The Human Behavioral and Socioeconomic Determinants of Malaria in Bacan Island, North Maluku, Indonesia

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In eastern Indonesia, malaria control activities mainly depend on residual spraying but the situation is almost unchanged since the past decade. Understanding the socioeconomic and human behavior determinants is needed to implement an effective malaria control in accordance with the local condition and development. Hence we conducted an unmatched case control study. Two hundred samples were recruited from all, 11 villages surrounding the centre in Bacan island, Maluku. For children aged 0 to 15 years old, the association of socioeconomic determinants: crowding and poor type of houses with malaria remained significant in the multivariate analysis. Meanwhile for persons above 15 years old, younger persons and regular going outside at night remained significant in the multivariate analysis. And for persons above 15 years old, a higher proportion of controls (14%) than cases (4%) slept under mosquito net regularly. The Indonesia Family Program should be promoted. There was a better quality of life in small family. For persons above 15 years old, going outside at night should be discouraged because exposed to mosquito bites. The malaria control strategy use of effective personal, regular use of mosquito net could be used as a completion for the present activities. Considering the low malaria knowledge among samples, inhabitants should be enhanced the malaria knowledge on causation, transmission, prevention and to provide proper knowledge on residual spraying. *J Epidemiol*, 2000; 10: 280-289.

INTRODUCTION

Malaria is still a major global health problem in spite of the enormous financial and technological input devoted towards its prevention and control. The WHO reported that in 1994 some 100 countries which mainly tropical were malaria endemic. Indonesia is one of the countries which still faces this problem, especially in areas outside of Java-Bali 3. In outside Java Bali, the situation is almost unchanged. The average PR (Parasite Rate) and SPR (Slide Positivity Rate) increased from 3.15 from 1986 to 4.9 in 1996 and 30.25 to 38.42, respectively during the same period 2. However, in Java Bali the API (Annual Parasite Incidence) decreased from 0.19 in 1986 to 0.09 in 1996. The Malaria control program is divided into 2 areas, Java-Bali and outside Java-Bali. This is because the Java-Bali is densely populated, 58% of the total projected of about 198.205 million people in 1996. The malaria control in Java-Bali consists of some activities, active and passive case detection (ACD and PCD), presumptive and radical treatments, indoor house spraying, larvaciding, or environment management. For areas outside of Java-Bali, the malaria control activities consist of residual spraying and malarometric survey in priority areas; in the remaining islands, it consists of case detection and treatment of clinical malaria cases in health centres and subcentres, and the control of malaria outbreak 3. The objective is to reduce the API to <1 per 1000 population in Java-Bali and for outside Java-Bali is to reduce PR to <4% in priority areas, and the SPR to <20% in the remaining islands.

Malaria transmission is complex. It is determined by the behavior of parasites, vector, and humans 4, being modified by socioeconomic conditions. In past decade, studies in Thailand, Colombia and Africa showed the association of low socioeco-
in 1997. Two villages rejected the spraying at the time the DDT was used. But the centre data showed that clinical malaria was the first leading cause of morbidity in 1993 and 1997, and the second in the years between. The API based on PCD was about 20 per 1000 population (Labuha Health Centre, 1993-1997). The predominant type of confirmed malaria cases is Plasmodium vivax. Plasmodium falciparum composed 10%-20% of the infections. While mixed infection is rare. The major malaria vector in Maluku is Anopheles farauti.

The main occupations in this subdistricts are traditional agriculture, fishing, and trading. The main agricultural products are corn, cassava, green bean. Some of these products are for home consumption. The main plantation products are coconuts, cacao, and clove. While villages close to the seashore deal in fishing. The incomes gradually increased as prices of agriculture and plantation products gradually rose. The main transport going from Bacan or to the island is by water transport. Every day, 2 ships depart from Bacan to Ternate island, the center of North Maluku, and vice versa. There is public transport within the villages surrounding Labuha in the daytime.

