Folk knowledge about dengue mosquitoes and contributions of health belief model in dengue control promotion in Northeast Thailand

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Abstract

The health belief model (HBM) has been adopted as the principal theory for health education and communication for dengue haemorrhagic fever (DHF) prevention and control in Thailand. The HBM focuses on persuading people to acknowledge their vulnerability and susceptibility to DHF, and the benefits of undertaking dengue larval control in household water containers. This study was undertaken in Khon Kaen province to investigate folk knowledge and beliefs about dengue mosquitoes and larval control campaigns and relating these to the theoretical components of HBM. Findings from this study indicate that health education messages can raise awareness during an outbreak but do not ensure sustained larval control practices. Several barriers are identified, including insufficient control agents, inadequate knowledge of control methods, and incompatibility of control practices with people’s beliefs. The barriers prevail over the benefits of recommended larval control practices. In developing health education messages, consideration should go beyond the HBM and focus on control methods that are compatible with the socio-cultural environment in which control practices are being encouraged.

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1. Introduction

Dengue, dengue haemorrhagic fever (DHF) and dengue shock syndrome remain important public health problems in Thailand with approximately 100 cases of DHF per 100,000 population occurring in 2003 (\textit{Division of Epidemiology, 2004}). The first DHF outbreak was recognised in Bangkok and the surrounding areas in 1958 and the incidence of DHF has increased cyclically ever since. In 1978, the Ministry of Public Health established the dengue prevention and control programs, carried out nationwide by integrating the control program into the Primary Health Care system (\textit{Chunsuttiwat and Wasakarawa, 1994; Wangroongsarb, 1998}). In 1999, the King project for dengue prevention and control program were introduced in Thailand. The program aims to increase knowledge of DHF disease and prevention as well as encouraging people to carry out the larval control in households.
In Thailand, controlling mosquitoes at their immature stages has been central to their dengue control programme (Chunsuttiwat and Wasakarawa, 1994). Productive larval sites in Thailand are stored water containers in and around houses. *Aedes aegypti*, the most important vector, exploits domestic artificial water-holding containers as its breeding sites. In northeast Thailand, built-in cement containers holding water for bathing or flushing toilets are the most productive breeding sites (Chau et al., 2001). The dengue control program has focused on promoting household responsibility for reducing the number of breeding sites, or treating essential water-holding containers with larvicides, or placing fish in water containers or covering them with lids to prevent mosquito oviposition or cleaning water containers weekly; as newly hatched larvae require approximately 9 days to develop to the adult stage, weekly emptying of containers will prevent emergence of adult mosquitoes. The larvicide temephos is distributed free to households for mosquito control.

The health belief model (HBM) has been very influential in the area of health education in Thailand (e.g., see Butraporn et al., 2004; Buckingham et al., 2005) and provides a conceptual basis for much of the strategizing around dengue control education by the Ministry of Public Health (MOPH) (Wangsirikul, 1991).

The HBM developed by Godfrey Hochbaum et al., in the early 1950s, consists of five major conceptual components (Hochbaum, 1958). *Perceived susceptibility* is a person’s subjective perception of the risk of developing a particular health problem. *Perceived severity* is defined as concerns about the seriousness of the health problem and its consequences, for example, death, disability and social restrictions. *Perceived benefit* refers to the individual’s beliefs in the effectiveness of actions designed to reduce the severity of the health problem. *Perceived barriers* are the perception of potential obstacles such as financial, psychological or costs, to implementing the desired behaviour. *Self-efficacy* refers to the confidence that one can successfully practice the behaviour required to produce the outcome (Strecher and Rosenstock, 1997). The HBM is among the most influential health behaviour change models in the world and has been extensively evaluated.

The message in the early period of control campaigns in the 1970s was “mosquitoes are more dangerous than a tiger, cause dengue hemorrhagic fever”. Health messages aimed to educate people to prevent themselves from mosquito bites. Control activities consisted mainly of spraying adulticides supplied by the central health authority. To maintain this activity at the national level required substantial effort and resources. The amount of adulticides used decreased after 1984, replaced by alternative control methods such as the elimination of breeding sites and larviciding (Gratz, 1993; Wangroongsarb, 1998). In 1988, the control campaigns began to focus on community-based interventions concerned with “larval control” within households. Dengue larval control health education messages in Thailand tend to emphasize a causal chain model beginning with larvae leading to a rise in the adult mosquito population and culminating in a rise in DHF (Fig. 1).

