IMPLEMENTATION OF A LARVAL AND PUPAL SOURCE REDUCTION PROGRAM (LSRP) FOR THE PREVENTION AND CONTROL OF DENGUE HAEMORRHAGIC FEVER (DHF) IN A COMMUNITY IN KRABI PROVINCE, THAILAND

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ABSTRACT: Dengue hemorrhagic fever (DHF) is a major public health problem in Krabi Province, Thailand. A quasi-experimental study was designed and conducted to assess the effectiveness of the newly-developed Larval and Pupal Source Reduction Program (LSRP) for the prevention and control of DHF in four villages in Plaipraya District, Krabi Province. Ninety students and ninety housewives were enrolled in this study using a simple random sampling method and then equally divided into 2 experimental and 2 control groups. The experimental groups were trained through a 3-day LSRP course in the village. Quantitative data from questionnaires were collected before and after the experiment. Knowledge, perceived susceptibility, self-efficacy, and regular larval survey practices were measured. Container Index (CI), House Index (HI), Breteau Index (BI), and Pupae Index (PI) as larval indices were used to measure the program outcomes. Monthly meetings of the groups of participants in the selected villages were used to share experiences. Repeated measure analysis of variance within-subjects factors was used to evaluate the differences in all dependent variables: knowledge, perceived susceptibility, self-efficacy, behavioral practices, HI, CI, BI, and PI, for each group, for four follow-up times of three-month assessment including the baseline session. The results revealed that 51.1% of the student group was female, with an average age of 13.62, whereas for the housewife group, it was 37.58 years. The data analysis of the pre-intervention surveys showed that there were no significant differences in the means for knowledge, perceived susceptibility, self-efficacy, behavioral practice in DHF prevention and control, HI, CI, BI, and PI ($p>0.05$) for both experimental groups. After the implementation of LSRP for three months, the results indicated that the knowledge, perceived susceptibility, self-efficacy, and behavioral practices in the experimental village for both students and housewives were significantly higher (*p-value* =0 .001) for all four outcome variables compared to the control village. The CI, BI, and PI determined after the implementation of LSRP in the housewife group were significantly lower, with *p-values* of 0.005, 0.005, and 0.05, respectively, than those in the control group, and there were no significant differences in HI between the groups. The CI and PI in the student group were significantly lower (*p-values* of 0.037 and 0.004 respectively), than those for the control groups, while there was no significant differences in HI and BI between the groups. Significant improvement in knowledge, perception, self-efficacy, and larval survey practice scores were achieved for the experimental groups of both students and housewives. CI, BI, and PI decreased and were lower than for the baseline data. This study shows that the LSRP appeared to be effective in improving knowledge, perception, self-efficacy, and larval survey practice scores, which, in turn, decreased the CI, BI, and PI. The results of this study suggest that public health intervention programs like LSRP could improve DHF prevention and control in Thai villages.

Keywords: Dengue Hemorrhagic Fever (DHF), Larval and Pupael Source Reduction Program (LSRP), Housewife, Pupae Index (PI), Breteau Index (BI)

INTRODUCTION

In Thailand, dengue has been a significant public health problem for the past forty years. The effectiveness of dengue treatment has improved but the mortality rate is still higher than the Ministry of Public Health's disease standard. In 1987, a major epidemic occurred in which the highest incidence of 174,285 cases and 1,241 deaths were recorded [1, 2]. From 1990 to 1996, the number of DF/DHF

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cases reported has been declining every year, to approximately 40,000–60,000 cases a year [3]. In the past five years, DHF has mainly affected the younger age-group (less than 15 years), with the highest number of cases occurring in the 5-9 year age-group, followed by the 10-14 year age-group [3]. The proportion of cases in the fifteen and over age-group has increased significantly from 20% to 30% during this same time period [3, 4]. The disease now needs to be monitored and further investigated because the concept of seasonal variation been questioned because the DHF outbreaks in 1997-1998 not only occurred in the rainy season but also throughout the year; in addition, there seemed to have been a shift in the age-groups affected from younger people to older people [5, 3]. Efforts to control the mosquito vector in Thailand have not been effective although most efforts and financial resources are still directed at the chemical control of *Aedes Aegypti*. Unfortunately none of the adult mosquito control methods used has had any impact on disease transmission and therefore DHF still remains a serious problem in the country [6].

