

## Environmental Effects of Settlement Against Malaria Incidence on the Island of Kapoposang Pangkajene Island District

A.A. Arsunan and Annice Suasatri Situmorang  
Department of Epidemiology, Faculty of Public Health,  
Hasanuddin University, Makassar, Indonesia

**Abstract:** This study aims to find neighborhood relations associated with the incidence of malaria. The study was observational with cross sectional study. Samples were taken with exhausted sampling technique. Total population of 515 people with a total sample of 254 people. Analysis of the data used is the Chi Square test with logistic regression. The results showed that environmental factors in the home associated with the incidence of malaria is being screened at home ventilation ( $p = 0.049$ ). There are no factors outside the home environment associated with the incidence of malaria. Cultural social environmental factors associated with malaria incidence is outside the customs house at night ( $p = 0.021$ ). The variables that most influenced the incidence of malaria is the habit of going out at night (Wald = 5.036,  $p = 0.034$ ). This study suggests that the need for community empowerment programs should be sought in particular increasing public awareness of the importance of managing malaria free environment, eliminating breeding place, improving housing conditions to improve prevention practices to reduce human contact with mosquitoes *Anopheles*.

**Key words:** Environmental settlements, Malaria incidence, socio cultural, Mosquitoes, population

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### INTRODUCTION

Malaria remains one of the most serious public health problems facing developing countries in the world, especially countries in the tropics and sub-tropics including Indonesia (Frits, 2003). Malaria is a disease spread widely, i.e., in areas ranging 600-320 North latitude to South latitude, altitude of 2.666 m, up to a region that is located 433 m below sea level (Husin, 2007).

WHO estimates that currently about 2.5 billion people in the world living or living in areas where malaria is endemic to date malaria remains a health problem in the world. Malaria remains a public health problem in Indonesia, especially eastern Indonesia (Barodj, 2000). In South Sulawesi, in 2004 the number of clinical cases of malaria as many as 12 009 patients (AMI = 1.433 per mile), the figure shows an increase of 1.43% compared to 2003. As for 2005, the data gathered through Subdin P2&PL provincial health office. Sulawesi recorded 9461 cases of clinical malaria, the number of specimens examined as many as 3,832 (40.50%) and was positive in 3.42%. In 2006, it was noted that the results of the discovery and treatment of patients with as many as 846 people (21.75%) of the examined 4,031 blood clots or 57.76% of the total number of reported clinical (case 6979) with the highest cases in the district. Bulukumba, 39 District Screen and

the District Soppeng. For 2007, the total number of patients with clinical malaria 13,029 patients with a positive number as many as 1,927 people (14.79%) with the highest cases in Kab. Selayar, Bulukumba, Enrekang and Tator. As for 2008, the number of people with clinical malaria decreased to 8,886 the number of positive cases was 1,153 cases (12.98%). The case of the highest in the district. Screen, Pangkep, North Luwu, Enrekang and Tator or AMI of 1.14 per 1000 population (Profile Sulawesi Health Office 2008).

The existence of public housing has an open condition of the house without a ceiling, mounted ventilation without wire netting and perforated the wall conditions is one of the risk factors of malaria incidence. This is because the mosquito is very easy to get into the house that the situation is not covered like the walls were no holes. The results of the study in Tanjung Ubin Health Centre found that housing conditions that are not protected are risk factors for the incidence of malaria with a large risk of 2.41 ( $p = 0.0001$ ) (Siahaan, 2008; Lamaka, 2005).

Malaria appears as a result of the interaction agent (*Plasmodium*), the transmission process and the host (humans and *Anopheles* mosquitoes) were all influenced by the environment (Suroso, 2001). Malaria infection and the development of an agent is entered into the infected

host and both physical and socio-cultural environment has a very important role in the distribution of malaria. Research conducted by Arsunan (2006), found that rainfall associated with the incidence of malaria. Where high rainfall results in a lot of puddles that appear suddenly mosquito used as breeding sites (breeding place).