Examples of control messages which have been promoted include “Yoong Lai causes fatal DHF, it is daytime biting, and lives close to you and your children” and “DHF causes high fever, bleeding and even death, so prevent your children from getting bit by dengue mosquitoes and eradicate the mosquito breeding sites in your house.” These messages have been promoted in conjunction with details of a variety of strategies to eradicate larvae suitable for different types of breeding sites. Such messages also have been used in the King project in 1999–2002 (Phuanukoonnon, 2003).

A number of studies have shown that the link between the disease (DHF) and mosquitoes is generally well known in the Thai population. In addition, most people can distinguish DHF from other diseases (Swaddiwudhipong et al., 1992b; Kittigul et al., 2003; Van Benthem et al., 2002). Although increased knowledge appears to have resulted in more frequent use of preventive measure such as mosquito nets, screening of windows, spraying and repellent use (Van Benthem et al., 2002), larval control in households (which is the most effective and sustainable way for dengue control), has not been satisfactory (Swaddiwudhipong et al., 1992a; Kantachuvesiri, 2002).

Little information is available about how Thai people perceive dengue and the larval control messages associated with it. The effectiveness of the dengue larval control program relies mainly on people’s control practices in their homes. However, many studies show that these household larval control activities can result in an unsatisfactory outcome (Gratz, 1993; Gubler and Clark, 1996; Fernandez et al., 1998; Winch et al., 2002). Householder’s participation in dengue control can be difficult to maintain, particularly outside periods of outbreak. Moreover, knowledge alone does not necessarily translate into behaviour change; larval
control promotion through household behaviour change needs to engage with a wide array of social and cultural factors, which can facilitate, or mitigate against, change. Numerous studies have shown how socio-cultural factors play a vital role in dengue control (Gordon et al., 1990; Kendall et al., 1991; Whiteford, 1997; Kendall, 1998; Van Benthem et al., 2002).

Psychological perceptions exist within a socio-cultural environment. The interplay between this environment and individual perceptions is therefore of particular interest here (see, for example, Rodriguez-Reimann et al., 2004). The fact that many people do not consistently adopt the promoted larval control practices sought of them by the Ministry of Public Health (MOPH) and others seeking control of dengue needs to be interpreted within the context of local beliefs and meanings associated with a range of practices related to the use of water in households. This study explores the cultural and social factors which influence household control practices, particularly folk knowledge about mosquitoes. Using the HBM as a reference point, a qualitative description of people’s perceptions of dengue and dengue larval control is provided with a view to demonstrating the socio-cultural context of the HBM in relation to household dengue control practices.

2. Subjects and methods

2.1. Study site

The study took place between September 2000 and June 2001 in Khon Kaen province, in northeast Thailand. Khon Kaen consists of 25 districts and 31 large urban municipalities. The provincial population was 1,733,434 in 2002. The main ethnic group in Khon Kaen is the Esaan Thai (subgroup Laos-Wieng). Two locations in Khon Kaen were selected for this study, Baan Toom an urban community in the Khon Kaen Municipality (population of 376,915) and Baan Moon Nark a rural village in Khok Pho Chai district (population of 25,890).

2.2. Research methods

The research methods used were focus group discussions (FGD), in-depth interviews (IDI), and participant observation, informal interviews and card ranking activities. This mixture of methods was chosen in order to facilitate a diversity of social dynamics within the overall qualitative approach as well as promote rigour through triangulation (Gerson and Horowitz, 2002). The multi-method approach also allowed for different kinds of questions to be posed within the research from very open-ended emergent questions (e.g., IDIs) to more specific questions about order of priority (card ranking activity). Question lines for the IDIs and FGDs centered on knowledge about mosquitoes generally, as well as specific perceptions toward dengue mosquito breeding sites and larval control. Thirteen FGDs were conducted (7 urban, 6 rural) along with 16 IDIs (8 urban, 8 rural) and 50 card ranking activity (25 urban, 25 rural).

