 The Concept of Malaria

Malaria is defined as an infectious disease with periodic fever caused by Plasmodium parasites (including protozoa) and transmitted by female Anopheles mosquitoes (WHO, 2015).

2.2 Epidemiology

Host Factors

Naturally, the population in a malaria endemic area is easy and there are those who are difficult to get malaria, even though the clinical symptoms are mild. The migration of people to and from malaria-endemic areas has still caused problems. It has long been known that outbreaks of this disease often occur in new residential areas, such as in the area of plantations and transmigration. This happens because workers come from other regions not yet have immunity so susceptible to infection (Elyazar, Hay, & Baird, 2011). Human vulnerability to malaria varies. There are people who are vulnerable, who can be infected by malaria, but some are more immune and not easily contracted by malaria (Miller et al., 2013).

The Agent Factor (Caused)

Malaria in humans can only be transmitted by female Anopheles mosquitoes. Anopheles species around the world have around 2,000 species and 60 species of them are known to be transmitters of malaria. Anopheles species in

Indonesia have around 80 species and 24 species of which have been proven to transmit malaria (WHO, 2016a). Anopheles mosquitoes live in tropical and subtropical climates but can also live in temperate regions. These mosquitoes are rarely found in altitude areas of more than 2,000-2,500 m. The breeding sites vary (depending on the species) and can be divided into three regions, namely the coast, the interior, and the foot of the mountain. Female Anopheles mosquitoes usually bite humans at night or from dusk to dawn. The flight distance is no more than 0.5-3 km from the breeding place (Bousema et al., 2014).

Anopheles mosquitoes usually put their eggs on the surface of water one by one. Eggs can survive for a long time in a dormant form. If enough water is available, the eggs usually hatch 2-3 days after being placed. Anopheles mosquitoes are often called mosquitoes. Malaria in humans can only be transmitted by female Anopheles mosquitoes. Anopheles species around the world have around 2,000 species and 60 species of them are known to be transmitters of malaria. Anopheles species in Indonesia have around 80 species and 24 species of which have been proven to transmit malaria (WHO, 2016a).

The Environment Factor

Environmental conditions have a major influence on the presence or absence of malaria in an area. The presence of brackish water, puddles of forest water, rice fields, fish ponds, clearing of forests and mining in an area will increase the likelihood of malaria occurring because these places are breeding places for malaria mosquitoes (Hasyim, Camelia, & Fajar, 2014). This is exacerbated by the movement of people from endemic areas to malaria-free areas and vice versa. Not all areas entered by malaria sufferers will contract malaria. If there is no malaria mosquito in the area, transmission of the disease will not occur. Vice versa, even if there is a malaria mosquito in an area but if there is no malaria sufferer, malaria transmission will not occur. An area will contract malaria if in that area there is a malaria mosquito that has bitten malaria sufferers (Hasyim et al., 2014).

Etiology

Malaria is caused by the plasmodium sporozoa parasite which is transmitted by the bite of an infective female Anopheles mosquito. Most Anopheles

mosquitoes will bite at dusk or at night, in some types of mosquitoes the peak of the bite is midnight to dawn (Miller et al., 2013). Malaria in humans is caused by four types of Plasmodium, namely Plasmodium vivax, Plasmodium falciparum, Plasmodium malariae, Plasmodium ovale. The type of malaria caused by the four types of Plasmodium causes malaria which has a different pattern of fever and the resulting clinical symptoms (Katz, Despommier, & Gwadz, 2012).

The Malaria Cycle

Plasmodium will experience two cycles. Asexual cycles (schizogony) occur in the human body, while the sexual cycle (sporogony) occurs in mosquitoes. The sexual cycle begins with the union of male and female gametes to form ookinete in the stomach of a mosquito. Ookinete will penetrate the stomach wall to form cysts in the mosquito's outer membrane (Farrar et al., 2013). The time needed for this process is 8-35 days, depending on the environmental situation and type of parasite. This is where the cyst will form thousands of sporozoites which are released and then spread to all mosquito organs including the mosquito salivary glands. It is in this gland that sporozoites mature and are ready to be transmitted if mosquitoes bite humans (Miller et al., 2013).

According to Meyers, Neafie, Marty, and Wear (2000), if plasmodium-infected mosquitoes from healthy human bite patients, the sporozoites contained in mosquito salivary glands are inserted through stab wounds. Within one hour this effective form is carried by the blood to the liver and then enters the liver parenchyma cells and begins the development of the primary preeritrocyte or exoerythrocytic cycle. Sporozoites will become round or oval and begin to divide quickly. The results of the schizogony are large amounts of exsoeritrocyter merozoites (Tatem, Gething, Smith, & Hay, 2013).

Humans bitten by infective mosquitoes will experience symptoms according to the number of sporozoites, plasmodium quality, and endurance. Sporozoites will begin the exsoeritrositer stage by entering the liver cells. In the liver, the sporozoites mature into schizonts which will rupture and release tissue merozoites (Hemingway, 2014). Merozoites will enter the blood and infect erythrocytes to start the erythrocyte cycle. Merozoites in erythrocytes will undergo morphological changes, namely: merozoites to form the next ring of trophozoites and finally become merozoites. This change process takes 2-3

days (Katz et al., 2012). Among these merozoites, there will be a developing form of gametocytes to re-start the sexual cycle into microgamet (male) and macrogamete (female). Infected erythrocytes usually rupture which manifests in clinical symptoms (WHO, 2016a).