Anopheles mosquito breeding sites found in brackish water estuaries and marshes are covered. Research conducted by Kazwaini and Martini (2006) found that the Anopheles mosquito breeding sites such as lagoons become potential mosquito breeding places for mosquito breeding good with clear or cloudy conditions. The ability to transmit malaria vector is determined by a complex interaction of several factors among others: the hosts, vectors, pathogens and environmental factors. Environmental factors (abiotic) that many factors play a role is the climate. Temperature (temperature) effect on vector density, frequency and duration of biting mosquitoes bite and extrinsic stage period plasmodium (Capah, 2008).

## MATERIALS AND METHODS

**Research location:** This study was conducted in Kapoposang island in Pangkep, site selection for sample is determined based on data obtained in 2010 that the island is an area Kapoposang malaria mesoendemic (AMI = 25.2/mile, API = 17.57/mile). The type of research is an observational by applying cross-sectional study design in order to find out residential neighborhood relations associated with the incidence of malaria cases in the Kapoposang Island.

**Population and sample:** Sampling was conducted by "Exhausted sampling". Every individual who settled on the Kapoposang Island, Liukang Tupabbiring District, Pangkajene Islands Regency, South Sulawesi Province will serve as the research sample. Each individual will be asked their willingness to be the respondent including information (informed consent) as needed research. Each individual blood drawn using standard aseptic techniques (blood sampling performed by a technician or physician), blood was taken from the tip of the ring finger/middle left hand, subsequent blood samples will be processed for the manufacture of thin blood film/thick.

Blood samples were collected are stored preparations (default storage), further blood preparations examined under a microscope by a microscopic power (standard techniques) to identify infected blood (as well as the species of Plasmodium mixed infections).

**Data collection:** Primary data were obtained through direct data collection from respondents through interviews and blood tests. Secondary data related to the study was obtained from relevant agencies such as the Health Department in Pangkep Regency.

**Data analysis:** Data analysis was performed using univariate to get an overview of the general characteristics of the respondents as well as the dependent variable. Bivariate analysis with Chi-square test to analyze relationship between independent variables with dependent variable. Multivariate analysis was also to see the most dominant influence variables on malaria incident by using multiple logistic regressions.

## RESULTS

### **Analysis of environmental relations in home genesis**

**Malaria:** Vectors can also get into the house through the roof leak/hole, there and causes malaria when in contact with humans. According to Table 1 that the general conditions of temperature and humidity in the house eligible respondents. Chi-square test results showed no relationship between wall construction ( $p = 0.576$ ), floor construction ( $p = 1.000$ ), ceiling ( $p = 1.000$ ), roof ( $p = 1.000$ ), temperature ( $p = 0.221$ ) and the humidity of the house ( $p = 0.225$ ) with the incidence of malaria in the Kapoposang Island, Pangkep Regency (Table 1).

Ventilation is not installed also affect the incidence of Malaria in humans due to improperly installed ventilation will make mosquito with easily entry into the house. Chi-square test results showed no relationship between the presence of gauze on home ventilation with the incidence of malaria in the Island Kapoposang Village, Pangkep Regency ( $p = 0.049$ ). Test results obtained by the strength of the relationship  $p = 0.318$  meaning that the presence of gauze on the ventilation of the house has a 3.18% contribution to the incidence of malaria (Table 1).

### **Analysis relations of external environmental home with the Malaria incidence:**

Environmental conditions are observed outside the home are estimated to have a positive effect on the incidence of malaria such as the puddles as breeding places and the presence of shrubs as a resting places. The existence of a pool of water close to the house, giving the chance of occurrence of malaria in humans. The results of the bivariate analysis between variables where a puddle with malaria incidence derived values ( $p = 1.000$ ) shows no significant relationship between the puddles with malaria incidence. Similarly, the presence of shrubs (Table 2).

