



Epidemiological and Entomological Investigation of Dengue Fever Outbreak in South Nias District, North Sumatera Province, Indonesia, 2016

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Abstract

Dengue infection continues to present as a serious public health problem in North Sumatera, Indonesia. A dengue fever outbreak was reported in Teluk Dalam Subdistrict, South Nias District, North Sumatera during February 2016. An epidemiological investigation was conducted to identify the risk factors and recommend control measures. An observational study with a matched case-control design was conducted. A case was defined as a resident of Teluk Dalam District who had suffered two or more clinical symptoms of fever, headache, pain behind eyes, muscle and joint pain, and rash from 14 Feb to 16 Mar 2016. Blood samples were tested to confirm the diagnosis and serotype identification. Total 68 cases and 68 controls were included in the matched case-control study. The case fatality rate was 2.9%, age ranged from six months to 51 years (median 25 years). Three out of six cases were tested positive for DEN-3 serotype. In multivariate analyses, not eliminating mosquito breeding sites routinely (adjusted odds ratio = 3.7, 95% CI = 1.48-9.46) and having habit of hanging worn clothes (adjusted odds ratio = 2.9, 95% CI = 1.21-6.96) were risk factors. Elimination of mosquito breeding sites routinely, proper management of worn clothes, and conducting strict surveillance for dengue infection were recommended.

Keywords: dengue fever, outbreak, case-control study, Indonesia

Introduction

Dengue fever (DF) is a viral illness caused by four distinct serotypes of dengue virus (DEN-1, DEN-2, DEN-3 and DEN-4) and can transmit among people through the bite of *Aedes* mosquito.^{1,2} Symptoms of infection usually begin 4-10 days after the mosquito bite and last for 2-7 days.² Infection with any one serotype confers lifelong immunity, yet there is no cross-protective immunity to other serotypes.^{2,3}

In Indonesia, DF is an emerging vector-borne disease of high public health significance. North Sumatera is a province with DF as a public health problem as well.⁴ The national dengue control program was initiated in 1974 and gradually expanded to be an integral part of general health services in the context of primary health care.³ In the DF control program, surveillance data on endemicity of an area, season of transmission and disease progression are collected routinely.⁴⁻⁶

South Nias District was not an endemic area of DF in North Sumatera Province until the end of 2015.⁴ On 26

Feb 2016, District Health Office in South Nias reported an outbreak of DF in Teluk Dalam Subdistrict. Surveillance officers from provincial health office and district health office jointly conducted an investigation from 27 Feb to 9 Mar 2016 to identify the risk factors and recommend the control measures.

Methods

Case-control Study

A case of DF was defined as a resident in Teluk Dalam Subdistrict who suffered from acute febrile illness for 2-7 days duration with two or more of the following manifestations: headache, retro-orbital pain, myalgia, arthralgia, rash, hemorrhagic manifestations or leucopenia², during 14 Feb to 16 Mar 2016, identified by active case finding in the affected area. A control was a neighbor of the cases, and did not have clinical signs and symptoms of DF. Cases and controls were matched for age and gender.

The house-to-house search was carried out to identify cases and controls in Teluk Dalam Subdistrict. The

standard outbreak investigation questionnaire from the Ministry of Health, including data on demographic profiles and sanitation practices, was administered to all cases and controls.

All data were analyzed by using the statistical software to calculate odds ratio (OR) and 95% confidence interval (CI). Logistic regression was also performed for all variables and those with p-value lower than 0.25 were included in the multivariate model. OR was used to determine the potential risk factors. Matched case-control was analyzed using McNemar's test.

Environmental Investigation

An environmental investigation was conducted through observing water and sanitation practices of all cases and controls. An entomologist of Puskesmas primary health center in Teluk Dalam inspected potential breeding sites of mosquitoes in and around houses of cases and controls in the subdistrict. The entomologist determined the species of mosquito larvae.

In Teluk Dalam and Nanowa Sub-villages, 100 households were randomly selected for calculation of the entomology indices as below: house index (HI), container index (CI) and Breteau index (BI). We compared the entomology indices with the goals of the Indonesia National Dengue Prevention and Control Program of lower than 5% for all three indices.³

$$HI = \frac{\text{Number of houses infested}}{\text{Number of houses inspected}} \times 100$$

$$CI = \frac{\text{Number of positive containers}}{\text{Number of containers inspected}} \times 100$$

$$BI = \frac{\text{Number of positive containers}}{\text{Number of houses inspected}} \times 100$$

Laboratory Investigation

Laboratory investigation was conducted by collecting blood samples from the consented cases to confirm the diagnosis and detect the serotype. The samples were

sent to the National Institute of Health Research and Development under the Ministry of Health of Indonesia. The real-time polymerase chain reaction was performed to detect the serotype of dengue virus.³