Study design

An unmatched case control study design was used. Indonesia national ethical clearance was obtained for the study. With the coordination of heads of the health centre, Bacan subdistrict, and 11 villages, inhabitants were told the purpose of the study and voluntarily asked to participate. They were people who either experienced febrile illness during the past week at the time blood smear was made, or those who did not experience febrile illness in the past one month. The examinations were done at the village head office. Axillary temperature was recorded at the time the blood smear made. Febrile cases were given antipyretic treatment, while the non febrile individuals were provided symptomatic treatments or vitamin.

Each village was visited by the team three times in 3 days. The first day was for blood smear collection and examination. Selected cases and controls were asked to come again on a second or third day for a physical examination and interview. Confirmed malaria cases were given radical treatment. Falciparum malaria was treated by chloroquine 25 mg base per kg over 3 d and followed by primaquine 15 mg 1 d and vivax malaria by chloroquine the same day followed by primaquine over 5 d (Department of Health of Indonesia). Controls were treated based on diagnoses, while the rest were referred to the centre. Blood samples for duffy genotype analysis were collected at 4 weeks after the blood smear were made.

A physical examination and interview were done by the investigator. For children aged 15 years or younger, questionnaires were directed to the mother. Regularity practice of behaviors was determined according to a frequency, with the cut point of 5 times a week. The behavior was classified as irregularly practice if it was used to be done less than 5 times a
week. It was classified as regular practice if used to be done at most 5 times a week. Never use was classified if the behavior was not used to done. Answers were mentioned: a. <5 times in a week, b. 5 times in a week, or c. everyday.

**Laboratory examination**

Thick smear and thin smear were stained with Giemsa. Blood smears were examined by the two health centre's microscopists using x 500 oil immersion. Thick smears were used to determine malaria cases, while thin smears were done to diagnose malaria types. 100 fields of each thick film were examined before declaring negative. Parasitemia was graded to determine severity of the infection. Parasitemia 1+ and 2+ were categorized if one to ten parasites found in every field of thick films, respectively. While parasitemia 3+ and 4+ were categorized if one to ten and ten to a hundred parasites were found in 100 fields of thick films, respectively. Parasites were reexamined and validated by one of the microscopists who had been trained at the Maluku Provincial Health Office.

**Samples selection**

Samples were residents of the respective villages. Individuals who had febrile illness in the past week at the time blood smear was made, and in whom the smear confirmed positive for malaria were selected as cases. They were infected malaria of any types. Those who did not have febrile illness and confirmed smear negative for malaria were selected as controls. Controls were those having an axillary temperature ≤ 37.5°C. Samples were restricted to only one person in a household because household members tended to exhibit the same behavior.

**Statistical methods**

$\chi^2$ test to determine the proportion differences of malaria knowledge. Epi-Info software (CDC 1997) was used to do univariate analysis to determine the variables associated with malaria and to do stratified analysis to determine interaction between risk factors, significant at \( P < 0.05 \). The SPSS software was used to do multivariate analysis including all variables simultaneously for children aged 0 to 15 years old and persons above 15 years old, respectively.

**RESULTS**

**Samples Distribution**

The overall 571 persons participated in the study, composed of 211 persons (37%) who complained had febrile illness and 360 persons (63%) who had not complained any febrile illness. Ninety three persons among those who had febrile illness were confirmed positive malaria by blood smear examination. The disease rate was 93/571 (16%). While among those who did not complain febrile illness, 45 persons were found having parasitemia. The total parasite rate was 138/571 (24%). According to the age, the febrile cases composed of 65 (70%) children aged 0 to 15 years old and 28 (30%) persons above 15 years old. They were 26 (28%) children aged 0 to 5 years old, 39 (42%) children aged 6 to 15 years old, 23 (25%) persons aged 16 to 45 years old, and 5 (5%) persons above 45 years old, respectively. The non febrile malaria composed of 28 (62%) children aged 0 to 15 years old and 17 (37%) persons above 15 years old. They were 12 (27%) children aged 0 to 5 years old, 16 (35%) children aged 6 to 15 years old, 12 persons (27%) aged 16 to 45 years old (27%), and 5 persons (11%) aged above 45 years old, respectively. Ninety febrile malaria were eligible for cases selection. We added more 10 persons from the outpatient ward of the centre who were eligible for cases randomly. The majority of febrile cases (79%) were malaria vivax, the rest (21%) were malaria falciparum. All cases, mostly (78%) had parasitemia 1+ infection. Only 4 cases (4%) were severe malaria or had parasitemia >2. Among vivax cases, the degree of parasitemia 1+, 2+, and 3+ were detected in 65 (82.2%) persons and 12 persons (15.2%), and 2 persons (2.5%), respectively. While among malaria falciparum, the degree of parasitemia 1+, 2+, and 3+ were detected in 13 cases (62%), 6 cases (28%) and 2 cases (10%), respectively. Similar to febrile cases the majority type of non febrile cases, 41 persons (91%) were malaria vivax and only 4 cases (9%) were malaria falciparum. But all had parasitemia 1+.