Table 1: Environmental relations in home malaria incidence of Kapoposang Island, Pangkep in 2011

Characteristics	Malaria incidence						p-value
	Positive		Negative		Total		
	n	Percentage	n	Percentage	n	Percentage	
<b>Wall house</b>							
Meeting	2	6.1	31	96.1	33	100	0.576
Not meeting	1	2.3	42	97.7	43	100	
Number	3	3.9	73	96.1	76	100	
<b>Floor house</b>							
Meeting	2	5.0	38	95.0	40	100	1.000
Not meeting	1	2.8	35	97.2	36	100	
Number	3	3.9	73	96.1	76	100	
<b>Net in ventilation</b>							
Exist	2	20.0	8	80.0	10	100	0.049
None	1	1.6	61	98.4	62	100	
Number	3	4.2	69	95.8	72	100	
<b>Ceiling house</b>							
Exist	1	3.7	26	96.3	27	100	1.000
None	2	4.1	47	95.9	49	100	
Number	3	3.9	73	96.1	76	100	
<b>Roof house</b>							
Exist	2	4.4	43	95.6	45	100	1.000
None	1	3.2	30	96.8	31	100	
Number	3	3.9	3	96.1	76	100	
<b>Temperature</b>							
Qualify	2	2.9	68	97.1	70	100	0.221
Not qualify	1	16.7	5	83.3	5	100	
Number	3	3.9	73	96.1	76	100	
<b>Temperature</b>							
Qualify	2	2.9	67	97.1	69	100	0.225
Not qualify	1	14.3	6	85.7	7	100	
Number	3	3.9	73	96.1	76	100	

Table 2: Analysis relations of external environmental home with the malaria incidence In Kapoposang Island, Pangkep regency in 2011

Characteristics	Malaria incidence						p-value
	Positive		Negative		Total		
	n	Percentage	n	Percentage	n	Percentage	
<b>Puddle</b>							
Exist	1	3.1	73	96.9	32	100	0.576
None	2	4	42	95.5	44	100	
Number	3	3.9	73	96.1	76	100	
<b>Bushes</b>							
Meeting	2	3.8	50	96.2	52	100	1.000
Not meeting	1	4.2	23	95.8	24	100	
Number	3	3.9	73	96.1	76	100	

**Analysis of the social environment cultural relations with the incidence of Malaria:** Social and cultural environment conditions also have a role to the incidence of malaria such as habit out at night do not use long-sleeved clothing when out in the evening and the habit of closing doors and windows at night. The habit of going out at night is effective for the current transmission. Analysis of the relationship habits go out at night with the incidence of malaria can be seen in Table 3.

The results of the bivariate analysis between the variable medication adherence with malaria incidence obtained  $p = 0.021$  shows a significant relationship. Test results obtained by the strength of the relationship  $p = 0.166$ , meaning that habit out at night to contribute

1.66% of the incidence of Malaria (Table 3). Using the enclosed clothing/long sleeves when going out at night to minimize human contact with mosquitoes so as to minimize the incidence of Malaria. This can be seen in Table 3.

Data obtained from the 5.8% explained that only 1.6% of patients who have a habit of wearing long sleeves/closed when performing activities outside the home at night, so the results of statistical tests obtained values ( $p = 0.291$ ) indicating no the relationship habit of susing clothes covered with the incidence of malaria. The data obtained also showed no association between the habit of closing doors and windows with malaria incidence ( $p = 1.000$ ) (Table 3).

Table 3: Analysis relations of the social environment cultural relations with the incidence of malaria in Kapoposang Island, Pangkep in 2011

Characteristics	Malaria incidence						p-value
	Positive		Negative		Total		
	n	Percentage	n	Percentage	n	Percentage	
<b>Out at night</b>							
Yes	4	5.7	66	94.3	70	100	0.021
No	1	0.5	183	99.5	184	100	0.166
Number	5	2.0	249	98.0	254	100	
<b>Long dressed</b>							
Yes	1	2.3	42	97.7	43	100	0.291
No	3	11.1	24	88.9	27	100	
Number	4	5.7	68	94.3	70	100	
<b>Close door and window</b>							
Yes	3	4.1	70	95.9	73	100	1.000
No	0	0.0	3	100.0	3	100	
Number	3	3.9	73	96.1	76	100	