Clinical Symptoms

The main complaints that often arise are fever more than two days, shivering, and sweating (often called the malaria trias). Fever in all four types of malaria differs according to the schizogony process. Fever due to P. falciparum can occur every day, in P.vivax or ovale the fever is intermittent one day, whereas fever in P. malariae attacks two days later (Katz et al., 2012). The period of budding/incubation of this disease can be several days to several months and then new signs and symptoms that the patient complains such as fever, chills, rheumatic pain or joint pain, sometimes to vomiting, appear pale/anemic, enlarged liver and spleen, urine appear cloudy or thick because it interferes with hemoglobin, feels tingling on the skin and experiences seizures (Miller et al., 2013).

Clinical signs and symptoms of malaria that arise vary depending on various things including the age of the patient, the way of transmission, immune status, type plasmodium, single or mixed infections. The patient had a fever of 37,5^{o} - 40^{o}C, and anemia as evidenced by pale palpebral conjunctiva. Patients are often accompanied by an enlarged spleen (splenomegaly) and enlargement of the liver (hepatomegaly). If there is a severe attack, symptoms are accompanied by shock characterized by a decrease in blood pressure, rapid and weak pulse, and increased breathing frequency (Bousema et al., 2014).

3.0 METHODOLOGY

Population is an element (individual, object, event or substance that matches the sample inclusion criteria in the study. Suwarjana, I. K. (2016), in Burn and Grover, (2010). The population in this study were all mothers in two sub-districts in the City of Sabang (Suka Karya Subdistrict and Suka Jaya District) which were spread in 18 villages as follows:

Table 3.0 Distribution of Research Populations by Village in Sabang in 2017

District	Village	Number of houses hold family
Sukakarya		
	Iboih	299
	Batee Shok	350
	Paya Seunara	280
	Krueng Raya	123
	Aneuk Laot	260
	Kota Bawah Timur	222
	Kota Bawah Barat	380
	Kota at	335
Sukajaya	Paya	268
	Keuneukai	165
	Beurawang	105
	Jaboi	222
	Balohan	172
	Cot Abeuk	178
	Cot Ba U	258
	Ie Meulee	157
	Ujong Kareung	150
	Anoi Itam	101
Total		3.525

The reason for the sampling focused on the mother in this study is that the mother is supportive if a family member is sick. Mothers are always at home doing daily activities such as cleaning the environment, managing household waste and others. Some other health reasons are 1). If a family member is sick or suffering from malaria, the mother will be in trouble and will seek medical help and if she is interviewed by a health worker or otherwise, the mother's memory of malaria is very helpful, such as: remembering a history of malaria infection by mentioning the previous symptoms. 2). if the mother is exposed to malaria during pregnancy, the risk it faces is very large for the baby such as congenital malaria, abortion, low birth weight. According to Le Port, A, (2012) in (Steketee, R.W, 2001), every year, 200,000 newborns die for reasons that are directly related to maternal malaria during pregnancy, namely stillbirth, fetal growth restriction, preterm delivery or low birth weight. Another 500,000 deaths occur among babies who experience Plasmodium falciparum during the first year of their lives.

The Information about malaria was obtained from the health office of the city of Sabang from early 2013 to February 2017. The data are taken as the number of malaria cases as well as receptive villages, which were villages without cases but found vectors in the area. The sampling technique in this study was conducted using a probability sampling method with the cluster random sampling technique. According to Arikunto (2010) cluster, random sampling is a sampling technique that is carried out by taking representatives from each existing geographical area. Cluster sampling is also called sample groups and not individuals. Based on the results of cluster random sampling, 4 (four) villages were chosen as sampling areas, there are villages Beurawang, Keuneukai, Batee Shok and Iboih Village. The number of samples from each village was set at 25 mothers.

3.1 Interviews

The interview technique was conducted to measure the variable knowledge and attitudes of mothers about malaria. In a research subject has a lot of information that can be explored by researchers through question questions submitted by researchers to respondents or participants. Question the researcher (interviewer) and the answers given by the respondent occur through the interview method. Interviews are methods of collecting data in a personal form carried out by trained interviewers. (Swarjana, 2012). In this study the author conducted a personal interview with the mother, namely asking questions directly and the researcher looked at the respondent's response whether he understood the questions raised by the researcher. To bias the information desired in this study, the language used is the local language (Acehnese).

Based on the results of the validity of the data collection instrument (attachment 4), it is known that the results of the validity test of the mother's knowledge instrument, 21 statement items obtained the value of corrected item-total correlation 6 0.632, so the instrument was declared valid. Furthermore, the validity of maternal attitude instruments, 15 items of statement obtained the value of corrected item-total correlation 6 0.632, so that the instrument was declared valid and the validity of the mother's skill instrument was tested, 14 items of statements also obtained corrected item-total correlation 6 0.632, so the instrument was declared valid. The reliability test results were obtained from Cronbach alpha values ≥ 0.80 so that the three instruments were declared reliable.

