

Effectiveness of the intervention program for dengue hemorrhagic fever prevention among rural communities in Thailand

A quasi-experimental study

Suda Hanklang

Faculty of Nursing, Vongchavalitkul University, Nakhon Ratchasima, Thailand

Paul Ratanasiripong

California State University, Long Beach, California, USA, and

Suleegorn Sivasan

Faculty of Nursing, Vongchavalitkul University, Nakhon Ratchasima, Thailand

Abstract

Purpose – The purpose of this paper is to evaluate the effectiveness of the intervention program for dengue fever prevention among people in rural communities.

Design/methodology/approach – A quasi-experimental study was designed for two groups. The intervention group received five weeks of dengue hemorrhagic prevention program consisted of knowledge broadcast, campaign, model house contest and group education. The control group received only the usual care of health promoting hospitals. The primary expected outcomes were changes in knowledge, perceived susceptibility, perceived severity, perceived benefit, perceived barriers and preventive action from baseline data, post-intervention and three-month follow-up, along with a comparison between the two groups. The secondary expected outcomes were changes in house index (HI) from baseline to post-intervention and three-month follow-up, along with a comparison between the two groups.

Findings – From the total of 64 participants, 32 were randomly assigned to the control group and 32 were randomly assigned to the intervention group. There were significant differences in knowledge, perceived susceptibility, perceived severity, perceived benefit, perceived barriers, preventive action and HI in the intervention group after received the five-week intervention program and at three-month follow-up ($p < 0.05$).

Originality/value – Dengue hemorrhagic prevention program based on the Health Belief Model was effective in lowering HI and improving knowledge, perceived susceptibility, perceived severity, perceived benefit, perceived barriers and preventive action among people in rural communities. The intervention program may be beneficial in primary care in such a rural community.

Keywords Thailand, Prevention, Health belief model, Dengue hemorrhagic fever, Quasi-experimental study

Paper type Research paper

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Introduction

Dengue is a mosquito-borne disease found mainly in countries with tropical and subtropical climates. The global prevalence of dengue has grown dramatically in recent decades. Currently, about half of the world's population is at risk of infection[1]. Globally, one recent estimate indicates 390m dengue infections per year (95 percent credible interval of 284–528m), of which 96m (67–136m) manifest clinical symptoms[2]. An estimated 500,000 people with severe dengue require hospitalization each year and about 2.5 percent of those infected dies[1].

Dengue fever is a disease caused by the dengue virus. The main cause of dengue virus infection in human is through bites from infected female mosquitoes (*Aedes aegypti*)[3]. Dengue virus is a carrier disease found in all age groups[3]. The symptoms of dengue fever include high fever, chills, fatigue, rash, nausea, vomiting, headache, sore throat and pain (muscle, back, joint and abdomen areas)[4]. In severe cases, it can be life threatening due to serious bleeding and shock[4]. The most effective intervention is to prevent mosquito bites[5].

Thailand is still suffering from dengue fever nationwide and during all seasons. In 2017, Thailand has reported 52,049 dengue cases from all 77 provinces, including 62 deaths[6]. The Ministry of Public Health has adopted a policy to control dengue hemorrhagic fever in the National Health Development Plan No. 11 (2012–2016) which targeted the reduction of dengue hemorrhagic fever rate to not more than 25 percent of the median in the past five years and the reduction of morbidity rate to not more than 0.02 percent[7].

The Northeastern region of Thailand has the largest land area. Nakhon Ratchasima province has the highest population in the Northeast region and the second highest population in the country. The incidence of dengue hemorrhagic fever in Nakhon Ratchasima in the past five years (2013–2017) were 269.29, 33.58, 274.53, 62.45, 65.38 per 100,000 population, respectively. In 2017, the prevalence of dengue hemorrhagic fever in Nakhon Ratchasima were 1,716 cases with the morbidity rate of 65.38 per 100,000 population and two cases of death by dengue hemorrhagic fever, giving the mortality rate of 0.08 per 100,000 population[6]. The model forecasting of dengue hemorrhagic fever in 2017 showed that Nakhon Ratchasima was the high-risk area to monitor the disease[8].

It is believed that the outbreak of dengue hemorrhagic fever is mainly from mosquitoes and by the general nature of mosquitoes, like laying eggs in containers of water inside and outside the house. This is due to the behaviors of local rural people. Some behaviors that may not be appropriate include disorganized house, inadequate lighting management, hanging dirty clothes in the house, not covering water storage container and leaving wet waste with water. As a result, mosquito breeding becomes widespread[9].

