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Field Epidemiology Training Program, Bureau of Epidemiology
Department of Disease Control, Ministry of Public Health, Thailand
Tel: +6625901734-5, Fax: +6625918581, Email: osireditor@osirjournal.net, http://www.osirjournal.net

Risk Factors of Lymphatic Filariasis in West Sumatera Province, Indonesia, 2010

Jontari Hutagalung[1,*], Hari K[1,2], Supargiyono[3], Hamim S[4]

1 Field Epidemiology Training Program, Gadjah Mada University, Indonesia

2 Health System Information, Gadjah Mada University, Indonesia

3 Parasitology Laboratory, Gadjah Mada University, Indonesia

4 Molecular Biology Laboratory, Gadjah Mada University, Indonesia

*Corresponding author, email address: jontarihutagalung@yahoo.com

Abstract

Lymphatic filariasis (LF) has long been endemic in Indonesia. Agam District is an endemic area for LF in West Sumatera. We conducted a case-control study and performed spatial analysis to assess distribution and risk factors for filariasis in affected community. Data were collected by direct interview, household observation and geo-coordinate capture of their houses by global positioning system. Risk factors for filariasis were estimated by bivariate and multivariate analysis. Spatial analyses by GeoDa (spatial significant), SaTScan (clustering poisson model) and Excel Discalc (distance) were used as tools for mapping. Total 91 cases, including 51 elephantiasis, were identified. Most cases (56%) were from Tiku Sub-district, with median age 45 years (range 10-80 years). Living near a palm plantation (<100 meter) (p-value=0.002, OR (95%CI) = 11.5 (2.56-45.89)), and not using ventilation net (p-value = 0.023, OR (95%CI) = 9.0 (1.21-26.42)), or bed net (p-value = 0.002, OR (95%CI) = 2.1 (2.45-2.79)) were strongly associated with LF. Spatial analysis found significant clustering in one area with 15 cases (16.5%) at elevation between 400-700 meters above the sea level.

Keywords: lymphatic filariasis, risk factors, GIS, clustering

Introduction

Lymphatic filariasis (LF) is a parasitic worm disease caused by *Wuchereria bancrofti*, *Brugia malayi* or *Brugia timori*. It is transmitted by mosquitoes, and causes disability and adversely impacts to economy of developing countries where it is endemic. Filariasis is the second most common vector-borne parasitic diseases after malaria and affects over 120 million people in 73 countries throughout the tropics and sub-tropics of Asia, Africa, the Western Pacific, part of the Caribbean and South America[1].

Most infected people are asymptomatic and never develop clinical symptoms, despite the fact that the parasite damages the lymph system. A small percentage will develop lymphedema.[1,2] Approximately 65% of those infected people live in Southeast Asia and 30% in Africa. About 40 million are disfigured and incapacitated by the disease, which comprised of 25 million men with genital disease and over 15 million with lymphedema. LF is a leading cause of disability and also creates social stigma for both individual and family from disfiguring limbs and genitalia.[3]

LF is a major health problem in many parts of Indonesia where all three species (*W. bancrofti*, *B. malayi* and *B. timori*) are prevalent and 22 competent vectors have been identified. Twenty six out of 32 provinces and 85 out of 444 districts, which comprised of approximately 150 million people, were found to be endemic for LF. During 2005-2009, 11,914 people were affected with elephantiasis and 6 million had LF, with microfilaria (Mf) rates of 1-39%.[3,4,5] LF was tested by microscopic thick blood smear stained with Giemsa, using venous blood collected between 9 pm and midnight. Mf prevalence rate was calculated as dividing number of person tested Mf positive by number of person tested.[6]

Agam District has an area of 2,232.3 km^2 and population of 439,611, with 16 sub-districts and 22 public health centers. It has been LF endemic region in West Sumatera Province since 2006, with 54 cases and 18.0% Mf rate in 2010 (Table 1).

These cases were reported from five sub-districts: Tanjung Raya, Lubuk Basung, IV Nagari, Palembayan and Tiku. Although filariasis could be identified by microscopy, laboratories in West

Sumatera did not routinely test for LF, which is very essential for understanding overall burden of LF disease and estimation of Mf rate.

