EFFECTIVENESS OF DENGUE AWARENESS CALENDAR AMONG ORANG ASLI POPULATION IN SELANGOR

ARULVANI A/P RAJANDRA

INSTITUTE OF ADVANCE STUDIES (IAS)
UNIVERSITI MALAYA
KUALA LUMPUR

2022

EFFECTIVENESS OF DENGUE AWARENESS CALENDAR AMONG ORANG ASLI POPULATION IN SELANGOR

ARULVANI A/P RAJANDRA

THESIS SUBMITTED IN FULFILMENT OF THE REQUIREMENTS FOR THE DEGREE OF MASTER OF PHILOSOPOHY IN HEALTH AND SOCIAL WELFARE

INSTITUTE OF ADVANCE STUDIES (IAS)
UNIVERSITI MALAYA
KUALA LUMPUR

2022

UNIVERSITI MALAYA

ORIGINAL LITERARY WORK DECLARATION

Name of Candidate: Arulvani a/p Rajandra

Matric No: 17029296

Name of Degree: Master of Philosophy (Health and Social Welfare)

Title of Thesis: Effectiveness of Dengue Awareness Calendar Among Orang Asli in Selangor

Field of Study: Health and Social Welfare

I do solemnly and sincerely declare that:

(1) I am the sole author/writer of this Work;
(2) This Work is original;
(3) Any use of any work in which copyright exists was done by way of fair dealing and for permitted purposes and any excerpt or extract from, or reference to or reproduction of any copyright work has been disclosed expressly and sufficiently and the title of the Work and its authorship have been acknowledged in this Work;
(4) I do not have any actual knowledge, nor do I ought reasonably to know that the making of this work constitutes an infringement of any copyright work;
(5) I hereby assign all and every rights in the copyright to this Work to the University of Malaya ("UM"), who henceforth shall be owner of the copyright in this Work and that any reproduction or use in any form or by any means whatsoever is prohibited without the written consent of UM having been first had and obtained;
(6) I am fully aware that if in the course of making this Work I have infringed any copyright whether intentionally or otherwise, I may be subject to legal action or any other action as may be determined by UM.

Candidate's Signature Date: 13/7/2022

Subscribed and solemnly declared before,

Witness's Signature Date: 13/7/2022

Name:

Designation:

UNIVERSITI MALAYA

PERAKUAN KEASLIAN PENULISAN

Nama: Arulvani a/p Rajandra

No. Matrik: 17029296

Nama Ijazah: Sarjana Falsafah (Kesihatan dan Kebajikan Sosial)

Tajuk Tesis: Keberkesanan Kalendar Kesedaran Denggi Dalam Kalangan Penduduk Orang Asli Di Selangor

Bidang Penyelidikan: Kesihatan dan Kebajikan Sosial

Saya dengan sesungguhnya dan sebenarnya mengaku bahawa:

(1) Saya adalah satu-satunya pengarang/penulis Hasil Kerja ini;
(2) Hasil Kerja ini adalah asli;
(3) Apa-apa penggunaan mana-mana hasil kerja yang mengandungi hakcipta telah dilakukan secara urusan yang wajar dan bagi maksud yang dibenarkan dan apa-apa petikan, ekstrak, rujukan atau pengeluaran semula daripada atau kepada mana-mana hasil kerja yang mengandungi hakcipta telah dinyatakan dengan sejelasnya dan secukupnya dan satu pengiktirafan tajuk hasil kerja tersebut dan pengarang/penulisnya telah dilakukan di dalam Hasil Kerja ini;
(4) Saya tidak mempunyai apa-apa pengetahuan sebenar atau patut semunasabahnya tahu bahawa penghasilan Hasil Kerja ini melanggar suatu hakcipta hasil kerja yang lain;
(5) Saya dengan ini menyerahkan kesemua dan tiap-tiap hak yang terkandung di dalam hakcipta Hasil Kerja ini kepada Universiti Malaya ("UM") yang seterusnya mula dari sekarang adalah tuan punya kepada hakcipta di dalam Hasil Kerja ini dan apa-apa pengeluaran semula atau penggunaan dalam apa jua bentuk atau dengan apa juga cara sekalipun adalah dilarang tanpa terlebih dahulu mendapat kebenaran bertulis dari UM;
(6) Saya sedar sepenuhnya sekiranya dalam masa penghasilan Hasil Kerja ini saya telah melanggar suatu hakcipta hasil kerja yang lain sama ada dengan niat atau sebaliknya, saya boleh dikenakan tindakan undang-undang atau apa-apa tindakan lain sebagaimana yang diputuskan oleh UM.

Tandatangan Calon Tarikh:13/7/2022

Diperbuat dan sesungguhnya diakui di hadapan,

Tarikh:13/7/2022

Tandatangan Saksi

Nama:

Jawatan:

EFFECTIVENESS OF DENGUE AWARENESS CALENDAR AMONG ORANG ASLI POPULATION IN SELANGOR

ABSTRACT

Background: Dengue cases are increasing at an alarming rate and prevalent among the marginalized minority community of Malaysia, Orang Asli due to their impoverished condition and lack of health awareness. Tailoring interventions using health educational materials is expected to curb dengue episodes by improving their knowledge, belief and practices (KBP) on dengue. **Aims:** This study aimed to evaluate the effectiveness of dengue awareness calendar on knowledge, beliefs, and practices on dengue. This study also investigated the socio-demographic, environmental factors, increment in knowledge score, changes in health belief associated with increment in dengue prevention practices score. **Method:** A pre and post non control group study was conducted in selected nine Orang Asli villages in Selangor from July 2017 to July 2018. During the interphase of the intervention, a printed dengue awareness calendar on dengue distributed to the participants. The KBP scores on dengue were assessed before and after the interventions in all the nine villages to evaluate the dengue awareness calendar. **Results:** A total of 609 complete responses were obtained. The dengue awareness calendar significantly improved the knowledge score, perceived severity, cues to action, self-efficacy and the prevention practices score($p>0.05$). The increment in prevention practices is significantly associated with tribes, education level, type of occupation, difference in perceived severity, difference perceived susceptibility and increase in total knowledge score. The Temuan tribe were significantly less likely (OR = 0.444, 95%CI= 0.254 – 0.777) to have increment in prevention practices score compared the reference group (other tribe). The findings showed that participants with primary (odds ratio (OR) =2.627. 95% Confidence Interval (Cl): (1.338-5.160, $p< 0.05$) and secondary level education (OR =2.263. 95% Cl:(1.126- 4.550, $p<0.05$) were more likely to exhibit improved dengue prevention

practices scores. Housewives were less likely to have improved scores of dengue prevention practices (OR=0.535, 95%Cl:(0.289-0.950, p<0.05) after the intervention. Participants with higher dengue knowledge score (7-17) were more likely (OR= 2.390, 95% CI = 1.521 – 3.757, p<0.001) to have higher increment in dengue prevention practices score compared to those scored lower total knowledge score. Participants with no increment in perceived severity (OR= 0.349, 95%CI = 1.521- 3.757, p<0.05) and no increment perceived susceptibility (OR= 0.474, 95%CI = (0.286 – 0.785, p<0.00) were significantly less likely to have higher increment in dengue prevention practices score. **Conclusion:** Findings imply that the dengue awareness calendar designed for the intervention improved dengue prevention practices score. Thus, this study highlights on the importance of incorporating dengue awareness calendar as one of the implementations in the national program to ensure the positive knowledge and beliefs transform into real dengue prevention practices.