3.2 Research Framework

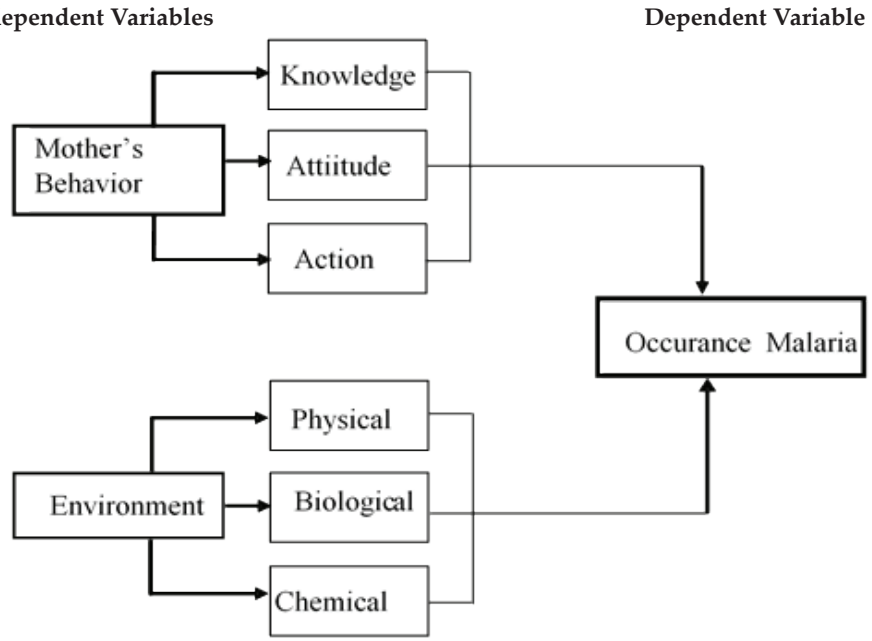

Figure 3.2 Research Framework

The independent variable in this study based on the image above is the mother's behaviour which includes knowledge, attitudes, and actions as well as the environment that includes. The dependent variable in this study is malaria occurrence.

4.0 RESEARCH HYPOTHESIS

The hypothesis in this study consists of the null hypothesis (Ho) and the alternative hypothesis (Ha) as follows:

3.3.1 Ho: There is no relationship between the knowledge of mothers and the incidence of malaria in Sabang.

Ha: There is a relationship between the knowledge of mothers and the incidence of malaria in Sabang.

3.3.2 Ho: There is no relationship between the attitude of mothers and the incidence of malaria in Sabang.

Ha: There is a relationship between the attitude of mothers and the incidence of malaria in Sabang.

3.3.3 Ho: There is no relationship between the actions of mothers and the incidence of malaria in Sabang.
Ha: There is a relationship between the actions of mothers and the incidence of malaria in the City of Sabang.
3.3.4 Ho: There is no relationship between the physical environment and the incidence of malaria in Sabang.
Ha: There is a relationship between the physical environment and the incidence of malaria in Sabang.
3.3.5 Ho: There is no relationship between the biological environment and the incidence of malaria in Sabang.
Ha: There is a relationship between the biological environment and the incidence of malaria in Sabang.
3.3.6 Ho: There is no relationship between the chemical environment and the incidence of malaria in Sabang.
Ha:There is a relationship between the chemical environment and the incidence of malaria in Sabang.
3.3.7 Ho: There is no influence between the mother's behaviour and environmental on the incidence of malaria in Sabang.
Ha:There is an influence between the mother's behaviour and the environment on the incidence of malaria in Sabang.

5.0 RESULTS AND DISCUSSIONS

Data collection in this study was carried out from February 29, 2017, to March 30, 2017, in four villages in the Sabang area. The sample in this study were 100 mothers spread in four villages, namely Beurawang Village, Keuneukai Village, Batee Shok Village, and Iboih Village. Data collection is done by interview, observation, documentation study and examination and observation of the physical, biological and chemical environment. The collected data is then processed and analyzed using univariate, bivariate and multivariate statistics. The results of the analysis of research data can be seen in the table below.

5.1 Univariate Analysis

Malaria Case

The data collection on malaria cases in the city of Sabang was carried out by collecting secondary data from the Sabang Health Office through documentary

studies of malaria cases from 2013 to 2016. The results of these measurements can be seen in the following table:

Table 4. 1 Distribusi Distribution Frekuensi Frequency Kasus Malaria Di Kota Sabang (n=100)

No	Malaria Case	Frequency (f)	Persentage (%)
1	Positif Positive	35 35	35,0
2	Negatif	65 65	65,0
Total		100 100	100

Table 4.1 shows that out of 100 respondents, 65 respondents (65.0%) were malaria negative or did not suffer from malaria.

Physical Environment

Research on the physical environment of malaria is carried out by using a rolling meter to measure the extent and depth of potential mosquito breeding sites and the presence or absence of stagnant water. If there is a puddle of water (supports), a score = 1 is given and if there is no puddle of water (not supporting) is given a score = 0. The water temperature at the breeding site is measured simultaneously if the temperature is high (not supported) a score = 0. If the temperature Normal (support) given a score = 1. The results of measurements on the physical environment of malaria can be seen in the following table:

Table 4.2 Physical Environmental Distribution in Sabang (n = 100)

No	Physical Environmental	Frekuensi (f)	Percentage (%)
1	Does not support	49	49
2	Does Support	51	51
Total		100	100

Table 4.2 shows that out of 100 respondents, 51 respondents (51.0%) had a physical environment conducive to the proliferation of malaria.

