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Sanitation-Related Behavior, Container Index, and Their Associations with Dengue Hemorrhagic Fever Incidence in Karanganyar, Central Java

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ABSTRACT

Background: Dengue Hemorrhagic Fever (DHF) causes not only epidemic but also social and economic impacts. Environmental sanitation, water reservoirs, and community behavior can influence the incidence of DHF. This study aimed to examine sanitation-related behavior, container index, and their associations with dengue hemorrhagic fever incidence.
Subjects and Method: This was an analytic observational field study using case control design. The study was conducted in sub-districts with the highest and lowest DHF cases in Karanganyar, Central Java, from May to July 2017. A total sample of 120 study subjects was selected for this study using fixed disease sampling, including 40 people with DHF and 80 people without DHF. The dependent variable was DHF. The independent variables were age, education level, family income, container index, and sanitation behavior. The data were measured by a set of questionnaire and examined using path analysis.
Results: Sanitation behavior (b= 1.50; 95%CI= 0.57 to 2.42, p= 0.001) and Container Index (b= 0.90; 95%CI= 0.03 to 1.84; p= 0.057) were directly and positively associated with DHF incidence. Container Index was associated with sanitation behavior (b= 2.09, 95%CI= 1.21 to 2.97, p<0.001). Age (b= -0.76, 95%CI= -1.60 to 0.08, p= 0.074), education level (b= -1.02, 95% CI= -1.87 to -0.17, p= 0.019), and family income (b= -0.70, 95% CI= -1.60 to 0.19, p= 0.122) were associated with sanitation behavior.
Conclusion: DHF incidence is directly and positively associated with sanitation behavior, and container index. DHF incidence is indirectly associated with age, education level, and family income.

Keywords: dengue haemorhagic fever, sanitation, container index, behavior, path analysis

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BACKGROUND

Dengue Hemorrhagic Fever (DHF) is a disease that has become a global problem in most tropical and subtropical regions. The incidence rate and geographical area of the distribution of DHF over the past 50 years have increased 30-fold with increasing geographical expansion to new countries (WHO, 2009). A study by Bhatt et al. (2013) reported that cases of dengue fever were far more than what WHO has estimated and indicated that 390 million dengue virus infections could occur every year.

According to WHO (2016), before 1970, only 9 countries experienced severe epidemics of dengue hemorrhagic fever cases but are currently endemic cases in more than 100 countries in WHO region namely Africa, America, the Eastern Mediterranean, Southeast Asia and the Western Pacific.

Areas in America, Southeast Asia and Western Pacific are the ones with the most

serious cases. In 2008 dengue cases throughout America, Southeast Asia and the Western Pacific exceeded 1.2 million and more than 3.2 million in 2015. In 2015, there were 2.35 million dengue cases reported by people in America. Of the 10,200 cases, 1,181 of them caused death (WHO, 2016).

DHF has been a public health problem in Indonesia since 1968. There is an increase in the number of provinces and districts/cities from 2 provinces and 2 cities to 34 provinces and 436 (85%) districts / cities. The number of cases has increased from 1968 to 58 cases to 126,675 cases in 2015 (Ministry of Health, 2015). WHO noted that Indonesia was the country with the highest DHF cases in Southeast Asia where 58 people were infected and 24 of them died (Mortality Rate= 41.3). Since then, this disease has spread throughout Indonesia (Achmadi et al., 2010).

The Ministry of Health of the Republic of Indonesia Directorate of Vector and Zoonotic Disease Control at the Ministry of Health stated that during January 2016 there were 3,298 dengue cases with 50 deaths in Indonesia. While in the KLB area, there were 492 cases, 25 of them died. *KLB* occurred in 11 districts/cities in 7 provinces. While in Central Java Province, 35 districts/cities have been infected with dengue. Incidence Rate (IR) of DHF in Central Java Province in 2014 amounted to 36.2 / 100,000 population (Profile of Central Java, Increased and spread of DHF cases was probably caused by the high population mobility, development of urban climate change, changes in population density and distribution as well as other epidemiological factors that still need further study. In addition, an increase in dengue cases each year is related to environmental sanitation conditions, this condition is exacerbated by a lack of understanding of the community about DHF and very low community participation. With the incidence of DHF, it is still considered problematic which in the home environment that looks clean, there are still conditions that can increase the risk of dengue incidence, such as open water reservoirs inside and outside the house, the presence of bushes and puddles around the house, keb the presence of used goods that can hold rainwater (Sofia et al., 2014).

