Jurnal Sains Kesihatan Malaysia Isu Khas 2019: 127-137
DOI : http://dx.doi.org./10.17576/JSKM-2019-15

Knowledge About *Aedes* Mosquitoes, Dengue Fever and Zika Virus among Primary School Students in the Dengue Cluster Areas of Hulu Langat, Selangor

(Pengetahuan Berkenaan Nyamuk *Aedes*, Demam Denggi dan Virus Zika di Kalangan Pelajar Sekolah Rendah di Kawasan Kluster Denggi di Hulu Langat, Selangor)

ZUL-'IZZAT IKHWAN ZAINI*, NORHAFIZAH KARIM, ISMARULYUSDA ISHAK, WEE LEI HUM & HIDAYATULFATHI OTHMAN

ABSTRACT

*In Malaysia, dengue fever is a common vector-borne disease. Most cases of dengue fever are reported in residential areas. Children are at high risk to be infected because they spend a lot of time around their housing area for outdoor activities. Such areas may have a high number of Aedes mosquitoes. As schools are equipped with infrastructure and medium for effective educational purposes, schools represent the most suitable facilities for learning and teaching process. A cross-sectional study was conducted to determine the level of knowledge among students in Hulu Langat on Aedes mosquitoes, dengue fever, and Zika virus. The study also reported on the demographic factors which affected the knowledge level. Based on sample size calculation using G*Power v3.1 software, a total of 171 respondents were needed from the two primary schools involved in the study. Data collection was conducted using a pre-tested questionnaire that consisted of two main sections on demography and knowledge about Aedes mosquitoes, dengue fever and Zika virus. From the total score of 55, the mean knowledge score is 34.2 ± 8.38. Based on the median value of 36.0, about 50.9% of respondents had satisfactory knowledge. From the study, it was found that students from School A, students who had been watching video related to Aedes mosquito, and those with history of dengue infection among family members had a significantly better knowledge score ($p < 0.01$). In conclusion, knowledge about Aedes mosquitoes and related illnesses need to be enhanced through a comprehensive module and effective educational materials that can serve as a reliable source of information for primary school students.*

Keywords: Aedes; dengue; knowledge; primary school; zika

ABSTRAK

*Di Malaysia, penyakit demam denggi merupakan penyakit bawaan vektor yang amat kerap berlaku. Kebanyakan kes bagi wabak demam denggi berlaku di kawasan perumahan. Kanak-kanak adalah golongan yang berisiko tinggi dijangkiti kerana banyak menghabiskan masa di kawasan perumahan dan aktiviti yang dilakukan sering berdekatan dengan tempat wujudnya nyamuk Aedes. Sekolah adalah medium yang sesuai bagi tujuan pendidikan kerana prasarana yang disediakan lengkap dan selesa memudahkan proses pembelajaran dan pengajaran. Sehubungan dengan itu, kajian keratan rentas dijalankan bagi mengenal pasti tahap pengetahuan para pelajar tentang nyamuk Aedes, demam denggi dan virus Zika dan faktor-faktor demografi yang mempengaruhi pengetahuan pelajar. Pengiraan sampel menggunakan perisian G*Power v3.1 dan seramai 171 orang responden dari dua buah sekolah rendah terlibat dalam kajian. Penggumpulan data adalah melalui borang soal selidik yang telah diuji yang dibahagikan kepada dua bahagian utama iaitu demografi dan pengetahuan tentang nyamuk Aedes, demam denggi dan virus Zika. Daripada 55 markah penuh, nilai min bagi skor pengetahuan adalah 34.2 ± 8.38. Berdasarkan nilai median 36.0, sebanyak 50.9% responden mempunyai pengetahuan yang memuaskan. Kajian mendapati responden dari Sekolah A, responden yang pernah menonton video berkaitan nyamuk Aedes, dan responden yang mempunyai ahli keluarga yang pernah menghidap demam denggi mencapai skor pengetahuan yang lebih tinggi yang signifikasi ($p < 0.01$). Kesimpulannya, tahap pengetahuan berkenaan nyamuk Aedes dan penyakit bawaannya perlu diperkasakan dengan membangunkan satu modul pembelajaran yang lebih menyeluruh dan menghasilkan bahan pendidikan yang berkesan sebagai sumber maklumat kepada para pelajar sekolah rendah.*

Kata kunci: Aedes; denggi; pengetahuan; sekolah rendah; zika

INTRODUCTION

Dengue and Zika are both mosquito-borne viral diseases and the main vector is the *Aedes* mosquitoes, namely the species of *Aedes aegypti* and *Aedes albopictus*. These species are also responsible for transmitting chikungunya and yellow fever (Normah et al. 2014; Wan-Norafikah et al. 2017; World Health Organization (WHO) 2018; Centres for Disease Control and Prevention (CDC 2018). These diseases are highly prevalent in tropical regions. The viruses are transmitted to humans through the bites of an infective female *Aedes* mosquito. Among the vector-borne diseases, dengue infections recorded one the highest number of cases

reported annually, and it also a fast emerging pandemic in many parts of the world, especially in the tropical and subtropical countries. The global incidence of dengue cases has increased steadily over the last six decades (Thai et al. 2011). It is now reported to be endemic in 100 countries, with 96 million cases estimated per year (WHO 2018).

In 2015, Malaysia recorded the highest dengue cases in history since 1995 with a total of 120,836 cases and 336 deaths. Although the number of dengue cases appeared to be on the decline since 2016, annual reported dengue cases still exceed 50,000 cases (Idengue 2018). Furthermore, in 2017, there was a global outbreak of Zika virus infection, in which cases were reported in 76 countries around the world (The Director-General of Health Malaysia 2017). In Malaysia, there are eight confirmed positive cases of Zika virus infections which were reported during that year. Since then, no further Zika cases were reported (The Director-General of Health Malaysia 2017).

