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The impact of self-monitoring with larva monitoring calendar on larva knowledge, behavior, and density rates

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Abstract

Purpose: There has been neither medicine nor vaccine for Dengue Hemorrhagic Fever (DHF). Prevention is the key to fighting the disease, and vector control is the primary strategy for the prevention effort. This study aimed to test whether applying the Self-Monitoring Model using LMC could increase knowledge, reduce DHF risk behavior, and reduce the larval density rate. **Methods:** This research was conducted using a quasi-experimental method with the pre-post control design. The intervention was done by applying the Self-Monitoring Model using LMC for 3 months. The intervention and control groups each consisted of 2 types of residential, a village and a housing estate. A baseline survey and follow-up survey were conducted to determine changes in variables. The Mann-Whitney and Chi-Square tests were performed before and after intervention and between the experimental and control groups. **Results:** Implementing the Self-Monitoring Model using LMC could increase knowledge and reduce DHF risk behaviors but not reduce the larval density rate. The model requires good cooperation from Jumantik. Combination with Integrated Vector Management (IVM) is needed for program success. **Conclusions:** Applying the Self-Monitoring Model using LMC could increase knowledge and reduce risk behaviors of DHF, but it could not mitigate larval density rate.

Keywords: behavior; knowledge; larva density rate; larva monitoring calendar; self-monitoring

INTRODUCTION

Dengue Hemorrhagic Fever (DHF) is a vector-borne disease that is very easily transmitted. The disease was found in 1953 in the Philippines, Thailand, Indonesia, Myanmar, and Sri Lanka [1]. In 1970, it was only found in nine countries, yet it has become endemic in 100 countries, including Indonesia. According to WHO, Indonesia has recorded the highest number of DHF cases among Southeast Asia's countries from 1968 to 2009 [2]. There were 204,171 cases and 1,589 deaths in 2016. There was an increase in DHF cases in 2016, compared to 129,650 cases in 2015 [3]. This increasing trend of DHF also happens in Malang City, an area belonging to East Java Province. The city has witnessed three increases in DHF cases from 2014. The increases occurred in 2015, 2016, and 2019. There were 187 DHF cases in 2014, 298 cases (3 deaths) in 2015, and 464 cases (3 deaths in 2016). The cases tended to decrease in 2017 (105 cases) and 2018 (82 cases) [4]. However, an increase happened again in 2019 with 300 cases [5]. Sawojajar Urban Village is experiencing a significant rise in DHF cases yearly.

Efforts have been made to fight DHF, including developing vaccines. However, developing anti-Dengue Virus (DENV) vaccines has not been successful because the trials are limited to specific age groups. A big chance is open for developing tetravalent vaccines [6]. Vectrol control can become a strategy to fight DHF transmission, although some studies show no relationship between vector index and dengue transmission [7].

A successful vector control at the household level needs good coordination between community members, government institutions, and the private sector. The high House Index causes controlling containers, as a larva habitat, to be one of the behaviors that need improvement [8]. It is expected that Jumantik or Community-Based Larval Habitat Observers can change community behaviors to live cleaner and healthier. However, community members often need to be more cooperative with Jumantik. A previous study confirmed that 1% of the community members did not allow the researchers to check on places in their houses containing water and becoming a larva habitat. This finding was supported by Jumantik's responses through the Focus Group Discussion (FGD). As an alternative, another method is needed to monitor mosquito larvae, such as applying Kalender Pemantauan Jentik (KPJ) or Larval Monitoring Calendar (LMC); this method was also once proposed by a community leader in our FGD [9].

LMC provides pictures and information related to DHF. It also has a checklist that community members can use independently to record cleaning on places that may contain water and become a larva habitat in their houses. LMC uses a Self-Monitoring approach. Using a self-reported form, a trial involving respondents showed improvement in the fight against mosquitoes using a mosquito net [10]. Thus, we are interested in examining whether LMC, as a self-monitoring method, can also reduce DHF risks and improve knowledge on DHF by decreasing the existence of mosquito larvae at home or larval density rate.

METHODS

This study was a quasi-experimental or community intervention with a Controlled Before and After (CBA) design, specifically the Pre-Post with Control Design [11]. The intervention used the self-monitoring method employing LMC for 3 months in the selected households of a neighborhood (Rukun Warga – RW). Once a week, Jumantik would monitor and survey the filling of LMC on 50% of household samples. Once in two weeks, the assistant of the researchers would monitor Jumantik and survey the filling of LMC on 20% of household samples. Once a month, the researchers would monitor Jumantik and survey the filling of LMC on 10% of household samples. Jumantik would receive a little reward for assisting in this study. Baseline and follow-up surveys were done to examine whether the intervention affected behavior change related to DHF risks, knowledge of DHF, and larval density rate.