Table 1. Number of lymphatic filariasis cases and microfilaria (Mf) rate in Agam District, West Sumatera, Indonesia, 2006-2010

Year	Number of prevalence case	Number of incidence case	Mf rate (%)
2006	37	Not available	12.3
2007	44	7	14.7
2008	48	4	16.0
2009	51	3	17.0
2010	54	3	18.0

In 2008, Agam District has initiated LF elimination program based on mass drug administration (MDA) with single dose of diethyl carbamazine (DEC) and albendazole according to World Health Organization (WHO) guidelines.[1] However, it was stopped in 2010 due to lack of funds.[6,7] Unfortunately, relatively little information was available to assess impact of the MDA on LF prevalence and incidence in Agam even though Mf rates have been increasing since 2004.[7]

Spatial analysis using geographic information system (GIS) has become an important tool for surveillance. Control of LF requires good monitoring and mapping of cases to guide decision making for LF treatment programs. The most important is that GIS can detect burden of LF early to improve LF control strategies in the region by identification of risk areas and provide early diagnosis and prevention by measuring risk factors.[8,9]

We also conducted a community study to measure risk factors for LF, actual prevalence, distribution and clustering by GIS. The goal was to generate useful data for the responsible persons to plan and implement national LF elimination program in Indonesia and other endemic countries as well.

Methods

The study was performed in five sub-districts (Tanjung Raya, Lubuk Basung, IV Nagari, Palembayan and Tiku) in Agam District of West Sumatera Province, Indonesia. These sub-districts are located approximately 90-110 km southwest of the provincial capital of Agam with 122,378 population. All five sub-districts were in endemic area and were selected with inclusion criteria of Mf rate more than 1%. We conducted active case finding with volunteer health practitioners from each sub-district to find suspect LF cases. Our field teams comprised of trained midwives, laboratory staff and nurses. We also met with community leaders and held outdoors activities to inform local people about significance of LF and importance of blood test for monitoring LF disease.

We conducted the study with three methodologies: case-control study to determine risk factors using odds ratio (OR), spatial analysis to analyze distribution and clustering of LF cases, and survey by standard diagnostic method of thick blood smear with 5% Giemsa stain[2] to identify villages with asymptomatic cases. Children under two years, pregnant women and people with severe chronic illness were excluded from the study.[10,11] Total 182 persons were included in the study, with 91 cases and 91 controls.

A confirmed LF case was defined as a person who lived in one of the five sub-districts and was confirmed to have LF positive by microscopic thick blood smear. Active case finding was conducted by survey of villagers in sub-districts. Total 185 villagers were surveyed and blood samples were collected from 182 villagers. Total 1-3 µl of finger spot blood was collected between 9 pm and midnight.[11] Laboratory confirmation was performed at provincial laboratories in West Sumatera. Clinical symptoms were assessed and households were spotted using global positioning system (GPS).

Controls were selected from people who lived in same villages with cases and had no LF by microscopic test. Cases and controls were matched for sex, age (range five years) and residency (less than 50 meter to the case's house).[13] We used simple random sampling to select 91 matched controls from five sub-districts.

Cases and controls were interviewed at their homes, and information on signs, symptoms and risk factors were collected by a standardized questionnaire. Home visit also allowed observation of participants' living environment and collecting of geo-coordinate spot using GPS.

To identify risk factors for LF, chi-square and logistic regression were used in bivariate and multivariate analyses. We conducted multivariate analysis (multiple logistic regression) to calculate the most association between risk factors and LF prevalence, and included all variables with p-value of less than 0.25 from the bivariate analysis. All the variables in the model had a normal distribution. The regression used an enter approach. Significant level was p-value less than 0.05.

For spatial analysis, we used GeoDa and SatScan to identify clustering of LF cases, and Excel Discalc to

measure distance to health centers. SatScan approach (Bernoulli models) was used for analysis.[14] Ethical clearance of this study was reviewed and approved by institutional review boards in Faculty of Medicine, Gadjah Mada University, Yogyakarta, Indonesia.

Results

Through active case finding, we identified 91 cases and 91 matched controls in five sub-districts where 51 out of 91 cases had elephantiasis. Most cases were males (63.7%), with median age 45 years (range 10-80 years). Tiku Sub-district had 51 cases (56.0%), with prevalence of 2.0 per 1,000 population (total 26,037 population) and Lubuk Basung had 33 cases (36.3%), with prevalence of 0.6 per 1,000 population (total 59,470 population).