DHF does not only often cause outbreaks but also has a negative impact both in terms of social and economic aspects. Social disadvantages that occur include due to panic in the family, death of family members, and reduced population expectancy (Ministry of Health, 2011). The economic impacts caused by dengue include the loss of work time, school time and the release of other costs other than for treatment, such as transportation and family expenses while maintaining patients. One of the social impacts caused by DHF is the occurrence of panic in the family and community when a dengue case occurs which causes death.

In addition, the increase in dengue cases every year is closely related to environmental sanitation conditions. This condition is exacerbated by the people's poor understanding of dengue and also very low community participation. The condition of the home environment and community behavior related to the incidence of DHF are still considered problematic which in the environment of the house that looks clean, there are still conditions that can increase the risk of dengue incidence, such as the presence of open water reservoirs inside and outside the house, bushes and puddles around the house, the presence of used goods that can hold rainwater (Sofia et al., 2014).

SUBJECTS AND METHOD

This study has received an approval from the ethics commission of the Faculty of

Medicine, UNS / Dr. Moewardi hospital, Surakarta No 571 / VII / HREC / 2017

1. Study Design

The method used in this study was field research techniques with a type of quantitative research with a case control design approach. It was implemented in May to July 2017 in the District with the highest DHF cases and the lowest DHF cases in Karanganyar District, Central Java.

2. Population and Sampling

The population of this study was the sample of the people in Karanganyar Regency, namely 120 subjects divided into 40 subjects with a history of DHF disease and 80 subjects with healthy criteria in Karanganyar Regency.

The sampling technique in this study was fixed disease sampling. The sampling using exclusion criteria is that if the chosen study subject moves out of town or dies then the subject of the study is replaced by another study subject. The study subjects who were less than 15 years old, then the data collection was carried out to the parents of the study subjects.

3. Study Variable

The independent variables in this study include age, education level, income, sanitation related behavior, and index container. Meanwhile, the dependent variable is a DHF case.

4. Operational Definition

The operational definition of dengue case was DHF patients in Karanganyar Regency which are stated by a statement issued by the doctor that the patient has a history of DHF and is supported by the results of laboratory tests. Age is the length of life, which is from birth until now. Age determination is done using a number of years.

The level of education is the last level of formal education that has been pursued by the study subject based on the last diploma owned.

Family income is income earned and used as a source of family economy. The behavior of environmental sanitation is the habit of the community in maintaining cleanliness of environmental sanitation which includes the provision of clean water, sewage and housing. The container index is a container or place for storing clean water that is found larva/larvae of all containers examined.

5. Variable Instruments

The data collection techniques used in this study were questionnaire instruments that have been tested for validity and reliability to 15 study subjects, obtained results of measurements of age, education, income, sanitation related behavior, container index with total item correlation values ≥0.28 and alpha cronbach ≥0.88, so that all the questions are reliable.

6. Data Analysis

Univariate analysis was conducted to display the characteristics of study subjects and descriptive study variables. Bivariate analysis was carried out to analyze independent variables on dependent. Path analysis (path analysis) was done to analyze the effect of independent variables on the dependent variable through the intermediate variable and find out the direct and indirect effects of the independent variables on the dependent variable. The magnitude of the influence of the independent variable on the dependent variable is seen from the value of the path coefficient, the greater the path coefficient, the greater the influence given from that variable. The steps in conducting path analysis include model specifications, model identification, model suitability, parameter estimation, and model specification.

RESULTS

The results of this study explain the univariate analysis, bivariate analysis and multivariate analysis.

1. Univariate Analysis

Univariate analysis consists of the characteristics of the study subject and descriptive study variables as described in table 1.