Everyone in an endemic area, regardless of age, is at risk of dengue infection. For uncomplicated dengue infections, a previous study was done in Brazil to investigate the relationship between age at primary infection and the risk of febrile illness. The results showed that adults are more likely to contract clinical dengue than children (Egger & Coleman 2007). On the other hand, age is a well-established prognostic factor for the disease severity of dengue infection (Thai et al. 2011). Pre-school children and infants often present with undifferentiated febrile illness while pre-adolescent children would develop fever (Rigau-Prez et al. 1998). Unlike many South East Asian countries, dengue cases in Singapore are predominantly seen in adults and the number of paediatric dengue cases is low as the country has a rigorous vector control program in place to reduce the transmission (Wilder-Smith et al. 2005).

Severe dengue or dengue haemorrhagic fever (DHF) is a leading cause of serious illness and death among children in some Asian and Latin American countries (WHO 2018). Among younger children with DHF, they tend to experience more severe clinical outcomes compared to adults, leading to a higher case fatality ratio (Guzman et al. 2002). In some studies, children between the age of 8 to 11 years have been shown to have the highest susceptibility to contract dengue shock syndrome (DSS) (Sangkawibha et al. 1984; Thein et al. 1997).

In Malaysia, from a total of 120,836 cases reported in 2015, about 18% or 21,750 of the cases were among those aged between 0 to 14 years old. Further analysis showed that about one-third or 7,250 cases were children aged between 5 to 9 years old while the remaining 9,667 cases were reported among older children aged between 10 to 14 years old (The Director-General of Health Malaysia 2016).

Sufficient knowledge about dengue disease is essential for early diagnosis, timely treatment, and prevention of morbidity and mortality (Abe et al. 2012). However, it is a challenge to create awareness that can lead to better understanding and good knowledge among the public about *Aedes* and its related disease. Several studies suggested that better knowledge leads to better prevention techniques adopted by people in the prevention of this disease (Abbasi et al. 2016). In Malaysia, the Ministry of Health (MOH) is collaborating with various bodies such as education institutions, resident's association, non-government associations (NGO), and private sectors in order to educate the public about *Aedes* mosquito and its related vector-borne diseases.

Education is an important component in the fight against *Aedes* mosquito-borne viral diseases such as dengue. Ministry of Education (MOE) in Malaysia has taken a good initiative in instilling the basic required knowledge on *Aedes* and dengue fever among the younger generation in primary schools. However, additional information is also important and need to be delivered to the students. These information included the life cycle of *Aedes* mosquito, characteristics at each phase of the life cycle, time taken to grow into an adult mosquito, common biting time, the transmission of the virus to human, and most importantly, the prevention and to control this disease. To date, no studies have been conducted in Malaysia to assess the level of knowledge among the younger generation about *Aedes* mosquitoes, dengue fever, and Zika virus. Thus, the aim of our study is to identify the degree of knowledge among primary school students about this disease and its vector and to examine the factors that may affect their level of knowledge. Findings from this study can be used by various agencies to establish a well-structured program for comprehensive dissemination of the necessary information to the students.

MATERIALS AND METHODS

STUDY PERIOD AND STUDY SITE

In 2015, Hulu Langat District reported the second highest dengue cases among all the health districts in Malaysia with a total of 14,919 cases (The Director-General of Health Malaysia 2016). A cross-sectional study was conducted in April 2016 in the district of Hulu Langat, Selangor. Two selected primary schools (School A and School B) located in the dengue cluster area were proposed by the District Education Office as the study sites. Figures 1 and 2 show the location map of the schools. Red arrow colour represents the school area while purple circles denote the dengue cluster areas and the red flag points to a hotspot locality for dengue cases (Idengue 2016). The distance between these two schools is approximately 8.0 km.

Idengue, is a system run by the Malaysian Remote Sensing Agency (MRSA) that provides accurate and up-to-date information on the residential areas affected by active dengue epidemic in Malaysia. Apart from that, this website also spread awareness within the public about the dengue status in their areas thus indirectly mobilizing the community to take necessary steps in eliminating mosquito breeding sites to prevent further outbreaks related to *Aedes* mosquitoes (MRSA 2015).

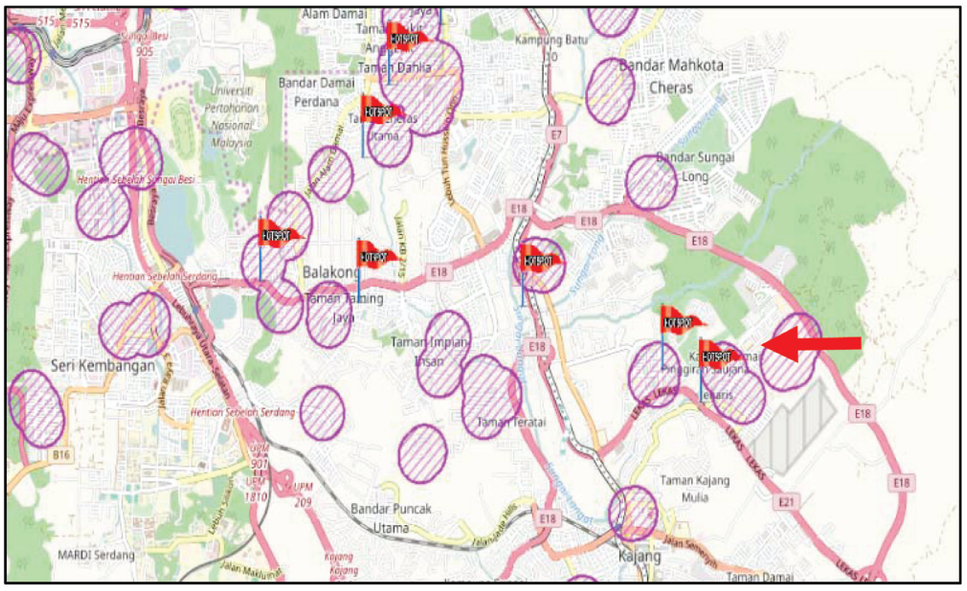

FIGURE 1. Location of school A (arrow)