The solution for dengue, which is a serious health threat, must be a community-based approach due to several factors. Previously, a new paradigm for changing its epidemiology involved a community-based program to identify such elements as setting, target, agents, and resources for intervention, but this program was not very successful because it lacked sustainability [7]. Since the students in the study village had some basic knowledge about DHF, they are important because they could convince their parents and other family members to control and prevent DHF [8]. Members of the housewife group usually are concerned about the safety of their family members, especially their children, since the latter are in the leading risk group for DHF. Due to the nature of the duties of housewives, they usually have enough free time to take care of their local village environment which is beneficial because it reduces the risk of DHF infection [9]. Sustainability is measured differently based on the specific situation. In this study, the success of community-based dengue prevention and control is defined as the successful outcome of community capacity building for dengue prevention and control and is measured by the improvement in knowledge, perception, and practices for dengue prevention and control [10], the housing environment, larval indices, consisting of the Breteau Index (BI), House Index (HI), Container Index (CI), and Pupae Index (PI), and the epidemiology index for the morbidity rate and mortality rate of dengue. To achieve sustainability, community capacity building is a necessary intervention process which increases a community's competence to define, analyze, evaluate, and act on the health concerns of its members. It is not only concerned with the large-scale prevention and control of communicable diseases, but is also focused on individual protection within communities. Community capacity building, community capacity, and the community capacity domains are related. Community capacity is the ability to conduct anti-dengue efforts, whereas the domains of community capacity are based on specific situations or areas. The domains of dengue community capacity are defined for this study as a set of characteristics relating to dengue prevention and control undertaken by housewives and students in the community. To achieve this short training program may help in the control of DHF in the villages and this concept was experimented in our study to know if it is effective.

The objectives of this study were: (1) to study the change in knowledge, perception, and self-efficacy regarding the prevention and control of DHF among students and housewives after the Larval and Pupal Source Reduction Program (LSRP) implementation; (2) to study the change in larva survey practices in the prevention and control of DHF among the students and housewives after LSRP implementation; and (3) to assess the House Index (HI), Breteau Index (BI), Container Index (CI), and Pupae Index (PI) in the experimental and comparison groups after implementation of the LSRP program.

MATERIALS AND METHODS

A quasi-experimental study was conducted in Plaipraya district, Krabi province among housewives and students. They were divided into a total of 4 groups- 2 experimental group (student and housewife) and 2 control or comparison group (student and housewife). Four villages with high DHF incidence rates [11] were selected using purposive criteria as the two experimental and two comparison areas. The Banghean village was the experimental area and Pak-nam village was the control area for the student group, whereas Na-suan village was the experimental area and Pak-ya village was the control area for the housewife group. All four target villages had similar population, numbers of households, DHF incidence rates, house index (HI), and container index (CI) and were under the Plaipraya District Public Health Office.

The sample size was calculated for the hypothesis

to test the difference in means for the experimental design in case $\sigma_1^2 \neq \sigma_2^2$ or Heteroscedastic Variance [12], for continuous variable to estimate sample size *n* was calculated as:

$$n=\frac{\left(Z_{\frac{\alpha}{2}}+Z_{\beta}\right)^2\times(\sigma_1^2+\frac{\sigma_2^2}{c})}{(\mu_1-\mu_2)^2}$$

Where $n = n_1$ and $n_2 = c\ n$ when $c = \frac{n2}{n1}$, n = the sample size of each group when $n_1 = n_2 = n$, μ_1, μ_2 = the mean for each group [3], σ_1^2, σ_2^2 = the variance of each group [3], at the 5% significant level, (1- α) = 95%, α = 0.05, $Z_{\frac{\alpha}{2}}$ = 1.96, (1-β) = 95%, Z_β = 1.645, σ_1 = 2.21, σ_2 = 4.31, $\mu_1 - \mu_2$ = 2.78, c = 1, (n+10%), n = 39.45 + 5 = 45.

A total of 180 participants (45 in each of the 4 groups) were selected using a simple random sampling technique. Prospective members of the housewife group were required to have resided in their respective community for more than 6 months, be aged between 20-50 years old, able to read and write, and had no plans to move out of the village during the study period. Among the student members both males and females were included, had to be in secondary school level 2 or 3 (Grade 8 and 9), able to read and write, have lived in their village for at least 6 months, and had no plans to move out of the village during the study period. The participants had been informed that they have the right to refuse to participate in the study and can withdraw anytime. Informed consent was provided by the participants and study was approved by the ethics committee of Chulalongkorn University.