Dengue morbidity can be reduced by applying effective communication that can achieve behavioral outcomes that augment prevention programs[10]. At present, the main method to control or prevent the transmission of dengue virus is to combat vector mosquitoes through preventing mosquitoes from accessing egg-laying habitats by environmental management and modification, active monitoring and surveillance of vectors to determine the effectiveness of control interventions[5, 10].

The Health belief model (HBM), developed from the theory of social psychology, describes the behavior of individuals[11]. The HBM believes that people who change their behavior must perceive their susceptibility, perceived severity, perceived benefits of modifying health behaviors and perceived fewer barriers of preventive behaviors, cues to action, modifying factors and health motivation[11, 12]. Therefore, from HBM constructs, the researcher expected to apply the theory of HBM to use in the prevention of dengue disease because theory says individuals will seek ways to follow the recommendations for prevention and rehabilitation as long as the disease prevention practice is more positive

than the difficulty[11]. By following these theory instructions, a person must feel fear for the disease or feel threatened. In addition, a person must feel to have an ability for disease prevention[13]. Previous studies in Thailand have adopted the HBM to modify dengue prevention behaviors and received good results[14, 15]. Therefore, this research is based on the HBM as a theoretical framework for the prevention measures and for designing intervention activities.

It is necessary to encourage people in the community to receive knowledge about the disease, promote risk perception and benefits of disease prevention so that people can find solutions to reduce the barriers to disease prevention then take action to prevent dengue fever. The dengue hemorrhagic disease prevention in the community must be supported by the community and apply the campaign for community awareness of the dengue problem. Previous studies have focused mainly on source reduction of water containers in a household and vector control[16–18]. These studies earlier did not investigate the combination of vector control activities, and the behavior changing based on the HBM for dengue fever prevention. For this study, the researchers are interested in examining the effects of the dengue hemorrhagic fever prevention intervention program in rural communities. The data from this study will lead to health promotion planning for dengue hemorrhagic prevention in rural communities. The focus is on promoting knowledge in disease prevention, raising awareness of risk and severity of disease, encouraging the benefits of disease prevention and reducing barriers to disease prevention. The main objective of the community intervention program is for eradicating dengue hemorrhagic fever which is a major public health problem in Thailand.

Research objective

The purpose of this study is to examine the effectiveness of the intervention program for dengue hemorrhagic fever prevention among rural communities in Thailand based on the theory of HBM (Figure 1).

Study design

This is a quasi-experimental study that examined the effect of dengue hemorrhagic fever prevention intervention in rural communities. Participants were randomly divided into two

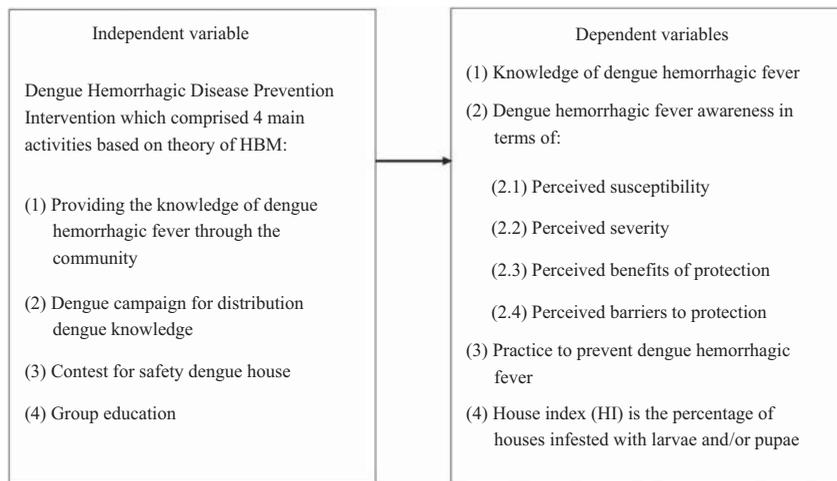


Figure 1.
Theoretical framework of the study

groups as explained below. The experimental group received a five-week intervention program while the control group continued life as usual. Variables were measured before the intervention, after the five-week intervention, and at three-month follow-up.