IV Nagari Sub-district had five cases (5.5%) while Palembayan and Tanjung Raya had only one case each (1.1%). The study revealed that 50.5% of cases and 42.9% of controls had no education background (Table 2). Although majority of them did not use bed net (97.8% of cases, 90.1% of controls) or ventilation net (86.8% of cases, 97.8% of controls), 79.1% of cases and 78.0% of controls used repellent (Table 3).

Table 2. Demographic characteristics of lymphatic filariasis cases and controls in 5 sub-districts of Agam District, West Sumatera, Indonesia, 2010 (n=182)

Characteristic	Case (n=91)		Control (n=91)	
	Number	Percent	Number	Percent
Gender				
Male	58	63.7	58	63.7
Female	33	36.3	33	36.3
Age (year)				
10-19	16	17.6	16	17.6
20-29	14	15.4	14	15.4
30-39	10	11.0	10	11.0
40-49	8	8.8	8	8.8
50-59	12	13.2	12	13.2
60-69	14	15.4	14	15.4
70-79	11	12.1	11	12.1
>80	6	6.6	6	6.6
Sub-district				
Tiku	51	56.0	51	56.0
Lubuk Basung	33	36.3	33	36.3
IV Nagari	5	5.5	5	5.5
Tanjung Raya	1	1.1	1	1.1
Palembayan	1	1.1	1	1.1
Education				
No education	46	50.5	39	42.9
Low	27	29.7	28	30.8
Middle	18	19.8	24	26.4
High	0	0	0	0

Table 3. Behavioral characteristics of lymphatic filariasis cases and controls in 5 sub-districts of Agam District, West Sumatera, Indonesia, 2010 (n=182)

Characteristic	Case (n=91)		Control (n=91)	
	Number	Percent	Number	Percent
Using bed net				
Yes	2	2.2	9	9.9
No	89	97.8	82	90.1
Using ventilation net				
Yes	12	13.2	2	2.2
No	79	86.8	89	97.8
Using repellent				
Yes	72	79.1	71	78.0
No	19	20.9	20	22.0
Had animal as reservoir				
Yes	64	70.3	48	52.7
No	27	29.7	43	47.3

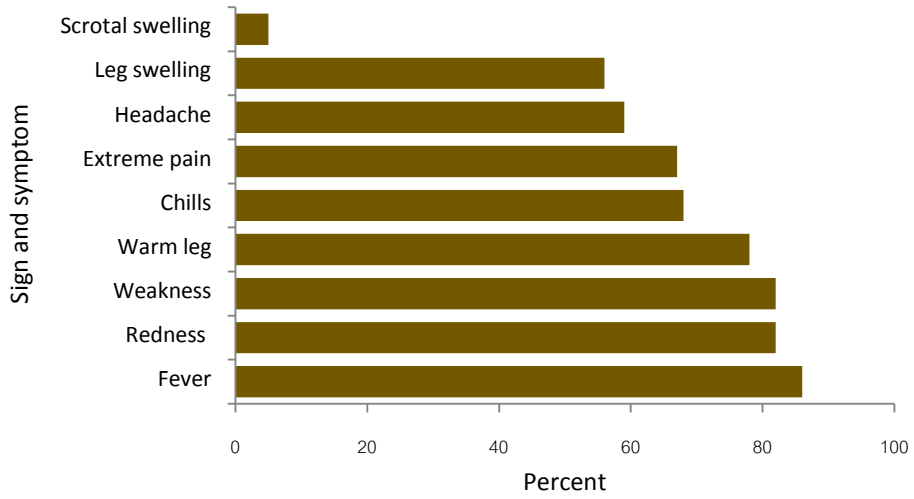

Figure 1. Signs and symptoms of lymphatic filariasis cases in5 sub-districts of Agam District, West Sumatera, Indonesia, 2010 (n=91)

The most common symptom of LF cases included fever (94.5%), followed by redness (90.0%), weakness (90.0%), warm leg (85.7%) and leg swelling (61.5%) (Figure 1).

Results of bivariate analysis showed that there were eight risk factors significantly associated with LF, including low level of knowledge, not using bed net, not using ventilation net, having a reservoir animal (cows, dog or monkey) based on observation, and living near swamp less than 100 meters, river, rice field and a palm plantation. Other factors were not significantly associated with LF (Table 4). Living near a palm plantation had the highest OR (Table 5) and thus, become the strongest risk factor for LF prevalence in Agam District.