Quantitative data were collected at baseline in all the groups. Data was collected in intervals of I month (1st, 2nd and 3 rd month) before and after, as well as during the intervention. The research support team consisted of 5 village health volunteers (VHVs) from each of the four study areas whose duties were to carry out dengue prevention and control activities.

The study involved:

Dengue community-capacity assessment tool

Interview questionnaire

The questionnaire was developed by the research team and the reliability was tested using quantitative methods on 68 randomly selected household members from a nearby village in the experimental area. The Cronbach's alpha coefficient value was 0.747. The survey consisted of five parts: (1) socio-demographic information; (2) knowledge regarding DHF; (3) perceived susceptibility to DHF; (4) self-efficacy in DHF; and (5) behavioral practices to prevent and control DHF.

Larval Record Survey Form

The Larval Record Form, from the Department of Disease Control, Ministry of Public Health [1, 2] was used in this study. The study subjects were asked to record the number of mosquito breeding sites they inspected by type and the number infested with larvae. The larval survey forms were completed on a monthly basis and the results were used to motivate the study subjects to perform larval surveys and to control mosquito breeding sites regularly and continuously.

Intervention

A Larval & Pupal Source Reduction Program (LSRP) was initiated in this study in order to control and prevent DHF. This was a continuing education process to empower the housewives and the students through their active participation. The participants, both students and housewives, attended asynchronous, 3-day-intervention group courses. The curricular activities included a lecture on how to prevent and control DHF, environmental methods to control *Aedes aegypti*, and man-vector contacts.

LSRP features

The program consisted of a 3 day training of the participants in the intervention group to enable them to gain knowledge about DHF, self efficacy, about the and involved teaching sessions, Most of the activities involved group discussions, teaching, sharing experiences, and a summary was provided at the end of session.

Day 1: Focused on dissemination of health knowledge about DHF: Participants learnt about the cause, epidemiology, signs and symptoms, as well as how to prevent and control DHF, danger of (DHF) including susceptibility, severity, and impact of DHF on their family and community.

Day 2: Focused on changing perceptions on the costs and benefits of prevention and controlling or destroying *Aedes aegypti* mosquito breeding places. Participants learnt about the benefits of eradicating DHF in their community by using environmental methods to control *Aedes aegypti*, and to reduce main-vector contacts by source reduction, solid waste management, and modification of man-made breeding sites.

Day 3: Focused on the breeding sites of Aedes aegypti mosquito and in this session the participants developed skills to survey the larvae of *Aedes aegypti* and also practiced the same.

Monthly meetings were conducted to share experiences, problems, and obstacles concerning the implementation of the LSRP within their groups.

Table 1 Socio-demographic characteristics of the study participants (*p-value* for group comparisons)

General information	Study participants					
	Housewife group		*p-value*	Student group		*p-value*
	Intervention n=45(%)	Control n=45(%)		Intervention n=45(%)	Control n=45(%)	
Sex			-			.527
Male	-	-		24 (53.27)	20 (44.44)	
Female	45 (100)	45 (100)		21 (46.63)	25 (55.56)	
Average age	37.58 (±7.27)	35.21 (±5.99)	0.104*	13.62 (±1.007)	13.31 (±.557)	.074*
Marital status			-			-
Single	-	-		45 (100)	45 (100)	
Married	45 (100)	45 (100)		-	-	
Education			.032			-
Primary	30 (66.67)	23 (51.06)		-	-	
Secondary	12 (20.66)	22 (48.84)		45 (100)	45 (100)	
Vocational	3 (6.67)	0		-	-	
Occupation			.012			-
Student	-	-		45 (100)	45 (100)	
Unemployed	1 (2.22)	0		-	-	
Housewife	31 (68.82)	42 (93.23)		-	-	
Un-skill labor	13 (28.86)	3 (6.67)		-	-	
Average income	14155.56 (±8673.25)	11155.56 (±4934.59)	.047*	10766.67 (±5259.84)	9377.78 (±3516.45)	.145*
Source of DHF information			.039			.271
Neighbors	2 (4.44)	8 (17.75)		0	3 (6.67)	
VPV	34 (75.47)	24 (53.27)		24 (53.27)	25 (55.56)	
PHO	4 (8.88)	10 (22.21)		10 (22.22)	10 (22.22)	
TV	5 (11.11)	3 (6.67)		11 (24.41)	7 (15.55)	
Social status			.483			-
Community Committee Member	10 (22.22)	5 (11.11)		-	-	
Village Public Health Volunteer	6 (13.32)	7 (15.54)		-	-	
Community Club Member	5 (11.11)	8 (17.76)		-	-	
Other	24 (53.28)	25 (55.56)		45 (100)	45 (100)	
Community meeting			197**			.826
Yes	42 (93.24)	37 (82.14)		30 (66.67)	28 (62.16)	
No	3 (6.67)	8 (17.76)		15 (33.33)	17 (37.74)	
DHF History of household members			.029**			.800
Yes	41 (91.02)	32 (71.04)		34 (75.48)	36 (79.92)	
No	4 (8.88)	13 (28.86)		11 (24.42)	9 (19.98)	
Chemical spraying in the village			.045			.739**
Yes	15 (33.33)	6 (13.32)		6 (13.32)	4 (8.89)	
No	30 (66.67)	39 (86.58)		39 (86.58)	41 (91.01)	

