

Household Dengue Prevention Interventions in Eco-Bio-Social Aspect in the COVID-19 Pandemic Era

Nur Siyam^{1*}, Dyah Mahendrasari Sukendra¹, Yunita Dyah Puspita Santik¹,
Nadia Indraswari Utomo¹

¹ Department of Public Health, Universitas Negeri Semarang, Indonesia

Corresponding author: nursiyam@mail.unnes.ac.id

Abstract: Control of dengue at the household level is the success key in reducing the incidence of dengue fever. However, relatively little information is known about the control intervention of *Ae. aegypti* in communities that have limited resources, especially during the COVID-19 Pandemic. The survey was conducted on 83 households in a high-risk community dengue fever in Semarang City, regarding knowledge and perceptions of dengue fever, vector control interventions, household expenditures, barriers, and factors that influence purchasing decisions. The results indicated that perceptions of dengue susceptibility decreased during the COVID-19 pandemic (88.1% to 66.3%). Households reported the most control intervention during the pandemic was using mosquito repellent lotion/burn/spray, the use of mosquito nets is still low (42.2%), and 47% due to changes in monitoring and roles from health workers/stakeholders during the COVID-19 pandemic. The community prioritizes the use of chemical insecticides to eradicate mosquitoes and less cleaning for the eradication of mosquito nests. In addition, dengue sufferers are found soon in their neighborhood, which is a densely populated settlement, with many neglected puddles found by larvae, many public places, and empty buildings that are not maintained so that they have a high potential to become a source of dengue vector development. Those findings can serve as the basis for developing future interventions and becoming evidence-based in policy-making by the health sector and government, as well as providing information on the burden related to controlling dengue during the COVID-19 pandemic.

Keywords: Knowledge, Vector Control, Perception

INTRODUCTION

COVID-19 has become an international public health crisis with devastating effects. In particular, this pandemic has further exacerbated the burden on tropical and subtropical regions of the world, where dengue fever, caused by the dengue virus (DENV), is already endemic in society (Pascawati et al., 2021). Dengue Fever is an infectious disease that causes illness and death in sufferers and attacks anyone regardless of age and gender. Dengue fever is a disease that has a serious impact (Harapan et al., 2019). Dengue fever is closely related to the *Aedes aegypti* vector whose development is related to environmental factors, climate, geographical conditions, and also community behavior. *Ae. Aegypti* mosquito is an efficient vector for dengue virus transmission, causing large epidemics and significant social and economic burdens throughout the tropics and

subtropics (Rather et al., 2017). Climate change causing the proliferation of mosquito vectors that cause dengue fever are also experiencing rapid changes. The increasing temperature of the earth causes the mosquito life cycle from egg to adult mosquito to be faster (less than 1 week). The use of larvicides in the prevention of *Aedes aegypti* mosquito vectors with inappropriate chemicals/insecticides can cause resistance in *A. aegypti* larvae (Shafique et al., 2019). This situation is exacerbated by the COVID-19 pandemic, where public attention is divided to control the very massive COVID-19 and on the other hand the community is still being watched by dengue fever.

Currently, dengue cases were spread in 472 districts/cities in 34 provinces. As of the 49th week of 2020, the number of dengue cases was 95,893, while the number of deaths from dengue fever up to the 49th week was 661. The government urges the public to implement 3M Plus Mosquito Nest Eradication. 3M consist of Draining, Closing and Reusing economically valuable secondhand waste (recycling), Plus is a form of additional prevention efforts such as keeping fish that eat mosquito larvae, using mosquito repellent, installing wire nets on windows and ventilation, and mutual cooperation in cleaning the environment is the prevention and control of the *Ae. aegypti* vector (Udayanga et al., 2018).

Data from the Semarang City Health Office showed that there has been an increase in the number of DHF cases in Semarang City from 2015 to 2019. In 2015 there were 1,729 cases of DHF with a death rate of 20 cases. In 2019 the number of dengue cases was 441 with a Case Fatality Rate (CFR) 3.17%. DHF cases in 2020 were 309 with 4 deaths (CFR: 1.29%). Semarang City as the capital of Central Java Province is an endemic city of DHF and has a high risk of DHF transmission. Bandarharjo Village is an outskirts of Semarang City whose community is at high risk of contracting dengue fever. It is a densely populated area that has a potential environment for breeding *Ae. aegypti*. It is known that the coverage of the larva-free rate in Semarang City is still below 95% and has a fairly high number of dengue vector density, which means that vector-borne transmission of dengue is still very possible.

