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Bancroftian Filariasis Transmission Parameters after the Fifth Year of Filiariasis Mass Drug Administration in Pekalongan City

Parameter Transmisi Filariasis Bancrofti Pasca Tahun Kelima Pengobatan Massal Filariasis di Kota Pekalongan

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Abstract

This study aimed to measure parasitology parameters (microfilariae rate, microfilariae density), immunology parameter (antigen prevalence), and entomology parameters (infection rate and infective rate) after the fifth year of mass drug administration at Pabean Village, Pekalongan City. This study was an observational study with cross-sectional approach that was conducted in July to August 2015 in Pabean Subdistrict, Pekalongan City. The microfilaria rate and microfilariae density were determined by finger blood survey of 313 respondents. Meanwhile, the antigen prevalence was determined by calculating the circulating antigen using the immunochromatographic test (ICT) *Wuchereria bancrofti* method. Finally, the infective rate and infection rate were both explicitly defined by detecting filarial worm larvae in the mosquitoes of man biting mosquitos collection. The results showed that the mf rate was 0.32% with average microfilariae density of 167/mL blood, the antigen prevalence of the calculation was 0%, the infection rate was 0.06% and the infective rate was 0%. In conclusion, after the fifth year of mass treatment in Pabean Area, Pekalongan City, the area is no longer included into the filariasis-endemic areas and the transmission parameters has no potential in causing the filariasis spreading.

Keywords: Filariasis, mass treatment, transmission parameter

Abstrak

Penelitian ini bertujuan untuk mengukur parameter parasitologi (*microfilaria rate*, kepadatan mikrofilaria), parameter imunologi (*antigen prevalence*) dan parameter entomologi (*infection rate* dan *infective rate*) pada tahun kelima pelaksanaan *mass drug administration* di Kelurahan Pabean Kota Pekalongan. Penelitian ini merupakan penelitian observasional dengan pendekatan potong lintang yang dilaksanakan pada bulan Juli sampai dengan Agustus 2015 di Kelurahan Pabean Kota Pekalongan. *Microfilaria rate* dan kepadatan mikrofilaria ditentukan dengan pemeriksaan darah jari pada 313 responden. *Antigen prevalence* ditentukan dengan mengukur antigen beredar menggunakan metode immunochromatographic test (ICT) *Wuchereria bancrofti*. *Incective rate* dan *infection rate* diukur dengan cara menemukan larva cacing filaria pada nyamuk hasil penangkapan nyamuk umpan orang. Hasil penelitian menunjukkan *mf rate* sebesar 0,32% dengan kepadatan mikrofilaria 167/mL darah, antigen prevalence pada hasil 0%, *infection rate* sebesar 0,06% dan infective rate sebesar 0%. Dapat disimpulkan bahwa pasca tahun kelima pengobatan massal filariasis di Kelurahan Pabean, Kota Pekalongan tidak lagi menjadi wilayah endemis filariasis dan parameter-parameter transmisi tidak berpotensi menimbulkan penularan.

Kata kunci: Filariasis, pengobatan massal, parameter transmisi

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Introduction

Since Pekalongan City was declared as filariasis-endemic area in 2010, from 2011 to 2015 the government begins to provide filariasis treatment to their population starting from the age of 2 years old (with several fixed criteria) known as Mass Drug Prophylaxis Administration against Filariasis (*Pemberian Obat Massal Pencegahan* (POMP) Filariasis) with Dietylcarmazine citrate (DEC 100 mg tablet), albendazole (400 mg tablet) and paracetamol (500 mg tablet).[1]

Integrated health care cadres dispense the drugs without direct supervision of ingestion drugs in front of officer. Although having counseling about drugs benefit and side effects, drug administration coverage rates never meet 100%, including the area of Dukuh Primary Health Care, Pabean Village. Drug administration coverage rates in 2011, 2012, and 2013 are 89.5%, 89.6%, and 95.1%, respectively. While in Pabean village itself in 2014 and 2015, drugs administration coverage rates are 86.8% and 747%.[1]