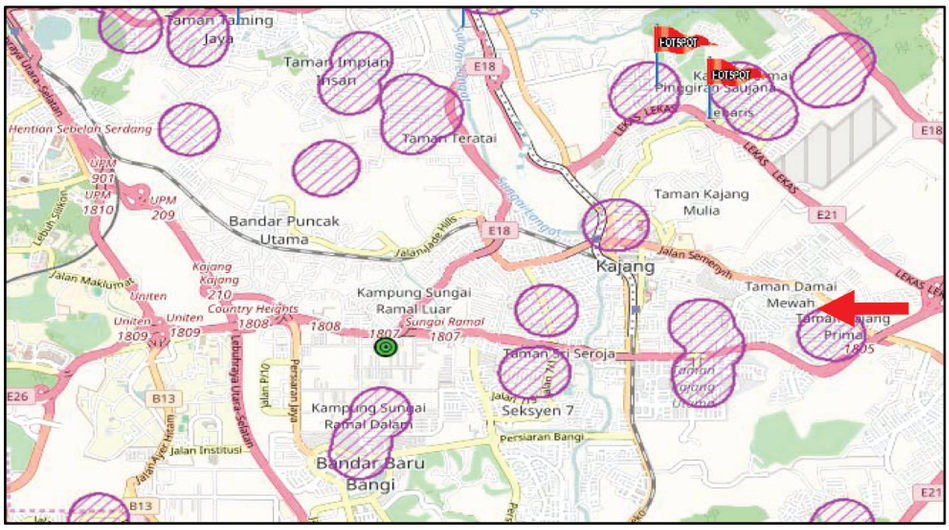

FIGURE 2. Location of school B (arrow)

SAMPLING PROCEDURE AND SURVEY

Multistage sampling was used. Initially, the purposive sampling method was applied to select the schools. As aforementioned, the selection of the schools was on the locations of cluster areas, as well as the willingness of the school to participate in the study. Two schools were selected in the study.

By using G*power v3.1 software, the details of F test as a test family, input parameters of 0.1 effect size f, 5% margin of error, power 0.8, a total of 164 respondents were the minimum recommended sample size. By taking into account a 10% non-response rate, the final sample size was 180 respondents. Thus, the minimum number of respondents required from each school was 90. Then, systematic random sampling was adopted to select a sample of respondents from a name list given by the school management which consisted of all the students in the Standard Three classes.

A pretested structured questionnaire with two main sections was used for data collection. The first part of the questionnaire captures the demographic data of the respondents. The second section contains 55 questions that are formulated to assess their knowledge. The second section is categorized into three sub-sections; the first part consists of 33 questions on about *Aedes* mosquitoes, the second part has 11 questions about dengue fever while the third section consists of 11 questions on Zika.

It was pretested and printed in the local Malay language since it is the national language and mother tongue of the respondents. Before they begin to answer the questionnaire, respondents were given a short briefing on question instructions and ways to answer them. After the briefing, respondents were given how long to complete the questionnaire.

This study was approved by the Ethical Review Committee National University of Malaysia (Ethical code number NN-2017-091). The application was submitted to the Education Policy Planning and Research Division (BPPDP), Ministry of Education Malaysia for official approval, upon which the approval will be forwarded to the Selangor Education Department and the Hulu Langat District Education Office.

DATA ANALYSIS

The data collected from the questionnaire were entered and analyzed with IBM SPSS v23. All of the questions were analyzed and assessed individually using a scoring system. Each correct answer was given a point and the total score was calculated for all the sections. Knowledge was assessed based on the median cut-off point of the total scores. Respondents who achieved a median score and above will be considered as having 'sufficient' knowledge while the remaining will be categorized as having 'insufficient' knowledge. Normality test was conducted before analytical statistics were performed.

RESULTS

SOCIO-DEMOGRAPHIC CHARACTERISTICS

During the data collection, out of total 180 students, nine students were absent. Thus, only 171 individuals were included in the final analysis of the study. Table 1 shows the characteristics of the respondents. A total of 87 (50.9%) respondents were males and the majority of the respondents (95.9%) were Malays. Only 17 or 9.9% of all the respondents reported having a history of dengue infection while 1 in 5 or 20.5% of total respondents had a family member with previous dengue infection. As many as 127 of the respondents (74.3%) claimed that they had watched animated videos related to *Aedes* mosquitoes and its vector borne diseases before this study.

CATEGORY OF KNOWLEDGE AMONG RESPONDENTS

Figure 3 shows that the scores of the overall knowledge level of the respondents categorized into sufficient or insufficient level. Based on the median value of 36.0, about 50.9% of the 171 respondents had sufficient knowledge about *Aedes* mosquitoes, dengue fever, and Zika virus.

TABLE 1. Socio demographic characteristics of the respondents (n = 171)

Variables	Frequency, n	Percentage, %
Gender		
Male	87	50.9
Female	84	49.1
Ethnicity		
Malay	164	95.9
Non Malay	7	4.1
History of dengue infection Self		
Yes	17	9.9
No	154	90.1
Family members		
Yes	35	20.5
No	136	79.5
Had ever watched any animated video related to *Aedes* mosquitoes		
Yes	127	74.3
No	44	25.7