Selection criteria for participants in this study were: they were members of the selected household and were involved in domestic water activities and were responsible for mosquito larval control. Participants of the FGDs were selected purposively. The researcher discussed selection of the participants with the head of the community, the village health volunteers (VHV), the head of the housewives group and the research assistants before organising appointment times and places with the nominated participants. The composition of FGD groups was based on gender and age, such as adult female, adult male and youth of both genders. The research team for FGDs consisted of the researcher as interviewer, a note taker and an assistant for tape recording. Local people in both settings understood the official Thai language well but they preferred to answer in Esaan. While all FGDs in urban settings were held during the day, most of the rural FGDs were held at night after people finished their work in the fields. Two youth groups had discussions in the afternoon on a school holiday. The question guides of FGDs explored household water practices, dengue control practices in households and people’s perception of the dengue mosquito A. aegypti and dengue control campaign.

In depth interviews (IDIs) in this study elicited detailed information about water practices especially those activities directly and indirectly supporting mosquito control, people’s perceptions and beliefs and barriers to control practices. IDIs also explored details rising from FGDs, and allowed triangulation of data from FGDs, informal interviews and participant observations (Neuman, 2003:137–138). The participants of IDI did not participate in FGDs, so the data were used to validate with the data from FGDs. The in-depth interview question guides were pre-tested with two housewives. The participants were selected from people who were well known to the researcher and those who were responsible for larval control in their houses. All IDI interviewees were asked to perform the ranking activity. The number of participants in both locations was 50, 16 from IDIs and an additional 34 participants from each setting were randomly selected from both study locations.

The principle researcher lived for 6 months in the rural study villages and 7 months in the urban study
community, which provided significant opportunities to be a participant observer in the everyday lives of community members. Various activities observed included simple household chores, such as bathing a baby or cooking dinner, and community activities, such as fermented fish production by the housewives group. Participant observation and informal interviews provided broader contextual data and validated data from FGDs and IDIs. Data from informal interviews and participant observations were written as a narrative in field notes.

The tool for the card ranking activity was a set of photographs of the 18 most common water-holding bodies and containers in the study areas, being ranked from most to least likely dengue mosquito breeding site. As all pictures were taken from the study sites, participants were familiar with the types of containers and had no problem in ranking the cards.

All data from IDIs and FGDs were tape-recorded and were transcribed and translated into English by the researcher. The transcriptions were coded to identify emergent themes. After each interview, the sections of data relating to each code were compared across transcripts. Interview question guides were then modified for subsequent use as part of the iterative process. Data from the card ranking activity were tabulated and presented in ranked order. At the end of the study, the researcher presented the results of the study at community meetings and allowed community members and participants to ask the researcher about the results of the study.

3. Results

3.1. Perception of dengue as a disease

Dengue haemorrhagic fever or “Kai Leard Ork” in Thai means “bleeding fever”. All participants knew DHF as a childhood disease caused by a bit of Yoong Lai (striped mosquito) or A. aegypti. Most participants had learnt about DHF from schools as a part of a health education subject and from the media such as TV, radio and newspaper reporting the fatality of DHF cases. All participants believed young children were the highest-risk group for DHF. Most participants recognised high fever, muscle pain and petechiae as a common sign of DHF. Nonetheless if DHF was epidemic in their community, high fever represented the most likely trigger for people to consider the presence of DHF. Besides high fever, the serious sign of DHF, bleeding, e.g., epistaxis would prompt the parents to seek the treatment for their sick children. The health education material also emphasises how to protect children from DHF.

I should take care of my children, protect them from Yoong lai (dengue vector) biting, I will be worried too because to prevent mosquito from biting is difficult.

Last year, a few children in this village got DHF, I was worried my children would get sick with DHF. So during the daytime when I worked in the rice field, I brought my children to the rice field too, it is at least better than staying home and got bitten by mosquitoes.

However, perceived susceptibility differed in some participants.

Although some might get sick with DHF, the treatment is available and we live in the city where the hospitals are properly equipped. I am never worried about dengue.

I have seen Yoong Lai here since I was born but I never knew about DHF until the health centre was built and the health officer told us about dengue and the bite by infected mosquitoes. That was about 20 years ago, we got bitten by mosquitoes every day but we’ve never been sick with dengue.