Characteristics of study subjecs consist of gender, age, occupation, and income between case group and control group were not different except education and income (Table 2). Study subjects were more than or equal to 21 years old (controls 66.7% and cases 33.3%), worked outside the home (66.4% and 33.6%) and had income below the UMK (64.7% and 35.3%). The control group 62.5% of the study subjects had education levels equal to or more than high school while the case study group subjects 37.5% had less education than high school.

Table 1. The characteristics of study subjects

Subject Characteristic	Control		Case	
	n	%	N	%
Age (years)				
<21	32	66.7	16	33.3
≥21	48	66.7	24	33.3
Gender				
Male	48	78.7	13	21.3
Female	32	54.2	27	45.8
Education				
<SHS	35	62.5	21	37.5
≥SHS	45	70.3	19	29.7
Occupation				
At home	7	70.0	13	30.0
Outside	73	66.4	37	33.6
Income				
<Minimum Wage	44	64.7	24	35.3
≥Minimum Wage	36	69.2	16	30.8

2. Bivariate Analysis

Chi Square test was used to analyze the relative risk of behavior related to sanitation and container index to the incidence of DHF in Karanganyar Regency. Bivariate analysis was conducted to see the relationship of independent variables (age, education level, container index, family income, and sanitation-related behavior) and the dependent variable (DHF case) analyzed using Chi-Square test and calculation of Odds Ratio (OR) with confidence level (CI) of 95%.

Age, education, income, sanitation-related behavior, and container index were related to the incidence of DHF (Table 2). Age (OR= 1.00; 95% CI= 0.46 to 2.17; p= 1.000), education (OR= 0.70; 95%CI= 0.33 to 1.51; p= 0.365), and income (OR= 0.82; 95%CI= 0.38 to 1.76; p= 0.602) the relationship is not significant, these three things increase the very weak risk of the risk of dengue cases. The results of the full bivariate analysis can be seen in Table 2.

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Table 2. The relationship between sanitation behavior and index container with dengue incidence

Variable	DHF incident				Total		OR	95%CI	p
	Control		Case						
	N	%	N	%	N	%			
Age (years)									
<21	32	66.7	16	33.3	48	100	1.00	0.46 to 2.17	1.000
≥21	48	66.7	24	33.3	72	100			
Education									
< SHS	35	62.5	21	37.5	56	100	0.70	0.33 to 1.51	0.365
≥ SHS	45	70.3	19	29.7	64	100			
Income (Rupiah)									
< Minimum wage	44	64.7	24	35.3	68	100	0.82	0.38 to 1.76	0.602
≥ Minimum wage	36	69.2	16	30.8	52	100			
Sanitation Behavior									
Poor	14	38.9	22	61.1	36	100	5.76	2.47 to 13.47	<0.001
Good	66	78.6	18	21.4	84	100			
Container Index									
Flicks	64	77.1	19	22.9	83	100	4.41	1.93 to 10.12	<0.001
No flicks	16	43.2	21	56.9	37	100			

3. Path Analysis

Table 3 showed the result of multivariate analysis by using path analysis model. Host and environmental factors for the incidence of DHF. Path analysis was used to determine the direct or indirect effects of host and environmental factors on the incidence of DHF. Table 3 showed that sanitation conditions, sanitation-related behavior and container index significantly affected the incidence of DHF.