Pekalongan City whose areas mostly are lowlands and beaches is area of filariasis-endemic in all regions. As a filariasis-endemic area, Pekalongan City has been conducting a filariasis mass treatment since 2011 corresponded to the World Health Organization (WHO) provisions. WHO has set out a global agreement (The Global Goal of Elimination of Lymphatic Filariasis as a Public Health Problem by the year 2020). The elimination program is carried out through annual mass treatments of DEC and Albendazole for 5 to 10 years in the endemic areas which is known as Distribution of Mass Drug Prevention of Filariasis.[2]

Filariasis Mass Drug Administration aims to eliminate filariasis by omitting the transmission sources, people whose blood contained microfilariae. The existence of microfilariae in the patients' blood is the transmission source to other individuals surrounding and to filariasis vector mosquitoes. The spreading or the transmission of filariasis can be actually either reduced or inhibited by eliminating microfilariae reservoir through the mass treatment and decreasing the contact between human and the vectors. The mass treatment of the filariasis elimination program in Indonesia intends to cut down the filariasis transmission by decreasing the mf rate to less than 1% and the average density of microfilariae. The mass treatment affects on the falling of the infection rate and the infective rate in the vectors population as well.[3]

Parasitology parameters which comprise the mf rate and the average density of microfilariae, entomology parameters which contains infection rate and infective rate, also the antigen prevalence which is the immunology parameter are the transmission parameters of filariasis.[3] In-depth information about these parameters are considered very important as for finding out the intensity of filarial infection in a certain population. The prevalence and density of microfilariae, together with drug coverage, are currently the best indicators for measuring the impact of filariasis mass drug administration.[4] This study aimed to calculate the parasitology parameters that contain the mf rate and the microfilariae density, entomology parameters which consist of the infection rate and infective rate, as well as the immunology parameter that is the antigen prevalence. Beside those transmission parameters, this study conducted a filarial drug/medicine medication adherence survey and self-protection efforts from mosquito bites as well. The filarial medication adherence is one of the significant factors to determine the success of filariasis elimination in many countries. The self-protection efforts from mosquito bites also holds a point to be carefully taken into account as for filariasis is transmitted by vector mosquitoes through dozens of times bites of infective mosquitoes. The Pabean area was chosen as the study site on the grounds that it is geographically the lowest land in Pekalongan City and had the mf rate more than 1% since 2010 until 2014. In addition, patients of bancrofti filariasis chronic were commonly found here, and there were vector mosquitoess *Culex quinquefasciatus* as well as a numerous amount of mosquito brood sites.

Method

This study was an observational study with cross sectional approach that was conducted in July to August 2015 in Pabean Area of Pekalongan City. Tools and materials used in this study consisted of those tools and materials to determine parasitology parameters, entomology parameters, and immunology parameter. As for defining the parasitology parameters, the tools and materials employed were glass objects, lancet blood, toilet rolls, alcohol swabs, gloves, box of glass objects, Giemsa stock solution, measuring cups, survey forms, pipette, pencils, and bottled water to make Giemsa solution. Meanwhile, the tools and materials to identify the entomology parameters (collecting adult mosquitoes that feed on human and mosquito surgery) were aspirator, paper cups, a flashlight, mosquito surgical needles, a microscope, petri dishes. Lastly, for calculating the immunology parameter, a set of examination kits of immunochromatography test (ICT) *Wuchereria bancrofti* was used.[3]

The microfilariae rate (mf rate) was calculated by dividing the number of people whose blood positive containing microfilariae with the number of blood tested clots multiplied by one hundred percent. The population was the residents aged 2 years old or older. The number of samples to determine the mf rate were 313 people. The sampling technique used was by collecting survey target population who lived around filariasis clinical cases.