Keywords: Dengue, Orang Asli, Knowledge, Health Beliefs, Prevention Practices, Educational Intervention

KEBERKESANAN KALENDAR KESEDARAN DENGGI DALAM KALANGAN PENDUDUK ORANG ASLI DI SELANGOR

ABSTRAK

Latar Belakang: Kes denggi meningkat pada kadar yang membimbangkan dan berleluasa dalam kalangan masyarakat minoriti terpinggir di Malaysia iaitu Orang Asli kerana keadaan mereka yang tidak menyenangkan dan kurang kesedaran kesihatan. Intervensi menggunakan bahan pendidikan kesihatan dijangka dapat membendung episod denggi dengan meningkatkan tahap pengetahuan, kepercayaan kesihatan dan amalan pencegahan (KBP) mereka terhadap denggi. **Matlamat:** Kajian ini bertujuan untuk menilai keberkesanan calendar kesedaran denggi terhadap tahap pengetahuan, "kepercayaan kesihatan dan amalan pencegahan denggi. Selain itu, kajian ini juga menyiasat sosio-demografi, faktor persekitaran, peningkatan skor pengetahuan, perubahan kepercayaan kesihatan yang dikaitkan dengan peningkatan skor amalan pencegahan denggi. **Kaedah:** Kajian kumpulan pra dan pasca telah dijalankan di sembilan perkampungan Orang Asli terpilih di Selangor dari Julai 2017 hingga Julai 2018. Semasa interfasa intervensi, kalendar kesedaran denggi telah diedarkan kepada para peserta. Skor KBP mengenai denggi telah dinilai sebelum dan selepas intervensi di semua sembilan kampung untuk menilai keberkesanan kalendar kesedaran denggi. **Hasil:** Seramai 609 respons yang lengkap telah diperolehi. Kalendar kesedaran denggi telah meningkatkan skor pengetahuan, persepsi keterukan, petunjuk untuk bertindak, keberkesanan diri dan skor amalan pencegahan ($p>0.05$). Peningkatan dalam amalan pencegahan dikaitkan secara signifikan dengan suku kaum, tahap pendidikan, jenis pekerjaan, perbezaan dalam persepsi keterukan, perbezaan persepsi kerentanan dan peningkatan jumlah skor pengetahuan. Suku kaum 'Temuan' mempunyai hubungan yang lemah dalam peningkatan skor amalan penceghan berbanding kumpulan rujukan (sukuk aum yang lain).(OR = 0.444, 95%CI= 0.254 – 0.777). Penemuan menunjukkan bahawa

para peserta yang berperingkat sekolah rendah ((OR) =2.627. 95% (Cl): (1.338-5.160, p< 0.05) dan berperingkat sekolah menengah (OR =2.263. 95% Cl:(1.126- 4.550, p<0.05) mempunyai hubungan yang positifingkatan skor amalan pencegahan denggi berbanding dengan kumpulan rujukan. Tambahan pula, suri rumah mempunyai hubungan yang lemah dalam peningkatan skor amalan pencegahan denggi (OR=0.535, 95%Cl:(0.289-0.950, p<0.05) selepas intervensi. Peserta dengan peningkatan skor pengetahuan yang lebih tinggi iaitu (7-17) mempunyai hubungan positif dalam peningkatan skor amalan pencegahan denggi (OR= 2.390, 95% CI: 1.521 – 3.757, p<0.00Peserta yang tidak mempunyai seberang peningkatan dalam persepsi keterukan (OR= 0.349, 95%CI = 1.521- 3.757, p<0.05) dan persepsi kerentanan(OR= 0.474, 95%CI = (0.286 – 0.785, p<0.00) terhadap denggi mempunyai hubungan yang lemah dalam peningkatan skor amalan pencegahan denggi selepas intervensi. **Kesimpulan:** Penemuan kajian ini menunjukkan bahawa kalendar kesedaran denggi yang direka untuk intervensi meningkatkan tahapamalan pencegahan denggi. Oleh itu, kajian ini menekankan kepentingan memasukkan kalendar kesedaran denggi sebagai salah satu pelaksanaan dalam program kebangsaan untuk memastikan pengetahuan dan kepercayaan positif berubah menjadi amalan pencegahan denggi yang sebenar.

Kata kunci: Denggi, Orang Asli, Pengetahuan, Kepercayaan Kesihatan, Amalan Pencegahan, Intervensi Pendidikan

ACKNOWLEDGEMENTS

First and foremost, I would like to thank GOD for his guidance and for giving me the patience, strength, and ability to write this Master of Philosophy thesis. I would like to express my sincere gratitude to my supervisors, Prof Dr Wong Li Ping (Department of Social and Preventive Medicine, Faculty of Medicine, University of Malaya) and Dr Lee Hai Yen (The Tropical Infectious Disease Research and Education Centre, University of Malaya) for their advice, encouragement, patience, support, ideas, and feedback that were given to me throughout the project. I am also grateful to Dr. Siaw Yan Li (Faculty of Education) and Prof Dr Wan Yusof (Faculty of Medicine) for their feedback and input during the candidature defense.

A heartfelt thanks to Department of Orang Asli Development (JAKOA) and Tok Batin of every respective village for their approval to carry out the research project in their village. Hereby, a special thanks to acknowledge the funding from the Ministry of Education, Malaysia for niche area research under the Higher Institution Centre of Excellence (HICoE) program (Project MO002-2019). This project was funded under Skim Dana Program Flagship DSTIN (Project number: FP0514D0025-2) Development, evaluation and integration of innovative tools to reduce Dengue morbidity and mortality in community by Ministry of Science, Technology and Innovation Malaysia (MOSTI Malaysia).

Many people have encouraged, inspired, supported, and motivated me during my master research study. I would like to express my special gratitude to my fellow friends and colleagues, Ms. Haridah Alias, Ms. Sharina Mahavera and Mr. Logaraj Ramakreshnan from the Department of Social and Preventive Medicine, and Professor Dr Sasheela Sri La Sri Ponnampalavanar from the Department of Infection Control for

their continuous support, valuable comments, kindness, help in data analysis, reviewing my manuscript, motivation, and time.

I am also grateful to Ms Joyce Thanushree Wasudewan, Ms Anetha Subramaniam and Ms Thurga Thevi Manickam for their assistance during field data collections. Finally, I gratefully acknowledge my deep appreciation to my beloved parents, Mr Rajandra Mariappan and Mrs Paramaveswary; siblings, Mr. Gajindran Rajandra and Mr. Lingeendran Rajandra; and my best friends, Ms Kirubahshini Krushnan and Mr. Hafiz Ghulam Fareed Hussain for their understanding, precious love, time, support, motivation, and prayers towards completing this study.

