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Knowledge, Attitudes and Practices towards the Density of Aedes Larvae in a Tourist Destination in Bali

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Authors' contributions

This work was carried out in collaboration among all authors. Authors SGP, MPK and IMS designed the study, performed the statistical analysis, wrote the protocol and wrote the first draft of the manuscript. Authors DS and MPK managed the analyses of the study. Authors IGHP and IMS managed the literature searches. All authors read and approved the final manuscript.

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ABSTRACT

Introduction: The lack of information can affect the level of knowledge, attitudes, and practices for dengue control. The purpose of this study was to measure knowledge, attitudes, and practices associated with the larvae density of Aedes sp.
Study Design: This study used a cross-sectional design by sampling as many as 250 households. Data measurements were carried out quantitatively using questionnaires and direct observation.
Results: The variable knowledge, attitudes, practices, family income, and door-to-door health promotion associated with Aedes larvae density. People who eradicated mosquito breeding sites were mothers (74.4%), draining mosquito breeding sites routinely once a week (43%). The media favored direct counseling (53%), television as much as (34%). The preferred electronic media was interactive interviews (78.8%). The *Aedes sp* entomology survey results were house index (HI): 31.2%, container index (CI): 20.4%, and breteau index (BI): 103.6%.

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Conclusion: The knowledge, attitude, practice, family income, and door-to-door health promotion variables were associated with the density of Aedes larvae. Education programs in the community could increase awareness of controlling dengue vectors.

Keywords: Knowledge; attitude; practice; aedes density.

1. INTRODUCTION

Dengue hemorrhagic fever (DHF) is still a global health problem. It is estimated that in the world there are around 390 million cases and a minimum of 2.5 billion people at high risk of which more than 70% of the population is at risk in Southeast Asia and the western pacific region [1]. DHF infection is caused by four types of dengue virus (DEN-1 to DEN-4), which are transmitted through the bite of the Aedes aegypti and Aedes albopictus mosquitoes [2].

Indonesia is one of the dengue-endemic countries, the average number of cases reported each year is more than 200,000 in the period 2004 and 2010, the second-highest incidence rate in the world after Brazil [3]. The economic burden of dengue fever in Indonesia is estimated at the US $ 381.15 million consisting of the US $ 355.2 million to be hospitalized and the US $ 26.2 million for outpatient care cases [4]. Research in Surabaya found that DENV-1 (52.3%) was the dominant serotype, then DENV-2 (40.3%), DENV-4 (4.6%), and DENV-3 (2.8%) [5].

Bali Island is one of the dengue-endemic areas in Indonesia [6]. All DENV serotypes were found to circulate in Bali. The most prevalent serotype was DENV-3 in the 2017 period, followed by DENV-1, DENV-2, and DENV-4 [7]. The mobility of workers and tourists visiting Bali contributes to spreading dengue infection [8]. Dengue infection is one of the causes of fever in travelers visiting Bali [9]. This issue can have an impact on the number of tourist visits to Bali. Efforts to control DHF have been carried out in Bali by mobilizing the community, controlling with larvicide, fogging with malathion but not optimal.

Intervention by providing education to the community can reduce larval density [10]. There is a relationship between increased knowledge and dengue prevention behavior [11]. Socio-cultural factors of the local community are related to efforts to control and prevent DHF. Communication for behavior impact (COMBI) develops communication techniques for changing people's behavior [12,13]. The behavior of placing containers inside and outside the house can be a potential breeding place for mosquitoes [14,15]. Gianyar is an endemic area for dengue hemorrhagic fever. ~~and~~ From 2016 to 2017 there was a DHF outbreak. This article is to find out the relationship between knowledge, attitudes, and practices on the density of larvae in the outbreak dengue area.

2. MATERIALS AND METHODS

2.1 Study Area

This study was conducted in the Gianyar Regency, which is in the Province of Bali. Gianyar Regency has an area of 368 Km2 and a population of 480,447 people. The coordinates of the Gianyar region are -8.5441, 115.325461, the location has the second largest population density in Bali. Gianyar Regency is an area that experienced a dengue outbreak from 2016 to 2017. The chosen area is the tourist area in Gianyar. Selected respondents were people aged over 17 years, had lived in Gianyar for more than 6 months, and were residents. Respondents were chosen randomly according to random numbers in proportional random sampling.