Sample size

The sample size was calculated by the following formula[19]:

$$n = \frac{2(Z_{\alpha/2} + Z_{\square})^2 \times \sigma^2}{\Delta^2} = \frac{2(1.96 + 0.84)^2 \times (3.41)^2}{(2.38)^2} = 32,$$

n = sample size; $Z_{\alpha/2}$ = percentile value (100-($\alpha/2$)) percent under the normal curve set at 0.05 = 1.96 (two-tailed); \square = 0.20; Z_{\times} = 0.84; Δ = $\bar{x}_2 - \bar{x}_1$, mean difference of preventive practice score for dengue fever prevention from previous studied[14] = 2.38, σ = standard deviation of mean difference of preventive practice score for dengue fever prevention from previously studied[14] = 3.41.

The sample size needed for this study was 32 for each group.

Participant inclusion criteria include: at least 20 years old; Thai nationality; both male and female; has lived in the community for more than six months; able to answer questions, no problem speaking, listening and communicating; no training on educational program for dengue hemorrhagic fever prevention in the previous six months; willing to participate in this study; and able to sign the informed consent form.

The criteria for excluding participants from this step are: participants who have difficulties communicating in Thai; and participants who are not available at the time of data collection (Figure 2).

Participants

Two districts were randomly selected from Nakhon Ratchasima province. Then, two sub-districts from two districts were randomly chosen. Further, two villages were randomly selected from the two sub-districts to be part of the study. To prevent the contamination of data, the entire village was randomly assigned as either experimental group or control group. Individual household from each village is randomly selected to be included in the study. They were excluded if they had lived in the community less than six months, had symptoms or illnesses that limit activity, or had participated in any education program for dengue prevention during the prior six months.

Data collection

Participants were randomly divided into two groups (intervention group, $n = 33$; control group, $n = 33$). The intervention group was assigned to a five-week program. The control group received the usual health education from public health personnel. Evaluations by questionnaire were measured three times for both groups. The questionnaire consisted of 52 questions that took approximately 45min for respondents to complete. Written consent forms were obtained from participants prior to data collection. This study was approved by the Committee of Human Ethical Research, Maharaj Hospital, Nakhon Ratchasima.

Research instrument

Part 1: demographic information included seven items on gender, age, marital status, highest education, occupation, income and information obtained from the community.

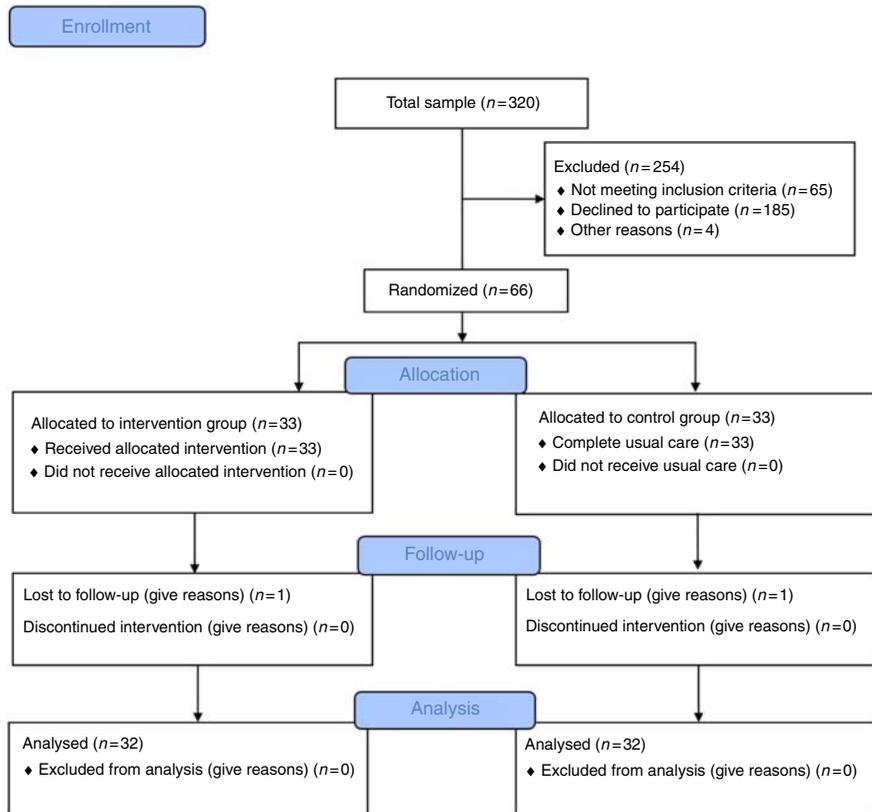


Figure 2.
Flow diagram
of the study

Part 2: knowledge about dengue hemorrhagic fever included 20 items that assessed participant’s knowledge of the causes of dengue fever, signs and symptoms, treatment and prevention. The score of 1 point was given for each correct answer and 0 point for each wrong answer.