TABLE OF CONTENTS

LIST OF FIGURES

LIST OF TABLES

LIST OF SYMBOLS AND ABBREVIATIONS

KAP	:	Knowledge, Attitude and Practices
KBP	:	Knowledge, Belief and Practices
DF	:	Dengue Fever
DHF	:	Dengue Hemorrhagic Fever
DENV	:	Dengue viruses
JAKOA	:	Department of Orang Asli Development
SPM	:	Social and Preventive Medicine
TIDREC	:	Tropical Infectious Disease Research and Education Centre
HBM	:	Health Belief Model
et al.,	:	*et alia* (others)
%	:	Percentage
OR	:	Odds Ratio
p	:	Level of significance
SPSS	:	Statistical Package of Social Science
RM	:	Ringgit Malaysia
vs.	:	Versus (in contrast)
CI	:	Confidence Interval
N	:	Population size
n	:	Sample size
Med	:	Median
IQR	:	Interquartile Range
$\chi 2$	:	Chi-square test
>	:	More than
<	:	Less than

LIST OF APPENDICES

CHAPTER 1: INTRODUCTION

This chapter presents an introduction and overall scope of the study aimed at studying the role of educational intervention using the dengue awareness calendar in knowledge, health belief and practices (KBP) on dengue among the Orang Asli in Selangor, Malaysia. This chapter briefly describes the overall context of the study, the purpose, the research question, and the significance of the study.

1.1 Background of study

Across the globe, the mosquito-borne disease (MBD) is spreading rapidly, especially in the tropic and subtropical regions where an ample number of human populations and mosquitoes reside (Johnson et al., 2018; Mejia et al., 2016). The mosquitoes are responsible for spreading infection that results in frequent epidemic outbreaks (Wong et al., 2015) and become foremost public health concerns (Chen et al., 2015; Vikram et al., 2015; Zaki et al., 2014). The most significant and dangerous MBDs today concerning the world are dengue and malaria (Mejia et al., 2016; Muller, Depelsenaire & Young, 2017).

Over the decades, dengue fever shows an alarming rate worldwide and has become a threat to nearly half of the world population (WHO, 2012). The tropical infectious disease dengue spilled into human natives around 1000 years ago (Juraina et al., 2020). About 3.6 billion people worldwide are at high risk of contracting dengue (Woon et al., 2016). Across the world, the estimated report yearly stated that about 2 million are susceptible to dengue infection, and approximately 21,000 people were dead due to severe dengue hemorrhagic fever (DHF) (Vikram et al., 2015; WHO,2012). Up to date, dengue is endemic to more than 150 countries, including Africa, America, Eastern

Mediterranean, Southeast Asia, and the Western Pacific. The rising incidence of dengue is prevalent mainly in tropical and subtropical countries worldwide, mostly in urban and semi-urban areas (Vikram et al., 2015). At the cornerstone, dengue-endemic countries are still fighting the battle against its vector, *Aedes aegypti* (Wong et al., 2016). Among many western pacific countries, Malaysia is ranked third among countries suffering from the hyper-endemic (Zaki et al., 2014; Jahan et al., 2016) outbreak of dengue (Cheah et al.,2014; Leong et al., 2014). Malaysia, with a population of 32.45 million and a population density of 86 per square kilometer, dengue is currently endemic throughout the country (Mia et al.,2013).

Sam et al. (2013) described that Malaysia was first diagnosed with dengue fever (DF) in the year 1901 in Penang (Ajibola et al., 2018; Naing et al., 2011) and first documented in 1902 (Azami et al., 2011). Subsequent major national dengue outbreaks in 1974, 1978, 1982, and 1990 were reported, respectively (Azami et al., 2011; Cheong et al., 2014; Pang & Loh, 2016). Besides, the first significant outbreak of Dengue Haemorrhagic Fever (DHF) in Malaysia involving the whole nation occurred in 1973 (Naing et al., 2011). From that on, dengue has become endemic, with significant outbreaks occurring every 3-4 years (Sam et al., 2013).

Azami et al. (2011) elaborated that Malaysia, as a developing country, has enormous infrastructure development and great urbanization (Hassan et al., 2016) and creates a favorable condition for Aedes mosquitoes to perform breeding that aids in the spread of dengue virus. The unplanned rapid expansion of urbanization, increasing world population, global warming, inefficient/ inadequate method of mosquito control, lack of health care facilities, migration, globalization travel and trade, and uneven climate (Hasan et al., 2016) are the key factors that contribute to the increasing rate of disease

transmission, extending into new territories and into more rural areas (Udyanga et al., 2018). However, little has been reported about the prevalence of dengue among the Orang Asli living in a community in forest fringe areas. A study showed dengue has spread from urban to rural areas in Malaysia, including forest fringe areas where most Orang Asli reside (Abu Bakar and Lim, 2011; Mia et al., 2016). A study claimed that years ago, Orang Asli was reported healthier without any contact with outside society; however, a modernization that brought outsiders with new pathogen or illness making them vulnerable to life-threatening disease (Othman et al., 2012). Indeed, Wong et al. (2014) revealed that the seroprevalence of immunoglobulin (Ig) dengue cases is significantly higher in rural areas than urban areas in Malaysia. The prevalence of dengue fever in the rural areas of Malaysia was estimated to range from 24% in the Lundu District, Sarawak (Cheah et al., 2006) to about 91% throughout the Malaysian population (Azami et al., 2011). A study conducted among the Orang Asli population in Peninsular Malaysia describes that adult above 30 years old from the tribe Temuan and Semai community in Hulu Langat, Selangor, had been badly affected by dengue fever (Smith Ce, 1956). About 73% of the Temuan Orang Asli community in Kampung Tanjong Rabok, Selangor, had been affected by dengue fever and related viruses (Rudnick and Lim., 1986).

Dengue was caused by an arbovirus classified under the Flavivirus genus, family Flaviviridae (Appanna et al., 2010; Sarti et al., 2016). Dengue viruses is also widely identified by the abbreviation DENVs. These are subdivided into four different serotypes includes DENV-1, DENV-2, DENV-3, and DENV-4, that are genetically identical but do not provide cross-linking protective immunity against each other (Muller, Depelsenaire & Young, 2017). Dengue virus is the primary root of a spectrum of clinical illnesses ranging from a mild fever to classical dengue fever and even to the extent of severe illness such as dengue hemorrhagic fever and dengue shock syndrome, in which some severe

cases lead to death (Appanna et al, 2010; Sarti et al., 2016). The classical dengue fever is identified as an acute infection where high-grade fever lasts for more than four days after infected with the mosquito's bite (Muller, Depelsenaire & Young, 2017). Hasan et al. (2016) reported other indications such as severe headache, joint pain, nausea, and rashes. The active virus is transmitted into humans through the bite of female mosquitoes, which is the important vector identity under genus Aedes (Sarti et al., 2016). The main vector is *Aedes aegypti* that predominates in urban areas, while *Aedes albopictus* is found in rural areas (Leong et al., 2014).

Since public health in Malaysia has no registered vaccine found yet or ready to use (Arunchalam et al., 2012; Gunasekara et al., 2012), primary prevention is the only key to combat this life-threatening dengue phenomenon (Gupta et al., 2015). Early detection and prompt access to medical care are the prime factors in reducing fatalities in the absence of any specific treatment (Mathur et al.,2020). The most accurate mechanism to control dengue is via vector control by destroying the breeding sites of *Aedes aegypti* from the human habitat (Arunchalam et al., 2012; Malhotra et al., 2013; George et al., 2015). Usman et al. (2018) stated that dengue is considered a vector-borne disease, thus, the initial prevention can be focused on vector elimination only. At present, the only method implemented to control dengue transmission in Malaysia is through active dengue surveillance and vector interventions (Yeo and Shafie,2018).