2.2 Study Design

The questionnaire was prepared by discussing it with public health experts. to determine the relationship of knowledge, attitudes, and practices to larva density. The questionnaire was tested in another area with 30 respondents. Questions were asked of the head of the household or other household members who 17 years are at least old. This study method is cross-sectional in Gianyar Regency. If They refused to do the survey, then the next respondent was chosen according to random numbers. The sample in this study was taken 250 households. Twenty-four respondents refused to take part in the survey because they were not at home [16], disagreed [5], and did not get a husband's permission [3]. Sampling was done by cluster random sampling. The measured variables are demographic characteristics, knowledge about dengue, attitudes, and practices of the community in controlling

mosquito breeding sites, media information expected by the community, and door-to-door health promotion. The results of the survey were compared with the density of Aedes larvae results from the entomology survey. The interviewer read out the questionnaire, then the respondents answered orally. The interviewer explains to the respondent if there are questions that are not understood, and to complement the interview results, it was equipped with direct observation.

2.3 KAP Survey

A Knowledge, Attitude, and Practices (KAP) survey is a quantitative method (predefined questions formatted in standardized questionnaires). There are 18 questions about the variable of knowledge by category (Who gave information, the characteristics of dengue mosquitoes, DHF symptoms, DHF can be prevented, Vector control method, Benefits of eradicating mosquito breeding sites). The attitude variable there are 15 questions with a Likert scale with ~~5~~ five categories (DHF can be prevented, vector control is the task of government, vector control needs community participant, prefer spraying insecticide, if DHF gets to health services), the practices variable there are 12 questions with ~~6~~ six categories (routinely clean containers, containers infested with larvae, who does container cleaning, cleaning containers for the past one week, container observation last one week, practices on water containers), the preferred media variable is ~~6~~ six questions (preferred electronic media, who is the best to provide health information in electronic media, the type of print media the community wants). Data collection was carried out using interview guidelines in the form of a questionnaire established by the Ministry of Health to conduct a COMBI survey.

Respondents are considered to have good knowledge, attitude, and practices if they can answer correctly above 70% of the questions. Odds Ratios (OR) and associated 95% confidence intervals (95% CI) for the association between knowledge, attitude, practice, and socio-demographic variables were calculated by logistic regression.

2.4 Larva Survey

Measuring larvae density with larval survey uses a single-larva method to find out the number of Aedes larvae in a container of water. Entomological measurements were carried out by larval surveys using house index, container index, and breteau index calculations. It aims to measure and detect the level of vector density. House index (HI): percentage of houses infested with larvae. Container index (CI): percentage of water-holding containers infested with larvae. Breteau index (BI): number of positive containers per 100 houses inspected [16].

2.5 Statistical Analysis

To analyze the Odds Ratios (OR) and associated 95% confidence intervals (95% CI) for the association between knowledge about dengue, attitudes, and practices of the community in controlling mosquito breeding sites, media information is expected by the community, and door-to-door health promotion related to larval density analyzed in stages using univariate and bivariate.

3. RESULTS AND DISCUSSION

The determinants of knowledge, attitudes, and practices of dengue control with good categories were (67.6%), (41.2%), and (34.4%). Respondents received information from volunteers (97.2%) and electronic media (94%). However, only 22.4% knew a virus caused DHF. Respondents who knew the characteristics of Aedes aegypti mosquitoes were (83%). There are 13% who have family members who have had dengue infection in the past year. For DHF symptoms, respondents know the main symptoms are fever (93%) and bleeding (44%) (Table 1).

DHF can be prevented (71%), vector control can be done by draining containers once a week (65%), using larvicide temephos (55%), spraying insecticides (70%). Respondents know the benefits of eradicating mosquito breeding sites to eliminate larvae (66%). Eradication of mosquito breeding sites is done once a week (62.4%) (Table 2).

Almost 90% of respondents agree that dengue can be prevented by controlling the vector. About 40% of respondents agreed that the community should participate in controlling the vector. Respondents also preferred spraying insecticides (47%). Spraying with chemical insecticides risks the emergence of resistance. Active community participation in vector control is needed.

Table 1. Knowledge of sources of information, causes of dengue, characteristics of mosquitoes, symptoms of dengue

Knowledge variable	N	Percentage (%)
Source of information on dengue		
a. Health workers	66	26.4
b. Village head	24	9.6
c. Health volunteer (jumantik=*juru pemantau jentik*)	235	94
d. Family	98	39.2
e. Electronic media	243	97.2
f. Mass media	167	66.8
There is a family member who has been infected with DHF in the past year	34	13.6
Cause of DHF		
a. Virus	56	22.4
b. Mosquito	102	40.8
c. Bacteria	67	26.8
d. Don't know	25	10
The characteristics of dengue mosquitoes	208	83.2
Aedes mosquito life cycle	68	27.2
How long from an egg to mature	103	41.2
DHF symptoms		0
a. Fever	234	93.6
b. Skin bleeding	111	44.4
c. Abdominal pain	47	18.8
d. Bleeding from the nose	89	35.6
e. Blood in the stool	23	9.2
f. Blood in vomiting	55	22
g. Shock	89	35.6
f. Doesn't know	24	9.6