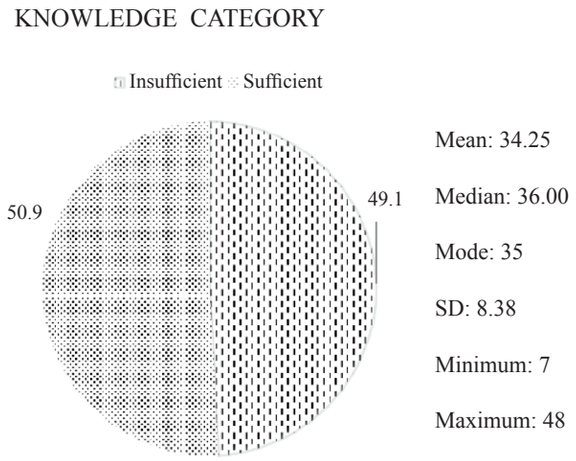

FIGURE 3. Knowledge category among respondent (n = 171)

KNOWLEDGE ON AEDES AND ITS PREVENTION AND CONTROL

Table 2 shows the knowledge of the respondents regarding *Aedes* and its prevention and control. Majority of respondents (90.6%) knew that the main feature of the mosquitoes was the black and white colours. About 85.4% of respondents correctly answered that *Aedes* mosquitoes lay eggs in uncovered containers with stagnant water, and 81.3% were correct in saying that larvicide can kill the larvae. However, our study found that more than half of the respondents did not know that pupa cannot be killed by insecticides (64.9%).

A high number (80.1%) of the respondents also knew that everyone was prone to be the bite victims of *Aedes* mosquitoes. Only one-third (33.9%) of respondents were aware that *Aedes* mosquitoes bite in the early morning and late evening. Similarly, only one-third (33.3%) of them

TABLE 2. Knowledge on *Aedes* mosquitoes (n = 171)

Variable	Frequency, n (Correct answer)	Percentage, % (Correct answer)
About *Aedes* mosquitoes		
• The time required for eggs to become adult mosquitoes is seven days	57	33.3
• Mosquitos lay eggs in clear, non-closed water reservoirs	146	85.4
• Mosquitoes' eggs are black	37	21.6
• The presence of water is important for egg hatching	99	57.9
• Mosquito eggs can survive without water for 6 to 12 months	5	2.9
• The life cycle starts with eggs, turns into larvae, eventually becoming pupae and then adult mosquitoes	116	67.8
• Larvicide can kill larvae	139	81.3
• Pupae cannot be killed with any insecticide	60	35.1
• Mosquito is black-white in colour	155	90.6
• Mosquitoes bite in the early morning and late evening	58	33.9
• Everyone is prone to become bite victims	137	80.1
Outdoor breeding sites		
• Clear stagnant water	149	87.1
• Clogged rainwater channel	98	57.3
• Unclosed container	136	79.5
• Flower pot trays	150	87.7
• Unused tires	98	57.3
• Waste that is not well managed	91	53.2
Indoor breeding sites		
Refrigerator liner (under the fridge)	54	31.6
Toilet tank	92	53.8
Dish rack's tray	64	37.4
Water tank	144	84.2
Prevention and control of breeding sites		
Rubbish is disposed of properly	138	80.7
Properly closed a container/tank that can store water	132	77.2
Dry or store unused containers	86	50.3
Make sure the flow of water in the drainage channels is always flowing and non-stagnant	129	75.4
Larvae insecticide are placed in water catchment areas	137	80.1
Prevention from bitten by *Aedes* mosquitoes		
Allow fogging inside and outside of the house	121	70.8
Use aerosol spray	110	64.3
Use mosquito repellent coil	136	79.5
Wear long attires when leaving the house	146	85.4
Use mosquito lotion repellent	125	73.1
Use mosquito nets when sleeping	155	90.6
Install mosquito nets at the window	131	76.6

answered correctly about the incubation period of *Aedes* mosquito from eggs to adult mosquitoes to be 7 days. About 21.6% answered that the colour of the mosquito eggs is black while only 2.9% of the respondents were able to answer correctly that mosquito eggs can survive without water for 6 to 12 months.

Under the section testing for knowledge about outdoor breeding grounds of *Aedes*, a high number of respondents were aware that flowerpot pads and stagnant water were potential breeding grounds. As for indoor breeding sites, most respondents (84.2%) were aware of water tank as main breeding areas but many were unaware of other breeding sites such as refrigerator liners and dish rack's tray. In order to reduce the number of adult mosquitoes, necessary action needs to be taken to control its potential breeding sites to prevent the mosquitoes from laying more eggs. Most of the steps about prevention and control activities were correctly answered in more than 75% of the respondents. However, only half of them (50.3%) realized the importance of drying and storing unused containers to prevent them from becoming breeding sites.

As for prevention of mosquitoes bite, the knowledge level is generally good. As high as 90.6% answered correctly about the use of mosquito net when sleeping as a prevention method but only 64.3% were aware of the use of aerosol spray for the prevention of mosquitoes bites.

KNOWLEDGE OF DENGUE FEVER AND ITS SIGNS AND SYMPTOMS

Table 3 outlines the knowledge level of the respondents on dengue fever. A high percentage of respondents (95.5%) knew that dengue is a dangerous disease. About 86.5% of respondents answered that *Aedes* mosquito is a vector for dengue infection. About 80.7% of them were aware that a severe dengue infection may cause death. However, only 24.6% of respondents knew that there was no specific treatment for dengue fever.

Regarding the knowledge on the signs and symptoms of dengue, about 75.4% answered fever as one of the dengue signs while only 47.4% were aware that bleeding in the gum, mouth, or underneath the skin can also be a manifestation of dengue infection.

TABLE 3. Knowledge on dengue fever (n = 171)

Variable	Frequency, n (Correct answer)	Percentage, % (Correct answer)
• *Aedes* mosquito is a carrier for dengue fever	148	86.5
• Dengue fever is dangerous	164	95.9
• There is no specific treatment for dengue fever	42	24.6
• Dengue fever can be fatal	138	80.7
Signs and symptoms		
• Headache	99	57.9
• Pain in bones, muscles, and joints	106	62.0
• Fever	129	75.4
• Rash	115	67.3
• Less appetite	111	64.9
• Nausea and vomiting	121	70.8
• Bleeding in the gum, mouth and under the skin	81	47.4

KNOWLEDGE ON ZIKA AND ITS SIGNS AND SYMPTOMS

Table 4 presents the knowledge level of respondents on the Zika virus. As high as 95.9% of respondents were aware that Zika is dangerous was 95.9%. However, only slightly more than half of them (59.6%) knew that *Aedes* is the carrier for Zika virus and only 56.7% knew that infection in pregnant mothers may cause microcephaly in their newborns. About one-fifth (22.8%) respondents knew that there is no specific treatment for Zika infection meanwhile 17.5% had the knowledge that Zika may not always cause death.