The success of vector control by reducing the vector population is evaluated from community participation with social and behavioral interventions carried out at the household level (Arunchalam et al., 2012). However, this control is often inhibited due to less community support and involvement (Chen et al., 2005). Community cooperation, elimination of vector breeding sites, and effective vector control measures encourage

dengue prevention and control (Mathur et al.,2020). For the success of the community-based intervention, it is significant to assess the community's perception regarding the disease, mode of transmission, and breeding sites (Malhotra et al., 2014). The important stakeholder in removing the vector breeding sites is the community. However, the success of the measures depends on the level of awareness and involvement of key stakeholders and end-users (Mathur et al., 2020).

Arunachalam et al. (2012) cited the integrated approach of community-based intervention, tailored to the local eco-epidemiological and sociocultural settings and combined with educational programs to increase knowledge and understanding of proper prevention practice. Aziz et al. (2014) claimed that health education plays a crucial role in providing correct knowledge about the disease and its vectors that aids in the vector control program. The published study emphasized that larvae and adult Aedes mosquitoes' control strategies must be carried out along with public awareness and health education (Aziz et al., 2014). Therefore, health education is a powerful method to be transferred into the community to eradicate the dengue-breeding site and encourage more people to engage in proper prevention practices (Gupta et al., 2015). It is also a tool to educate people to break the mosquito life cycle by performing proper prevention like eliminating the breeding site of Aedes mosquitoes such as water tanks, drainages, and disposable tires (Aziz et al., 2014). Health education is the most crucial tool that helps create awareness of Aedes mosquito and dengue and prepares the community to instate Aedes control and prevention (Zaini et al., 2019). Kusuma et al. (2016) claimed that health educational intervention increases knowledge, which helps adapt/ change certain behaviors to protect themselves from disease burden.

Studies on knowledge, attitude, or health belief and self-reporting dengue practices are essential to measuring the success of health education. Malhotra et al. (2013) cited earlier that the knowledge, awareness, and practices (KAP) study is a framework that serves as an educational diagnosis of a population. The information obtained from KAP or knowledge, health belief and practice (KBP) studies help in programs to set objectives that can increase community engagement and demand for service and developing better strategies that are suitable to the social, cultural and political contexts of an at-risk community (Ajibola et al., 2018). Rav-Marathe et al. (2016) cited KAP studies as cost-effective, highly focused, and limited in scope compared to other social research methods.

1.2 Problem Statement of the study

1.2.1 Increasing population numbers leads to an increase in dengue cases and eventually leads to an economic burden.

The rapid expansion of the human population with a significant change in the environment has caused the re-emerging of dengue fever. Up to date, the number of dengue cases is still high as shown in Figure 1.1. Based on the data received from the Statistic Department of Malaysia, among the number of dengue cases from 2008 to 2019, the highest dengue case was recorded in 2015 with 120836 cases and 336 deaths, respectively. The cases decrease slightly from 2016 till 2018 and increase tremendously in 2019, recording the highest dengue case of 130101 and 183 deaths in that year. The dengue case number is still high compared to 2014 (Department of Statistic Malaysia, MOH).

Bujang et al. (2017) stated that bigger expenses were acquired to treat dengue infection than the government's total expenditure on vector control within the country. Mia et al. (2013) specified that dengue cases enact a more significant economic burden

on the public health care system making the household vulnerable to the disease. In Malaysia, the estimated annual cost of dengue is US$103.4m per year (range: US$78.8m–US$314.2m) (Shepard et al., 2013). In addition, Lim et al. (2010) estimated an annual cost of US$133m (range: US$88m–US$215m) for treating dengue. A yearly cost of dengue comprises treating illness, vector control activities, research, and development activities. Thus, this clearly shows an urgent need for educational intervention to combat the dengue case and reduce the economic burden in terms of medical expenditure incurred for mosquito-borne disease.

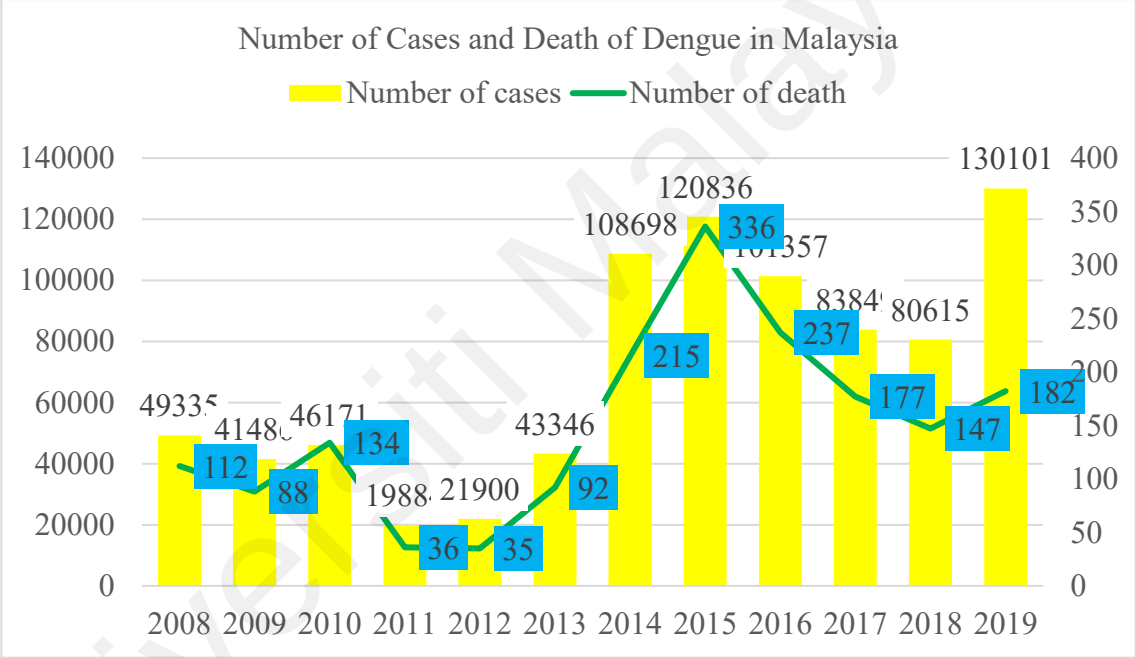

Figure 1.1 Number of dengue cases and death reported in Malaysia from 2008 to 2019 (Source: Department of Statistics, Malaysia)

1.2.2 Dengue cases have shifted from urban areas to rural or forest fringe areas.

Dengue is predominantly affecting urban areas in Malaysia. However, a study shows that dengue has spread from urban to rural areas in Malaysia, including forest fringe areas where most Orang Asli reside (Abu Bakar and Lim, 2011; Mia et al., 2016). Therefore, special attention needs to be given to the population of Orang Asli. To date, very few studies focused on dengue-related investigations among Orang Asli (Cheong et al.,2014; Chen et al.,2005; Hasnan et al.,2016; Pang and Loh, 2015; Zaki et al.,2014). In

terms of knowledge, attitude, and practices, only one study was carried out among the Orang Asli in Peninsular Malaysia (Chandren al.,2015), where the findings of the study shows that the low level of dengue knowledge leads to poorer precautionary practices against dengue among the community.