Table 2. Knowledge of vector control methods

	N	Percentage (%)
How to prevent DHF	178	71.2
Vector control method		
a. Clean water container	164	65.6
b. Water storage is covered	145	58
c. Recycles non-essential container	120	48
d. Larvicide (temephos)	139	55.6
e. Control larva with fish	78	31.2
f. Spraying with insecticide	176	70.4
g. Use repellent	36	14.4
Benefits of eradicating mosquito breeding sites		
a. Removes larva	165	66
b. Prevents dengue transmission	153	61
c. Kill mosquito	121	48
How often should you mosquito breeding places		
Once a week	156	62.4
Once a month	42	16.8
When there is free time	52	20.8
Practices took if the family is infected with DHF		
a. Drink a lot	167	66.8
b. Compress worm water	56	22.4
c. Giving fever medicine	124	49.6
d. Goes to health services	227	90.8

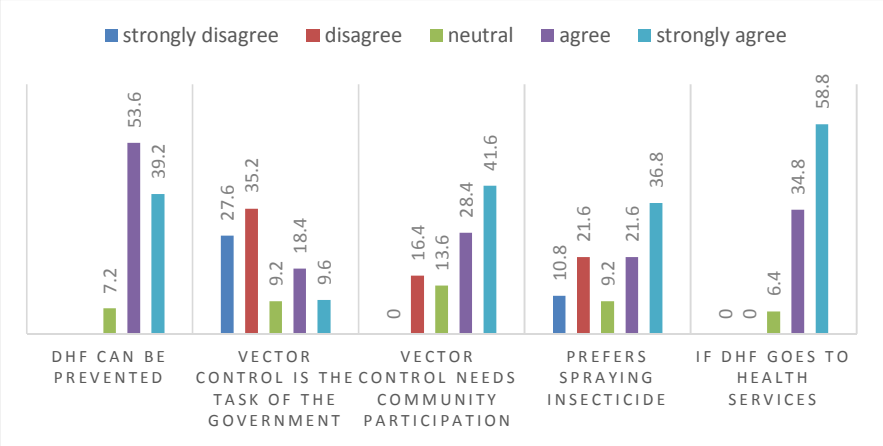

Fig. 1. Respondents' attitudes towards dengue control

Practices to eradicate mosquito breeding sites that do not clean the water container in the last week were only (43%) of reports, container infested with larvae was reported by (31.2%) of interviewed. These conditions are associated with the risks of increasing larvae density in an area. Mothers have an important role in cleaning the house, shown in this study (74.4%). Mothers are more involved in house-cleaning and at-home activities. Cleaning activities of mosquito breeding sites are carried out by giving insecticide (22%), cleaning containers (34%), and leaving containers untreated (32%).

Table 3. Practices regarding DHF control

Variable	Number	percentage
Routinely clean containers		
not a routine	107	42.8%
clean containers only in the house	120	48%
clean inside and outside the house	23	9.2%
Containers infested with *larvae*		
Yes	78	31.2%
No	172	68.8%
Who does container cleaning		
Father	2	0.8%
Mother	186	74.4%
Child	17	6.8%
Housemaid	14	5.6%
The other	31	12.4%
Cleaning containers for the past 1 week		
Yes	109	43.6%
No	141	56.4%
Container observation last 1 week		
Yes	109	43.6%
No	141	56.4%
Practices on water containers		
No action	81	32.4%
Dry out	5	2%
Giving larvicide	55	22%
Clean the container	87	34.8%
Brush off container	8	3.2%
Give the container covers	14	5.6%

One of the reasons the community did not eradicate mosquito breeding sites was "claiming to be busy" (23,2%). Generally, those who work find it difficult to allocate time to mosquito breeding eradicating activities. Respondents who received education about larval control was (86%). Information was provided, in most, by health volunteers (65%) and health workers (24%) (Table 4).

The most preferred media information by the community to get information about dengue control was direct health education (53.2%). Through direct education, the community can communicate with health workers and feel comfortable. Through television (33.6%), they can get information quickly and easily. Through electronic media, the most preferred is through interactive interviews (78.8%). Interactive interviews can usually be via television and radio. Communication can be two-way, so that listeners should communicate interactively. Respondents prefer health workers who interact through electronic media. Health workers are considered more competent in delivering information than community leaders, health volunteers, or film stars. The preferable print media was a newspaper, that is considered more regularly published and easily accessed by the public.