Chi square test, *: Independent t-test, **: Fisher's Exact Test

Table 2 Comparing of outcome variable of the baseline data between intervention and control area

Variables	Study participants					
	Housewife group			Student group		
	Intervention	Control	*p-value*	Intervention	Control	*p-value*
	$\bar{x}$(S.D.)	$\bar{x}$(S.D.)		$\bar{x}$(S.D.)	$\bar{x}$(S.D.)	
Knowledge	12.47 (±1.42)	12.40 (±.986)	.797	10.87(±1.66)	11.40(±1.39)	.102
Perceived Susceptibility	33.51(±2.99)	34.56(±2.11)	.059	31.69(±2.20)	33.64(±2.33)	<.001
Self-efficacy	25.89(±3.82)	27.09(±4.08)	.154	25.31(±2.31)	25.69(±2.88)	.495
Practices	21.31(±2.05)	22.58(±2.57)	.011	19.16(±1.52)	19.27(±1.49)	.728
HI	95.56(±14.39)	93.33(±17.19)	.508	96.67(±12.61)	95.56(±14.39)	.698
CI	27.23(±7.59)	26.07(±5.09)	.398	26.29(±6.69)	25.46(±5.93)	.533
BI	290.00(±88.29)	280.00(±72.61)	.559	303.33(±94.39)	277.78(±62.66)	.134
PI	186.67(±65.19)	182.22(±76.24)	.767	178.89(±67.83)	162.22(±53.47)	.199

: Independent t- test

Assessment

Data were collected at baseline and 3 times after the LSRP intervention at 1 month, 2 month and 3 month using the interview questionnaire and mosquito larval survey

Data Analysis

Descriptive statistics, comprising the percentage, mean ($\bar{x}$), and standard deviation (S.D.) were calculated for the socio-demographic characteristics, source of DHF information, social status, community meeting status, DHF history of household member, and chemical spraying in the village (independent variables), and knowledge, perceived susceptibility, self-efficacy, behavioral practices in relation to prevention and control, and the HI, CI, BI, and PI (dependent variables) between the intervention and control areas in both groups. Independent t-tests were used to compare the continuous data between groups while the Chi-square test was used to examine the relationship between the categorical variables.

Inferential statistics

The effects of intervention on the scores were assessed at three points during the study: one month, two months, and three months after the intervention in each group. At each subsequent evaluation point, the effect size of the intervention was measured with a difference-of-difference analysis using the equation:

$$\textit{Intervention effect} = (\text{mean score at follow-up} - \text{mean score at baseline})_{\text{intervention}} - (\text{mean score at follow-up} - \text{mean score at baseline})_{\text{control}}.$$

A linear mixed model analysis was constructed to test the statistical significance of the intervention effect at each follow-up time. Unadjusted fixed-effects models included the main effects of intervention at each follow-up time and the intervention-time interactions for each follow-up time for each group. In these models, the interaction terms are equal to the intervention effects at the 3 follow-up times. A "repeated" statement, with an unstructured covariance type, was included to adjust for repeated within-subject measurements of outcomes at different times [13].

RESULTS

Baseline data of the student groups in the experimental and control areas showed no significant differences in age (13.62 ± 1.007 vs. 13.31 ± 0.56 years-old) and income (฿10,766.67 ± 5259.84 vs. ฿9,377.78 ± 3516.45). There were no significant differences in gender, the main source of DHF information, the participation in the community meetings, the DHF cases in the household and the chemical spraying in the village (Table 1). In addition, there were no significant differences in the mean knowledge, self-efficacy, behavioral practice in DHF prevention and control, HI, CI, BI, and PI with p > .05 (Table 2).