Table 4: Relationships being outside home at night, temperature and the presence of Kasa With Malaria incidence Kapoposang Island, Pangkep in 2011

Variabels	B	Wald	Sig.	Exp (B)	95% CI	
					Lower	Upper
Habits go out at night	-1.902	1.986	0.161	0.058	0.004	0.806
Net in ventilation	-2.853	4.493	0.034	0.149	0.10	2.128
Constant	5.036	13.087	0.000	153.804		

**Multivariate analysis:** Based on multivariate analysis were performed using multiple logistic regression, the variable presence of gauze on ventilation are the most influential determinants of Malaria incidence with a value (Wald = 4.493, p = 0.034) (Table 4).

### DISCUSSION

The house with the condition that the wall has a percentage of 6.1% meeting lead to malaria incidence for occupants than homes with walls not meeting the conditions (2.3%) and based on the results of the statistical analysis by chi square test showed that there was no connection between the walls of the house with the incident Malaria in the Kapoposang Island, Pangkep with p = 0.576. This condition can be influenced by various factors such as behavioral toxicity night out which has greater potential for humans to contact with mosquitoes Anophele, so the incidence of malaria is not caused by the condition of the walls of the house that are not meeting but by the behavior of the patient. People in these areas also have a habit of closing the house walls with cloth at night as a form of prevention, thereby reducing the chances of entry of mosquitoes into the house.

A house with no ventilation conditions attached mosquito netting/strimin will allow mosquitoes to enter the house to bite humans and to rest. Home ventilation conditions are not attached wire netting contributes 3.18% incidence of malaria for the residents. This was

reinforced by the results of statistical tests through chi square test showed that there is a relationship between net in ventilation with malaria incidence at the Kapoposang Island, Pangkep with p = 0.049. The test results obtained relationship strength value phi = 0.318, meaning that net in ventilation to contribute 31.8% of the incidence of malaria. Virtually all the houses on this island who install mosquito netting in the vents of his house, there is also a built-in part and there is also attached but there are holes.

This is in line with the existing theory that the presence of malaria incidence caused by the condition of the house that is not attached wire netting, thus simplifying the entry of mosquitoes into the house and a large potential for human contact. The theory also says that there is an obstacle when the wire netting wire netting is in good condition. This is also in line with the senior official research (Depkes, 2006; Budiarto, 2003) in the Village of Mayong Buaran District of Jepara indicates that conditions ventilation improperly installed wire netting has a tendency to the occurrence of Malaria by p = 0.021. In another research also showed no relationship between house ventilation wire netting attached to the incidence of malaria in the Village District of Ketosari Purworejo at  $\alpha = 0.05$  with p = 0.013. Also in accordance with the statement of Sub-Directorate of Malaria that the installation of wire netting on home ventilation will minimize contact with mosquitoes.

Condition of the house with ceilings that do not exist in all or most rooms of the house has a percentage of 4.1 on the incidence of Malaria in inhabitants compared to the ceiling mounted (3.7%). In theory, if housing conditions across the room is not given the ceiling will facilitate the entry of mosquitoes into the house. The ceiling of the upper room divider wall with a roof made of wood, bamboo wicker internit smooth. If there is no ceiling means no holes or gaps between the walls with a roof, so that mosquitoes are more freely into the house. Thus, the

risk of contact between the occupants of the home of *Anopheles* higher than the existing house ceiling (Depkes, 2009, 2003; CDC, 2004). However, the results obtained indicate the existence of a relationship of no ceiling with malaria incidence. This is caused by the condition of the ceiling is only installed on most any room in the house most of the island's population. And the materials used as ceiling average house made of plastic sheeting, thereby reducing the entry of mosquitoes into the house.

The condition can also affect the roof of the house entry of mosquitoes into the house like a perforated roofing/leaking and the house did not have a ceiling as a barrier, so that people who are in the house will be at risk of being bitten by mosquitoes. The data obtained by observation at home respondents there were 45 homes (17.7%) contained the hole/leak in the roof while the results of the statistical analysis by chi square test showed that there was no relationship between the state of the roofing material to the incidence of Malaria on the Kapoposang Island, Pangkep with  $p = 1.000$ .