Among those who did not complain febrile illness and had no parasitemia, 90 persons were recruited and eligible as control selection. An additional 10 individuals were recruited from the first outpatients who were eligible as control selection. Table 1. shows the cases and controls symptoms. Some (13%) who complained the paroxysm malaria symptoms, febrile illness accompanied by either shivering, headache, vomiting, or in combination 38 were detected to have P. falciparum infection.

Variables associated with malaria were presented in Table 2. The average monthly family income among the subjects, Rp. 213,415 (US$≈29.23), was an estimate of money received. Most cases (69%) were children 15 years old or below. The ratio of children 15 years old or below and persons above 15 were 2.2 : 1. The total subjects composed of 92 males (46%) and 108 females (54%). Relatively more malaria cases were male. According to age, males composed of 16 children aged 0-5 years old, 25 children aged 6-15 years old, 8 persons aged 16-45 years old, and 5 persons above 45 years old, respectively. An overall only 24 persons (12%) lived in temporary type of houses, a half of them were children aged 0 to 15 years old. Others, mostly 112 persons (56%) lived in semipermanent houses.

Types of house were classified according to the materials of wall and roof. Houses were classified as temporary type, if both the walls and roof made of light materials. The permanent type was for the walls and roof were made of hard materials.
The permanent type of houses included semipermanent type of houses in which either walls or roof was made of hard materials. Permanent houses which some part remained temporary type was also classified as the semipermanent type. The common temporary houses were wall made of wood with roof of leaves, while the common permanent type of houses were made of brick with corrugated tin roof. The average number of household members among samples, 5.8 members, was the same as the subdistrict data. Crowding was classified as having more than 4 family members in accordance with the Indonesian Family Planning Program promoting 2 children. Crowding was significantly associated with malaria.

Most subjects used to go outside at night. The average time they used to go outside was 2000 h. Approximately a half (55%) of those who used to go outside regularly was to watch television. The rest (45%) were for taking air, talking, or else and for some children were playing. Only 11 persons (5.5%) visited other malario areas the past month before the study. Most subjects used to bum mosquito coil at night. The average time those who used to bum coil was 2000 h. Meanwhile an overall only 30 persons (15%) who owned mosquito nets and all were non insecticide impregnated nets. And just 20 persons (10%) reported slept under the nets. The malaria risk for persons above 15 years old who never use of mosquito net was 4.57 (95% CI: 0.54-38.87) than those who used the net regularly. The association was not significant. No association of burning mosquito coil was found. All subject seek medical treatment if getting sick. About half of them used to visit health centre to seek medication. The rest visited the nurses, private clinic, doctor, or else.

The determination of knowledge for those above 15 years old was supposed that they had some basic knowledge and mature enough to express their own opinion. Table 3. shows about half of the 88 persons above 15 years old, received some information on malaria. Approximately 40% of those who received the information, knew the right cause or transmission of malaria. Some (14%) answered variously that it was caused by dirty environment, dirty water or garbage. Nobody knew how to prevent malaria by preventing mosquito bites. Some wrong answers said a variety of environmental cleaning. The information and overall malaria knowledge were not significantly different to controls, P>0.05.

No interaction was found between the risk factors, P>0.05. Table 4. And 5. show the multianalysis results including all variables.