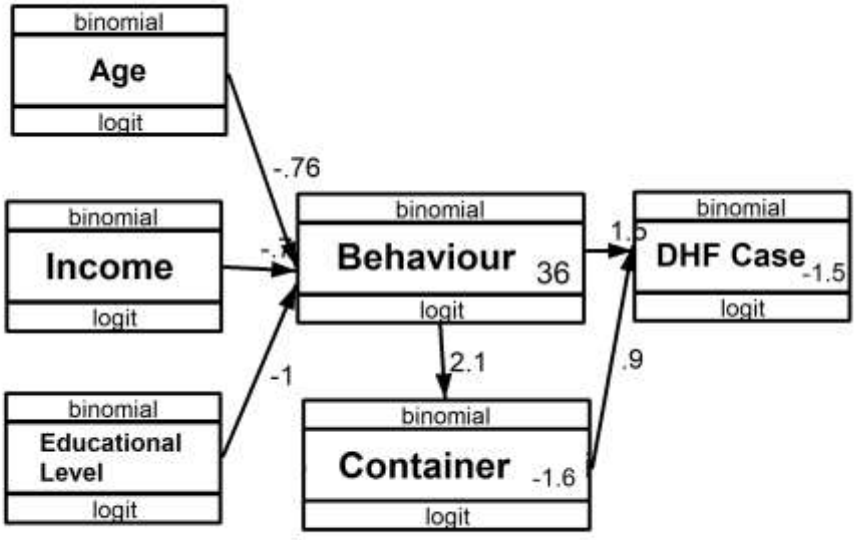

Figure 1. Structural Model with Unstandarized

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Table 3. Path Analysis Result of Sanitaion-Related Behavior and container index on the Incidence of terhadap kejadian DHF

Dependent Variables		Independent Variables	Path Coeffi-cient (b)	95%CI		p
				Lower Limit	Upper Limit	
Direct Effect						
DHF Case	←	Container Index	0.90	0.03	1.84	0.057
	←	Sanitation-Related Behavior	1.50	0.57	2.42	0.001
Container Index	←	Sanitation-Related Behavior	2.09	1.21	2.97	<0.001
Indirect Effect						
Sanitation Behavior	←	Age	-0.76	-1.60	0.08	0.074
	←	Education Level	-1.02	-1.87	-0.17	0.019
	←	Income	-0.70	-1.60	0.19	0.122
AIC = 404.42 BIC = 429.51						

Path analysis showed that Container Index (b= 0.90, 95%CI = 0.03 to 1.84, p= 0.057), sanitation-related behavior (b= 1.50, 95%CI= 0.57 to 2.42, p= 0.001) affected DHF cases. Sanitation-related behavior (b=2.09, 95%CI= 1.21 to 2.97, p <0.001) has a direct effect on container index. Age (b= -0.76, 95%CI= -1.60 to 0.08, p= 0.074), educational level (b= -1.02, 95%CI= -1.87 to -0.17, p= 0.019), income (b= -0.70, 95%CI= -1.60 to 0.19, p= 0.122) have an indirect effect on environmental sanitation behavior through sanitation behavior.

DISCUSSIONS

1. The Effect of Age on the Incidence of DHF

Residents with a more mature age have a higher awareness of maintaining sanitation, and it can reduce the incidence of DHF. Wichmann et al., (2004) showed that adult DHF patients tended to have a higher severity caused by secondary infections than children patients. Adult individuals who have been exposed to or have a history of suffering from previous DHF increase the risk of secondary infections and this affected the severity of their illness.

The highest morbidity rates in DHF cases were found at the age of 15-30 years old (Toan et al., 2015). Dung and Cam (2005) reported that more than 90% of DHF morbidity was in the age range of 15 to 25 years old. This was related to differences in the behavior of adults and children. Adults have different lifestyle behaviors, time spent outside the house tended to be infected by dengue vectors, sleep without using mosquito nets, and children could not take preventive actions to prevent DHF (Toan et al., 2015).

2. The Effect of Education on the Incidence of DHF

The results of this study showed that there was an effect between the level of education on the incidence of DHF. Residents who have a higher level of education have a higher awareness in maintaining the sanitation of the environment to reduce the incidence of DHF.

The level of educations was related to knowledge. Higher levels of education lead to broader knowledge of prevention of dengue (Siregar et al., 2015). A study done by Siqueira et al., (2004) in central Brazil showed that a low level of education was assoc-

iated with an increased incidence of dengue infection and it was statistically significant.

The results of study conducted in Central Nepal showed that the practice of DHF prevention was related to the level of education (Dhimal et al., 2014). DBD prevention action which was based on knowledge would be more effective than actions that were not based on knowledge. The results of the study indicated that research subjects who have a good level of knowledge tend to be able to take preventive action to prevent DHF.

The result of this study was supported by a study done by Koenraadt et al., (2006) in Kamphaeng Phet Province, it was found that increased knowledge would increase the practice of reducing the number of unprotected containers/puddles, thereby reducing the environmental potential for vector breeding. With the existence of education, a person was able to obtain knowledge and implications and can provide a more rational response to the information she/he got. The ability to receive an information was strongly influenced by the level of education. The higher the level of education, the easier it was to live independently, creatively, and sustainably (Mubarak, 2007).