Al-Delaimy. (2014) published even though there is a major reduction in the overall prevalence of the disease in urban areas, while the trend among rural especially Orang Asli people remains the same /unchanged since 1920. The severity of dengue in rural or fringe areas are still at peak or unknown as there is no proper mechanism to show the causality and severity of the incidence rate. Hence, no studies have elucidated the effectiveness of the educational interventions among Orang Asli in combating dengue. Due to that, Nasr et al. (2013) stated that health education that is effective, simple, and targeted is the best option for underprivileged communities to practice correct illness prevention.

1.3 Significance of the study

Firstly, most studies show an urge to implement health education as a recommendation to increase knowledge and proper prevention practices related to dengue (Hairi et al., 2003; Al-Zurfi et al., 2015; Mayiddin et al., 2016; Azfar et al., 2017). Health education is the most crucial tool that helps create awareness of Aedes mosquito and dengue and prepares the community to instate Aedes control and prevention (Zaini et al., 2019). Kusuma et al. (2016) claimed that health educational intervention increases knowledge, which helps to adapt/change certain behaviors to protect themselves from disease burden. Hence, this study accesses the implementation of the dengue awareness calendar intervention to increase knowledge levels, change behavior and perform better prevention practices.

Secondly, in a bigger scope, this study aims to act as one of the starting points to evaluate the effectiveness of dengue awareness calendar among the Orang Asli population, which can act as baseline data for adaptation or mitigation strategies to be performed for the entire nation. A dengue awareness calendar is an educational intervention tool that is designed specifically to illustrate the dengue characteristics, signs and symptoms, active period of dengue, prevention practices to perform in and out of surrounding area in images and short texts. Thus, this study also focuses on determining the preference shown towards the acceptance of the dengue calendar, the content and design of the calendar.

Thirdly, the results of this study are also expected to bridge the existing knowledge and research gap by examining the current knowledge, health belief, and practices of dengue among Orang Asli in the state of Selangor compared to other published studies that reported the knowledge, attitude, and practices (KAP) of dengue among the Orang Asli community in Peninsular Malaysia were poor (Chandren et al.,2015). The findings of this study able to elucidate the factors that influence the effectiveness in terms of the level of knowledge, health belief, and prevention practices. Therefore, this study is expected to quantify factors associated with the knowledge, health belief, and practice interpretation compared to the previous studies.

1.4 Hypothesis

The following hypothesis guided the study:

- Null hypothesis I (H_O): There is no increment in the total knowledge score of dengue after the implementation of the dengue awareness calendar intervention.
- Alternate hypothesis I (H_A): There is an increment in the total knowledge score of dengue after the implementation of the dengue awareness calendar intervention.
- Null hypothesis II (H_O): There are no differences in the health belief of dengue after the implementation of the dengue awareness calendar intervention.
- Alternate hypothesis II (H_A): There are differences in the health belief of dengue after the implementation of the dengue awareness calendar intervention.
- Null hypothesis III (H_O): There is no increment in the total dengue prevention practices score after the implementation of the dengue awareness calendar intervention.
- Alternate hypothesis III (H_A): There is an increment in the total dengue prevention practices score after the implementation of the dengue awareness calendar intervention.
- Null hypothesis IV (H_O): There are no significant factors associated with the increment in the dengue prevention practices score after the implementation of the dengue awareness calendar intervention.
- Alternate hypothesis IV (H_A): There are significant factors associated with the increment in the dengue prevention practices score after the implementation of the dengue awareness calendar intervention.

1.5 Research Question

The following research questions are formulated to guide the development of specific research objectives and to test the achievement of those objectives at the end of this study. The research questions of this study as follows:

i. Is there an increment in the total knowledge score after the after the implementation of the dengue awareness calendar intervention?
ii. Are there any differences in the health belief after the implementation of the dengue awareness calendar intervention?
iii. Is there an increment in total prevention practice score after the implementation of the dengue awareness calendar intervention?
iv. What are the significant factors associated with the increment in dengue prevention practices score after the implementation of the dengue awareness calendar intervention?

1.6 Objectives of the study

General Objective

The study aimed to evaluate the effect of the dengue awareness calendar intervention among the Orang Asli in Selangor.

Specific Objective

I. The study aimed to evaluate the level of knowledge on dengue before and after the implementation of the dengue awareness calendar intervention.
II. To assess the health beliefs before and after the implementation of the dengue awareness calendar intervention.
III. To evaluate the dengue prevention practices before and after the implementation of the dengue awareness calendar intervention.

IV. To determine the perception of Orang Asli on the dengue awareness calendar.

V. To determine the significant factors (socio-demographic, surrounding environmental factor, dengue experience, increase in knowledge score, differences in health belief) associated with increment in the dengue prevention practices score.

1.7 Research Conceptual Framework

The study was designed and interpreted based on the conceptual framework (Figure 1.2). The underlying hypothesis is that knowledge, health belief and prevention practices could improve after the implementation of dengue awareness calendar intervention and the socio-demographic characteristics, experience of dengue fever and surrounding environment could affect the increment in prevention practices score.

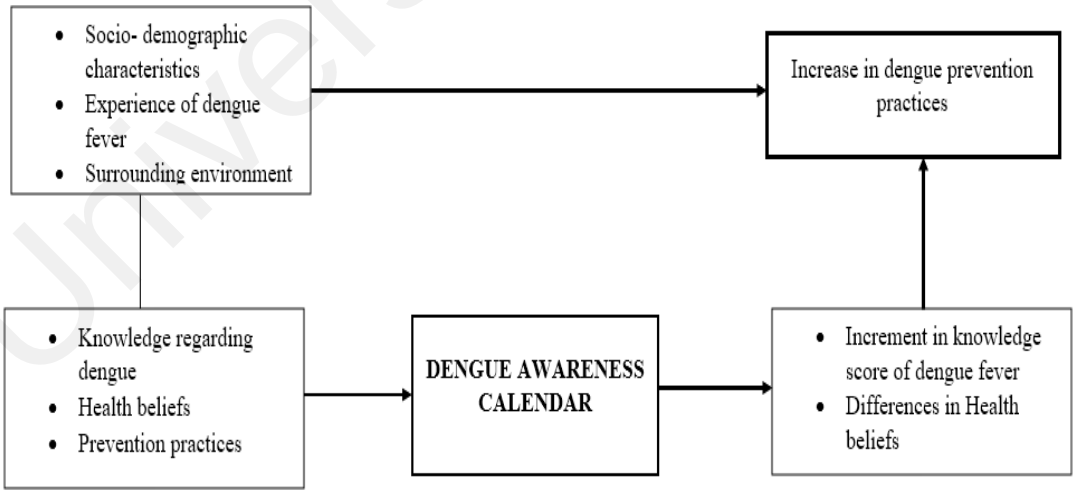

Figure 1.2: Research Conceptual Framework

1.8 Operational Definition

i. **Knowledge:** Defined as the acquisition, retention, and use of information or skills (Badran, 1995). Wan et al. (2016) claimed that knowledge comes from both education and experience. In this research, knowledge is used to access the awareness of the community about dengue. It is measured by calculating the median score of the 40 items and categorized as knowledgeable (if participants scored>median score of the correctly answered questions) or less knowledgeable (if participants scored < median score of the correctly answered questions).

ii. **Practice**: Behavior or action that can prevent a disease or delay its progression. In the study, the habit perceived by the community in preventing dengue. It is measured by 19 questions with a four-point Likert scale. All individual answers to practice questions were computed to obtain a median score. If participants scored > median score categorized as good practice or participants scored < median score categorized as poor practice.

iii. **Health Belief**: An individual perception on dengue. Only 5 out of 6 domains in Health Belief Model (HBM) are used in this study. The HBM is widely used to predict health behaviors and comprises six constructs: perceived severity, perceived susceptibility, perceived benefits, perceived barriers, cues to action, and self-efficacy.