The increase in DHF cases is a big threat to public health and causes huge economic losses due to the cost of DHF disease. It is not only the government level that has an economic burden in controlling DHF, but also at the household level is economically affected to control dengue vectors if mosquito nest eradication efforts are not optimal. In addition, the COVID-19 pandemic has more or less impacted the health, economy and society crisis, so it also has an impact on controlling dengue fever at the household level (Harapan et al., 2019).

Government efforts in controlling dengue vectors have been implemented, but the number of dengue cases is still high. Control efforts must be strengthened by vector surveillance activities to monitor the development and distribution in the community by health officers/cadres with innovations to increase community participation. In addition, efforts to control DHF in the community are still experiencing barriers. The success of a community-based DHF control program depends on community participation to implement the program in a sustainable manner. Empowerment programs to increase community participation in eradicating mosquito nests independently can be carried out through increasing community knowledge, attitudes, awareness and practices in preventing and controlling DHF (Sulistyawati et al., 2019).

Data from previous studies stated that the barriers to implementing effective community involvement are : 1) lack of interest and attitude of dependence on action from community health committees, 2) lack of enthusiasm for community organizations and community leaders, 3) workloads that are too heavy and lack of communication skills from the health sector, 4) low awareness and preparedness from the community, 5) lack of detailed policy guidelines and poor enforcement of related policies, and 6) limited budget.

The main way to prevent dengue fever is mosquito control at the household level. However, relatively little information is known about the control intervention of *Ae. aegypti* in communities that have limited resources, especially during the COVID-19 Pandemic. Households reported using an average of five different mosquito control and dengue prevention interventions, including aerosols, liquid sprays, mosquito repellents, mosquito coils, and see-through bed nets. The results of the study found that effectiveness and cost are the most important factors influencing people's decisions to buy mosquito control products.

The purpose of this study was to investigate eco-bio-social aspect to dengue vector control interventions in households during the COVID-19 pandemic. Our findings are expected to be the basis for developing future and evidence-based interventions in policy making by the health sector and the government, as well as providing information on the economic burden related to dengue fever control during the COVID-19 pandemic.

METHOD

Bandarharjo Village has population of 22951 people. The area of Bandarharjo Village is 342.68 M², with a topography of 342,000 Ha lowland area, 5,000 Ha Coastal area, 3,000 Ha River stream area, and 15,000 Ha Riverbank area.

Bandarharjo is a suburb of Semarang City which is densely populated with limited resources. Data on the education level of the Bandarharjo Village community showed that the 18-56 years old who have never attended school are 1716, the 12-56 years old who did not finish junior high school are 1153, the 18-56 years old who did not finish from high school a total of 3076.

The high larval density and the low larva free rate have caused this area become an endemic area for dengue fever, which is also supported by the large number of slum settlements in the area. This household was chosen because according to data from the Semarang City Health Office, it identified that Bandarharjo Village was a high risk area for dengue hemorrhagic fever with a fairly high density of larvae. In addition, Semarang City Health Office data states that dengue control in coastal areas is highly dependent on the use of chemical substances, such as the use of mosquito coils, sprays, mosquito repellent lotions, etc. As well as reports from DHF prevention officers experiencing problems during the COVID-19 pandemic. The study was conducted from June 2021 to July 2021, eighty-three households were selected based on (a) their willingness to participate in the study, (b) they did not have an air conditioning unit (AC), (c) have lived for at least 2 years.

This survey is a modification of the instrument used previously in the dengue surveillance study in Machala.² Our survey get 83 households who were willing to fill out the online questionnaire. Survey respondents asked questions about mosquito control and dengue fever prevention practices in eco-bio-social aspect. The survey instrument was piloted before the study began. We recruited a field research coordinator from the health section who works in Bandarharjo Village who has access to all residents through the WhatsApp group. We also asked two RT (neighbourhood) and RW (hamlet) heads for help in distributing the questionnaire links.

RESULTS

The percentage of household heads who only have primary education is 26.1% (30). Sixteen respondents (19.3%) lived in the rented house. The average number of people living per household is five people (4.49). Most households have piped water inside the house (92.8%). However, 20.5% (n = 17) reported daily or weekly disruptions to the piped water supply.