The study occurred in Sawojajar Urban Village, Kedung Kandang Sub-District, Malang City. We had two research groups: (1) the Control Group consisting of community members within a neighborhood (Rukun Warga – RW) that did not apply the Self-Monitoring Method (1 cluster from the village, 1 cluster from the housing estate), and (2) the Experimental Group consisting of community members within a neighborhood (Rukun Warga – RW) that applied the Self-Monitoring Method (1 cluster from the village, 1 cluster from the housing estate). Samples for the survey were chosen using a convenience sampling method. The sample size was determined using a formula for a limited population.

Our previous study had p=0.39, N=1,493, d=0.05, and α=0.05, and n=296 samples. The respondents were household members capable of providing information on their houses related to DHF. The two groups' sociodemographic factors (highest level of education of family members, occupation, respondent age, age of the youngest family member, occupant load density, and total income) were first analyzed to determine the similarity of initial conditions. The independent variable was the application of the self-monitoring model. In contrast, the dependent variable was knowledge about DHF, DHF risk behavior, the presence of larvae at home, and the larval density rate. DHF risk behaviors include several habits, including sleeping in the morning (08.00 - 12.00), sleeping in the afternoon (15.00 - 18.00), hanging clothes in the room (not a wardrobe), cleaning the tub at least once a week, littering well, closing the trash can, closing the clay barrel, using mosquito nets, and using anti-mosquito lotion or insect repellent. Knowledge of DHF includes an understanding of DHF, characteristics of mosquitoes, symptoms of DHF, first aid, and DHF prevention slogans of Draining, Closing, and Burying (Menguras, Mengubur dan Menutup – 3M).

The Mann-Whitney test compared the control and experimental groups' knowledge about DHF and DHF risk behavior. The Wilcoxon test compared knowledge and behavior before and after treatment. The Chi-Square test compared the presence of larvae between the control and experimental groups before and after treatment. The Spearman Correlation test analyzed the impact of the completeness of filling out KPJ forms on knowledge.

RESULTS

Sawojajar Urban Village covers an area of 18,125 hectares, located 250 above sea level (asl), and receives 1280 mm/year rainfall. The topography of this village is flat to choppy by 90%, with an average air temperature of 24-31° C. It has 118 RT and 16 RW, with a population density of about 4,066 inhabitants/km². Most residents subscribe to the local water company as a water source for their daily needs [12].

Baseline survey

Primary data was collected from 320 samples, with the following characteristics: the oldest respondents were 8s, the youngest were 15s, and the average age was 4s.

Most respondents were female (86%), and the highest frequency of respondents' last education was High School (41%). Table 1 compares sample characteristics before intervention. Table 1 shows that samples from both groups had the same attributes before intervention or treatment. However, the control group had better knowledge than the experimental group. Based on observations of 320 houses, larval-stage mosquitoes were found in 62 houses (19.4%). Some households refused to inspect several objects, and some houses had no objects to be inspected. The observation results are presented in Table 2.

The bathroom (13.8% had the most larval-stage mosquitoes, followed by containers for refrigerator wastewater, clay barrels, water dispensers, flowerpots, ponds, and waste of unused cans/bottles. The follow-up survey involved 319 respondents since we could not meet one respondent. The youngest respondent was 18 years old, and the oldest was 82 years old. The average age of respondents was 43.5 years old, with a median of 43 years old. Most respondents (272 or 83.5%) were female. The highest education background within the households was university graduates (171 or 53.6%), senior high school graduates (115 or 36.1%), junior high school graduates (23 or 7.2%), and one person did not even finish elementary school. The sample characteristics during the follow-up surveys were similar (Table 3). However, the behavior scores of the control and experimental groups were different.