**DISCUSSION**

Before the discussion, it is worthwhile to point out some biases and limitation, and how they were minimized. The study design was not matched on age aimed to have more capability detecting the association of human behaviors and socioeconomic determinants to malaria. Then we stratified the age for children aged 0 to 15 years old and persons above 15 years old in analyzing the association of the determinants to malaria because different age group tended to have different behavior and socioeconomic risks to malaria. The possible of selection bias because controls above 15 years old were older persons who had higher immunity than cases was minimal because this influences the clinical immunity hence they developed milder malaria symptoms. As more individuals above 45 years old were detected to have non febrile malaria than febrile cases. This study selected only the febrile cases. The possible recall bias of febrile illness was minimal because adults could recall the febrile experiences for the past one week. In children, the febrile illness was also depending on the mother acknowledgements. Mothers were usually aware to the health conditions for their young children, aged 0 to 5 years.
There was a possible recall bias for children aged 6 to 15 years old if they did not complain at the time having febrile and did not develop to a disease. Likely children who developed malaria disease would have a better recall of febrile experience in comparison to those who did not develop the disease which lead to a misclassification of the disease. If the misclassification was non differential, among those with exposure and those with non exposure, then it would toward underestimation of the association. The association of age and malaria had been already rather high.

The questionnaires were given directly to those above 15 years old but asked to mother for children 15 years old or

**Table 2. Odds Ratios associated with malaria.**

| Variables                          | Cases No. (%) | Control No. (%) | cOR (95% CI) | p-value |
|------------------------------------|---------------|-----------------|--------------|---------|
| Age:                              |               |                 |              |         |
| 0 - 5 years                        | 26 (37)       | 10 (23)         | 1.98 (0.79 - 5.29) | NS      |
| > 15 years                         | 43 (63)       | 33 (77)         | 1.0          |         |
| Sex:                              |               |                 |              |         |
| males                             | 41 (59)       | 24 (56)         | 1.16 (0.50 - 2.68) | NS      |
| females                           | 28 (41)       | 19 (44)         | 1.0          |         |
| Number of family members:         |               |                 |              |         |
| crowding                          | 56 (81)       | 27 (63)         | 2.53 (0.98 - 6.64) | 0.03    |
| ≤ 4 persons                       | 13 (19)       | 16 (37)         | 1.0          |         |
| Visit endemic area:               |               |                 |              |         |
| yes                               | 5 (7)         | 0 (0)           | 4.06 (0.47 - 34.91) | NS      |
| no                                | 64 (93)       | 43 (100)        | 1.0          |         |
| Go outside at night:              |               |                 |              |         |
| regular                           | 17 (24)       | 14 (32)         | 0.77 (0.28 - 2.11) | NS      |
| irregular                         | 33 (48)       | 17 (39)         | 1.23 (0.48 - 3.11) | NS      |
| never                             | 19 (28)       | 12 (29)         | 1.0          |         |
| Member sick of malaria:           |               |                 |              |         |
| yes                               | 12 (17)       | 1 (2)           | 8.72 (1.20 - 386.2) | 0.015   |
| no                                | 57 (83)       | 42 (98)         | 1.0          |         |
| House:                            |               |                 |              |         |
| temporary                         | 12 (17)       | 1 (2)           | 8.72 (1.20 - 386.2) | 0.015   |
| semi permanent/permanent          | 57 (83)       | 42 (98)         | 1.0          |         |
| Health facilities:                |               |                 |              |         |
| other services                    | 40 (58)       | 28 (65)         | 1.35 (0.60 - 2.98) | NS      |
| health centre                     | 29 (42)       | 15 (35)         | 1.0          |         |
| Net use:                          |               |                 |              |         |
| never                             | 60 (87)       | 43 (100)        | 0.46 (0.05 - 4.59) | NS      |
| irregular                         | 7 (10)        | 0 (0)           | 2.67 (0.12 - 57.62) | NS      |
| regular                           | 2 (3)         | 0 (0)           | 1.0          |         |
| Coil use:                         |               |                 |              |         |
| never                             | 21 (30)       | 18 (42)         | 0.74 (0.30 - 1.86) | NS      |
| irregular                         | 26 (38)       | 11 (25)         | 1.50 (0.57 - 3.98) | NS      |
| regular                           | 22 (32)       | 14 (33)         | 1.0          |         |
| Income:                           |               |                 |              |         |
| ≤ 200,000                         | 48 (69)       | 30 (70)         | 0.99 (0.39 - 2.44) | NS      |
| > 200,000                         | 21 (31)       | 13 (30)         | 1.0          |         |
| Education:                        |               |                 |              |         |
| no education                      | 27 (39)       | 10 (23)         | 3.15 (0.85 - 11.67) | NS      |
| elementary                        | 36 (52)       | 26 (60)         | 0.62 (0.49 - 5.37) | NS      |
| high school                       | 6 (9)         | 7 (17)          | 1.0          |         |
| Occupation                        |               |                 |              |         |
| preschoolers                      | 31 (45)       | 10 (23)         | 0.37 (0.16 - 0.87) | NS      |
| school children                   | 38 (55)       | 33 (77)         | 1.0          |         |