Part 3: perception of dengue hemorrhagic fever prevention included 20 items which derived from four main constructs of HBM: perceived susceptibility, perceived severity, perceived benefits, and perceived barriers to prevention. Perception measurement utilized a three-point Likert scale that included disagree (1), neither agree nor disagree (2) and agree (3).

Part 4: dengue fever prevention practices were measured using five items derived from principle for dengue hemorrhagic fever prevention practices from the Department of Disease Control, Ministry of Public Health, Thailand[20].

Intervention

Participants in the control group did not receive any interventions. Participants in the experimental group were enrolled in the intervention program based on the HBM theory. The HBM has four constructs representing the perceived threat and net benefits: perceived susceptibility, perceived severity, perceived benefits and perceived barriers[12]. The specific intervention program included four main activities based on HBM theory.

Activity 1: providing knowledge of dengue hemorrhagic fever

Implementation timeframe: Weeks 1–5.

The objective of this activity was to provide the knowledge of dengue hemorrhagic fever through the daily community broadcast. The messages were based on HBM constructs as described below:

- (1) Raise the perceived susceptibility: “dengue is a problem in community for all age group.”
- (2) Raise the perceived severity: “it is a little one but it is the one that can kill you.”
- (3) Raise the perceived benefits: “take care of the house environment, then the safe environment will protect your family from dengue hemorrhagic fever.”
- (4) Reduce the perceived barriers: “just few minutes for easy clean-up can reduce many risks from dengue.”

Activity 2: dengue hemorrhagic fever campaign

Implementation timeframe: Week 2.

The emphasis is on individuals to receive information through campaign activities:

- (1) The individuals who took part in the campaign consisted of the head of the village, assistant head of the village, village health volunteer, adults in the village and students in the village. Mosquito mascot and cartoons were also part of the campaign parade.
- (2) Poster boards were used during campaign parade to raise awareness of dengue hemorrhagic fever such as principle for dengue hemorrhagic fever prevention practices from the Department of Disease Control[20] and mosquito life cycle.
- (3) Campaign announcements about practices to eradicate larvae using temephos or abate sand and using mosquito repellent.
- (4) Distribution of leaflet and messages on dengue hemorrhagic fever, such as signs and symptoms of dengue hemorrhagic fever.
- (5) All participants in the parade campaign went to all the houses in the village to identify mosquito breeding sites. If an open water container was found, the participants removed all the water from it.

Activity 3: a contest for safety dengue house

Implementation timeframe: Weeks 3–4 and announcement of the winner during Week 5.

The objective of this activity was to find a model house that is safe from dengue and to encourage villagers to see the importance of environmental management and create good examples for their neighbors:

- (1) Defined the attributes of the house that is safe from dengue on the basis of the hygienic and clean house assessment from the Department of Disease Control, Thailand[20] then selected major topics in the assessment. An award-winning house has to show the important features of all attributes.
- (2) Assigned the committee to evaluate the houses that participate in community contest. The committee consisted of seven representatives of the community,

including the village head (one), the assistant village heads (two) and village health volunteers (four).

- (3) Public announcement to recruit people in the community to the contest and to inform the rules of the contest.
- (4) Evaluation process.
- (5) The announcement of the award for the winner and the second place during the group activity at the village hall.
- (6) The winners received a large certificate to display at the front of their houses to be examples to neighbors and motivate them to be safe from dengue.

Activity 4: group education

Implementation timeframe: Week 5.

The objective of this activity was to provide knowledge about dengue hemorrhagic fever. Activity was set in the community hall with the following activities:

- (1) knowledge exhibition about dengue, mosquito's repellent and methods for eradicating mosquitos; and
- (2) stage play and role play that reflected the susceptibility for risks, the dengue severity, the benefits of prevention, and reduction in barriers to prevent dengue hemorrhagic fever.