Table 1. Sample characteristics before intervention (baseline survey)

Variable	(Mean± SD)		P-value
	Experimental group (n=150)	Control group (n=170)	
Average age	45.02 ± 13.76	42.73 ± 12.15	0.135
The average age of the youngest family members	12.83 ± 13.29	12.83 ± 13.42	0.729
Average total gross income of all family members	1.93 ± 0.932 mio	2.09 ± 0.971 mio	0.153
Average occupant load density	0.05 ± 0.03	0.05 ± 0.03	0.792
Average behavior score	3.82 ± 0.44	3.84 ± 0.59	0.422
Average knowledge score	9.25 ± 3.21	10.18 ± 3.42	0.015
% respondents with the highest education (High School - University)	54	67.6	0.072*
% of family members with the highest education level (High School - University)	88.7	95.3	0.168*
Larval density:			
House Index	20	18.82	
Container Index	6.58	7.25	
Breteau Index	21.33	21.17	

Note: The statistical test used is the Mann-Whitney test, except for those marked with the Pearson Chi-Square test

Table 2. Larval-stage mosquitoes found in some containers before intervention (baseline survey) (n=320)

Objects	Observation results							
	(+)		(-)		TD		TP	
	n	%	n	%	n	%	n	%
Bathroom	44	13.8	264	82.5	7	2.2	5	1.6
Water dispenser	4	1.3	79	24.7	1	0.3	236	73.8
Refrigerator wastewater container	7	2.2	180	56.3	7	2.2	126	39.4
Flower vase/flowerpot	2	0.6	59	18.4	0	0	259	80.9
Pool/aquarium	1	0.3	52	16.3	1	0.3	266	83.1
Clay barrel	5	1.6	126	39.4	3	0.9	186	58.1
Pet water dispenser	0	0	36	11.3	3	0.9	281	87.8
Others*	1	0.3	76	23.8	0	0	243	75.9

Note: (+) = Larva found; (-) = Larva not found; TD = Not allowed; TP = Not having the objects
*Waste or unused cans/bottles around the house

Table 3. Sample characteristics after intervention (follow-up survey)

Variable	(Mean±SD)		P-value
	Experimental (n=128)	Control (n=191)	
Average age	44.97 ± 12.89	42.96 ± 12.12	0.418
The average age of the youngest family members	12.75 ± 15.58	12.82 ± 14.07	0.077
Average total gross income of all family members	1.9 mio ± 0.97	1.87 mio ± 0.878	0.665
Average occupant load density	0.06 ± 0.06	0.05 ± 0.03	0.241
Average behavior score	3.84 ± 0.50	3.95 ± 0.62	0.01
Average knowledge score	8.53 ± 4.02	8.23 ± 3.38	0.681
% respondents with the highest education (High School - University)	63.3	71.6	*0.278
% of family members with the highest education level (High School - University)	85.9	92.7	*0.220
Larval density:			
House Index	18.4	15.18	
Container Index	7.56	7.98	
Breteau Index	21.6	22.51	

Table 4. Larval-stage mosquitoes in some objects after intervention (follow-up survey) (n=319)

Objects	Positive (+)		Negative (-)		TD		TP	
	n	%	n	%	n	%	n	%
Bathroom	40	12.5	262	82.1	14	4.4	3	0.9
Water dispenser	2	0.6	92	28.8	3	0.9	222	69.9
Refrigerator wastewater container	11	3.4	154	48.3	18	5.6	136	42.6
Flower vase/flowerpot	2	0.6	22	6.9	0	0	295	92.5
Pool/aquarium	1	0.3	39	12.2	2	0.6	277	86.8
Clay barrel	3	0.9	123	38.6	3	0.9	190	59.6
Pet water dispenser	0	0	46	14.4	2	0.6	271	85
Others*	5	1.6	49	15.4	2	0.6	263	82.4

Note: (+) = Larva found; (-) = Larva not found; TD = Not allowed; TP = Not having the objects
*Waste or unused cans/bottles around the house

Table 5. Differences in behavior, knowledge, and the existence of larval-stage mosquitoes before and after intervention in the experimental and control groups

Variable	*P-value*			
	Experimental vs. Control		Before vs. After	
	Before intervention	After intervention	Control	Experimental
Morning naps (08.00 - 12.00)	0.622	0.003*	0.177	0.031*
Afternoon naps (15.00 - 18.00)	0.971	0.526	0.496	0.282
Hanging clothes in the room (not the wardrobe)	0.417	0.687	0.018*	0.022*
Cleaning the tub at least once a week	0.233	0.134	0.004*	0.019*
Littering well	0.652	0.309	0.483	0.034*
Closing the trash can	0.350	0.019*	0.028*	0.674
Covering the clay barrel	0.410	0.212	0.477	0.811
Using mosquito net	0.076	0.007*	0.019*	0.382
Using other methods***	0.560	0.374	0.157	0.002*
Knowledge	0.015*	0.681	0.000*	0.009*
Existence of larval-stage mosquito	0.901**	0.549**	0.435**	0.856**

Note: *significant, the statistical test used is Mann Whitney except those marked; **using the Chi-Square test; ***anti-mosquito lotion/mosquito repellent/ mosquito racket; Exp = experimental group; Cont = control group

Table 3 also shows that the House Index for both groups decreased slightly after the intervention compared to before. However, other indexes did not decrease. Three of the 319 households did not allow observation, so we observed only 316 households. We observed larval-stage mosquitoes in 16.5% of households but not in 83.5%. Table 4 presents the data on larval-stage mosquitoes on each object in the house that could contain water. Table 5 presents the role of LMC in decreasing the risk of DHF and increasing related knowledge.