Biological Environment

Biological environmental research carried out by using a dipper (*dipper*), pipettes, containers larvae (small bottle), microscope and microscope stereogram. If there are mosquito larvae *Anopheles* (support), then given a score

= 1 and if there are no mosquito larvae *Anopheles* (not support), is assigned a score = 0. If there are fish predators on breeding sites in various types (not support) then given a score = 0 and if not there is a predatory fish in the breeding site (support), given a score = 1. If there is diverse aquatic vegetation and dense at the breeding site in different types of (support) then given a score = 0 and if not found aquatic vegetation vary and is solid at breeding sites in various types (no support) is assigned a score = 1

Biological environment research results can be seen in the following table:

Table 4. 3 Distribusi Distribution Biological Environment At Kota Sabang (n = 100)

No	Biological Environment	Frequency (f)	Percentage (%)
1	Does not support	70	70.0
2	Support	30	30.0
Total		100	100

Table 4.3 shows that out of 100 respondents, 70 respondents (70.0%) have a biological environment which does not support to malaria.

Chemical Environmental

Research on the chemical environment is done by using a pH meter digital, *hand refractometer*, water thermometer digital and survey equipment mosquitoes. If the conditions on the ground, breeding *of Anopheles* support given a score = 1 and if the conditions on the ground, breeding *of Anopheles* do not support is assigned a score = 0.

Table 4.4 Distribution of Chemical Environment in Sabang (n = 100)

No	Chemical Environment	Frequency (f)	Percentage (%)
1	Does not support	56	56.0
2	Does Support	44	44.0
Total		100	100.0

Table 4.4 shows that out of 100 respondents, 56 respondents (56.0%) have a chemical environment that does not support the proliferation of malaria.

Knowledge

Research on the mother's knowledge about malaria was carried out by the interview method. The following results of data collection on maternal knowledge were analyzed descriptively and the results can be seen below:

Table 4.5 Knowledge Distribution of Respondents In Sabang (n = 100)

No	Knowledge of Respondents	Frequency (f)	Percentage (%)
1	Less	61	61.0
2	Good	39	39.0
Total		100	100.0

Table 4.5 above shows that out of 100 mothers, 61 mothers (61.0%) had insufficient knowledge about malaria.

Attitudes

Research on maternal attitudes toward malaria is carried out by the interview method. The following results of data collection on maternal attitudes were analyzed descriptively and the results can be seen below:

Table 4.6 Distribution of Respondents Attitude in Sabang (n = 100)

No	Attitude	Frequency (f)	Percentage (%)
1	Less Support	53	53.0
2	Support	47	47.0
Total		100	100

Table 4.6 shows that out of 100 mothers, 53 mothers (53.0%) had less supportive attitudes towards malaria prevention.

Skills

Research on the skills of mothers in preventing malaria is carried out by the interview method. The results of the data collection on the mother's skills are then analyzed descriptively and the results can be seen below:

Table 4.7 Distribution of Respondent Skills in Sabang (n = 100)

No	Skills	Frequency (f)	Percentage (%)
1	Less Skilled	60	60.0
2	Skilled	40	40.0
Total		100	100

Table 4.7 shows that out of 100 mothers, 60 mothers (60.0%) are less skilled in preventing malaria.

The Discussions of Malaria Cases

The results of research on malaria cases as illustrated in Table 4.1 show that of 100 mothers as respondents, 65 people (65.0%) were families with negative malaria cases or did not suffer from malaria. These results illustrate that malaria cases in the city of Sabang after being declared as a low case incidence but still occur. Based on secondary data from the Monthly and Annual reports of the Sabang Health Office from 2013 to March 2017 there were 35 cases of positive malaria cases in Sabang. This study is in line with Asih et al. 2010 in Sabang, there were 19 cases of malaria positive out of 16,229 blood samples examined by residents in 14 villages, namely (83.47%) with a prevalence point of 0.12%, 14 positive cases of P vivax and P falciparum originating from villages Batee Shok.

This study is in accordance with the research of Herdiana et al. (2016) that the risk factors for malaria infection in low endemic areas in Aceh Besar District are that the community works where the forest-related occupation has to stay, such as: illegal logging, collecting rubber tapping, gold miner (mining), planting ganja (Cannabis Farming). The results of this study were strongly associated with malaria infection for people who worked in the forest with non-forest (near the forest), i.e. with an Odd ratio 7.9 (95% CI 1.6-39.7, P = 0.012). Kleinschmidt and Sharp (2001) explain that adults have a risk of malaria infection in low transmission areas (low transmissions), which is closely related to behavioural factors.

Epidemiologically malaria transmission in Sabang still occurs even though Sabang has been decommissioned by a malaria-free area or low case incidence in 2013. Cases that occur are cases of imported malaria caused by dominant plasmodium namely P. falciparum, P.vivax, and the latest findings have also found *Plasmodium knowlesi*, which previously had not been identified from hundreds of thousands of laboratory tests conducted in Sabang about the presence of Plasmodium. To determine *Plasmodium knowlesi* it should be done by using PCR, because Plasmodium is very identical to plasmodium palififum so that laboratory workers are very difficult to distinguish except for officers who are trained in their skills in the accuracy of diagnosis so that this is the only way to get rational malaria treatment.

Transmission of malaria that has occurred in the city of Sabang is also inseparable from the factors that influence it, namely environmental factors such as 1. physical environment, namely breeding sites, climate, rainfall, water temperature, sunlight, wind speed. 2. Biological environment, namely: water vegetation (flora and fauna) waters, predators, and 3. Chemical environment, namely: Ph, salinity and other supporting factors social environment or community behaviour. Community behaviour is also a major factor in malaria transmission.