Validity and reliability of research instruments

The intervention program and research instrument were adapted from the literature review based on the HBM theory and were reviewed by experts in the field. Content validity: a panel of three experts evaluated the content validity of the intervention program and research instrument. For content validity testing, CVI was analyzed and found to be 0.89.

Reliability: the questionnaire was tested for reliability with 30 people with similar characteristics to the samples. For internal consistency reliability testing, Cronbach's α coefficient was analyzed. All scales had good levels of internal consistency of more than 0.70.

Data analyses

Statistical Packet for the Social Sciences 23.0 was used for data analyses. Descriptive statistics were calculated to describe demographic characteristics and other backgrounds of the participants. To compare the data between the two groups, t -test and χ^2 test were used. Two-way repeated measures ANOVA was used to analyze the difference in the total scores of six scales for dengue hemorrhagic fever prevention between the two groups across times of measure. The χ^2 test was used for analyzing the difference in the number of house index (HI) between the two groups.

Results

A total of 64 of the initial 66 participants completed the study questionnaires at three timeframes. Thus, data analyses were performed using 64 subjects. At baseline, there were no significant differences in general characteristics between the intervention group and control group. However, there was a significant difference in gender (see Table I).

Demographic data	Intervention group (n = 32)		Control group (n = 32)		χ^2 or t	p-value		
	Number	Percent	Number	Percent				
<i>Gender</i>								
Male	2	6.3	11	34.4	7.819	0.005		
Female	30	93.8	21	65.6				
Age (years) (mean \pm SD)	60.50 \pm 11.84		56.34 \pm 10.54		1.483	0.143		
<i>Marital status</i>								
Single	1	3.1	0	0.0	6.425	0.093		
Married	23	71.9	30	93.8				
Widowed	7	21.9	1	3.1				
Divorced	1	3.1	1	3.1				
<i>Highest education</i>								
Primary school	26	81.3	29	90.6	2.306	0.316		
High school	4	12.5	3	9.4				
Higher	2	6.3	0	0.0				
<i>Occupation</i>								
Farmer	20	62.5	20	62.5	5.486	0.360		
Trader	3	9.4	4	12.5				
Hired	2	6.3	3	9.4				
Official	0	0.0	1	3.1				
Housewife work	3	9.4	4	12.5				
Other	4	12.5	0	0.0				
Income	8,862.50 \pm 6,278.62		9,025 \pm 6,626.68				-0.101	0.920

Note: * $p < 0.05$

Effectiveness
of the
intervention
program

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Table I.
Comparison of
general characteristics
between intervention
and control groups
at baseline

Table II showed HI decreased in both groups at the end of the intervention program and revealed a significant difference between groups for both the post-intervention and the follow-up.

Comparison of the groups before starting intervention revealed no significant difference in the scores of knowledge, perceived susceptibility, perceived severity, perceived benefits, perceived barriers and preventive action (see Table III).

The intervention group had increases in the scores of knowledge, perceived susceptibility, perceived severity, perceived benefits, perceived barriers and preventive action after intervention. Only preventive action showed the interaction between group and time ($F = 11.19$, p -value < 0.001) (Table IV).

Discussion

A quasi-experimental study was designed to assess the effectiveness of the intervention program based on HBM to prevent dengue hemorrhagic fever.

Measuring time	Intervention group (n = 32)		Control group (n = 32)		χ^2	p-value
	Found larvae (n)	HI	Found larvae (n)	HI		
Pre-intervention	12	37.50	11	34.38	0.068	0.794
Post-intervention	0	0	10	31.25	11.852	0.001
Follow-up	0	0	12	37.50	14.769	< 0.001

Table II.
Comparison of the
number of larvae
and house index
(HI) (percentage of
houses infested with
larvae and/or pupae)
between intervention
and control groups

Results demonstrated that this intervention program significantly increased the knowledge, perceived susceptibility, perceived severity, perceived benefits, perceived barriers and preventive action. This finding supported the assumption that applying the HBM to the intervention in rural communities can promote the preventive actions and may be beneficial in the primary care of people with a high risk of dengue hemorrhagic fever.