As for the signs and symptoms, only 43.3% and 46.8% of respondents knew that Zika infection can cause pain to the nerve and pain to the muscles and joints respectively. Mostly, the respondents (66.1%) answered fever as the sign and symptom of Zika infection.

TABLE 4. Knowledge of Zika Infection (n = 171)

Variable	Frequency, n (Correct answer)	Percentage, % (Correct answer)
Aedes mosquito is a carrier for Zika virus	102	59.6
There is no specific treatment for Zika	39	22.8
Zika infection is dangerous	164	95.9
Zika cannot cause death to the infected person	30	17.5
Pregnant women with Zika may cause microcephaly in new-borns	97	56.7
Signs and symptoms		
Fever	113	66.1
Headache	104	60.8
Rash	91	53.2
Pain in muscle and joints	80	46.8
Red eyes	101	59.1
Nerve pain	74	43.3

LEVEL OF KNOWLEDGE BASED ON SOCIO-DEMOGRAPHIC FACTORS

Five socio-demographic variables were analysed against the total knowledge score and category to determine if there are any associations. Table 5 shows a significant difference ($p < 0.01$) on the knowledge scores for three of the socio-demographic factors. Firstly, respondents from School A (Mean = 36.66, SD = 6.54) recorded a significantly higher knowledge level than respondents from School B (M = 31.63, SD = 9.35; t = -4.04). Furthermore, the knowledge score was also higher among respondents who had ever watched any animated videos related to *Aedes* mosquitoes (M = 35.66, SD = 9.18) compared to who had never (M = 30.18, SD = 7.62; t = –3.56). Lastly, respondents who had family member with history of dengue infection scored better (*Md* = 40, *n* = 35) than those without (*Md* = 35, *n* = 136), U = 1600.

TABLE 5. Level of knowledge based on socio-demographic factors (n = 171)

Factor	*n*	Level of knowledge Mean ± SD Median (Q1-Q3)	Test of statistic	*p*
Gender			t = –0.09	0.93
Male	87	34.20 ± 8.77		
Female	84	34.31 ± 8.00		
Primary School			t = –4.04	< 0.01
A	89	36.66 ± 6.54		
B	82	31.63 ± 9.35		
Had ever watched any animated video related to *Aedes* mosquitoes			t = –3.56	< 0.01
Yes	127	35.66 ± 9.18		
No	44	30.18 ± 7.62		
History of dengue infection			U = 1072	0.22
Yes	17	38.00 (33 – 41)		
No	154	35.00 (29 – 40)		
Family member with a history of dengue infection			U = 1600	< 0.01
Yes	35	40.00 (33 – 43)		
No	136	35.00 (29 – 39)		

DISCUSSION

The present study shows similar results with other studies conducted among school students that reported a good or sufficient level of knowledge about *Aedes* mosquitoes. By using a different set of questionnaire, a study was done by Sultana and Junaid (2013) at a secondary school in Karachi found that 59% of student had good knowledge about dengue fever and its control methods. However, a different study result in Islamabad found that 67.2% of ninth and tenth-grade students had poor knowledge of dengue. Another study in Sri Lanka found that 54.7% and 9.6% of the respondents had average and poor knowledge respectively on dengue prevention (Javed, Ghazanfar & Naseem 2018; Dimbulagedara et al. 2014).

In our study, a high percentage of respondents knew that *Aedes* is transmitted by a mosquito. This result is relatively higher than a study in Karachi (72%) by Sultana and Junaid (2013) and 60.3% in another Malaysian study and another study in Sri Lanka (47.2%) (Dimbulagedara et al. 2014; Su, Lim & Beth 2016). Similar results were also obtained from a study done in Karachi in terms of the high number of students who knew they were at risk of getting an infection (81%), and the low percentage of students who answered correctly about the biting period of mosquitoes (13%). The study by Su, Lim & Beth (2016) among high school students in Malaysia also reported poor knowledge with regard to mosquito biting time.

There are many potential breeding sites for mosquitoes as long as the particular areas contain clear water. Our study, similar to the Karachi study, both found that the respondents answered correctly about clear stagnant water, flower vase, or flower pot trays being the common breeding sites. Apart from that, a study in India reported that majority of the respondents were aware that thrown away tyres, pots, containers, and jars are the possible breeding sites of *Aedes* mosquitoes (Singaravel & Kandaswamy 2018; Sultana & Junaid 2013). These findings were in contrast with the study by Su, Lim & Beth (2016) which found that the majority of the respondents chose roof gutter as the most common breeding ground.

With regard to prevention of mosquitoes bites, this study shows good knowledge among the respondents. This echoes the findings in the study done by Su, Lim & Beth (2016) in which majority of the respondents reported the use of mosquitoes repellents and mosquito nets, followed by wearing long pants as the preventive measures. Another study by Khun And Manderson (2007) also found that most respondents were aware that mosquito

bites can be prevented by sleeping under a net. However, this result is almost similar with the study in Karachi in which 32%, 23%, and 21% of the respondents reported the use of mosquito net, lotion, and covering-up of the body as prevention against mosquito bite (Sultana & Junaid 2013). Further findings in this study echoed a Cambodian study. Respondents in both studies were aware of others preventive measures related to source reduction activities, including the removal of potential water containers such as tyres, cans, coconut shells, and bottles, and also using Abate to control larvae (Kun & Manderson 2007).