3. The Effect of Family Income on the Incidence of DHF

The results of this study residents that residents with higher incomes would be able to build healthy houses so that it would decrease the incidence of DHF.

Some research results showed that income levels negatively affected the incidence of DHF. People with low income levels and socio-economic status tend to live in environments with low capacity to provide good residents, low physical condition of the house, high density, poor sanitation, and lack of capacity to provide adequate water storage (Mulligan et al., 2015).

4. The Effect of Behavior of Environmental Sanitation on the Incidence of DHF

The results of this study showed that the behavior of residents who pay attention to the environmental sanitation reduced the incidence of DHF.

According to WHO (2012), Bruteau Index (BI) was the most informative index because it was able to show a positive relationship between the condition of the house and the existence of puddle. This index was relevant for focusing efforts to manage, control, and eliminate mosquito habitats through public health education that DHF vectors can be controlled through improved environmental sanitation to minimize the breeding places of the vector.

Was management was related to the transmission of DHF. Waste such as plastic and bottles was a place of dengue vectors. Poor management of waste could create a breeding environment for the Aedes Aegypti mosquito. The results showed that the frequency of managing waste disposal which was less than 1 time per week increased the incidence of DHF and it was statistically significant (Bohra and Andrianasolo, 2001; Cordeiro et al., 2011; Suwannapong et al., 2014).

Aji et al., (2016) and Fibriana (2004) stated that there was a relationship between the implementation of the behavior of closing, draining puddles, and hoarding used goods (3M) with the incidence of DHF. Therefore, it was recommended that people could improve the 3M behavior regularly to eradicate mosquito growth.

4. The Effect of Container Index on the Incidence of DHF

The greater the container index number, the greater the chance of developing mosquito larvae so that it increased the DHF cases.

The result of a study done by Budiyanto (2008) showed that 182 containers were found to contain puddle, 54 containers were found to have Aedes Aegypti larvae (91%). It was suggested that people could regularly clean the containers.

WHO (2003) stated that House Index (HI) was one of the indicators that can be used to measure the risk of disease transmission. HI can provide a percentage of positive homes and instructions on the proliferation of human populations who have risk of DHF. Containers index showed the percentage of positive containers that have Aedes Aegypti larvae. Although positive container areas have epidemiologically small numbers of Aedes Aegypti larvae, people still need to be aware because generally, Aedes Aegypti mosquitoes produced large numbers of larvae and vice versa, and it caused less risky epidemic.

The result of a study done by Fibriana (2004) showed that there was a relationship between the presence of Aedes Aegypti larvae and the incidence of DHF.

Yudhastuti (2005) stated that the density of mosquito larvae of Aedes Aegypti in Wonokusumo village was measured by using HI parameters and the score was 58%, CI= 30.6%, BI= 82% and DF= 7 which indicated the speed and easiness of DHF transmission.

According to Muchlastriningsih (2005) the numbers of free larvae which was less than 95% can increase the chances of dengue transmission. A study done by Fathi (2005) showed that the presence of Aedes Aegypti larvae was related to DHF and it was statistically significant.

The result of a study done by Aji et al., (2016) showed that HI= 5% and CI= 4%. The results of the study also showed that there was a relationship between the presence of Aedes Aegypti larvae and the incidence of DHF.

Prastyowati (2013) showed that types of containers which contained Aedes Aegypti larvae include dispensers, buckets outside the house, and water reservoirs. The results of the study also showed that the activity of the Aedes Aegypti mosquito was around 18:00 to 3:00 am. both inside and outside the house.

Zulkarnaini (2008) stated that environmental sanitation conditions affected the incidence of DHF, the results of the study showed that there were positive containers with Aedes Aegypti larvae both inside and outside the house with the score of HI= 86.27%, Container Index (CI)= 28%, and Bruteau Index (BI) = 137%.

The results of this study showed that there was a relationship between home environmental sanitation and the incidence of DHF. Therefore, preventive efforts were needed to control DHF vector mosquitoes through PSN activities (eradication of mosquito nests).

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