The intervention program was created to meet the HBM theory because protective behavior is related to the knowledge, perceived susceptibility, perceived severity, perceived benefits and perceived barriers. Although education campaigns have increased people’s awareness of dengue, it remains unclear to what extent this knowledge is put into practice, and to what extent this practice actually reduces mosquito populations. In this study, the intervention encouraged the practice of participants in many ways. The knowledge was provided via daily broadcast to the community, dengue campaign and group education at the village hall. Cues-to-action was implemented via the contest for a model house for safety from dengue, which was in line with an earlier research suggestion[13] that there is a greater likelihood of positive outcomes for preventive actions when the participants are supported and encouraged by the good model in the community.

After the intervention program, the total scores on the six scales for dengue hemorrhagic fever prevention were significantly higher in the intervention group than those in the control group. These results support the effectiveness of the intervention program directly. However, in the follow-up phase, some scores were decreased; this may be because the community engagement tends to be insufficient. Thus, the approach toward enhancing community involvement is important.

The results of this study showed that the HI for the intervention group decreased for both post-intervention and follow-up. The effectiveness of the program on preventive action is consistent with the earlier studied that showed the direct link between knowledge of dengue preventive measures and container protection practice[21]. In order to decrease the breeding site of mosquitoes, it is necessary for people in the community to change the behaviors for the dengue hemorrhagic fever prevention.

Conclusions

Dengue hemorrhagic fever is pervasive among rural communities. In the present study, we conducted a quasi-experimental study to investigate the effectiveness of the intervention program. The effects were measured by the knowledge, perceived susceptibility, perceived severity, perceived benefits, perceived barriers and preventive action. After participation in the intervention program, the five scales showed a significant increase; therefore, the intervention program may be beneficial in primary care in such a rural community.

Variables	Intervention group \bar{X} (SD)	Control group \bar{X} (SD)	<i>t</i>	<i>p</i> -value
Knowledge	15.28 (2.22)	14.91 (1.91)	0.725	0.471
Perceived susceptibility	13.28 (1.17)	13.16 (1.14)	0.433	0.667
Perceived severity	13.16 (1.25)	13.00 (0.95)	0.564	0.575
Perceived benefits	13.47 (1.08)	13.37 (1.13)	0.340	0.735
Perceived barriers	14.09 (0.93)	13.97 (0.93)	0.537	0.593
Preventive action	4.41 (0.76)	4.25 (0.84)	0.781	0.438

Note: *n* = 64

Table III.
Comparison of study variables between groups at baseline

Variables	Group	Baseline \bar{X} (SD)	Post-test \bar{X} (SD)	Follow-up \bar{X} (SD)	Group	Time F (p -value)	Group \times Time
Knowledge	Intervention	15.28 (2.22)	16.84 (1.63)	17.22 (0.91)	12.35 (0.001)	11.82 (< 0.001)	1.12 (0.327)
	Control	14.91 (1.91)	15.71 (2.14)	15.94 (1.85)			
Perceived susceptibility	Intervention	13.28 (1.17)	14.06 (1.08)	13.44 (1.08)	3.20 (0.075)	4.62* (0.011)	0.80 (0.450)
	Control	13.16 (1.14)	13.50 (1.08)	13.28 (0.99)			
Perceived severity	Intervention	13.16 (1.25)	13.84 (1.22)	13.53 (0.95)	5.80 (0.017)	4.10* (0.018)	0.49 (0.616)
	Control	13.00 (0.95)	13.34 (0.87)	13.13 (0.79)			
Perceived benefits	Intervention	13.47 (1.08)	14.00 (1.11)	13.75 (0.84)	3.73 (0.055)	1.72 (0.181)	0.66 (0.518)
	Control	13.37 (1.13)	13.50 (0.88)	13.50 (0.98)			
Perceived barriers	Intervention	14.09 (0.93)	14.41 (0.84)	14.31 (0.69)	4.14 (0.043)	1.22 (0.299)	0.28 (0.756)
	Control	13.97 (0.93)	14.13 (0.83)	13.97 (0.86)			
Preventive action	Intervention	4.41 (0.76)	4.94 (0.25)	5.00 (0.00)	65.86 (< 0.001)	0.26 (0.775)	11.19 (< 0.001)
	Control	4.25 (0.84)	3.66 (1.15)	3.78 (0.87)			

Notes: $n = 64$. *Statistical significant difference between baseline and post-test measures

Table IV.
Changes in
knowledge, perceived
susceptibility,
severity, benefits and
barriers of preventive
action for dengue
hemorrhagic fever
over time

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Corresponding author

Suda Hanklang can be contacted at: en101_987654@hotmail.com