Before the intervention, the experimental group differed from the control group in terms of knowledge about DHF. However, after the intervention, the experimental group differed from the control group regarding sleeping habits, closing the trash can, and using mosquito nets. The number of significantly different variables increased from one to three. Knowledge, a significantly different variable before the intervention, became insignificant after the intervention. In this case, initially, the understanding of the control group was slightly better than that of the experimental group.

However, knowledge was similar between the control and experimental groups after the intervention. Tables 1 and 3 also show that the behavioral score slightly increased after the intervention, but both groups' knowledge scores decreased. This was probably because the respondents were different people living in the same home. This includes difficulties maintaining the same respondents before and after the intervention because of their high mobility.

The significant variables before and after the intervention in the control group were hanging clothes, cleaning the tub in the bathroom at least once a week, closing the trash can, using mosquito nets, and knowledge. In the experimental group, the significant variables were the habit of morning naps, hanging clothes, cleaning the tub in the bathroom at least once a week, littering well, using mosquito repellent lotion/mosquito repellent/mosquito racket, and knowledge. Several variables that were not significant in the control group but significant in the experimental group were the habit of morning naps, littering well, and using mosquito repellent lotion/mosquito repellent/mosquito racket. On the other hand, some significant variables in the control group but not significant in the experimental group were closing the trash cans and using mosquito nets.

Overall, the experimental group had significantly different variables before and after the intervention. Several variables that showed significant differences in the control and experimental groups were hanging clothes, cleaning the tub in the bathroom, and knowledge. The knowledge variable was substantial, yet the significance value decreased because having the same respondents before and after the intervention was difficult. Of the 150 households in the experimental group, 128 (40.1%) received LMC, and the rest did not accept it. Thus, 191 households, including the control group, did not apply for or complete LM. Only 13 households (10.2%) completed it entirely as instructed. Table 6 illustrates LMC performance from the perspective of respondents.

Table 6. LMC performance from the perspective of respondents (n=128)

	Strongly agree		Agree		Neutral		Disagree		Strongly disagree	
	n	%	n	%	n	%	n	%	n	%
Easy filling	44	34.4	59	46.1	12	9.4	11	8.6	2	1.6
Complete information or messages	33	25.8	73	57.0	17	13.3	5	3.9	0	0
Attractive pictures	38	29.7	76	59.4	12	9.4	2	1.6	0	0
Attractive color	39	30.5	75	58.6	12	9.4	2	1.6	0	0
Easy-to-read font types and sizes	27	21.1	76	59.4	11	8.6	13	10.2	1	0.8
Interesting design	32	25.0	76	59.4	14	10.9	5	3.9	1	0.8
Design/size suitable for home use	27	21.1	82	64.1	9	7.0	9	7.0	1	0.8
Very needed	37	28.9	65	50.8	18	14.1	6	4.7	2	1.6

The Spearman correlation test shows that the percentage of filling in LMC significantly relates to knowledge about DHF. However, the relationship is weak, with r=0.240 (p=0.006). These results indicate that the higher the percentage of completeness in filling out LMC, the higher the user's knowledge levels.

DISCUSSION

Before the treatment, sociodemographic characteristics, larval density, and average behavioral scores differed between the experimental and control groups. A significant difference was found in the knowledge variable. This might be because the percentage of respondents and family members with higher education was more important in the control group than in the experimental group. Meanwhile, after treatment, the behavioral score was significantly different.

The baseline and follow-up surveys confirmed that the bathroom was the primary larval habitat, as revealed by previous research in Malang Raya [13]. Some families have more than one bathroom. Bathrooms not allowed to be observed during our study were generally private or highly private.

The critical finding in this study is that self-monitoring using LMC has yet to improve knowledge. However, it has successfully changed the habits of morning naps, hanging clothes, cleaning the tub at least once a week, littering well, closing the trash can, using mosquito nets, and using mosquito repellent lotion/mosquito repellent/mosquito racket. The habits of hanging clothes and using mosquito repellent are significantly correlated with DHF cases in Semarang [14].