3.2. Perception of long term changes in mosquito population

All participants revealed that mosquitoes have always been present. In the past, mosquitoes were ‘remembered’ as being found mostly in forests or sometimes on cattle. Mosquitoes around the home have been abundant for the last two decades. At present people have to use bed nets or have their windows and doors screened to protect themselves from mosquito bites. Participants in both rural and urban locations had similar thoughts about the increasing number of mosquitoes. In particular, many people associated sanitation, piped water and electricity with mosquitoes as at about the time piped water and electricity became available, the number of mosquitoes increased dramatically.

A common view particularly among rural participants is that piped water made water use more convenient and therefore more likely to be used excessively. This resulted in more water being disposed of on the ground or in the drains creating mosquito-breeding sites. Prior to the piped water supply, water was collected and transported manually, so water was used conservatively especially during a long dry season. In the past, mosquitoes were only abundant during the rainy sea-
son (May–October), whereas, at present, mosquitoes are abundant in all seasons though the number of mosquitoes in winter season, which is from November to February (temperatures range between 15 and 25 °C) is slightly lower than in other seasons. Participants also pointed out that electric lights attract insects, including mosquitoes, which naturally rest in the bush or the forest.

### 3.3. Why mosquitoes are a problem

‘Mosquitoes cause annoyance’ was often the first response by both rural and urban participants when asked about problems caused by mosquitoes. Mosquitoes cause annoyance when people are resting or working. Preventing being bitten was often seen as inconvenient. Participants, especially in rural areas, mentioned inconvenience caused by being forced to stay inside bed nets while watching TV at night, or their children having to eat dinner inside bed nets. Urban people often cited the inconvenience of having to keep doors and windows closed—an unsatisfactory solution in hot, humid weather. Importantly, participants tend not to perceive disease risk as the major problem associated with mosquitoes but rather the more everyday problem of ‘annoyance’. As one rural housewife expressed:

I know Kai Leard Ork (DHF) is caused by Yoong Lai (dengue mosquito) biting us. Though this disease is fatal, they come once a year or every two years. It is less severe when we think of how often we are annoyed by mosquitoes, which come daily, all the time and every where.

### 3.4. Perceived larval habitats of dengue mosquito

Participants generally understood that mosquitoes breed in any water-holding body irrespective of location, volume or other characteristics of water such as cleanliness. The local name of mosquito larvae, mang ngong ngang, is used for all mosquito types. Larvae were described as tiny living objects commonly found in any water-holding bodies or containers in and around houses. When asked about the breeding sites specifically for dengue mosquitoes, *A. aegypti* most participants from both locations mentioned breeding sites located outside houses such as sewage drains, trash, swamp, damp bushes, as well as noting breeding sites inside houses such as ant traps and containers holding water for bathing and flushing toilets. Table 1 shows how participants ranked mosquito-breeding sites according to their likelihood of containing dengue mosquito larvae.

Although dengue vectors do not breed in water on the ground or in polluted water, rubbish, drains, containers for animal drinking water and swamp or ponds, were ranked as their most likely breeding sites. Sewage drains located underneath houses or along roadsides were ranked as the second most likely breeding sites for all types of mosquitoes (including dengue mosquitoes). People believed that one breeding site could contain several types of mosquito larvae of different size; none of the participants associated larval size with stages of larval growth.

Though health education materials state that dengue vectors breed in clean water, people in this study believed that this type of mosquito also breeds in wastewater. Many participants said they recalled rubbish and ant traps