In the experimental and control areas of the housewife group, the baseline data showed no significant differences, between the groups in age (37.58 ± 7.27 vs. 35.21 ± 5.99 years-old), social status, and participation in the community meetings. There were also no significant differences in knowledge, perceived susceptibility, self-efficacy, HI, CI, BI, and PI with p > .05. The remaining categories, average income, education level, occupation, DHF cases in the household, the chemical spraying in the village, and the mean of behavioral practices in DHF prevention and control showed significantly differences with p= .047, .032, .012, .045, and .011 respectively (Table 1 and Table 2).

However, at three months after the implementation of the LSRP and after adjusting the mean differences for repeated measurement time and confounding factors (like income, age, occupation) by linear mixed model analysis, the results revealed that the LSRP had improved in several key-categories. In the student group, the differences between baseline and after 3 months of LSRP, there were significant differences in the student experimental group in the mean in variables like knowledge (95% CI 1.13 to 2.33, p <.001) , perceived susceptibility (95% CI 3.76 to 5.79, p <.001) , self-efficacy (95% CI 0.49 to 2.61, p <.001), and behavioral practices (95% CI 1.67 to 3.34, p <.001) compared to those in the control area. In addition, the mean differences in CI was -4.07 (95% CI (-7.88) to (-0.26), p <.001) and PI was -47.78 (95% CI (-79.77) to (-15.79), p <.001) and these were significantly lower than in the control group (Table 3).

In the housewife group, the differences between baseline and after three months of LSRP showed significant differences in mean for knowledge (95% CI 0.32 to 1.19, p = .001), perceived susceptibility (95% CI 1.35 to 3.54, p <.001), self-efficacy (95% CI 1.28 to 3.96, p <.001) and behavioral practices (95% CI 2.91 to 5.31, p <.001) respectively. These are also significantly higher than those control group, where the CI mean differences were -5.35 (95% CI (-9.06) to (-1.64), p =.005), the BI mean differences were -55.56 (95% CI (-94.05) to (-17.06), p = .001), and the PI mean differences were -33.33 (95% CI (-66.72) to (0.05), p =.050). These are significantly lower than for the control group (Table 4).

Table 3 Comparing of outcome variable of repeated measure between intervention and control area of student group

Variables	Follow-up one			Follow-up two			Follow-up three		
	Intervention	Control	*p-value*	Intervention	Control	*p-value*	Intervention	Control	*p-value*
	$\bar{x}$(S.D.)	$\bar{x}$(S.D.)		$\bar{x}$(S.D.)	$\bar{x}$(S.D.)		$\bar{x}$(S.D.)	$\bar{x}$(S.D.)	
Knowledge	12.91(±.848)	12.33(±.826)	<.001	13.42(±.965)	12.58(±.657)	<.001	13.78(±.823)	12.58(±.543)	<.001
PS*	34.76(±2.28)	34.69(±1.58)	<.001	37.44(±1.88)	35.02(±1.71)	<.001	38.16(±1.99)	35.33(±1.55)	<.001
Self-efficacy	27.18(±2.29)	26.11(±2.71)	.003	27.49(±1.78)	26.20(±2.52)	<.001	27.87(±1.58)	26.69(±2.05)	.004
Practices	22.98(±1.60)	20.73(±1.94)	<.001	23.64(±1.51)	21.40(±1.47)	<.001	24.53(±1.69)	22.13(±1.49)	<.001
HI	95.56(±14.39)	95.56(±14.39)	.320	94.44(±15.89)	94.44(±15.89)	.562	91.11(±24.52)	95.56(±14.39)	.092
CI	22.97(±6.89)	23.41(±4.14)	.355	24.02(±5.19)	25.68(±6.07)	.146	23.68(±8.57)	26.91(±6.54)	.037
BI	268.89(±89.37)	266.67(±59.35)	.106	278.89(±79.41)	285.56(±77.33)	.085	282.22(±98.95)	300.00(±81.88)	.053
PI	174.44(±80.21)	171.11(±66.13)	.411	140.00(±71.98)	171.11(±61.69)	.003	145.56(±76.74)	176.67(±63.60)	.004

: Mixed model analysis, *: Perceived Susceptibility

Table 4 Comparing of outcome variable of repeated measure between intervention and control area of housewife group