This is consistent with research conducted by The Work Area Health Center Kenanga District Sungailiat District, Bangka which states there is no significant relationship between the state of the roofing material with malaria incidence with  $p = 0.81$ . Condition of the house with a floor that does not have a meeting at 5% for the percentage malaria incidence on inhabitants. Statistical analysis by Chi-square test showed that there was no connection between the condition of the floor that are not meeting with the incidence of malaria in the Kapoposang Island, Pangkep with  $p = 1.000$ .

A large part of the population in this region is made of the type of wood/board with the kind of conditions that shaped stage. Based on the statistical results it is known that there is no relationship between the condition of the house floor with malaria incidence, this is due to the condition of the house floor sealed by a rubber carpet so that the opportunity for mosquitoes to enter the house is very small. The results showed that there was no relationship with the temperature conditions in the incidence of Malaria with  $p = 0.221$ . These results do not prove the existence of the effect of temperature to the incidence of Malaria, the state conditions relate to the island whose radius is only about 5 km<sup>2</sup>. Thus, the average temperature is not the member's contribution to the development of vector (Arsunan, 2004). The observation and in book suggests changes in air temperature affect the type of malaria vector breeding. Meanwhile, the study site has a relatively constant temperature. This is not in line with the research where there is no statistically significant relationship between temperature with Malaria incidence (Kementerian, 2010; Gunawan, 2000).

Based on univariate analysis that the temperature at the study site ranged from 28-34°C. The results showed that this temperature affect development of the parasite in the mosquito. The optimum temperature for the development of the parasite ranged 20-30°C while the temperature is slightly below the optimum temperature and slightly above the optimum does not allow for the development of the parasite in the mosquito. Temperature affects the development of the parasite in the mosquito's body, the higher the temperature (to some extent) the shorter extrinsic incubation period (sporogoni) and conversely the lower the temperature the longer the extrinsic incubation period. The results showed that the percentage of homes are eligible for a 2.9% growth vector contribute to the incidence of malaria in inhabitants. No statistically significant relationship with the humidity in the house with a value malaria ( $p = 0.255$ ). This condition is related to the temperature conditions on the island who are not members contribution to the development of the vector. This study supports the theory that the low air humidity will shorten the life of the mosquito, though mosquitoes can survive up to a lowest air humidity (60%).

The data show that the incidence of malaria that occurred in the house that there is a puddle of water at a distance of >0.5 km by 2.5%. Based on the results of the bivariate analysis found no relationship between the larvae puddle with malaria incidence with  $p = 1,000$ . This could be due to a very small area of the Kapoposang Island and the Distance to mosquitoes fly  $\pm 2$  km so far and a pool category determined based on the distance the water has no difference because the population has an equal chance of suffering from malaria.

Puddles were found in the island is neglected which is where the potential for breeding (breeding places) *An. subpictus* mosquitoes. The presence of breeding places around the house of course, a risk factor for malaria transmission. Based on research from the Ministry of Health is known that a major factor in the transmission of malaria is a mosquito *An. sundaicus* Kudat coast. Mosquitoes of this type can be found in a pool/pond is not neglected. Flick will gather in the space enclosed by the plants and the moss that gets sunlight. With the puddle is overgrown by grass, moss and form brackish mud-around the house of course, increase the mosquito population around the house. This is certainly very risky increase the chances of contact between mosquitoes as vectors of malaria to people whose homes were around the puddles. Based on the theory *An. sundaicus* are anthropophilic mosquitoes that prefer human blood if the density of mosquitoes around the house high and is supported by the availability of human, it will increase the capacity of the vector that enables people around the puddle to be the greater of contracting Malaria.