Identification of microfilariae in the blood was through survey technique of finger prick test. The sampling collection was carried out in Pabean area at around filariasis clinical cases at night from 9.00 p.m. until 01.00 a.m.[3]

The technique of blood test to determine microfilariae rate with survey was started by cleaning the second or third finger's tip using alcohol 70%. After drying, the finger was vertically plugged in line with the track of finger lines using a lancet so that its blood trickled out. The first blood droplets that came out were wiped up with dry cotton pads and the next subsequent blood droplets were dropped as much as 6 drops or about 60 mL into a clean glass object. Those blood droplets were dilated using one end of the glass object to form oval thick blood clots. The blood clots were dried for one night at room temperature for those were further stained with Giemsa paint.

Average density of microfilariae was the average number of microfilariae per milliliter (mL) of blood which was calculated by summing all the microfilariae which were found in all the clots divided by the number of people with positive filariasis blood multiplied by the multiplier. In this study, the multiplier factor was 16.7.

Antigen examination aimed to detect circulating *Wucheria bancrofti* antigen in the blood, to assess whether filariasis transmission is present in this region. Antigen testing from 100 mL of finger-stick blood collected in EDTA coated microtainer tubes. Subject assessed were 73 children aged 6-7 years old using ICT on 1 mL vein blood sample. Antigen prevalence identification was conducted to all children in aged 6 to 7 years old to rate whether there were still active filariasis transmission or new transmission occurrence after the fifth year of mass filariasis treatment to evaluate the success of the filariasis elimination.

The infective rate and infection rate were determined by collecting mosquitoes that feed on human (man biting collection) using aspirator which began at 6.00 p.m. to 6.00 a.m., to three chosen houses (located at around the patients with filariasis chronic). Three persons were assigned to do outdoor collection (the mosquitoes were collected from outside of the house), indoor collection (the collection of mosquitoes inside the house), and resting collection both from the walls inside and outside of the house. Collecting time per hour were 40 minutes for collection through man biting collection and 10 minutes through walls resting collection, and the last 10 minutes was used to replace the mosquito container and to give a break-time for the collectors as well. The mosquito dissection were applied to all female *Culex quinquefasciatus* mosquitoes that were successfully collected at every hour. These dissection were targeted on finding and identifying *Wuchereria bancrofti* larvae (L1, L2, and L3). On the other hand, the infective rate was calculated by dividing the infective larvae rate (L3) by the total number of all *Culex quinquefasciatus* mosquitoes dissected and then multiplied it by 100%.

Filarial medication adherence in the mass filariasis drug program and the efforts to avoid mosquito bites were carefully carried out through interview technique which was done with the help of five trained health cadres.[2]

Results

Table 1 shows that most of the respondents were at the age of 35-42 years old category, they were 69 respondents (22.3%); 166 respondents (53.5%) were male; elementary school graduate/equivalent respondents were 115 respondents (37.1%); and Batik Labor respondents were 106 respondents (34.2%). Filarial medication adherence in the filariasis mass drug in 2015 were noted 84.5%. Most of them, as many as 69% or 214 respondent, had no habitual outdoor activities in the night more than an hour between 6.00 a.m. – 11.00 p.m. at least three times a week. Using mosquito lotion repellent before going to sleep is a habit that almost all of the respondents, 283 respondents (91.3%), did as an effort to avoid mosquito bites.

Table 2 displays the fact that there were still people with microfilaremiae found with 0.32% mirofilariae rate and 84.5% filarial medication adherence in the Filariasis Mass Drug Administration in 2015. However, the result of circulating antigen examination was shown to be negative.

Table 3 presents that the entomology survey result at Pabean Village, Pekalongan City in 2015 revealed filariasis transmission was still identified in *Culex quinquefasciatus* rate of 0.06%.