<table>
<thead>
<tr>
<th>Ranking no.</th>
<th>Rural (N = 25)</th>
<th>Mean rank</th>
<th>Urban (N = 25)</th>
<th>Mean rank</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Rubbish, coconut shells, tin cans</td>
<td>1.48</td>
<td>Sewage drains</td>
<td>1.76</td>
</tr>
<tr>
<td>2</td>
<td>Animal drinking containers</td>
<td>2.08</td>
<td>Rubbish, coconut shells, tin cans</td>
<td>2.44</td>
</tr>
<tr>
<td>3</td>
<td>Sewage drains</td>
<td>2.48</td>
<td>Animal drinking containers</td>
<td>2.60</td>
</tr>
<tr>
<td>4</td>
<td>Swamps, ponds</td>
<td>4.68</td>
<td>Swamps, ponds</td>
<td>4.20</td>
</tr>
<tr>
<td>5</td>
<td>Ant traps</td>
<td>5.00</td>
<td>Ant traps</td>
<td>4.72</td>
</tr>
<tr>
<td>6</td>
<td>Containers holding water to flush toilets</td>
<td>5.32</td>
<td>Dragon jars</td>
<td>5.32</td>
</tr>
<tr>
<td>7</td>
<td>Bathroom containers</td>
<td>7.84</td>
<td>Bathroom containers</td>
<td>7.84</td>
</tr>
<tr>
<td>8</td>
<td>Dragon jars(^a)</td>
<td>7.92</td>
<td>Containers holding water to flush toilets</td>
<td>7.92</td>
</tr>
<tr>
<td>9</td>
<td>Large cement jars with lids</td>
<td>8.96</td>
<td>Water plant pots</td>
<td>9.52</td>
</tr>
<tr>
<td>10</td>
<td>Buckets</td>
<td>10.56</td>
<td>Flower vases</td>
<td>10.44</td>
</tr>
<tr>
<td>11</td>
<td>Big plastic containers</td>
<td>11.00</td>
<td>Big plastic containers</td>
<td>10.92</td>
</tr>
<tr>
<td>12</td>
<td>Water plant pots</td>
<td>11.72</td>
<td>Large cement jars with lid</td>
<td>11.36</td>
</tr>
<tr>
<td>13</td>
<td>Flower vases</td>
<td>13.16</td>
<td>Buckets</td>
<td>13.08</td>
</tr>
<tr>
<td>14</td>
<td>Dragon jars with lids</td>
<td>13.56</td>
<td>Dragon jars with lid</td>
<td>13.64</td>
</tr>
<tr>
<td>15</td>
<td>Small earthen jars with lid</td>
<td>14.88</td>
<td>Big plastic containers with lid</td>
<td>15.04</td>
</tr>
<tr>
<td>16</td>
<td>Big plastic containers with lid</td>
<td>15.28</td>
<td>Small earthen jars with lid</td>
<td>15.12</td>
</tr>
</tbody>
</table>

\(^a\) An enamel pottery container decorated with a painting of a dragon.
as potential breeding sites from source reduction health promotion campaigns, which concentrated on rubbish around the house.

Household water containers in toilets and bathrooms, as well as dragon jars without lids were ranked from the sixth to the eleventh most likely dengue-breeding sites. Dragon jars used for storing water for washing or gardening were frequently not covered by a lid. Water plant containers and flower-vases, found mostly in urban areas, are located both inside and outside houses for decoration. Most participants thought that these were not likely to be very productive sites because they were small and contained few larvae compared with other sites. Big plastic containers are found only in urban communities. Some participants mentioned that they would be less likely to contain mosquito larvae because they are cleaned frequently. Drinking water containers such as large cement jars (2000 l), which are always covered by lids, were seen as unlikely to be a mosquito breeding site in rural areas (not mentioned in urban areas).

3.5. Perceptions of control effectiveness

3.5.1. Space spraying or ultra low volume or (ULV)
Most participants from both locations regarded adulticide space spraying or ULV by the local authorities as the most effective control measure. When the number of mosquitoes reduces, people feel more comfortable; for example, they can eat outside closed or screened rooms or watch TV outside bed nets or do household tasks without turning on fans without being annoyed by mosquitoes. However, most thought ULV involved a harmful chemical that would contaminate their food and therefore, they only accept the spray being used outside the house.

3.5.2. Larvicide or temephos
Control messages recommend adding temephos to containers that cannot be covered by lids. The common perception, that temephos is a harmful chemical, discourages its use particularly in drinking water, although health education materials indicate that temephos added in the correct dose is safe for drinking. Only one participant mentioned adding temephos to drinking water. However, there is insufficient information about how to do this or when to re-add temephos or even the right amount needed for particular sized containers. Most participants in this study did not know this information, nor did they know that emptying treated containers reduces temephos’s effectiveness. Insufficient temephos distribution creates further barriers for control activities. Though temephos can be obtained from health centres or the municipal health office, people have to spend valuable time (during office hours) and effort to obtain temephos. Unless people perceived temephos as necessary, they were unlikely to make such an investment.