Another Aceh study mentions that cleaning the tubs or any water containers is correlated considerably with DHF [15-16]. A survey in Aceh mentions that LMC could also improve knowledge, attitude, and behavior related to larval-stage mosquito monitoring. However, the study only involved a few samples and included other interventions besides LMC. Thus, it cannot be confirmed whether decreasing larval density rates were caused by the self-monitoring effort using LMC.

The intervention in this study could not significantly decrease larval density. This result is similar to a survey in Yogyakarta on the use of LMC. The study confirms no significant difference in larval-positive containers and houses after using LMC. The low respondent participation in filling out LMC, which was only 10%, may have caused this result. This number is smaller than in Yogyakarta's study, which was 28.3% [17].

The low community participation in filling out LMC may be due to Jumantik's low quality and quantity of work. This is in line with the study in Semaran, which mentions that Jumantik has yet to conduct the survey according to the procedure and play its role well. Remembering that we are now in the 4.0 Industrial Revolution Era, other technological methods, like an independent online survey, may be more suitable.

The community may need to familiarize itself with conducting independent larval-stage monitoring and recording the results using LMC. Although people have become accustomed to surveying independently, they have yet to record their findings; some rarely conduct independent larval-stage monitoring. Adopting this self-monitoring intervention requires several steps: activating change, implementing specific information areas of education and self-monitoring, developing skills, obtaining environmental resources, and building social support [18].

Surveys are one way to measure community health behavior. Observing and measuring community behavior is necessary for program planning and evaluation [19]. However, sometimes, self-monitoring results can also overrepresent actual conditions; respondents may claim to have taken several preventive actions, even though they only take one. Although there are concerns that self-monitoring will overrepresent preventive behavior data, if carried out properly, it can serve as a reminder and encouragement for the community to improve its behavior. Improvements in behavior without being preceded by enhancements in knowledge show that sometimes people behave in specific ways without expertise. This contradicts the Precede-Proceed Planning Model, which states knowledge underlies behavior [20].

Other findings reveal that sometimes Jumantik receives false-negative observation results compared to our observations or those of our assistant. This also happens in Semarang [21], confirming that survey data from Jumantik needs to be more accurate. Jumantik is mostly female and is formally tasked with monitoring larval-stage mosquitoes.

All community members must be informed about DHF prevention efforts. Religious leaders, community leaders, and health centers are essential in building cooperation to fight DH and F in Pakistan [22]. The low involvement of Jumantik and community figures in preparing LMC may also contribute to the results of the self-monitoring effort. Combining bottom-up and top-down approaches is indispensable for the urban community to reach settlements and public facilities legally [23].

Most respondents showed a good appreciation for LMC (table 6), yet only a few filled it (10.2%); this might cause an insignificant decrease in larval density in this study. Everett Rogers mentions that theoretically, to ensure the success of an effort, five community groups needed to be involved in adopting the new method: early adopters, innovators, early majority, late majority, and the resistant remainder [24]. Jumantik can act as collaborators who conduct regular visits and follow up on the behavior of community members. Thus, Jumantik can become an intermediary agent to support the success of health centers' programs [25].

This study uses LMC as an educational medium and monitoring tool to change community behavior. Its results align with research in Bandung, which also uses calendars as an education and monitoring tool [25]. Research in Cuba also shows that a community-based environmental management approach is better than conventional methods (entomological surveillance, killing adult mosquitoes, destroying mosquito nests, and health education) [18]. WHO developed Integrated Vector Management (IVM) as a strategic approach to vector control. IVM has five key elements in the management process: a) advocacy, social mobilization, and legislation; b) collaboration with the health sector and other sectors; c) an integrated approach to disease control; d) evidence-based decision-making; e) capacity-building [26]. In this case, the role of the community becomes crucial. Models to increase community participation in dengue prevention will always be relevant to social, cultural, and technological developments.

CONCLUSION

The self-monitoring model using the larval monitoring calendar (LMC) can reduce the risk of behavior fever, but it has not succeeded in lowering larval density or increasing knowledge. However, better LMC completion represents a higher level of expertise—this model requires Jumantik's high surveillance to monitor community members' implementations. Future research can combine integrated vector management (IVM) and self-monitoring models to obtain more significant knowledge about behavior and larval density changes. In addition, the next trial should consider using online surveys.

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