Dengue infection is dangerous as it can be fatal. Our study suggested that a high percentage of school children knew about the severity of dengue infection. However, a study in India found a much lower percentage of respondents (59.7%) who were concerned about dengue infection. With regard to the signs and symptoms, a study in Karachi (Sultana & Junaid 2013) found that the commonest symptom known to the respondents was body ache (17%) as compared to our study whereby fever is the commonest symptom (75.4%). In Su, Lim & Beth (2016), 100% of the respondents answered high fever. As for the study in Cambodia, students in the primary school were aware of fever and the appearance of small red spots on the skin as signs of dengue fever (Kun & Manderson 2007). Based on the findings of this study, other common signs and symptoms should be made aware to the students and public, for example, headache, pain in bones, muscles and joints, rash, reduced appetite, nausea and vomiting, and bleeding in the gum, mouth, and under the skin. Improved knowledge of symptoms and signs of dengue infection will lead to early diagnosis and prompt treatment to reduce morbidity and mortality.

As for Zika, we found that slightly more than half (60%) of the respondents knew that *Aedes* mosquito was the vector for Zika virus. A study conducted among undergraduates in university found a much higher percentage (88.1%) of correct answers for the same question (Plaster et al. 2018). However, a study in Malwa region, India reported that only 18% of school children knew that Zika virus can be transmitted through mosquito bites (Taran, Taran & Bhandari 2016). Zika virus is even more dangerous to a pregnant woman as it can lead to microcephaly among newborns (CDC 2018). With regard to this, only about half of the students answered correctly even though this information had been disseminated. Plaster et al. (2018) reported a slightly higher percentage of correct answer regarding this matter at 73.3%. The percentage is even higher among public respondents in New York City where 95.0% were aware that there is an association between the Zika virus and microcephaly (Samuel et al. 2018).

Currently, both dengue and Zika infections have no cure. This study found that only 30% of the respondents knew about the signs and symptoms of the Zika infection, indicating that the public is still not well-informed about these important information. Studies by Plaster et al. (2018) and Samuel et al. (2018) found a similar result with this study, in which fever was known as the common symptom for Zika virus. However, not many respondents were aware of other signs and symptoms of Zika infection. Only 46.0% knew that skin rash is one of the signs (Plaster et al. 2018). Samuel et al. (2018) reported a lower percentage of correct answers than our study for other signs and symptoms of Zika infection such as headache (42%), rash (31.0%), joint pain (29.0%), and conjunctivitis (15.0%).

Respondents with a history of dengue infection had a higher median knowledge score than those who were not previously infected. Similar results were reported in Jamaican study among community dwellers which found that individuals with a prior history of dengue fever were more likely to have higher knowledge scores compared to those with no previous dengue infection (Alobuia et al. 2015). Furthermore, this study found that the knowledge scores were significantly higher among respondents who have a family member with a history of dengue infection.

In terms of locality, this study found a significantly higher knowledge score among respondents from school A compared to school B. Both schools are located in residential areas that are known to be dengue cluster areas. Many awareness programs on dengue fever have been carried out among the communities in the two areas by the local authorities. However, health education programs conducted in school A area were larger in scale, with the involvement of multiple agencies including those from private sectors and educational institutions which come together to educate the community and increase their awareness about dengue. This awareness campaigns included activities such as educational talk, *gotong-royong*, brochure distribution, abate usage for larvicide, and door-to-door visit (Kajang Municipal Council 2018; Majlis Perbandaran Kajang 2011). Involvement from multiple agencies can improve the effectiveness of the program. This is believed to be the factor that resulted in a higher knowledge level among students from school A.

However, awareness campaigns do not necessarily guarantee a good outcome. A study in Islamabad found that despite various awareness campaigns in schools, the majority of the students still had poor or average knowledge of dengue fever. Therefore, there is a need to re-evaluate the structure of the awareness campaigns (Javed, Ghazanfar & Naseem 2018). Similarly, a study in Thailand on dengue prevention and control in primary school suggested that the awareness program failed to provide basic knowledge on dengue and did not place enough attention on the aspect of dengue prevention. Furthermore, there was a lack of involvement from the school and parents (Suwanbamrung et al. 2013). Even though our study shows that the health education campaigns in Malaysia are on the right track to increase the school student understanding, further improvement can be made to increase the success of the program.

The study by Javed, Ghazanfar, and Naseem (2018) suggested that electronic multimedia such as video is

the most useful tool to disseminate knowledge and it has been proven to be able to increase the effectiveness of the awareness campaigns. Respondents in the study who had ever watched animated videos about *Aedes* reported a higher knowledge score than those who did not. Therefore, it can be a media of choice to disseminate information among the young generation. According to Zainuddin et al. (2008), the use of interactive multimedia technology will assist greatly in the learning system. Multimedia software which incorporates sounds, graphics, diagrams, animations, and colourful images to deliver the messages has been proven to increase cognitive achievement, psychomotor ability, interest, and behaviours among the recipients of the messages. Ultimately, it can strengthen understanding and improve performance output (Mohamad Johdi & Ariegusrini 2009).

Apart from video, a study in Ampang, Selangor also reported other mass media such as television or radio as the commonest source of information (Nur Syakilah et al. 2016). Mass media can have a major role in disseminating vital information (Luangdilok 2006; Kittigul et al. 2003). A study by Taran, Taran, and Bhandari (2016) suggested that apart from television, many students also relied on newspaper and internet as a source of information.

LIMITATIONS

Inevitably, there are some limitations to this study. Firstly, the study did not identify the respondents' attitudes towards *Aedes* mosquito and its related diseases. Secondly, it does not measure respondents' practices on prevention and controls. Therefore, this study is unable to determine the association between the knowledge of the student and their actual attitudes and practices in vector-borne disease control activities. Furthermore, since it is a cross-sectional study, we are unable to gauge the sustainability of their knowledge. Finally, we are unable to control the fact that students might be getting the correct answers to the questions from other sources.