NS: not significant. cOR: crude Odds Ratio, 95%CI: 95% Confidence Interval
Table 2 Continued.

| Variables                        | Cases No. | Cases (%) | Control No. | Control (%) | cOR       | (95% CI)    | p-value |
|----------------------------------|-----------|-----------|-------------|-------------|-----------|-------------|---------|
| Age:                             |           |           |             |             |           |             |         |
| 15 - 45 years                    | 26        | (84)      | 34          | (59)        | 3.47      | (1.09 - 13.29) | 0.02    |
| > 45 years                       | 5         | (16)      | 23          | (41)        | 1.0       |             |         |
| Sex:                             |           |           |             |             |           |             |         |
| males                            | 13        | (42)      | 14          | (24)        | 2.20      | (0.78 - 6.23) | NS      |
| females                          | 18        | (58)      | 43          | (76)        | 1.0       |             |         |
| Number of family members:        |           |           |             |             |           |             |         |
| ≤ 4 persons                      | 19        | (61)      | 33          | (58)        | 1.15      | (0.43 - 3.13) | NS      |
| Visit endemic area:              |           |           |             |             |           |             |         |
| yes                              | 4         | (13)      | 2           | (3)         | 4.0       | (0.54 - 46.87) | NS      |
| no                               | 27        | (87)      | 55          | (97)        | 1.0       |             |         |
| Go outside at night:             |           |           |             |             |           |             |         |
| regular                          | 9         | (29)      | 2           | (3)         | 16.07     | (2.80 - 92.16) | 0.00    |
| irregular                        | 15        | (49)      | 30          | (52)        | 1.79      | (0.63 - 5.06) | NS      |
| never                            | 7         | (22)      | 25          | (45)        | 1.0       |             |         |
| Member sick of malaria:          |           |           |             |             |           |             |         |
| yes                              | 2         | (7)       | 7           | (13)        | 0.50      | (0.05 - 2.85) | NS      |
| no                               | 29        | (93)      | 50          | (87)        | 1.0       |             |         |
| House:                           |           |           |             |             |           |             |         |
| temporary                        | 3         | (10)      | 8           | (14)        | 0.66      | (0.10 - 3.04) | NS      |
| semi permanent/permanent         | 28        | (90)      | 49          | (86)        | 1.0       |             |         |
| Health facilities:               |           |           |             |             |           |             |         |
| other services                   | 13        | (42)      | 34          | (59)        | 2.05      | (0.54 - 4.98) | NS      |
| health centre                    | 18        | (58)      | 23          | (41)        | 1.0       |             |         |
| Net use:                         |           |           |             |             |           |             |         |
| never                            | 28        | (90)      | 49          | (86)        | 4.57      | (0.54 - 38.47) | NS      |
| irregular                        | 2         | (6)       | 0           | (0)         | 13.50     | (0.88 - 207.63) | NS     |
| regular                          | 1         | (4)       | 8           | (14)        | 1.0       |             |         |
| Coil use:                        |           |           |             |             |           |             |         |
| never                            | 10        | (32)      | 22          | (38)        | 0.86      | (0.29 - 2.58) | NS      |
| irregular                        | 9         | (29)      | 17          | (29)        | 1.21      | (0.27 - 2.36) | NS      |
| regular                          | 12        | (39)      | 18          | (33)        | 1.0       |             |         |
| Income:                          |           |           |             |             |           |             |         |
| ≤ 200,000                        | 20        | (64)      | 42          | (73)        | 0.65      | (0.23 - 1.88) | NS      |
| > 200,000                        | 11        | (36)      | 15          | (27)        | 1.0       |             |         |
| Education:                       |           |           |             |             |           |             |         |
| no education                     | 2         | (6)       | 7           | (12)        | 0.32      | (0.06 - 1.80) | NS      |
| elementary                       | 14        | (46)      | 33          | (59)        | 0.48      | (0.19 - 1.22) | NS      |
| high school                      | 15        | (48)      | 17          | (29)        | 1.0       |             |         |
| Occupation                       |           |           |             |             |           |             |         |
| no work                          | 5         | (16)      | 10          | (17)        | 0.48      | (0.12 - 1.94) | NS      |
| housewives                       | 6         | (19)      | 25          | (43)        | 3.00      | (0.37 - 24.17) | NS     |
| school children                  | 3         | (11)      | 2           | (5)         | 1.70      | (0.49 - 5.95) | NS      |
| workers                          | 17        | (54)      | 20          | (35)        | 1.0       |             |         |