Table 1. Socio-Demographic Information from Survey Respondents (n=83)

Socio-Demographics	% Household (n)
Households head age < 26 years old	8.4% (7)
Live in rented house	19.3% (16)
Head of household has only primary education	36.1% (30)
Head of household has secondary education	63.9% (53)
Work as Laborer	31.3% (26)
Work as private employee / entrepreneur	37.3% (31)
Another job	28.9% (24)
Income below minimum wage before Pandemic	63.9% (53)
Income below minimum wage during Pandemic	83.1% (69)
Water and Garbage Access	
Households not use water pipe sources	7.2% (6)
The plumbing not work well	20.5% (17)
Garbage pick up 1-3 times a week	47.0% (34)
No garbage collection	12.0% (10)
Housing Condition	
House ventilation use window/door	48.2% (40)
House ventilation use fan	51.8% (43)
Walls material from wood / bamboo	6.0% (5)
Road access rocky/ soil	19.3% (16)
Knowledge and perception	
There were family member / neighbour infected DHF / Chikungunya 6 months ago	9.6% (8)
Knowledge that dengue is transmitted by mosquitoes	100% (83)
Consider dengue to be a serious problem in the community	83.1% (69)
Consider dengue to be a serious problem in the community in COVID-19 Pandemic era	66.3% (55)
Implementation of DHF Prevention different before and during COVID-19 pandemic	32.5% (27)
Expenditure mosquito control different before and during COVID-19 pandemic	24.1% (20)

Employment as a laborer is 31.3%, and 28.9% of household heads work in other categories. Prior to the COVID-19 pandemic, 63.9% (53) reported that the head of household earned less than the minimum wage, and this figure increased to 83.1% (69) during the pandemic, meaning that household income decreased during the COVID-19 pandemic. they spend for different mosquito control before and during COVID-19 (24.1%).

Most survey respondents 83.1% (69) reported that dengue fever was a serious problem in their community, however perceptions of DHF vulnerability decreased with the COVID-19 pandemic by 66.3% (55) (Table 1). About 8 residents reported that someone in their family/neighbor had been sick with dengue fever or chikungunya. All respondents were aware that dengue fever is

transmitted through mosquitoes. The implementation of dengue prevention in 27 respondents (32.5%) was different before and during the COVID-19 pandemic.

The most common mosquito control interventions carried out by respondents both before and during the COVID-19 Pandemic were checking for the presence of mosquito larvae, draining bathtubs, closing water reservoirs, using anti-mosquito lotion/burning repellent/spray, and changing water in flower vases/bird feed. While the use of mosquito nets was less widely used by the community (42.2%, n=35) and also the used of fish for ponds that are difficult to clean (61.4%, n=51).

Table 2. Mosquito control and dengue prevention strategies reported with eco-bio-social aspect by survey respondents (n = 83)

Mosquito Control and Dengue Prevention Strategies	%Household (n)	
	Before Pandemic Era	Pandemic Era
Drain the bathtub once a week	96.4% (80)	97.6% (81)
Closing existing water reservoirs	94.0% (78)	95.2% (79)
Managing trash	88.0% (73)	88.0% (73)
Manage/bury tires/used bottles in the environment around the house so they don't get flooded	74.7% (62)	83.1% (69)
Change the water in the flower vase/bird drinking water regularly at least once a week	85.5% (71)	86.7% (72)
Keeping fish in ponds that are difficult to clean	61.4% (51)	59.0% (49)
Not hang clothes	84.3% (70)	83.1% (69)
Use a mosquito net while sleeping in the morning	42.2% (35)	49.4% (41)
Using larvicides/Abate to kill larvae in water reservoirs	77.1% (64)	81.9% (68)
Use anti-mosquito lotion/burning repellent/spray if needed	94.0% (78)	95.2% (79)
Checking for the presence of mosquito larvae once a week at home / at residents' houses	98.8% (82)	96.4% (80)

DISCUSSION

Efforts to control dengue fever are still a top priority in Indonesia as a tropical country where geographically it is very suitable as a breeding ground for mosquitoes. Mosquito control in Indonesian community, especially in the lower middle class really needs attention because based on the results of a household survey, households spent about 1.5% of their income on mosquito control. Similar to the results of a study in Makala, Ecuador that people in densely populated suburbs also spend about 1.9% of their income on mosquito control (Lippi et al., 2021). Mosquito

control carried out by the people of Bandarharjo Village was by using mosquito burn repellent, lotion, spray, with a minimum application once a day.