Discussion

Mass Drug Administration of Filariasis throughout the world aims to eliminate filariasis by eliminating transmission events from the patients to other individuals. The filariaris transmission will decline or even become diminished if only the number of circulating microfilariae in the population is very low. Therefore, although there are mosquitoes which tend to be vectors, their bites will never be able to transmit filariasis.[5]

Filariasis mass treatment is conducted in the areas of lymphatic filariasis endemic, namely the areas with the mf rate is 1% or more. The mass treatment is intended to kill all microfilariae in the residents' blood, at the same time, it terminates the transmission chain. Mass treatment for eliminating lymphatic filariasis has a purpose to decrease the mf rate to be less than 1% and to reduce the average density of microfilariae.[6]

The concept of mass drug administration is to approach every eligible individual in the target community and administer annual single dose of anti-filarial drugs

Table 1. Respondents' Characteristics in Pabean Area, North Pekalongan, Pekalongan City

Characteristics	Category	Frequency (n)	Percentage (%)
Age (years)	2-10	8	2.6
	11-20	43	13.9
	21-30	62	20.0
	31-40	69	22.3
	41-50	65	21.0
	51-60	50	16.1
	61-70	11	3.5
	>70	2	0.6
Sex	Male	166	53.5
	Female	144	46.5
Education degree	Elementary school dropouts	52	16.8
	Elementary school graduate/equivalent	115	37.1
	Secondary school graduate/equivalent	95	30.6
	High school graduate/equivalent	45	14.5
	Undergraduate/higher education	3	1.0
Occupation	Unemployed	68	21.9
	Civil servant	3	1.0
	Private Employee	19	6.1
	Vendor	24	7.7
	Batik Labor	106	34.2
	Entrepreneur	14	4.5
	Other	76	24.5
Filarial medication adherence in filariasis mass drug 2015	Disobedient	45	15.5
	Obedient	245	84.5
Habitual outdoor activities in the night more than an hour between 6.00 a.m- 11.00 p.m at least three times a week	Yes	96	31.0
	No	214	69.0
Using mosquito lotion repellent before sleep	No	27	8.7
	Yes	283	91.3

Table 2. Microfilariae (Mf) Rate, Average Microfilariae Density per mL of Blood, after the Fifth Year of Filariasis Mass Drug Administration in 2015

Mass Drug Year	Adherence (%)	Microfilariae Rate	Mf Average Density/mL of Blood	Circulating Antigen Examination (%)
2015	84.50	0.32	167	0

Table 3. Infection Rate, Infective Rate of Filarial Larvae in 2015

Year	n	Filarial Larvae Found			Infection Rate (%)	Infective Rate (%)
		L1	L2	L3		
2015	1577	1			0.06	0

Note:
n : number of dissected female *Culex quinquefasciatus* mosquitoes
L1 : filarial larvae stage Il; L2 : filarial larvae stage II; L3 : filarial larvae stage III

(DEC+Albendazole). This annual dose is to be repeated every year for a period of 5 years or more aiming at minimum 85% actual drug compliance. A high coverage (> 85%) is essential to achieve the interruption of transmission and elimination of disease.[7]

Mass Drug Administration has been implemented in the Pabean Area that takes the drug consisting of DEC, albendazole and paracetamol given once a year for at least 5 years. DEC and albendazole are safe and well-tolerated drugs, but sometimes the reaction can occur mainly on the treatment of filarial worm infections species *Brugia malayi* and *Brugia timori*. The reactions may be in the form of general reactions and local reactions.[8]

Even though the mass drug administration using combination of DEC and albendazole has a potential chance to reach the elimination target if the drug coverage is more than 75%, however, most elimination program cannot achieve the goal on the grounds that community participation is very low. One of the reasons is that several asymptomatic microfilaremia patients get fever and cold after consuming the drug. This indicates the importance of strengthening the full comprehensive knowledge transfer of the disease to the community.[9]