NS: not significant. cOR: crude Odds Ratio, 95% CI: 95% Confidence Interval

The possible systematic difference responses were minimized by mentioning frequencies of the behavior. Furthermore, those who used to practice the behavior at most 5 times a week used to practice everyday and who used to practice the behavior less than 5 times a week only sometimes recall the behaviors.

In Java-Bali most malaria cases are confirmed by smear
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Table 3. Distribution of malaria knowledge.

| Variables                        | Cases | Control | \(X^2\)-test | p-value |
|----------------------------------|-------|---------|---------------|---------|
|                                  | No.   | (%)     | No.           | (%)     |
| Information of malaria no       | 15    | (52)    | 28 (47)       | 0.14    | NS     |
| yes                              | 16    | (48)    | 29 (53)       |         |        |
| Malaria cause: DN or wrong answer | 23    | (74)    | 46 (80)       |         |        |
| mosquito bites                   | 8     | (26)    | 11 (20)       |         |        |
| Malaria transmission: DN by mosquitoes | 26    | (84)    | 47 (82)       |         |        |
| by mosquitoes                    | 5     | (16)    | 10 (18)       | 0.03    | NS     |
| Malaria prevention: DN or wrong answer | 31    | (100)   | 57 (100)      |         |        |
| prevent mosquito bites           | 0     | (0)     | 0 (0)         | 0.00    | NS     |
| DN : do not know                 |       |         |               |         |        |

Table 4. The logistic regression analysis for children aged 0 to 15 years old.

| Variables                        | B     | SE    | Significance | Exp (B) |
|----------------------------------|-------|-------|--------------|---------|
| Age                              | -.1402| .1182 | NS           | .8692   |
| Sex                              | .3851 | .5027 | NS           | 1.4697 |
| Number of family members         | 1.4108| .6058 | .0199        | 4.0992 |
| Visit endemic area               | 8.6223| 38.4558| NS          | 5553.9208 |
| Regular going outside            | .2275 | .7064 | NS           | 1.2555 |
| Irregular going outside          | .2284 | .6174 | NS           | 1.2566 |
| Members sick of malaria          | 2.0881| 1.2181| NS           | 8.0697 |
| Type of houses                   | 2.5189| 1.2391| .0421        | 12.4148 |
| Centre                           | .5509 | .5000 | NS           | 1.7348 |
| Never use of net                 | -6.7300| 63.6946| NS          | .0012  |
| Irregular use of net             | 1.9320| 72.7645| NS          | 6.9034 |
| Never use of coil                | .4088 | .6468 | NS          | 4.5050 |
| Irregular use of coil            | .9256 | .6368 | NS          | 2.5233 |
| Income                           | -.2142| .5378 | NS           | .8072  |
| No education                     | -8.8730| 44.7147| NS          | .0001  |
| Primary school                   | -.4532| .9138 | NS          | .6356  |
| School children                  | -8.6147| 44.6852| NS          | .0002  |
| Constant                         | 14.7472| 77.8376| NS         |        |