The data obtained show that the house contained the bush has a contribution of 3.8% on the incidence of malaria. Statistical analysis by chi square test showed that there was no relationship between the bushes with the incidence of malaria in the Kapoposang Island, Pangkep with  $p = 1.000$ . This is due to overgrown bushes and cannot be penetrated by sunlight close around the house. Judging from the bionomics of *Anopheles* mosquitoes in the area during the Ketosari day that *Anopheles maculatus* and *Anopheles balabacensis* found a break in the bushes. The presence of overgrown bushes blocking the sunlight will penetrate the soil surface, so that the presence of dense bushes resulted into shady and humid environment and this situation is a favored resting places of *Anopheles*, so that the population of mosquitoes around the home increases and causes families live in homes that are in the surrounding bush at risk for malaria transmission occurs compared with the family living in the house no bushes around, it (Harijanto and Carta, 2010; Depkes, 2005).

Based on bivariate analysis, it can be seen there is a relationship between habitual outdoors at night with malaria incidence with  $p = 0.021$ . The test results obtained relationship strength value  $\phi = 0.166$ , meaning that the habit outside the house at night to contribute 16.6% of the incidence of malaria. The habit out at night on the hour *Anopheles* spp. Active bite is very risky for contracting malaria, because mosquitoes are *eksófagik* which is actively looking for blood outside the house at night. This habit will be more at risk if people are used to leave the house without wearing protective clothing such as long-sleeved shirt and long pants. This shows that the habits outside the home at night at risk of contact between healthy people with *Anopheles* spp. who needs blood to meet geotropic cycle. If a mosquito bite in saliva contains sporozoid then the chances of contracting malaria will be even greater. Based on the interview location the research found that the activities of the night outside the house chatting, fishing, sleeping in unconventional mining sites, to stay up and defecate in the back of the house.

Based on bivariate analysis, it can be seen there is no relationship between the habit of using long-sleeved clothing/closed with malaria incidence with  $p = 0.291$ . This is because, they are in the habit of using long-sleeved clothes/covered when outdoors but not uncommon type of fabric used, made of thin fabric types, so it is still possible to penetrate the mosquito's mouth cloth and bite hosts its host. Based on *bivariate* analysis showed that there was no relationship between the habit of closing doors and windows with malaria incidence with  $p = 1.000$ . The habit of closing doors and windows after sunset is a

practice to avoid mosquito *Anopheles* spp. order not to get into the house, so that residents are protected from mosquito bites. Conditions at the study site is the average of the respondents are not accustomed to opening the doors and windows at night, so the mosquitoes that enter the house not through the door or window but passing ventilation or vent that is not attached gauze, hollow walls of the house/not meeting and there is a gap between the top of the wall of the house that is not attached to the roof ceiling.

In addition, the habit of closing doors and windows is one way to reduce the influx of *Anopheles* spp. into the house, in order to reduce contact between humans healthy by vectors (*Anopheles* spp. infected with plasmodium). This is consistent with research conducted by Harmendo (2008) that there is no relationship between the habit of closing doors and windows with malaria incidence ( $p = 0.079$ ). Multivariate analysis performed after bivariate analysis, the variables that have a  $p < 0.05$  were included in multivariate analysis. Variables that have a  $p < 0.05$  there are two variables: the variable presence of gauze on home ventilation as well as the habit of being outdoors at night. Results of multivariate analysis using logistic regression was concluded that the dominant factor affecting the incidence of malaria is the presence of gauze on the home ventilation (Wald = 5.036,  $p = 0.034$ ). This is because the condition of the house that is not attached wire netting will facilitate the entry of mosquitoes into the house and a large potential for human contact.

## CONCLUSION

Based on the research relationship in the residential neighborhood of malaria incidence at the Kapoposang Island, Pangkep. In the home environment factors associated with the incidence of malaria is the presence of gauze on home ventilation. No outside environmental factors associated with the incidence of Malaria. While the socio-cultural environmental factors associated with the incidence of Malaria is the custom in the evening outside the home. The most influential variables on the incidence of malaria is the habit of going out at night (Wald = 5.036,  $p = 0.034$ ).

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