Results

Case Characteristics

The total number of DF cases identified in Teluk Dalam Subdistrict was 68. Age ranged from six months to 51 years (median 25 years) and 57% were female. All cases presented with fever and other associated common symptoms such as myalgia (90%), headache (87%), rash (80%), vomiting (63%) and arthralgia (55%). About 41% (28/68) of cases were hospitalized. Only 17.9% (5/28) were diagnosed with dengue hemorrhagic fever (DHF). Five cases experienced with thrombocytopenia ($<100,000/\text{mm}^3$) and hemoconcentration ($\geq 20\%$).² The total attack rate (AR) in this area was 12.7%.

Dengue cases were firstly reported on 14 Feb 2016, and peaked on 29 Feb 2016. Investigation was conducted on 27 Feb 2016. The outbreak continued for more than three weeks, with the last case identified on 9 Mar 2016 (Figure 1). Two deaths occurred, with the case fatality rate as 2.9%, including one female (age <1 year) and one male (age >44 year) (Table 1). The total number of respondents was 136 people (68 cases and 68 controls). There was no significant difference between cases and controls (Table 2).

Case-control Study

There were 68 cases and 68 controls included in the case-control study. In the bivariate analyses, not routinely eliminating mosquito breeding sites (OR = 3.0, 95% CI = 1.34-6.79), having habit of hanging worn clothes (OR = 2.9, 95% CI = 1.22-6.99) and without using personal protective measures against mosquitoes (OR = 2.5, 95% CI = 1.13-5.37) were statistically significant risk factors.

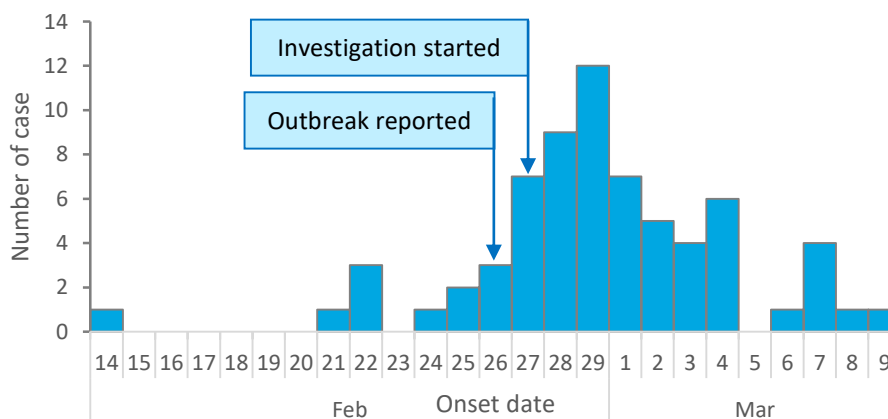


Figure 1. Dengue fever cases by date of onset in Teluk Dalam Subdistrict, South Nias District, North Sumatera Province, Indonesia, 14 Feb-9 Mar 2016 (n=68)

Table 1. Number of cases and deaths, attack rates, and case fatality rates of dengue fever outbreak in Teluk Dalam Subdistrict, South Nias District, North Sumatera Province, Indonesia, 14 Feb-9 Mar 2016 (n=68)

Variable	Population at risk (n=536)	Number of case (n=68)	Number of death	Attack rate (%)	Case fatality rate (%)
Age group (year)					
<1	15	2	1	13.3	50.0
1-4	68	4	-	5.9	-
5-14	83	8	-	9.6	-
15-44	150	35	1	23.3	2.9
>44	220	19	-	8.6	-
Gender					
Male	250	29	1	11.6	3.4
Female	286	39	1	13.6	2.6

Table 2. Characteristics of cases (n=68) and controls (n=68) of dengue fever outbreak in Teluk Dalam Subdistrict, South Nias District, North Sumatera Province, Indonesia, 14 Feb-9 Mar 2016

Characteristic	Number of case (%)	Number of control (%)
Level of education		
None	5 (7.4)	6 (8.8)
Primary	12 (17.6)	14 (20.6)
Secondary	18 (26.5)	17 (25.0)
Tertiary	33 (48.5)	31 (45.6)
Occupation		
None	15 (22.1)	16 (23.5)
Farmer	28 (41.2)	25 (36.8)
Businessman	10 (14.7)	12 (17.6)
Employee	5 (7.4)	8 (11.8)
Housewife	10 (14.7)	7 (10.3)

The findings in the multivariate analyses showed that without eliminating mosquito breeding sites routinely (adjusted OR = 3.7, 95% CI = 1.48-9.46) and having habit of hanging worn clothes (adjusted OR = 2.9, 95% CI = 1.21-6.96) were significantly associated as risk factors for DF (Table 3).