CONCLUSION

In conclusion, this study highlighted the fact that the existing knowledge level among primary school children regarding *Aedes* mosquitoes, dengue fever, and Zika infection are not sufficient and need to be enhanced. More information should be disseminated to them regarding *Aedes* mosquitoes, dengue fever, and Zika virus. The results from this study can be used to develop a learning module which may contain more comprehensible and relevant information in order to educate students in the schools. One of the outputs from this research is the development of effective educational materials on the multimedia platform as it will be more interesting and captivating to attract the interest of the students and ultimately enhance the students' understanding and knowledge about the various vector-borne diseases. By developing a proper teaching aid, the necessary can be conveyed to the young generation in a more effective manner. Early education is crucial to deliver the knowledge that can translate into better attitudes and practices on *Aedes* mosquitoes, dengue fever, and Zika virus to guarantee success in the prevention and control of the diseases.

ACKNOWLEDGMENTS

We would like to sincerely thank the Ministry of Education, Selangor State Education Department, Hulu Langat District Education Department, and the school management for allowing this research to be carried out in their administrative areas and for their students to participate in the survey. The volunteers from undergraduate students of biomedicine program, Health Science Faculty, UKM are greatly appreciated. We also thank the UKM for invaluable assistance throughout the study.

REFERENCES

Abbasi, A., Abbas, K., Arooj, S., Habib, N., Aziz, W. & Ashaq, A. 2016. Dengue fever: A statistical analysis regarding awareness about dengue among university students in Azad Kashmir. *J Healthc Commun.* 2(1): doi: 10.4172/2472-1654.100041.

Abe, A. H. M., Solomar, M. M. & Costa, P. S. S. 2012. Dengue in children: from notification to death. *Rev Paul Pediatr* 30(2): 263-271.

Alobuia, W. M., Missikpose, C., Aung, M. & Jolly, P. E. 2015. Knowledge, attitude and practices regarding vector-borne diseases in Western Jamaica. *Annals of Global Health* 81(5): 654-663.

CDC. 2018. *Microchepaly and Other Birth Defects*. https://www.cdc.gov/Zika/healtheffects/birth_defects.htmlb [14th of November 2018].

CDC. 2018. *Zika Virus*. https://www.cdc.gov/Zika/index.html [11th of November 2018].

Dimbulagedara, D.P., Jayathilaka, K.J.N.M.B.R., Madhavi, A.V.P. & Yapa, H.E. 2014. Knowledge and practices among school children on dengue prevention. *Annual Academic Session,* The Open University of Sri Lanka.

Egger, J. R. & Coleman, P.G. 2007. Age and clinical dengue illness. *Emerg Infect Dis*. 13: 924-925.

Guzman, M.G., Kouri, G., Bravo, J., Valdes, L., Vazquez, S. & Halstead, S. B. 2002. Effect of age on outcome of secondary dengue 2 infections. *Int J Infect Dis.* 6: 118-124.

Idengue. 2018. *Dengue Statistic*. http://idengue.remotesensing.gov.my [11th of November 2018].

Javed, N., Ghazanfar, H. & Naseem, S. 2018. Knowledge of Dengue Among Students Exposed to Various Awareness Campaigns in Model Schools of Islamabad: A Cross-Sectional Study. *Cureus* 10(4): e2455. doi:10.7759/cureus.2455.

Kajang Municipal Council. 2018. *Dengue Awareness Preventive Program – Free Dengue Community (KOMBAD)*. http://www.mpkj.gov.my/en/mpkj/media-centre/news/dengue-preventive-awareness-program-%E2%80%93-free-dengue-community-kombad [19th of November 2018].

Khun, S. & Manderson, L. 2007. Community and school-based health education for dengue control in rural Cambodia: A process evaluation. *PLoS Neg Trop Dis* 1(3): e143. doi:10.1371/journal.pntd.0000143.

Kittigul, L., Suankeow, K., Sujirarat, D. & Yoksan, S. 2003. Dengue haemorrhagic fever: knowledge, attitude and practice in Ang Thong Province, Thailand. *Southeast Asian Journal of Tropical Medicine and Public Health* 34(2): 385-392.

Kyu, H. H., Thu, M. & Van der Putten. 2005. Myanmar migrant woman caretakers on preventive of dengue fever: a study on knowledge, attitude and practices in Tak province, Thailand. *Hospital* 24: 9.

Luangdilok, W. 2006. *The Performance of Caretakers for Prevention of Dengue Fever during Care of Patients at Home*. Chulalongkorn University. Bangkok: College of Public Health.

Majlis Perbandaran Kajang. 2011. *Majlis Perwakilan Penduduk*. https://public.mpkj.gov.my/mpp/?MN=6&zon=14 [19th of November 2018].

Malaysia Remote Sensing Agency. 2015. *iDengue*. http://www.remotesensing.gov.my/portal/index.php/component/content/article?id=154:dengue-*Aedes*-community [11th of November 2018].

Mohamad Johdi S & Ariegusrini A. 2009. *Transformasi pengajaran Sejarah berasaskan multimedia*. Pekan Baru, Indonesia: Penerbitan Bersama: Fakulti Pendidikan, Universiti Kebangsaan Malaysia dan FKIP, Universiti Riau.

Normah, A., Rosalina, K., Hidayatulfathi, O. & Nurul, F. K. 2014. Keberkesanan sebatian difenilstanum (iv) dan trifenilstanum (iv) alkilfenilditiokarbamat sebagai insektisid ke atas *Aedes aegypti* LINN. (Diptera: Culicidae) di makmal. *Jurnal Sains Kesihatan Malaysia* 12(1): 35-39.