Other supporting factors for transmission and an increase in malaria cases in Sabang are high population mobility to and from Sabang Island. Sabang is a tourist destination both local and international, this situation affects the occurrence of malaria transmission known as the case (import case) or indigenous case (indigenous). Epidemiologically Sabang still has a chance of positive malaria cases, especially for 4 (four) malaria plasmodium namely: Plasmodium falciparum, Plasmodium vivax, Plasmodium ovale while the latest plasmodium confirmed based on the results of case reports from 2013 to June 2017 is Plasmodium knowlesi which the bite of the Anopheles mosquito which is infective as an intermediary host originating from the primate namely the long-tailed macaque (*Macaca facicularis*).

Geographically, there are still many Villages in Sabang, where receptive areas are found, that is, there are no cases of positive malaria, but suspect vectors are present and spread to 18 villages. Potential breeding sites are found along the coast and mountains around people's homes in Sabang. These environmental factors are very influential in the occurrence of malaria transmission. The statement above is in line with the opinion expressed by Pratama (2015), where the physical environment influences the breeding place of An. Sundaicus mosquitoes, one of the factors that influence is water. Rainfall plays a role in the availability of water as a breeding place for mosquitoes which affects swamps and puddles. when heavy rain then the water level in the swamp and inundation increases, as well as the water flow, gets heavier.

High rainfall also affects air humidity, In Suwito's research, the highest humidity was in December (84.30%) and the lowest was in August (76%). 8 Other influential physical environmental factors were the height of the location. Malaria decreases at increasing altitude. Rajabasa District is less than 100 sea level. Pentury and Nusaly (2011), states that sunlight is a physical

environmental factor that affects the presence of mosquitoes and affects humidity and temperature. In some types of mosquitoes like to take shelter under moss so that it is not exposed to sunlight. Water temperature also affects the breeding of mosquitoes. in the research conducted by Setyaningrum, Murwani, Rosa, and Andananta (2008), it was found to range from 32-33.5^{o}C, whereas according to the Indonesian Ministry of Health (2008) 2 temperatures ranged from 25-27^{o}C for breeding mosquitoes. Generally, rain is accompanied by wind which affects the distance of flying mosquitoes.

Based on the description above, it can be concluded that malaria cases in Sabang are caused by environmental factors and maternal behaviour in preventing the breeding of anopheles mosquito larvae. According to Elvi Sunarsih et al., in 2009, a prolonged dry season could reduce mosquito density due to a decrease in the number of breeding sites so that it would affect the decreasing incidence of malaria. Wind speed has a positive and negative role in the malaria vector mosquito cycle. High wind speeds can bring mosquitoes to fly further (more than 30 kilometers), whereas the normal flight distance of mosquitoes is 3 km. The optimum wind speed needed by mosquitoes to reach humans is 1.0-1.2m/sec.4 The average wind speed in Pangkalpingang is 3.0m/s (range 2.9-10.8m/s) so that this condition is able to extend the distance of flying vector mosquitoes in the research location.

Pentury and Nusaly (2011), states that sunlight is a physical environmental factor that affects the presence of mosquitoes and affects humidity and temperature. In some types of mosquitoes like to take shelter under moss so that it is not exposed to sunlight. Water temperature also affects the breeding of mosquitoes. in the research conducted by Setyaningrum, Murwani, Rosa, and Andananta (2008), it was found to range between 32-33.5^{o}C, whereas according to the Indonesian Ministry of Health (2008) temperatures ranged from 25-27^{o}C for mosquito breeding. Generally, rain is accompanied by wind which affects the distance of flying mosquitoes. Based on the explanation above, it can be concluded that malaria cases in Sabang were caused by physical, biological, chemical and maternal environmental factors in preventing the breeding of Anopheles mosquito larvae.

6.0 CONCLUSION

This study concluded that environmental factors, namely physical, chemical, biological and behavioural statistics were the dominant contributors to malaria transmission in 4 research villages in Sukajaya and Sukakarya Sub-districts, Sabang. All factors related to maternal behaviour have contributed to the occurrence of malaria in Sabang. In terms of physical, biological and chemical environmental factors is also a contributor to the occurrence or absence of malaria. Thus a public concern for behaviour is the main capital for reducing malaria cases, and the commitment of the regional government financially through program support to the health office needs to be improved both in terms of the amount of finance and supervision of health workers as well. This demonstrates the crucial function of human capital in hospital ecosystem. The human capital is shaped by social equity hence the well being of individual and the community (local or global) increases institutional-individual relationship (Ahamat, 2017).

In a recent study conducted on 105 private hospitals in Indonesia, it is evidenced that entrepreneurial orientation of hospital organizations in Indonesia proved has a significantly positive influence on organizational performance in the disruptive environment condition (Dewi and Ahamat, 2018). A different disruptive strategy could be employed. The Sabang Government policy fully supports malaria prevention programs through regional policies both physically and financially in handling and preventing malaria in Sabang. Screening cases through sea and airports for local and international tourists and tourists entering and leaving Sabang if fever is identified by using a Heat detector in each entry port.

Conclusively, for future study it is recommended here that one of the ways to progress management inquiry or research, is to challenge the traditional methodologies and to use scientific approach in observing, measuring, analyzing, and concluding management phenomena (Ahamat, 2014). This could be achieved by using qualitative research strategies. Though this study employs interview and observation, structured interviews and longitudinal study may lead to the discovery of key emerging themes, which may not have been uncovered as explicitly if only non-qualitative approaches had been applied (Ahamat, 2019).