Variables	Follow-up one			Follow-up two			Follow-up three		
	Intervention	Control	*p-value*	Intervention	Control	*p-value*	Intervention	Control	*p-value*
	$\bar{x}$(S.D.)	$\bar{x}$(S.D.)		$\bar{x}$(S.D.)	$\bar{x}$(S.D.)		$\bar{x}$(S.D.)	$\bar{x}$(S.D.)	
Knowledge	12.98(±.988)	12.56(±2.23)	.046	13.20(±.869)	12.62(±.576)	.007	13.64(±.883)	12.82(±.777)	.001
PS*	34.67(±2.23)	34.69(±1.58)	.001	35.29(±1.93)	34.98(±1.55)	<.001	37.04(±2.04)	35.64(±1.59)	<.001
Self-efficacy	26.22(±3.04)	26.11(±2.71)	.015	28.13(±2.17)	26.51(±2.67)	<.001	28.42(±1.79)	27.00(±2.08)	<.001
Practices	22.96(±1.71)	22.64(±1.82)	<.001	26.29(±1.34)	23.53(±1.50)	<.001	27.24(±1.51)	24.40(±1.75)	<.001
HI	95.56(±14.39)	93.33(±17.19)	1.00	95.56(±14.39)	93.33(±17.19)	1.00	93.33(±20.23)	93.33(±17.19)	.320
CI	24.84(±4.97)	24.54(±4.24)	.456	23.42(±6.64)	25.21(±5.19)	.020	18.86(±7.81)	23.05(±5.24)	.005
BI	277.78(±72.74)	268.89(±58.67)	.929	252.22(±81.85)	272.22(±75.79)	.031	206.67(±95.11)	252.22(±76.09)	.005
PI	173.33(±64.49)	134.44(±58.21)	.008	156.67(±86.34)	142.22(±54.31)	.561	108.89(±72.53)	137.78(±57.56)	.050

: Mixed model analysis, *: Perceived Susceptibility

DISCUSSION

Based upon our preliminary results after a 3-month implementation of the LSRP, there were significant improvements in knowledge, perception, self-efficacy, and larval survey practices for both student and housewife groups in the experimental areas when compared to the control areas. The individual level variables like behavioral practices, education, occupation, source of DHF information, DHF history of household member, and chemical spraying in the village of the housewives group, and the perceived susceptibility in the student group at the beginning of the study had significant differences. However, when analyzed using a mixed model analysis method with the variables as covariates, it was found that they were no significant differences between the groups. Therefore, it can be concluded that the behavioral practices in the housewife group and the perceived susceptibility in the student group did not affect the results.

After the implementation of the LSRP, the outcome variables like knowledge regarding DHF, perceived susceptibility to DHF, self-efficacy in the control of mosquito breeding sites, and larvae survey practices were significantly better in the experimental areas compared to control areas and this shows that LSRP has some benefit in the control of DHF. The different indices like CI, BI and PI to show the presence of larvae and pupae were significantly lower than the baseline at 3 months but not significantly lower in 1st and 2 nd month. After implementation, the mean scores for all outcome variables for the experimental group were significantly higher than the comparison group. The improvement in the measures CI, BI, and PI, strongly support the effectiveness of the LSRP. Though HI did not change in the 2 groups, this can be due to the fact that the study period was only 3 months. May be over time there may have been some changes. These four larval indices in the experimental village decreased from the initial baseline levels to the fourth survey levels, although they did not decrease sharply. This was due to the heavy rain throughout Krabi Province.

The three larval indices (CI, BI, and HI) in the experimental village decreased from the baseline (before the experiment) to the third survey (after the experiment). This was due to the regular weekly larval survey practices among the participants. These findings were the same as Meesuk [14]; Lloyd [15], and Fernandez [16]. During the first survey, both study groups had CI, HI, BI, and PI results that were higher than the national targets for CI and HI (10), and for BI (50) [17]. When the CI, HI, BI, and PI for the first, second, and third surveys were compared, only the CI, BI, and PI values for the experimental group decreased monotonically. The larval indices for the experimental group during the third survey and after the experiment were still higher than the national target but they were likely to reduce and did not have a negative trend.

Therefore, the LSRP appeared to demonstrate its effectiveness in improving knowledge, perception, self-efficacy, and larval survey practice scores, which in turn, decreased the CI, BI, and PI. Empowering the participants through LSRP and on-going activities can play a great role in ensuring the success of the program and reducing the burden of DHF. Working in partnership with stake holders is a crucial strategy towards the prevention and control of DHF in villages. in. DHF prevention and control programs at the district and sub-district health level should be more proactive. The direct learning experiences of community stakeholders should be focused at the village level.

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