Table 4. Bivariate analysis on risk factors of lymphatic filariasis cases in 5 sub-districts of Agam District, West Sumatera, Indonesia, 2010 (n=182)

Risk factor	P-value	Odds Ratio	95% CI
Low education level	0.312	0.7	0.24 - 2.24
Low income	0.441	0.9	0.49 - 1.67
Low level of knowledge	0.001	2.9	1.56 - 5.27
Not using bed net	0.002	1.7	1.24 - 2.35
Not using ventilation net	0.005	6.8	1.47 - 31.13
Not using repellent	0.500	1.7	0.53 - 2.17
Had an animal	0.010	2.1	1.15 - 3.91
Had activity at night	0.226	1.3	0.73 - 2.37
Living near swamp	0.001	6.2	1.75 - 22.30
Living near river	0.024	2.0	1.04 - 3.50
Living near rice field	0.018	2.0	1.08 - 3.53
Living near a palm plantation	<0.001	15.9	3.64 - 69.80

In addition, we found strong spatial correlation in one cluster of 15 cases (16.5%) at coordinate (00.185790S, 099.775720E). The farthest distance of case to public health centre was 840 meters, which was in Tiku Sub-district.

Table 5. Final multivariate analysis (logistic regression) on risk factors of lymphatic filariasis cases in 5 sub-districts of Agam District, West Sumatera, Indonesia, 2010 (n=182)

Risk factor	P-value	Odds Ratio	95% CI
Not using bed net	0.002	2.1	2.45 - 2.79
Not using ventilation net	0.023	9.0	1.21 - 26.42
Living near swamp	0.077	2.8	0.92 - 16.54
Living near a palm plantation	0.002	11.5	2.56 - 45.89

Discussion

This was the largest number of LF cases reported in West Sumatera Province from 2006 to 2010. Males were more exposed to LF than females. Level of knowledge, with median 45 out of 100, was associated with LF because people were lack of information about infection, drug administration and location of health facilities. Majority of cases did not know about drugs for LF and lived in rural areas which were far away from health facilities, thereby causing low compliance of drugs. Thus, giving health education to communities about benefits of LF drugs that kill the worms was necessary and global campaign to eliminate LF should be conducted.[15]

Our results showed that living near a palm plantation and not using bed net or ventilation net were significantly associated with LF. These could