REFERENCES

Aderaw, Z., & Gedefaw, M. (2013). Knowledge, attitude, and practice of the community towards malaria prevention and control options in anti-malaria association intervention zones of Amahara national regional state, Ethiopia. *Global Journal of Medical Research*.

Ahamat, A. (2019). Using Structured Interviews and Personal Observation to Study Entrepreneurial Opportunity: A Reflection, SAGE Research Methods Cases. SAGE Publications Ltd, London. DOI: https://dx.doi.org/10.4135/9781526490964.

Ahamat, A. (2017). Is Islamic Banking and Finance Doing Enough? Shaping the Sustainable and Socially Responsible Investment Community, *Asian Social Science*. Vol. 13, No. 3. DOI:10.5539/ass.13n3p170.

Ahamat, A. (2014). Examining How Management Research Learns from Research in the Physical Sciences, *Journal of Law & Social Sciences*, *4*(1), 95.DOI: 10.7603/s40741-014-0013-2.

Ajami, W.A., Ottay, R.I., & Rombot, D.V. (2016). Hubungan Antara Perilaku Masyarakat dengan Kejadian Malaria di Wilayah Kerja Puskesmas Tombatu Kabupaten Minahasa Tenggara. *JURNAL KEDOKTERAN KOMUNITAS DAN TROPIK, 4*(1).

Ambarita, L., Taviv, Y., Purnama, D., Betriyon, B., Pahlepi, R. I., & Saikhu, A. (2011). Beberapa Aspek bionomik Anopheles maculatus dan An. leucosphyrus di perkebunan kopi daerah endemis malaria Kabupaten Oku Selatan. *Jurnal Ekologi Kesehatan, 10*(4 Des), 229-238.

Amoran, O.E. (2013). Impact of health education intervention on malaria prevention practices among nursing mothers in rural communities in Nigeria. *Nigerian medical journal: journal of the Nigeria Medical Association, 54*(2), 115.

Arsin, A.A., & Karim, S.A. (2012). Pola spasial kasus malaria dengan aplikasi sistem informasi geografis (SIG) di Kabupaten Halmahera Tengah. *Jurnal masyarakat Epidemiologi Indonesia, 1*(2), 84-89.

Astatkie, A. (2010). Knowledge and practice of malaria prevention methods among residents of Arba Minch Town and Arba Minch Zuria District, Southern Ethiopia. *Ethiopian journal of health sciences, 20*(3).

Borkowski, N. (2015). *Organizational behaviour in health care*: Jones & Bartlett Publishers.

Bousema, T., Okell, L., Felger, I., & Drakeley, C. (2014). Asymptomatic malaria infections: detectability, transmissibility and public health relevance. *Nature reviews. Microbiology, 12*(12), 833.

Caminade, C., Kovats, S., Rocklov, J., Tompkins, A.M., Morse, A.P., Colón-González, F. J.,Lloyd, S.J. (2014). Impact of climate change on global malaria distribution. *Proceedings of the National Academy of Sciences, 111*(9), 3286-3291.

Carter, E.D. (2012). *An enemy in the blood: malaria, environment, and development in Argentina*: University of Alabama Press.

Cibulskis, R.E., Alonso, P., Aponte, J., Aregawi, M., Barrette, A., Bergeron, L., Patouillard, E. (2016). Malaria: global progress 2000–2015 and future challenges. *Infectious diseases of poverty, 5*(1), 61.

Cohen, J.M., Smith, D.L., Cotter, C., Ward, A., Yamey, G., Sabot, O.J., & Moonen, B. (2012). Malaria resurgence: a systematic review and assessment of its causes. *Malaria Journal, 11*(1), 122.

Cotter, C., Sturrock, H.J., Hsiang, M.S., Liu, J., Phillips, A.A., Hwang, J., Feachem, R.G. (2013). The changing epidemiology of malaria elimination: new strategies for new challenges. *The Lancet, 382*(9895), 900-911.

Cullen, K.A. (2016). Malaria surveillance. *MMWR. Surveillance Summaries, 65*.

Dinkes. (2016). *Profil kesehatan Aceh tahun 2015. Banda Aceh: Dinas Kesehatan Aceh*.

Effendi, H. (2003). *Telaah kualitas air, bagi pengelolaan sumber daya dan lingkungan perairan*: Kanisius.

Elyazar, I.R., Hay, S.I., & Baird, J.K. (2011). Malaria distribution, prevalence, drug resistance and control in Indonesia. *Advances in parasitology, 74*, 41.

Ernst, K.C., Lindblade, K.A., Koech, D., Sumba, P.O., Kuwuor, D.O., John, C.C., & Wilson, M.L. (2009). Environmental, socio-demographic and behavioural determinants of malaria risk in the western Kenyan highlands: a case-control study. *Tropical medicine & international health, 14*(10), 1258-1265.

Farrar, J., Hotez, P., Junghanss, T., Kang, G., Lalloo, D., & White, N.J. (2013). *Manson's tropical diseases e-book*: Elsevier Health Sciences.

Friaraiyatini, Keman, S., & Yudhastuti, R. (2006). Pengaruh Lingkungan Dan Perilaku Masyarakat Terhadap Kejadian Malaria Di Kab. Barito Selatan Propinsi Kalimantan Tengah. *JURNAL KESEHATAN LINGKUNGAN INDONESIA, 2*(2), 121-128.