NS : Not Significant

examination, hence the malaria indicator is the Annual Parasite Incidence (API). While in outside of Java-Bali because the areas are more spread out and the transportation is not as good as in Java-Bali, not all cases are confirmed by smear examination. Hence the malaria indicator in priority areas used is the Parasite Rate (PR) based on malariometric survey, and in the remaining island is the SPR (Slide Positivity Rate) based on passive case detection. So the clinical malaria diagnose, acute clinical malaria for those having fever and periodical shivering and accompanied by headache or fever with unknown causes and chronic malaria, is still used.

Similar to the Garki study in Sudan [19], the majority of cases were children and male. This could represent the malaria incidence. The overall ratio of male and female among malaria cases was 1.17:1. Sex was not associated with malaria. It more represented activity which introduced to man-vector contact. Likely male had more activities which exposed to mosquito bites than females. Previous studies in Thailand, Colombia, and Africa showed that malaria was endemic in low socioeconomic areas [14-18]. In the low socioeconomic condition where the majority was of low income, the association of family income and malaria was difficult to determine for both children aged 0 to 15 years old and persons above 15 years old. This finding was similar to Koram from Gambia [18]. However, Banguero from Colombia proved the association of low income and malaria [14]. For children aged 0 to 15 years old,
more cases live in poor houses than controls. It has been known that the quality of house affects entry of mosquitoes in dwelling places and the use of measures, such as mosquito screens on doors and windows and the presence of a ceiling reduce the entry of mosquitoes. The positive finding of the association between house quality and malaria was similar to the previous studies. Relatively more malaria cases who were children aged 0 to 15 years old found having family members sick of malaria. The malaria risk for having family members sick of malaria, OR=8.72 (95% CI: 1.20-386.2) was to similar malaria risk for poor houses. The multivariate analysis failed to show the association, between the presence of family members sick of malaria and getting malaria likely because it had been shown by the association of the type of houses.

And for children aged 0 to 15 years old, malaria cases were found more often among those having more than 4 family members, a finding similar to reported by Bungaero from Colombia and by El Samani from Sudan. The majoritly lived in brick houses, crowding was a better predictor for low socioeconomic conditions.

For persons above 15 years old, no association of socioeconomic determinants and malaria was detected. Younger persons and regular going outside at night remained significant in multivariate analysis for those persons above 15 years old. regular going outside at night. The regular going outside at night was at a higher chance of mosquito bite than going outside irregularly. They used to go outside at night for leisure because in tropics, it is also warm at night. It was similar to the study by Fungladda from Thailand and Bungaero from Colombia which reported the association of forestry activities and malaria. More cases, either for children aged 0 to 15 years old and persons above 15 years old, had a journey to other malarious areas in the past month of the study. Although some variety of malaria parasites could encountered in the same locality. A journey to other malarious areas may have encountered a new strain of parasites which was not recognized by the persons immunity hence more likely to develop malaria. In contrast to previously reported by Koram from Gambia and Ng’andu from Zambia, visit to other malarious areas was not significantly associated with malaria in the univariate analysis. Possibly an overall just a few, 11 persons (5.5%) had the journey to other malarious areas. All subjects used to seek medical treatment if getting seek. No association between the behavior to seek medication to the centre and malaria was detected. The accessibility to health centre which likely caused the severity malaria were not associated to mild malaria.