Nur Syakilah, M., Rosmawati, M., Hamid, J. J. M. & Norfarhana, R. 2016. High knowledge on dengue but low preventive practices among residents in a low cost flat in Ampang, Selangor. *The Malaysian Journal of Nursing* 8(1): 39-48.

Plaster, A. N., Painter, J. E., Tjersland, D. H. & Jacobsen, K. H. 2018. University students' knowledge, attitudes and source information about Zika virus. *Journal of Community Health* 43(4): 647-655.

Rigau-Perez, J.G., Clark, G.G., Gubler, D.J., Reiter, P., Sanders, E.J. & Vorndam, A. V. 1998. Dengue and dengue haemorrhagic fever. *Lancet* 352(9132): 971-977.

Samuel, G., DiBartolo-Cordovano, R., Taj, I., Merriam, A., Lopez, J.M., Torres, C., Lantigua, R.A., Morse, S., Chang, B.P., Gyamfi-Bannerman, C. & Thakur, K.T. 2018. A survey of the knowledge, attitudes and practices on Zika virus in New York City. *BMC Public Health* 18(1): 98.

Sangkawibha, N., Rojanasuphot, S., Ahandrik, S., Viriyapongse, S., Jatanasen, S., Salitul, V., Phanthumachinda, B. & Halstead, S. B. 1984. Risk factors in dengue shock syndrome: a prospective epidemiologic study in Rayong, Thailand. I. The 1980 outbreak. *Am J Epidemiol* 120(5): 653-669.

Singaravel, S.S. & Kandaswamy, E.K. 2018. A cross sectional study on knowledge, attitude and practice of dengue fever among high school students in Villupuram municipality of Villupuram. *Int J Community Med Public Health* 5(2): 538-548.

Su, W.N., Lim, S.Y. & Beth, M.R.M. 2016. A study to determine the effectiveness of health education on knowledge of dengue fever and preventive measures among high school students in a selected private school. *Malaysia. Int J Contemp Pediatr* 3: 553-8.

Sultana, H. & Junaid, A. 2013. Perceptions and practices for the control of dengue fever in Karachi - a school based survey. *Pakistan Journal of Medical Research* 52(4): 102-105.

Suwanbamrung, C., Promsupa, S., Doungsin, T. & Tongjan, S. 2013. Risk factors related to dengue infections in primary school students: Exploring students' basic knowledge of dengue and examining the larval indices in Southern Thailand. *Journal of Infection and Public Health* 6: 347-357.

Taran, S., Taran, R. & Bhandari, V. 2017. Knowledge, awareness and practice study for mosquito borne diseases among school children of Malwa region of India. *Indian Journal of Child Health* 3(2): 125-128.

Thai, K. T., Nishiura, H., Hoang, P. L., Tran, N. T., Phan, G. T., Le, H. Q., Tran, B. Q., Nguyen, N. V. & de Vries, P. J. 2011. Age-specificity of clinical dengue during primary and secondary infections. *PLoS neglected tropical diseases* 5(6): e1180.

The Director-General of Health Malaysia. 2017. Zika. https://kpkesihatan.com/tag/Zika/ [11th of November 2018].

The Director-General of Health Malaysia. 2016. *Situasi Semasa Demam Denggi di Malaysia bagi Minggu 1/2016*. https://kpkesihatan.com/2016/01/11/kenyataan-akhbar-kpk-11-jan-2016-situasi-semasa-demam-denggi-di-malaysia-bagi-minggu-12016-3-januari-hingga-9-januari-2016/ [11th of November 2018].

Thein, S., Aung, M.M., Shwe, T.N., Aye, M., Zaw, A., Aye, K. M. & Aaskov, J. 1997. Risk factors in dengue shock syndrome. *Am J Trop Med Hyg* 56(5): 566-572.

Wan-Norafikah, O., Azahari, A. H., Kamal-Hidayat, K., Saleh, I. & Lee, H. L. Field evaluation of the efficacy of the mosquito killing system. *Jurnal Sains Kesihatan Malaysia* 15(2): 9-18.

Wilder-Smith, A., Yoksan, S., Earnest, A., Subramaniam, R. & Paton, N.I. 2005. Serological evidence for the co-circulation of multiple dengue virus serotypes in Singapore. *Epidemiol Infect.* 133(4): 667-671.

WHO. 2018. *Dengue and Severe Dengue*. http://www.who.int/news-room/fact-sheets/detail/dengue-and-severe-dengue [11th of November 2018].

WHO. 2018. *Vector-borne Disease*. ww.who.int/mediacentre/factsheets/fs387/en/index1.html [11th of November 2018].

WHO. 2017. *Vector-borne Disease*. http://www.who.int/news-room/fact-sheets/detail/vector-borne-diseases [11th of November 2018].

Zainuddin AB, Meor IK Mohd. Ali I & Rahman Sukor AS. 2008. *Kemahiran ICT dikalangan guru pelatih IPTA Malaysia*. Shah Alam: Arah Publications.

Zul-'Izzat Ikhwan Zaini
Faculty of Health Sciences,
Universiti Teknologi Mara, Selangor Branch,
Puncak Alam Campus, 42300 Selangor, Malaysia

Norhafizah Karim
Ismarulyusda Ishak
Hidayatulfathi Othman
Center for Health Sciences and Applied
Faculty of Health Sciences,
Universiti Kebangsaan Malaysia,
Jalan Raja Muda A. Aziz,
50300 Kuala Lumpur, Malaysia.

Zul-'Izzat Ikhwan Zaini
Wei Lei Hum
Community Health Center
Faculty of Health Sciences,
Universiti Kebangsaan Malaysia,
Jalan Raja Muda A. Aziz,
50300 Kuala Lumpur, Malaysia.

*Corresponding author
Zul-'Izzat Ikhwan Zaini
Faculty of Health Sciences,
Universiti Teknologi Mara, Selangor Branch,
Puncak Alam Campus, 42300 Selangor, Malaysia
email: ziiz.izzat86@gmail.com