Health behaviors are determined by four domains:

- Perceived susceptibility: Participants feel susceptible (vulnerable) to the risks of contracting the disease.

- Perceived severity: Believe in the seriousness of the disease and its consequences for individuals and the community.
- Perceived benefits: Belief in carrying out health action.
- Perceived barriers: Perceive barriers in conducting practices.
- These four elements that encourage one to take a step to prevent illness are activated by cues to action, and self-efficacy is considered as the confidence level in conducting proper prevention practices.

iv. **Intervention**: Series of activities aimed to change a process, course of action or sequences of events in the interest of change one or several of their characteristics or behavior

v. **Health Education**: Learning experiences constructed to help individuals and communities improve their health by increasing their knowledge or influencing their attitudes.

1.9 Summary

This chapter outlines the background and significance of the study and explains the purpose, objectives, research questions, and hypothesis. The entire research is concluded using a conceptual research framework. The main focus of the study is the effectiveness of the dengue awareness calendar on knowledge, health beliefs, and proper prevention practice

CHAPTER 2: LITERATURE REVIEW

2.1 Introduction

This chapter describes the literature on mosquitoes, followed by a description of the general viewpoint of dengue, the prevalence of dengue fever among Orang Asli, knowledge on dengue, the health beliefs perceived towards dengue, prevention practices related to dengue and treatment strategies.

2.2 Mosquitoes

Mosquitoes are the main reason for human diseases compared to other organisms. Every year, the deaths associated with the mosquitoes is on rise with almost millions of people are dying worldwide (Benelli et al., 2016; Smith et al., 2016). Mosquitoes are the major vectors for important pathogens and parasites, including malaria, dengue, filariasis, yellow fever, Japanese encephalitis, West Nile, and Zika (Kalimuthu et al., 2017; Masud et al. 2017), collectively known as a vector-borne diseases (Wilson et al., 2015). The incidence of vector-borne disease is still at peak (Masud et al., 2017), and till now the world is experiencing massive disease outbreak, especially dengue and other viral infection transmitted by mosquitoes (Smith et al., 2016). The rising of many vectors worldwide is due to alterations in the environment such as changes in temperature, changes in feeding behaviour. (Masud et al., 2017).

Light is one of the significant factors for ovipositing mosquito species. Most mosquito species like to oviposit in a shaded area with temperatures are lower than the area exposed to direct sunlight (Madzlan et al., 2016). Other factors contributing to the

oviposit include water temperatures, pH, ammonia, nitrate, sulfate, phosphate, and dissolved solids (Madzlan et al., 2016). For breeding to occur, some important criteria must be acknowledged, especially the types of containers, the quality of water, and the condition of water containers. The mosquito infestation occurs when there is a favorable condition where water resides for a prolonged period in the container, long-drawn-out rainfall during the last rainy season, ambient relative humidity, and temperature. The risk of dengue virus infection in a new geographical area occurs when factors including warm and humid climate, rise in population density, water storage in the house, and storage of trash favor the infestation of massive vectors (Madzlan et al., 2016).

The infected female Aedes mosquitoes cause a human disease called dengue (Quedraogo et al., 2018). Aedes mosquitoes have four basic live periods, including eggs, larva, pupa and adult (Figure 2.1). These mosquitoes are known to be fully adapted in urban settings, where the high density of the human population lives closely with a large mosquito population (Quedraogo et al., 2018). The most prominent, world-known mosquitoes responsible for the transmission of disease are *Aedes aegypti* and *Aedes albopictus*. They are the major vectors of dengue that transmit different arboviruses and filariasis (Cardo et al., 2015). The similarities of these mosquitoes are their fond to breed in clear and clean water, either in natural or artificial containers (Madzlan et al., 2016). The most preferred breeding sites are ant traps, earthen jars, flower pots, drums, concrete tanks, coconut shells, and discarded tires (Koenraadt et al., 2006; Madzlan et al., 2016).

The important criteria of *Aedes aegypti* are highly anthropophilic and favor staying near human dwellings (Sairi et al., 2016). Females *Aedes aegypti* prefers to breed in a domestic container, while in a peri domestic environment, it favors breeding in rainwater accumulated containers (Sairi et al., 2016). *Aedes albopictus* is a mosquito that usually lives in suburban and rural areas and does not colonize in indoor water collection.

In many countries, including Malaysia, both these species overlap with each other in indoor and outdoor breeding habitats (Sairi et al., 2016) as both are mostly found near the human community (Madzlan et al., 2016).