Interventions to prevent dengue fever mosquitoes at the household level have actually been carried out in the Bandarharjo sub-district community, such as draining the bathtub, managing waste/used goods, not hanging clothes, and the community also become aware of the importance of checking the presence of mosquito larvae once a week at home or at neighbourhood (Asri et al., 2017). Chemical control is still high compared to natural control which also occurs in other areas in Indonesia where dengue is endemic. For example, the high percentage of people who used larvicides and use anti-mosquito repellent such as lotions, burning repellents and sprays to kill mosquitoes. The high demand/expenditure for mosquito control indicates that the density of mosquito vectors in Bandarharjo Village was still quite high. In addition, people were not aware yet of the advantages and importance of protecting themselves and their families by using mosquito nets when sleeping in the morning and evening, the importance of keeping fish as larvae eaters even though it is a healthier and more important way recommended by the government (Hassan et al., 2021).

Interventions that were easy to do, effective and safe for health in reducing the population of *Ae. aegypti* urgently needs to be immediately socialized and educated to the community, especially at the household level. This study can help guide the development of mosquito control strategies that are cheaper even without cost and safer for health and also the environment than chemical mosquito control which creates economic costs on households and can lead to resistance if used inappropriately. In addition, the strategy for implementing mosquito control must pay attention to economic limitations, namely related to expenditure costs, barriers and those that determine the success of control in the household such as the availability of information and the role of health workers/cadres and stakeholders closest to the household (Siyam et al., 2022, 2023). It has been found in research that economic limitations, lack of information, time constraints and changing roles of health workers/cadres and stake holders were factors that hold up preventing dengue mosquito vectors during the COVID-19 pandemic. Where based on the Edaran Direktur Jenderal Pencegahan Dan Pengendalian Penyakit kementerian kesehatan Number: HK.02.02/IV/2360/2020, concerning the Implementation of Prevention and Control of DHF in the COVID-19 Pandemic Situation from the government that dengue vector control in the house is carried out by residents of the house by carrying out eradication mosquito nests through the One Jumantik at a House

Movement with 3M Plus and indoor spraying with household pesticide products. So its success rests on the independence and ability of citizens to do it well.

The survey results showed that public knowledge about transmission of dengue hemorrhagic fever through mosquito bites was very high whether they have family/neighbors who have been exposed to dengue or not, and public perception was very high that dengue is a serious problem in the community. The results of other studies in Thailand, Malaysia and Venezuela have reported a direct relationship between knowledge about dengue prevention and prevention practices. Good knowledge and perception can be the main basic capital in the success of dengue control. However, public perception about the seriousness of dengue in the community during the COVID-19 pandemic has decreased. COVID-19 was a disease that has just emerged and causes high morbidity and mortality, so that public attention and expenses are also devoted to controlling covid, such as buying masks, hand sanitizer, etc. because of the nature of COVID-19 can spread quickly (Hassan et al., 2021; Siyam et al., 2021; Sommerfeld & Kroeger, 2012).

Evaluation of household knowledge, perceptions, and practices in densely populated suburbs/coastal areas was very important to improve integrated control measures and implement health education programs to address the problem of DHF. This study provides an important perspective on the control of *Ae. aegypti*, although the minimum sample size has not been met. This was because the number of residents who have mobile phones and also understand about filling out questionnaires through google forms is limited. The questionnaire form is distributed online via the WA link (whatsApp group) such as the PKK group, RT group, RW and Dasa Wisma because at the time of the study there were restrictions on community activities due to the COVID-19 emergency on 3 July 2021-20 July 2021. We chose our study location in Bandarharjo Village because this is an area with limited resources and has many health problems, as well as an unsanitary environment.

The results of a study in Machala Ecuador found that residents in the suburbs felt neglected by government institutions (Heydari et al., 2017). Residents with limited resources and economic levels needed special attention to prevent dengue fever and other mosquito-borne diseases in their families, especially during this COVID-19 pandemic. Otherwise, the community will spend more of their income on mosquito control which may be less effective that can actually be replaced by easy control interventions that don't even cost money. Such as carrying out environmental management actions and important behavior changes related to the prevention and control of DHF.

Environmental management actions and important behavior changes in dengue control programs have been shown to be effective in reducing the density of *Ae. aegypti*.

The advantage of this research is it can photograph how mosquito control expenditures were made during the COVID-19 pandemic in outskirts community groups who experienced a decrease in income and uncertain economic conditions. This can be evidence based by the government in controlling DHF during the COVID-19 Pandemic so people are not careless which causes an increase in DHF cases.

CONCLUSION

Dengue has a high health impact which can actually be prevented with primary control with eco-bio-social aspect, namely environmental management actions and behavioral implementation to prevent dengue. Information on prevention interventions, expenditures and barriers in controlling DHF was important for policy makers in the health sector in continuous and integrated DHF control, as well as determining appropriate control according to household characteristics.

Conflict of Interest

The author(s) declare that they have no conflict of interest.

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