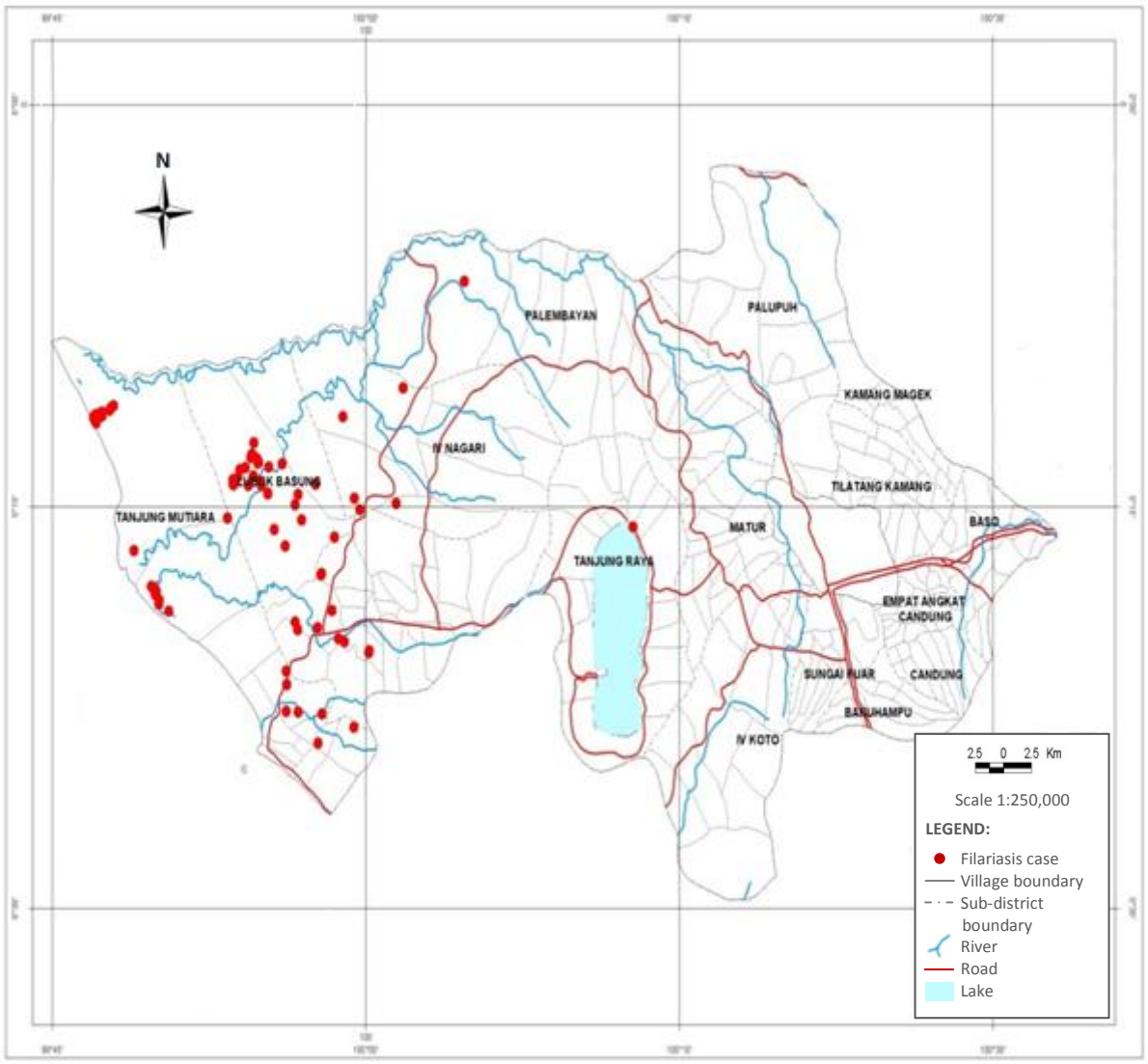

Figure 2. Spatial analysis on lymphatic filariasis cases in Agam District by mapping with GPS, West Sumatera, Indonesia, 2010

also relate to biological factors such as presence of mosquito breeding sites and frequent contact with mosquitoes during outdoor activities. Farmers and workers in palm plantation not only spend most of their time outside, but also work during night time which is the biting time of mosquitoes. The ways to prevent LF are to avoid bitten by mosquitoes especially at night, sleep under mosquito net such as long-lasting pretreated nets, wear long sleeves and trousers, and use mosquito repellent.[16] Another approach of prevention is implementing MDA by giving medicines that kill microscopic worms to all communities in order to reduce microfilariae in blood. Surprisingly, we also found five LF cases with scrotal swelling which indicated that more than one type of parasite causing LF were circulating in Agam District.[17]

Study on spatial analysis found that Tiku Sub-district had the highest number of cases (56.0%) and most of them lived in rural villages with environmental risk factors such as vector breeding sites. In addition, this study found significant clustering in one area with 15 cases (16.5%) at elevation between 400-700 meters above the sea level, which implied that the study area was highly endemic with LF. Spatial analysis is becoming important for epidemiology as control of LF requires good monitoring by good mapping. These mapping results provided tools to implement MDA which was going to conduct in 2012-2015 and provide basis information for future monitoring and evaluation of local LF elimination programs. In addition, the results could be helpful to early detect LF burden, and improve effectiveness and safety of LF control strategies in Agam Region.

Limitations

This study could not determine vector density, impact of vectors ecologies on local transmission and nature of parasite vector. Elimination of vector would be a cost effective measure to interrupt LF transmission in

Agam District. Since lymphedema may develop many years after infection and MDA had been implemented in Agam District, laboratory tests were most likely to be negative with the patients who had MDA before. Thus, more specific laboratory tests such as serologic antifilarial (IgG4) might be necessary.

Conclusions and Recommendations

Although the LF elimination program in Agam District has been ongoing for five years, it had not succeeded in reducing of LF prevalence. Living near a palm plantation which was the most significant factor was related to mosquitoes breeding places as vector also plays a role in LF transmission. More health education and awareness raising campaigns could improve drug compliance. More bed nets should be provided to stop the transmission. MDA should be implemented in the LF elimination program. The best ways to prevent LF are to avoid bitten by mosquitoes between dusk and dawn, and eliminate mosquitoes in the area.

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