Table 4. Reasons for not cleaning mosquito breeding sites

	Number	percentage (%)
Reason for not cleaning breeding sites		0.8
Not important	2	7.6
Don't understand	19	23.2
Busy	58	13.6
Lazy to do	34	18.4
Lack of sanctions	46	9.2
Peer influence	23	6.4
Low motivation	16	20.8
Not answering	52	
Ever get information about dengue control		
Ever	215	86
Never	35	14
who gave information about dengue control		
Health workers	61	24.4
Voluntary (*jumantik=juru pemantau jentik*)	163	65.2

Table 5. Preferred media for providing information

Variable	Number	Percentage (%)
Preferred electronic media		
Spot	19	7.6
Soap opera	6	2.4
Lecturer	18	7.2
Interactive interview	197	78.8
Social media	10	4
Who is the best to provide health information in electronic media		
Health workers	245	98.0
Public figure	1	0.4
Health volunteer	1	0.4
Movie star	3	1.2
The type of print media the community wants		
Newspaper	210	84
Brochure	17	6.8
Poster	12	4.8
Magazine	7	2.8
Billboard	4	1.6

Table 6. Relationship of knowledge, attitudes, practice, family income, education door to door associated with Aedes larva density

Variable	Larva density	Odds ratio	95% CI	p-value
Knowledge				
• Low	34 (43.6%)	2.0	1.175-3.595	0.01*
• High	44 (56.4%)			
Attitude [#]				
• Negative	58 (74.4%)	2.7	1.50-4.87	0.01*
• Positive	20 (25.6%)			
Practice [+]				
• Bad	66 (84.6%)	4.1	2.09-8.2	0.00*
• Good	12 (15.4%)			
Education				
• Low	56 (71.8%)	1.07	0.59-1.93	0.816
• High	22 (28.2%)			
Occupation				
• Employment	39 (50%)	0.75	0.44-1.29	0.304
• Unemployment	39 (50%)			
Family income				
• Low	43 (55.1%)	0.26	0.14-0.47	0.00*
• High	35 (44.9%)			
Door to door health promotion				
• Don't get	32 (41%)			
• Get	45 (59%)	39.18	11.4-133.7	0.00*

**) P-value < 0.05; [#]) A positive attitude is characterized by agreeing to take dengue prevention efforts; [+]) Good practice is characterized by routine vector control activities*

There is an association between knowledge, attitudes, practices, income, get an education with larvae density. This association occurs because the education provided increases community knowledge, attitudes, and practices in vector control to decreases larvae density. Education to the community is needed to increase their awareness of dengue vector control efforts.

Two hundred and fifty residences have been to observe the breeding places of larvae in and outside the house. Aedes sp entomology survey results are house index (HI): 31.2%, container index (CI): 20.4%, and breteau index (BI): 103.6%. These indexes show that this area has a high risk of dengue transmission due to its high larval density. The most positive type of larvae container was in the bathtub (59.40%), buckets (29.32%), water tanks (4.51%), holy water containers (Tirta) (3.76%), and drums (3.01%).

This study was conducted to assess the implementation of the communication for behavior impact (Combi) program in controlling DHF, measuring the level of knowledge, attitudes, practices, preferred media of educational information, and larval density. Determinants of community knowledge, attitudes, and practices in carrying out dengue control efforts are interrelated. Efforts to increase public knowledge about this disease can affect community awareness in eradicating mosquito breeding activities.

Dengue control is related to individual factors like knowledge, attitudes, practices, education level, occupation, and mobility. Information is spread by various of electronic media, print media, social media, and direct health education. The preferred electronic media is the television, although interactive discussions like, for example, which should provide health information are health workers. Socio-cultural factors related to family habits, as have water containers and buckets rarely cleaned, contribute to maintaining breeding sites for mosquitoes. The number of used containers outside the house can also be a breeding ground for mosquitoes such as used bottles, old tires, drinking places for birds. Regulations to forbidden this and provide fines do not yet exist even though this is necessary. Environmental conditions like rainfall, temperature, mosquito breeding sites were associated with most larvae containers found in the house, and the most dominant types of

containers are bathtubs and buckets. Temperatures between 31-32°C and humidity of 90-92% are favorable conditions for mosquito breeding. The entomology survey was carried out in people's houses and public buildings such as schools, hotels, and lodgings by looking at the containers and larvae and pupae on each container. High larvae density was found in dengue-endemic areas.