3.5.3. Fish
Some participants accept that fish are very effective at controlling larvae, so fish are kept in non-potable water containers, e.g., containers for water plants such as lotus. Some larvivorous fish are colorful and beautiful so people rear them, mainly in water plant containers, as recreation. As mentioned in health education materials, fish should be kept in water containers that cannot be covered by lids, but fish are difficult to maintain. Health education information does not include details about maintaining fish. Moreover, several people thought that fish dirtied the water or brought disease, and hence were not a desirable option.

3.5.4. Covering containers
Health education materials suggest containers that can be covered should be covered with nets and topped with lids. Lids are commonly used to cover drinking water containers, but not every container is covered. Using lids on frequently used containers was impractical. People thought that lids were unnecessary for containers with non-potable water. People pointed out that because they forgot to cover containers correctly, mosquitoes were able to get into containers. However, they failed to mention, without prompting, the condition of the lid. Ill-fitting or damaged lids allow mosquitoes to enter the container. The perception that ill-fitting or broken lids are useable discourages people from obtaining new lids reducing the effectiveness of lids in preventing mosquito infestation. Lids were not affordable for some households.

3.5.5. Weekly cleaning of containers
Cleaning containers weekly is an effective larval control measure but is not practical with large containers such as cement jars hence these are normally cleaned yearly. Weekly cleaning of less frequently used water containers was perceived to be unnecessary and wasteful, as people either covered those containers with lids (mainly drinking water) or did nothing, as the cleanliness of water was not a concern (non-potable water). Another barrier to weekly cleaning is that containers may not be cleaned due to seasonal migration or sickness of the person responsible for their cleaning.
3.5.6. Comparing control methods

Though some accepted that the larvicide temephos was effective in larval control, the result was not as tangible as ULV spraying. Some participants claimed that placing fish in containers was more effective than using temephos. Nonetheless, people in both locations believed that temephos and fish were more effective than source reduction or use lids on containers in controlling dengue vectors.

3.6. Perception of dengue larval control campaigns

Participants revealed that the present dengue control campaigns were only effective over a short period of time. Outside campaign times, control activities were irregularly carried out and this decreased their effectiveness. Moreover, people did not fully participate in larval control activities. Most participants undertook larval control but inconsistently, finding it difficult to keep up with the suggested regimes of mosquito control. They did not think they were at risk of dengue or had larvae at home and they thought that control was best left in the hands of the authorities who could undertake more widespread spraying activities.

Many held an over-riding belief that control of Aedes mosquitoes was an unrealistic goal. Most participants in both locations believed that since mosquitoes can fly from one place to another, households were ‘fighting a losing battle’ and controlling mosquitoes at the household level would make little difference to the overall population of mosquitoes, which they perceived as coming from the neighbourhood, especially public places such as drains.

Participants pointed out that successful larval control was possible only if carried out by all households and control agents were accessible and available. People’s perception of the effectiveness of control is based on the reduction of adult mosquitoes not larvae. Getting rid of Aedes larvae from water containers may not reduce the number of adult mosquitoes greatly, as other mosquitoes were found in and around houses. Therefore, people perceive that the Aedes control program is not effective or responding to their problems.

4. Discussion

In 2001, a study in urban Khon Kaen showed that DHF was ranked at 9 out of 13 diseases, coming afteramphetamine addiction, diabetes mellitus, joint pains, accidents, back pain, leptospirosis, liver cancer and cold (J.H. Bryan, unpublished data). The perception of severity and susceptibility of DHF is significant during an outbreak when people were strongly motivated to undertake control activities at home. However, DHF is not new, people have been living with it for many years and believe that DHF is curable, and health services are reliable. Most participants felt control over the threat, and this reduces their perception of its severity and their susceptibility.

Reducing the ‘annoying’ aspects of mosquitoes was the greatest perceived benefit of mosquito control. The benefits of dengue larval control as perceived by householders, is not as significant as the benefit expected by the health authority. This is due to the continuing presence of mosquitoes even when they have undertaken the recommended control activities. People perceived the benefits of larval control as more related to keeping water and the environment clean, and fish are kept for recreation. Moreover, the barriers or costs discouraging dengue control activities prevail over these benefits. Barriers to control activities come mainly from the incompatible control practices promoted in the health messages with household water practices. Zimmerman and Vernberg (1994) suggested that if fear is induced without being accompanied by specific plans of action, it often leads to inaction.