Harijanto, P. (2000). *Malaria (Epidemiologi, Patogenesis, Manifestasi Klinis, dan Penanganan)*. *Jakarta: EGC, 211*.

Harmendo, H., Wahyuningsih, N. E., & Raharjo, M. (2009). Faktor Risiko Kejadian Malaria di Wilayah Kerja Puskesmas Kenanga Kecamatan Sungailiat Kabupaten Bangka Propinsi Kepulauan Bangka Belitung. *JURNAL KESEHATAN LINGKUNGAN INDONESIA, 8*(1), 15-19.

Hasyim, H., Camelia, A., & Fajar, N.A. (2014). Determinan kejadian malaria di wilayah endemis. *Kesmas: National Public Health Journal*, 291-294.

Hemingway, J. (2014). The role of vector control in stopping the transmission of malaria: threats and opportunities. *Phil. Trans. R. Soc. B, 369*(1645), 20130431.

Herdiana, H., Cotter, C., Coutrier, F.N., Zarlinda, I., Zelman, B.W., Tirta, Y. K., Whittaker, M. (2016). Malaria risk factor assessment using active and passive surveillance data from Aceh Besar, Indonesia, a low endemic, malaria elimination setting with Plasmodium knowlesi, Plasmodium vivax, and Plasmodium falciparum. *Malaria Journal, 15*(1), 468.

Herdiana, H., Fuad, A., Asih, P. B., Zubaedah, S., Arisanti, R. R., Syafruddin, D., . . . Imran, A. (2013). Progress towards malaria elimination in Sabang municipality, Aceh, Indonesia. *Malaria Journal, 12*(1), 42.

Heriyanto, B., Trapsilowati, W., & Widiarti, W. (2013). Faktor Risiko Dan Pengetahuan, Sikap, Perilaku (Psp) Masyarakat Pada Kejadian Luar Biasa (Klb) Malaria Di Kabupaten Purbalingga. *Buletin Penelitian Kesehatan, 41*(2 Jun), 84-102.

Hocking, A., Laurence, C., & Lorimer, M. (2013). Patients' knowledge of their chronic disease: The influence of socio-demographic characteristics. *Australian family physician, 42*(6), 411.

Junaidi, H., Raharjo, M., & Setiani, O. (2016). Analisis Faktor Risiko Kejadian Malaria di Wilayah Kerja Puskesmas Kuala Bhee Kecamatan Woyla Kabupaten Aceh Barat. *JURNAL KESEHATAN LINGKUNGAN INDONESIA, 14*(2), 40-44.

Katz, M., Despommier, D.D., & Gwadz, R. (2012). *Parasitic diseases*: Springer Science & Business Media.

Kemenkes. (2012). Pedoman penatalaksanaan kasus malaria di Indonesia. *Kementerian Kesehatan RI, Jakarta*.

Kemenkes. (2015). *Profil kesehatan Indonesia tahun 2015*. *Kementerian Kesehatan RI*.

Kemenkes. (2015) *Rencana strategis kementerian kesehatan*. Jakarta: Kementerian Kesehatan RI.

Kleinschmidt, I., & Sharp, B. (2001). Patterns in age-specific malaria incidence in a population exposed to low levels of malaria transmission intensity. *Tropical medicine & international health, 6*(12), 986-991.

Kramer, R.A., & Lesser, A. (2015). Sustaining the gains made in malaria control and elimination. *Infectious diseases of poverty, 4*(1), 26.

Kurniasih, D.A. (2009). *Hubungan Faktor Lingkungan dan Perilaku Masyarakat dengan Kejadian Malaria di Wilayah Kerja Puskesmas Tangkiling Kota Palangkaraya.* Diponegoro University.

Lisanuddin, L., Ismail, N., & Aulia, B. (2016). Hubungan Pengetahuan Perubahan Iklim Dan Sikap Masyarakat Terhadap Kejadian Penyakit Malaria Di Wilayah Kecamatan Darul Imarah Kabupaten Aceh Besar. *Jurnal Kedokteran Syiah Kuala, 16*(2), 69-74.

Le Port, A., Cottrell, G., Martin-Prevel, Y., Migot-Nabias, F., Cot, M., & Garcia, A. (2012). First malaria infections in a cohort of infants in Benin: biological, environmental and genetic determinants. Description of the study site, population methods, and preliminary results. *BMJ Open*, *2*(2), e000342.

Mading, M., & Kazwaini, M. (2014). Ekologi Anopheles spp. di Kabupaten Lombok Tengah. *ASPIRATOR-Journal of Vector-borne Disease Studies, 6*(1), 13-20.

Maulana, T. (2004). *Beberapa Aspek Lingkungan Yang Berhubungan Dengan Angka Kejadian Malaria Di Desa Suka Jaya, Suka Karya, Suka Makmur Dan Air Dingin, Kecamatan Simeulue Timur, Kabupaten Simeulue, Provinsi Naggroe Aceh Darussalam Tahun 2003.*

Mbengue, A., Bhattacharjee, S., Pandharkar, T., Liu, H., Estiu, G., Stahelin, R.V,Chotivanich, K. (2015). A molecular mechanism of artemisinin resistance in Plasmodium falciparum malaria. *Nature, 520*(7549), 683.