As well as filariasis elimination program in Tanzania, lymphatic filariasis transmission parameters are still considered high in some areas even after the eighth year of Mass Drug Administration program. It is said so because

of the very low drug coverage, the absence of optimal efforts in avoiding mosquito bites by the community, and the lack of community's filariasis knowledge and its prevention as well.[10]

The success of Mass Drug Administration to eliminate filariasis is influenced by several factors, such as the availability of health workers and sufficient volunteers in distributing and monitoring the drug consumption, training for the health workers on duty, local government commitment, advocacy, and social mobilization.[11]

Another influential factor in the success of the filariasis elimination through the Mass Drug Administration is information education communication activity. It helps bridge the knowledge gap and it is an important and very cost-effective tool to improve both coverage and compliance of mass drug administration. Interruption can be achieved sooner depending on other factors including baseline prevalence, treatment coverage, drug selection, and vector control.[12]

Since declared as endemic area, health cadres and health workers from Dukuh Primary Health Care give counseling about filariasis including transmission method and its prevention in Pabean Village region, in every given opportunity such as religion activities and other community activities. Although residents of Pabean Village have sufficient knowledge about filariasis, some residents still believe that disease and its cure come from God The Omnipresent, so they still underestimate the benefit of drugs given from health cadres and health workers from Primary Health Care.

The success of filariasis elimination in Pabean Pekalongan City which is signified by less than 1% of mf rate, less than 2% of antigen prevalence and less than 0.06% of infection rate after the fifth year of the filariasis mass drug administration is highly supported by the high rate of filarial medication adherence (84.5%). The mass drug administration program after 4-6 rounds with high coverage of ≥ 80% is expected to reach the elimination stage where the prevalence of infection falls below 1%. A sustainable high coverage of 85% or more is required for stopping transmission and elimination of disease from the community.[13]

The achievement of mf rate to 0.32% is also supported by the previous year mf rate data that is considered low, 1.33% in 2014 and 1.4% in 2013. Any L3 that is not found in the dissection of *Culex quinquefasciatus* mosquitoes is clearly the result of the Filariasis Mass Drug Administration which causes the reduction on the worm loads to the human population drastically. If the number of microfilarial sucked by vector mosquitoes is small, the opportunity of developing into L3 also becomes low.[13]

Community's behavior factor also determines the success of the filariasis elimination in Pabean. Respondents (91.3%) have carried out efforts to avoid mosquito bites by using mosquito lotion repellent, and most of them (69%) have no outdoor activities in the night. Filarial infection occurs because the vector mosquitoes, in this case is *Culex quinquefasciatus*, bite repetitively, thus efforts to avoid mosquito bite behaviors significantly ensure the success of the filariasis elimination program in the mass drug administration.[14]

The success of filariasis elimination program through the Mass Drug Administration is the same as that of in Surat City India, which shows that through a well-organized program, the drug coverage can reach 90%. Besides, the government support on the program preparation, capacity improvement and medical institution participation are the supporting factors of the success of the filariasis elimination in the fourth year of the Mass Drug Administration with the mf rate is 0.69% and the infection rate is 0.03%. Certainly fewer rounds of Mass Drug Administration would result in programmatic cost savings and eliminate the need for unnecessary drug administration to healthy individuals.[15]

One limitation of this survey is the potential selection bias introduced by testing only children whose parents or guardian provided consent to participate. It is conceivable that those unwilling to participate may be at greater risk for infection, leading to a sample that may not completely represent the target population. The second limitation is that this study covers only one particular filariasis-endemic area. It would be much better if the geographical area coverage is widened that more comprehensive conclusions can be drawn.

Conclusion

Pabean Village, North Pekalongan, Pekalongan City has attained the filariasis non-endemic status after the implementation of the fifth year of Filariasis Mass Drug Administration is supported by 84.50% filarial medical adherence rate. By 91.30% of the population have already used mosquito repellent lotion to avoid and protect themselves from mosquito bites.

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