The larval control methods suggested in health education materials, e.g., leaflets and posters, are simple; hence it is assumed that people can follow them without professional support. Besides, control agents were provided and available at health centre-level. Degrees of self-efficacy for larval control vary. For example, high self-efficacy is found for covering containers and cleaning container as these activities are common water practices in household, while self-efficacy is low for using temephos for effective larval control, which need instruction for correct application.

People did not fully recognize breeding sites of the dengue vector. People associated other “dirty” sites such as sewage drains, where they found lots of larvae and adult mosquitoes, with dengue. There is a marked hierarchy of people’s perceptions of breeding sites. Sites outside the home were ranked as highly probable breeding sites, while containers in the houses were ranked as less likely sites. This outside/inside distinction overlaid a dirty/clean distinction, which people used to discern their level of risk from mosquito breeding populations in their household environment. This finding assists in understanding why people did not fully cooperate in controlling larvae inside their houses, an important source of A. aegypti.

Adult mosquito control strategy (space spraying) was more popular than larval control because the effects of mosquito control are felt and seen immediately. This
helps support the logic that such strategies are superior to larval control. People buy commercial products to kill adult mosquitoes, or to prevent mosquito bites. Since participants undertake activities to reduce adult mosquitoes or to protect them from being bitten, mosquito larval control becomes unnecessary. Ultimately, most participants felt the overriding responsibility for dengue control lay with government officers. They felt like minor players in a very large problem, which was clearly ‘beyond them’. The drive for community participation has resulted in a feeling of ‘enlistment’ rather than community ownership. Many people felt they were passive participants in the DHF control program, with decisions about the timeline for temephos distribution and ULV spraying in the hands of the health officers who followed the plan set by the Provincial Health Office.

Often there is an assumption in health promotion campaigns that people need to be ‘scared’ into action. Ironically, this is the least influential component of the HBM. Several studies have concluded that the HBM is less powerful at explaining behaviour change than other models, e.g., the theory of reasoned action and social cognitive theory, and the HBM is less likely to be related to long-term behaviour change (Montgomery et al., 1989; Carmel, 1990; Zimmerman and Vernberg, 1994). Despite many limitations of the application and usefulness of the HBM, many health development programs, especially tropical disease control programs such as diarrhoea, malaria and acute respiratory tract infection, have used this model with some success (Kendall, 1998). The literature suggests that the success of preventive health programs using HBM is more likely if attention is paid to the socio-cultural context.

The HBM has contributed mostly to the production of health education material, which is only one component of a health promotion strategy. This article demonstrates that lack of knowledge, skills and resources are all implicated in householders not fully engaging with the dengue control messages currently delivered to them. Whilst the HBM is a useful tool for understanding the psychological dynamics of behaviour, it remains limited in addressing the broader social, cultural, economic and community dynamics involved in initiating and maintaining behaviour change.

Overall, the HBM can facilitate and improve knowledge about dengue prevention and control and raise awareness about the threat of the disease. In fact, development of critical awareness is one of the most important stages for effective development. “As awareness rises and insights develop, so the demand for new knowledge, new skills and new understandings will often grow; and as knowledge, skills and understanding grow, so the picture of the possible range of actions and of the goal will change” (Rogers, 1992, pp. 124–125). This study has found that although the community has heightened awareness, the control messages being delivered do not always resonate with householders lived experience of mosquitoes, dengue and household water use practices.

To improve the present health promotion in dengue control, consideration should be extended beyond the HBM to find innovative approaches to connect education messages with local circumstances. For example, people perceive that the A. aegypti control program is not effective in solving their problems as even when they carried out larval control, other nuisance mosquitoes remain. Health education messages should acknowledge that eliminating all dengue mosquitoes will not eliminate all nuisance mosquitoes. Some people were passive about larval control activities as they felt incapable of making a meaningful contribution to the overall control effort. Not surprisingly, health officers were held primarily responsible for effective control of dengue vectors. This sense of powerlessness discourages people from taking control action. Community engagement in dengue control strategies requires more than just information about dengue control, but also needs processes for encouraging meaningful community participation founded on an understanding of community attitudes and beliefs.

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