Miller, L.H., Ackerman, H.C., Su, X.Z., & Wellems, T. E. (2013). Malaria biology and disease pathogenesis: insights for new treatments. *Nature medicine, 19*(2), 156-167.

Mohammad khani, M., Khanjani, N., Bakhtiari, B., & Sheikhzadeh, K. (2016). The relation between climatic factors and malaria incidence in Kerman, South East of Iran. *Parasite Epidemiology and Control, 1*(3), 205-210.

Moller-Jacobs, L.L., Murdock, C.C., & Thomas, M. B. (2014). The capacity of mosquitoes to transmit malaria depends on the larval environment. *Parasites & Vectors, 7*(1), 593.

Nonvignon, J., Aryeetey, G.C., Malm, K.L., Agyemang, S.A., Aubyn, V.N., Peprah, N.Y., Aikins, M. (2016). Economic burden of malaria on businesses in Ghana: a case for private sector investment in malaria control. *Malaria Journal, 15*(1), 454.

Notoatmodjo, S. (2010). *Ilmu perilaku kesehatan*. *Rineka Cipta: Jakarta*.

Parham, P.E., Waldock, J., Christophides, G.K., Hemming, D., Agusto, F., Evans, K.J.,.LaDeau, S. (2015). Climate, environmental and socio-economic change: weighing up the balance in vector-borne disease transmission. *Phil. Trans. R. Soc. B, 370*(1665), 20130551.

Pentury, K., & Nusaly, W. (2011). Analisa Kepadatan Larva Nyamuk Culicude dan Anophelidae pada Tempat Perindukan di Negeri Kamarian Kecamatan Kairatu Kabupaten Seram Bagian Barat (SBB). *Jurnal Molucca Medika vol 4 No, 1*.

Prabowo, A. (2004). *Malaria mencegah dan mengatasinya*. *Jakarta: Puspa Swara*.

Pratama, G.Y. (2015). Nyamuk Anopheles sp dan faktor yang mempengaruhi di Kecamatan Rajabasa, Lampung Selatan. *Majority, 4*(1).

Putri, D.F. (2013). Studi Fauna Vektor Malaria Di Daerah Endemis Malaria Desa Way Muli Kabupaten Lampung Selatan. *Jurnal Dunia Kesmas, 1*(1).

Rajan Pillai, T. & Ahamat, A (2018). Social-cultural capital in youth entrepreneurship ecosystem: Southeast Asia, *Journal of Enterprising Communities: People and Places in the Global Economy*, Vol. 12 Issue: 2, pp.232-255. DOI: https://doi.org/10.1108/JEC-08-2017-0063.

Regmi, K., Kunwar, A., & Ortega, L. (2016). A systematic review of knowledge, attitudes, and beliefs about malaria among the South Asian population. *Infection Ecology & epidemiology*, *6*(1), 30822.

Suharjo, S. (2015). Pengetahuan Sikap dan Perilaku Masyarakat Tentang Malaria di Daerah Endemis Kalimantan Selatan. *Media Penelitian dan Pengembangan Kesehatan*, *25*(1), 23-32.

Sachs, J., & Malaney, P. (2002). The economic and social burden of malaria. *Nature, 415*(6872), 680-685.

Setyaningrum, E., Murwani, S., Rosa, E., & Andananta, K. (2008). *Studi Ekologi Perindukan Nyamuk Vektor Malaria di Desa Way Muli, Kecamatan Rajabasa Lampung Selatan.* Paper presented at the *Makalah Disampaikan pada Seminar Pengabdian Masyarakat, Universitas Lampung. Bandar Lampung*.

Soleimani-Ahmadi, M., Vatandoost, H., & Zare, M. (2014). Characterization of larval habitats for anopheline mosquitoes in a malarious area under elimination program in the southeast of Iran. *Asian Pacific journal of tropical biomedicine*, *4*, S73-S80.

Singh, M.P., Saha, K.B., Chand, S.K., & Sabin, L.L. (2019). The economic cost of malaria at the household level in high and low transmission areas of central India. *Acta Tropica, 190*, 344-349.

Soegijanto, S. (2016). *Kumpulan Makalah Penyakit Tropis dan Infeksi di Indonesia (Jilid 1)*: Airlangga University Press.

Sormin, S.M. (2018). Hubungan Iklim (Temperatur, Kelembaban, Curah Hujan dan Kecepatan Angin) dengan Kejadian Malaria di Kabupaten Mandailing Natal Tahun 2011-2015.

Swarjana, I.K., & SKM, M. (2012). *Metodologi penelitian kesehatan*. Penerbit Andi.

Suwarjana, I.K. (2016). *Statistik kesehatan*. Penerbit Andi.

Tatem, A.J., Gething, P.W., Smith, D.L., & Hay, S.I. (2013). Urbanization and the global malaria recession. *Malaria Journal, 12*(1), 133.

Yadav, S.P. (2010). A study of treatment-seeking behaviour for malaria and its management in febrile children in a rural part of the desert, Rajasthan, India. *Journal of vector-borne diseases*, *47*(4), 235.

WHO. (2015). *Guidelines for the treatment of Malaria*: The World Health Organization.

WHO. (2016). *World malaria report 2015*: World Health Organization.

Widodo, H. (2013). *Parasitologi Kedokteran. D-Medika. Yogyakarta*.

Zein, U. (2005). Penanganan terkini malaria falciparum. *Penanganan Terkini Malaria Falciparum*.