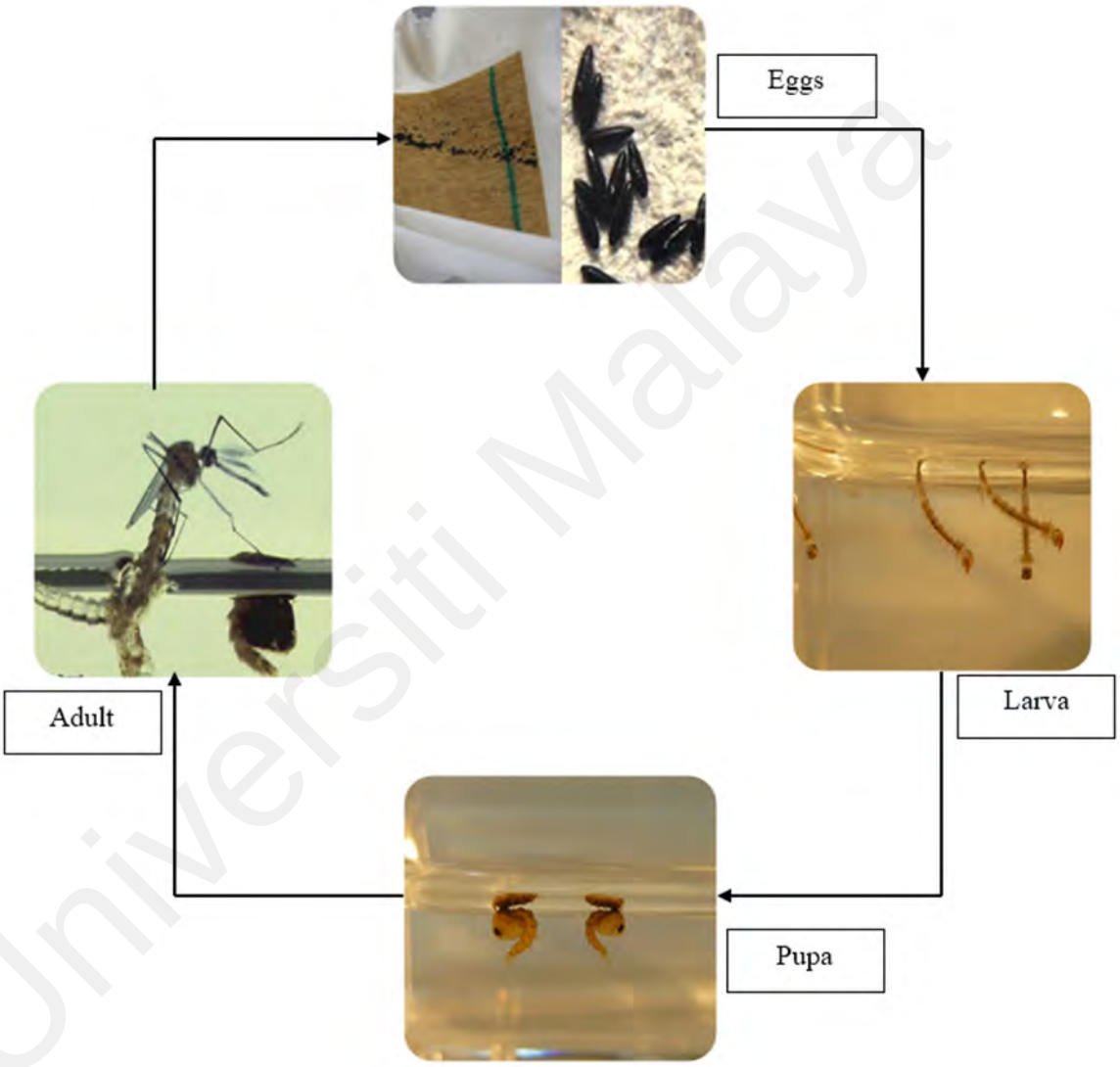

Figure 2.1: Life Cycle of an Aedes Mosquito

(Source: http://www.cdc.gov/Dengue/lifecycle.html)

2.3 Dengue

Masud et al. (2017) mentioned that dengue emerged as a severe public health concern and ranked as the most significant mosquito-borne viral disease worldwide. According to WHO (2012), the estimates of total dengue virus was 50-100 million infections annually and the global distribution of dengue presence throughout the world (Figure 2.2).

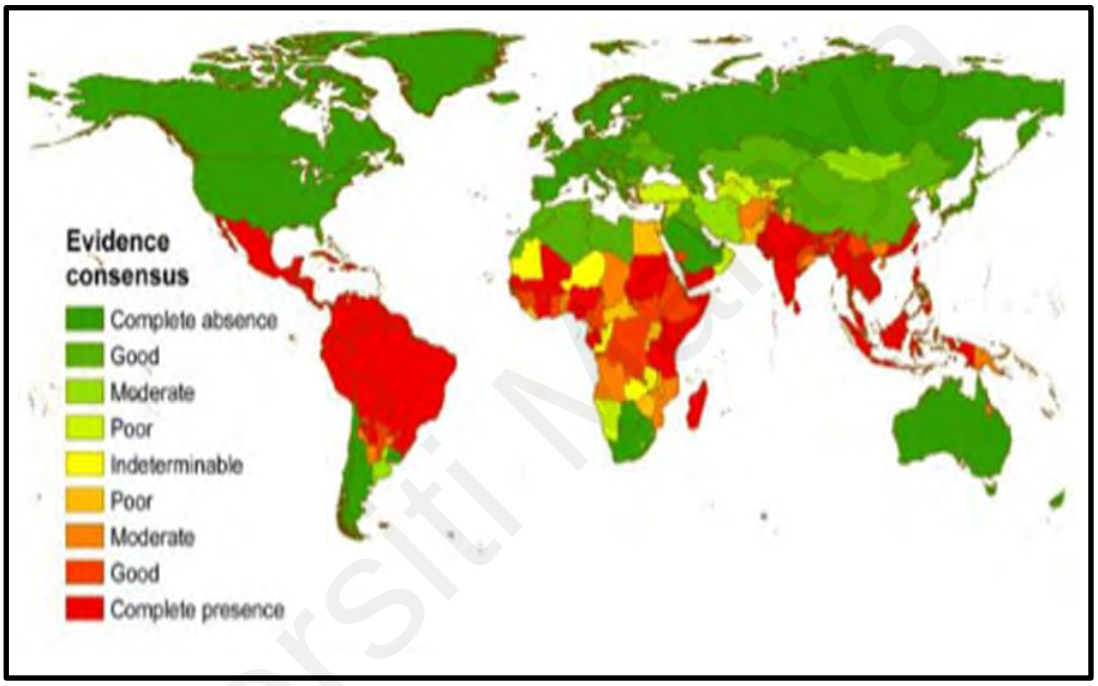

Figure 2.2: The presence of dengue in worldwide.

(Source: The global distribution and burden of dengue (Bhatt et al., 2013))

Factors that derived the emerging of dengue are uncontrollable urbanization, the massive growth of population, and no or lack of preventive measures taken in endemic areas (Siddiqui et al., 2016). The cost paid by humans (death) and economic (sanitary system) are astounding as the number of mosquito-transmitted diseases, especially dengue cases, in the past 50 years increasing drastically (Cardo et al., 2015; Masud et al.,

2017). A study conducted in Africa stated that dengue is a neglected disease because often confuse with the burden of malaria. (Quedrago et al., 2018).

Dengue infection occurs when an individual is bitten by *Aedes aegypti* or *Aedes albopictus* that carries the dengue virus serotypes, including DENV-1 DENV-2 DENV-3 DENV-4 (Gunasekara et al., 2012). The appearance of dengue can be observed via symptoms like fever, headache, muscle pains, joint pains, rashes, nausea, and vomiting (Alobuia et al., 2016). Gunasekara et al. (2012) mentioned that an individual is highly likely to be infected with dengue fever more than once during their lifetime. Symptomatic dengue infections can be identified via mild dengue fever or more adverse form disease, including Dengue Hemorrhagic Fever (DHF) or Dengue Shock Syndrome (DSS) (Dick et al.,2012). The urbanization, globalization, lack of effective mosquito control and climate change are the key factors that drive the dengue outbreak in a region outside the urban settings (Quedraogo et al.,2018).

2.4 History of Dengue in Malaysia

Malaysia, with a population of 32.45 million and a population density of 86 per square kilometer, dengue is currently endemic throughout the country (Mia et al.,2013). Malaysia experiences dengue fever with a high number of cases and also deaths that fluctuate every year. Based on the data obtained from the Statistic Department of Malaysia from 2008 to 2019, the highest dengue case was recorded in 2015 with 120836 cases and 336 deaths. The cases decrease slightly from 2016 till 2018 and has increased tremendously in 2019, with the highest number of dengue case of 130101 and 183 deaths. The current dengue cases are still high compared to the one recorded in 2014 (Department of Statistic, Malaysia, 2020).

The disease has been acknowledged as one of the national health threats to the public in Malaysia (Er et al., 2010). Al-Dubai et al. (2013) cited that dengue cases in Malaysia are fluctuating and uncontrollable due to unpredictable weather conditions, climate change, and tropical seasons. Arima and Matsui (2011) mentioned that in 2009, there were 242,424 dengue cases and 785 dengue deaths reported in 25 out of 37 countries. The first outbreak of dengue in Malaysia occurs in Penang in the year 1901-1902. Next major national dengue outbreaks were reported in 1974, 1978, 1982, and 1990 (Azami et al., 2011; Cheong et al., 2014; Pang and Loh, 2016).