Environmental Investigation

The team observed multiple breeding sites of *Aedes* in

the backyard of cases' houses such as discarded tires, plastic bottles and other water containers. Majority of the cases had no proper waste disposal.

In addition, entomologist confirmed that of mosquito larvae that collected during the investigation were larvae of *Aedes*. The result of entomology indices were 30% for HI, 24% for CI and 32% for BI while all were above the national standard indices of less than 5%².

Table 3. Factors associated with dengue fever outbreak in Teluk Dalam Subdistrict, South Nias District, North Sumatera Province, Indonesia, 14 Feb-9 Mar 2016

Variable	Crude odds ratio	95% CI	Adjusted odds ratio	95% CI
Activity around house in the morning and late afternoon	0.2	0.05-1.13	0.10	-
Without using personal protective measures against mosquitoes	1.0	1.13-5.37	0.36	-
Having habit of hanging worn clothes	2.9	1.22-6.99	2.90	1.21-6.96
Without routinely eliminating mosquito breeding sites	3.0	1.34-6.79	3.75	1.48-9.46

Laboratory Investigation

Blood samples were collected from six cases who were willing to be tested during the epidemiological investigation. All the cases presented with headache, rash, myalgia and arthralgia after three days of fever. Laboratory examination confirmed that three were positive for DEN-3 serotype and the rest were not dengue or other arbovirus infections.

Discussion

The epidemiological and entomological investigations revealed an outbreak of DF in Teluk Dalam Subdistrict. The main risk factors of the outbreak were not eliminating mosquito breeding sites routinely and having habit of hanging worn clothes. Mosquito breeding sites should be routinely managed as it can interrupt the lifecycle of mosquitoes by eliminating mosquito eggs and larvae. Without the breeding site or if the water containers are covered with a fine mesh, the mosquitoes have less opportunities to lay eggs and cannot develop through their aquatic life stages.^{2,7} The large number of disposable containers (plastic, coconut shell, discarded bottles and tyres) were identified and *Aedes aegypti* were detected in the affected areas. The abundance of breeding habitats for *Aedes* signified that the area was sensitive and vulnerable to DF transmission.^{4,8,9}

In addition, mosquito breeding sites can contribute to high entomological indices (HI, CI and BI) and poor sanitation as well.^{2,7} The most effective way to control *Aedes aegypti* larvae is by removing or treating containers that can serve as larval habitats in the environment.¹⁰ Prevention and control relies primarily on reducing the number of natural and artificial water-filled habitats that support the mosquitoes breeding. This requires persistent contribution from the affected communities.^{10,11}

Habit of hanging clothes that have been worn was another risk factor of DF outbreak in South Nias District as well. *Aedes aegypti* prefers to rest indoor in the dark and humid houses/buildings or objects. Clothes that have been worn obtain human odors, amino acids, lactic acids, sweats and other substances that attracts *Aedes aegypti*.^{2,8} Hanging worn clothes is a favorite resting place for *Aedes aegypti* after sucking human blood. After that, they will suck human blood again until the blood is enough for maturing their eggs.¹²

Personal Protective measure is the way to prevent *Aedes aegypti* bites as they are most active in the morning and late afternoon.² The protective measures included using of repellent creams, mosquito nets (plain or insecticide-treated), mosquito coils,

repellents, electric rackets, mats and smokeless coils, and wearing long-sleeved shirts and long trousers.^{2,13}

Strength and Limitation

This was the first epidemiological investigation of DF outbreak with serological testing in North Sumatera since the previous epidemiological investigations were performed merely with clinical symptoms.

Limited testing of clinical specimens was conducted in this study. Since not all cases were laboratory confirmed as DF infection, some of them might be affected by other illnesses with similar manifestations such as chikungunya.

Conclusion

An outbreak of DF was confirmed in Teluk Dalam Subdistrict, South Nias District, North Sumatera. Not eliminating mosquito breeding sites routinely and having habit of hanging worn clothes were the most potential risk factors associated with the outbreak.

Public Health Actions and Recommendations

During the outbreak, fogging was conducted on 29 Feb and 7 Mar 2016. Intensive information, education and communication (IEC) campaigns as well as promoting behaviors to remove, destroy or manage mosquito larva habitats were conducted in the affected communities, churches, mosques and schools.

In addition, people in the communities were recommended to conduct routine activities for eliminating mosquito breeding sites such as managing the natural and artificial water-filled containers, and to avoid hanging of clothes that have been worn. A strict surveillance of DF should be conducted and multi-sectoral collaboration should be enhanced to prevent and control DF in the future.

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Suggested Citation

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