In Bali, there are 4 four circulating dengue virus serotypes, the most dominant Denv-3 in the 2017 period [7]. Dengue infection in tourist destinations can cause the transmission to other countries after tourists return to your countries from endemic areas [17]. Several international travelers and residents have reported dengue fever and DHF [9,8]. This condition makes the travelers pay attention to prevention efforts. Found larvae in tourist destinations show the vulnerability of these areas to the occurrence of dengue outbreaks. Special attention is needed to prevent transmission to travelers visiting tourist destinations. Currently, there is no known effective dengue vaccine. To prevent dengue transmission, tourists should avoid mosquito bites by using insect repellents, protective clothing, and insecticides [17].

This study found an association of variables of knowledge, attitudes, practices, family income, and get door-to-door health promotion with Aedes larval density. Information provided routinely from door to door can increase knowledge and influence public awareness to practice dengue vector control. The result of our study is similar to research conducted in Jamaica [18], Thailand [11], Taiwan [19], Pakistan [20], Australia [21], Saudi Arabia [22], Indonesia [23].

The person who cleans the house is usually the mother. Only 43.6% of respondents do a container inspection and clean it once a week. The reason presented by them is that they are busy working. They prefer to get information about health promotion directly from health workers because they can be more communicative, and feel better cared for. They also get information about dengue through television, social media, print media. Studies in Thailand also found that exposure to information media influences people's knowledge and practices in controlling vectors [24]. Likewise, there are studies in Islamabad that found information media more easily from television, newspapers, parents, and schools [25]. Sources of information affect their awareness to control dengue.

The door-to-door health promotion intervention was carried out by officers who observed larvae by providing education and larvicide (jumantik). This officer routinely visits residents' homes every month. This program aims to increase public participation in controlling DHF. This study also showed that people exposed to door-to-door health promotion get to reduce the density of larvae in their houses.

Dengue infections that cause mortality and morbidity can have economic impacts on developing countries such as India [26], Thailand [27], Mexico [28], and Indonesia [4]. In the community group that has a low income, it turns out that efforts to control dengue hemorrhagic fever are difficult to do optimally. Their primary needs take precedence over buying larvicides, container covers, and other preventive measures. They tend not to clean the environment properly, so many potential containers become breeding sites. The same study about this was also carried out in Ecuador, people who have low incomes tend to have limited budgets to control larvae and pupae [29]. Low family income influences elevate the risk of DHF [30].

The community's socio-cultural habit in placing containers inside and outside the house also influences the larvae density. In every house, community culture has a container in the bathroom and a bucket in the house. A typical container in Bali is the holy water container *(Tirta)*. *Tirta* is a place of holy water used for worship of Hinduism. *Tirta* containers also often contain water and are open, so that it can become a potential to become a breeding site for mosquitoes. Cans, bottles, used tires also have the potential to become mosquito breeding sites.

The characteristics of mosquito breeding sites affect larvae density in the environment [31]. Knowledge about mosquito breeding sites is important to know the interaction with the environment. Environmental characteristics influence the selection of breeding habitat and larvae density. The characteristics of the type of container, number, color, indoor and outdoor location affect the larvae density [32,33].

Larval density measurements with house index, container index, and breteau index are commonly used [34]. The entomology index can

be used to predict mosquito density and dengue infection [15], [35], as well as intervention in risk areas [36,37]. A high entomology index is an early warning for an outbreak in an area [38,39,40]. This study found high entomology indexes: house index (31.2%), container index (20.4%), and breteau index (103.6%). These indexes mean that this area is at high risk for dengue infection.

4. CONCLUSION

Knowledge, attitude, practice, family income, door-to-door health promotion are variables associated with the Aedes larvae's density. Lack of information can be a cause of low levels of knowledge. Respondents who have received door-to-door education can increase their understanding so that larvae density decreases. Low family income can also affect vector control efforts. The density of larvae can be an early warning for an outbreak in an area that needs to be done quickly to practice reducing larvae density.

CONSENT AND ETHICAL APPROVAL

The study's ethical clearance was obtained from the Medical Faculty, Udayana University. This study was approved by the Medical Ethics Commission of Udayana University. This study was carried out by the Declaration of Helsinki and the recommendations of those committees with written informed consent from all participants. Informed consent was signed by the respondent before the survey was conducted, Informed consent was obtained before the commencement of the data collection

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COMPETING INTERESTS

Authors have declared that no competing interests exist.

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