Occupation was not significantly associated with malaria. The daily activities likely was not introduce to mosquito bites. Previous studies by Fungladda from Thailand and Bungaero from Colombia reported the association of education and malaria. Similar to the study by Koram from Gambia whom did not detect any association of guardian level and malaria because the overall education in the community was low, in this study the association of education or occupation

Table 5. The logistic regression analysis for persons above 15 years old.

| Variables                  | B     | SE   | Sign | Exp (B) |
|----------------------------|-------|------|------|---------|
| Age                        | -0.0806 | 0.0354 | 0.0238 | 0.9226   |
| Sex                        | 1.4835 | 0.8628 | NS   | 4.4086   |
| Number of family members   | 0.9055 | 0.7476 | NS   | 2.4730   |
| Visit endemic area         | 1.5258 | 1.3946 | NS   | 4.5986   |
| Regular going outside      | 3.3228 | 1.2906 | 0.0100 | 27.7376  |
| Irregular going outside    | 0.1401 | 0.8366 | NS   | 1.1503   |
| Members sick of malaria    | 0.0571 | 1.2767 | NS   | 1.0588   |
| Type of houses             | 0.2584 | 1.0213 | NS   | 1.2948   |
| Centre                     | 1.959  | 0.6737 | NS   | 1.2164   |
| Never use of net           | 2.3779 | 1.5568 | NS   | 10.7821  |
| Irregular use of net       | 10.6680 | 35.1473 | NS   | 42999.840 |
| Never use of coil          | -0.2190 | 0.8202 | NS   | 0.8033   |
| Irregular use of coil      | -0.6405 | 0.8648 | NS   | 0.5271   |
| Income                     | 0.1188 | 0.7741 | NS   | 1.1261   |
| No education               | -0.7710 | 1.6911 | NS   | 0.4625   |
| Primary school             | -0.5573 | 0.7984 | NS   | 0.5728   |
| Housewives                 | -2.7262 | 1.5906 | NS   | 0.0655   |
| School children            | -4.2351 | 2.3817 | NS   | 0.0145   |
| Workers                    | -2.6772 | 1.4441 | NS   | 0.0688   |
| Constant                   | 1.3452 | 3.0146 | NS   |          |

NS : Not Significant
was difficult to assess because mostly were elementary school children. In accordance with Koram, determining the malaria knowledge among adults was better. Relatively higher, 50% adults received some information on malaria. And about 40% of them knew the right cause and transmission of malaria. Some mentioned the prevention of malaria by environment cleaning in accordance with the wrong answer cause of malaria by garbage. But none knew the prevention by preventing mosquito bites. No significant different of the information and the overall malaria knowledge among cases and controls. The low malaria knowledge on prevention seemed to influence the preference of personal practices. Subjects more common used to burn mosquito coil, while only some among few individuals who owned mosquito nets used the nets. No association mosquito coil use and malaria was found for children aged 0 to 15 years old and persons above 15 years old. Coils decreased An. farauti bites in relatively near rooms. They were likely not stay in the rooms where the coils were burning, as the average time they used to burn coil and go outside at night was the same. Maybe coil was used for repelling mosquito nuisance. More controls used regular mosquito net than malaria cases. The malaria risk for regular net use was OR=4.57 (95% CI : 0.54-38.47) for persons above 15 years old. In contrast to the study by Funglada from Thailand and Bungaero from Colombia, the univariate analysis was not able to show the significant association between regular net use and malaria. Probably because only a few individuals used the net. The Indonesia Family Program should be promoted. There is a better quality of life in small family. Activities which introduce to mosquito bites should be discouraged. Because the widespread areas in outside of Java-Bali, the malaria control activities could applied the human behavior determinant: use of effective personal practice, especially for persons above 15 years old. Genton showed that untreated net reduced malaria infection. Besides effective, it is cheap. The present bed model does not provide net hanging influence the net use seemed to have some influence. But in Gambia there were some preferences caused individuals to use the nets such as protecting from insects, barrier against dust and droppings from roof, or protect from cold in the early morning. Inhabitants should be enhanced the malaria knowledge on the causation, transmission and prevention of malaria. It is also important to provide the proper knowledge on residual spraying for all villages. Furthermore, the centre equipped with laboratory facilities should promote confirmed malaria diagnose. Although the falciparum malaria developed the paroxysm symptoms of malaria, the clinical symptoms was difficult to diagnosis malaria. As most cases only complained febrile illness.

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