Azami et al. (2011) mentioned that Malaysia, as a developing country, has enormous infrastructure development and great urbanization (Hassan et al., 2016) as a favorable condition for Aedes mosquitoes to perform breeding that aids in the spread of dengue virus, DENV. Selangor is a state with a high-density population compared to other states in Malaysia. The behaviour of the citizen has a high impact on the transmission and spread of dengue, at which the household plays a vital role in mosquito control and prevention (Ghani et al., 2019).

2.5 The prevalence of dengue among Orang Asli

In Malaysia, some rural or forest fringe areas or remote areas are populated by Indigenous communities, known as Orang Asli (NikNadia et al., 2016). Of the total population of the entire nation, 0.6% are populated by Orang Asli (SyedHussain et al., 2017). The Orang Asli population is subdivided into three main races comprises of Porto-Malays, Negrito, and Senoi. Each race has its own ethnic group (NikNadia et al., 2016; SyedHussain et al.,2017). Total number of Orang Asli villages in Malaysia is 869 (Masron et al., 2013). The majority of them reside in rural or remote areas (Kardooni et al., 2013). Khor et al. (2019) stated that most Orang Asli resides in forest or forest fringe

areas, and they depend significantly on surrounding forest for wild fruits, ornamental plants, and wood products and hunt wild animals as a source of income and food.

Geeta Malhotra et al. (2014) revealed that the poor living conditions of people in low socio-economic areas like rural areas contribute to the spread of dengue and make it hard for health services to eradicate the vector population effectively. NikNadia et al. (2016) stated that a high prevalence of the disease among the Orang Asli population in rural areas is due to low levels of education, poor environmental sanitation, and lack of clean water. Othman et al. (2012) claimed that majority of Orang Asli were reported healthier without contact with outside society years ago. The scenario changed when modernization brought outsiders with new pathogens or illnesses, making them vulnerable to life-threatening diseases (Othman et al., 2012). In 2014, the seroprevalence immunoglobin G (lgG) for dengue fever was reported significantly higher in rural areas than in urban areas (Wong et al., 2014).

The prevalence of dengue fever in the rural areas of Malaysia was estimated to range from 24% in the Lundu District, Sarawak (Cheah et al., 2006) to about 91% throughout the Malaysian population (Azami et al., 2011). A study conducted among the Orang Asli population in Peninsular Malaysia showed that most adults above the age of 30 years from the Temuan and Semai community in Hulu Langat, Selangor, had been affected by dengue fever (Smith Ce, 1956). Another study conducted in 1986 by Rudnick & Lim (1986) showed that 73% of the Temuan Orang Asli community in Kampung Tanjong Rabok, Selangor, had been affected by dengue fever and its related viruses.

2.6 Knowledge, Attitude and practices of dengue

Koendraadt et al. (2006) mentioned that knowledge, attitude, and practice (KAP) surveys deliver an excellent framework to assess the existing programs and determine the effective strategies for a behavior change. However, in dengue, the KAP studies focus more on evaluating the impact of health education and community-based programs (Koendraadt et al., 2006).

According to Syed et al. (2010), the knowledge is assessed by focusing on the communities' understanding of the disease process (vector, etiology, vector, and transmission), risk factor (season, time of day, location), general signs and symptoms (days attain fever, types of pain) and standard preventive practices (proper disposal, use of abate, water storage).

A study conducted by Siddiqui et al. (2016) stated that elements influence an individual's awareness / knowledge, belief, and preventive health behavior, including the socio-economic status, gender, literacy, and household income. Research carried out in Colombo, Sri Lanka, stated that almost 98% population have heard about dengue fever and their main source of information is the television. Most of the participants classified high fever as the main symptom of dengue fever. More than half of participants were aware that dengue fever is transmitted by a mosquito vector (Gunasekara et al., 2012). The study conducted in Karachi, Pakistan by Itrat et al., 2008 stated that 93% are aware that the vector for dengue is mosquito and half knew that it is caused by Aedes mosquito.

Bota et al. (2013) mentioned that the rise of dengue fever cases and its severe forms show that greater attention should be imposed on importance of health behaviors and attitudes in preventing dengue. Therefore, it can be enhanced by addressing the knowledge attitude and practices related to dengue fever.

A study published by Naing et al. (2011), claimed that the community's KAP is the factor that shows respondents' participation in community-based activities. KAP survey on dengue is carried out to identify the extent and effect of health activities, intervention, etc., in a particular domain. In addition, it is also a way to know how the people in the domain were informed and accessed. Furthermore, the use of the KAP study as the baseline acts as a mitigation strategy as well as encourages community participation in combating the arising of dengue fever (Naing et al., 2011).

2.7 Knowledge on Dengue

Knowledge about dengue is measured via frequently applied prevention practices, including usage of mosquito nets, screening of windows, usage of spraying method and repellent, larval control in the household (Phuanukoonnon et al., 2006). A study claimed that the majority of respondents were not aware/unsure about the cause of dengue (Naing et al., 2011).

A study on the effects of a community-based project for children on knowledge, behavior, and residential mosquito infestation conducted among primary schools showed that children and parents must acquire knowledge about dengue to change their behaviours on dengue prevention and control (Suwanbamrung et al., 2013). A cross-sectional survey conducted by Naing et al. (2011) claimed that knowledge of dengue was significantly associated with good practice of dengue prevention and control.

Rozita et al. (2006) stated that respondents perceived low knowledge prompt to poor prevention practices. Al-Zurfi et al. (2015) and Yussof et al. (2017) stated that better knowledge would lead to a positive attitude and thus encourages good prevention

practices. However, contrast studies claimed that good knowledge does not prompt good prevention practices (Hamid et al., 2015).

2.8 Health Belief in preventing dengue

In the 1950s, Godfrey Hochbaum, Irwin M. Rosenstock and Stephen Kegels established Health belief Model (HBM) that comprises five main important components (Phuanukoonnon et al., 2006). The HBM ideas can be used to study the effect of dengue and their household practices to prevent and control dengue (Siddiqui et al., 2016). HBM also refers to a guide to predict the motive of people to carry out the action in controlling and preventing a particular illness or disease (Siddiqui et al., 2016).

Identification of these beliefs in the population using the HBM allows comprehensive understanding of health behavior. The health belief model asserts that, even an individual identifies personal susceptibility, action will not occur till an individual believes to estimate how serious the disease may be that becoming ill is very serious.

The approach towards perceived susceptibility where an individual belief in the accuracy of the diagnosis, defines as a person's idiosyncratic perception of the risk of occurring a particular health problem. Perceived severity refers to the alertness (concern) towards the austerity of the health problem and its consequences involved like death, disability, and social restrictions. Cues to action denote individuals' belief in the effectiveness of designed mechanisms in reducing the seriousness of health problems. The cues to action are also a way to enhance the awareness and alertness in executing the proper prevention practices (Siddiqui et al., 2016). Perceived barriers are meant as the perception of possible hurdles such as lack of attention from authorities, community, or cost that can occur in implementing the preferred behavior/action to control or prevent a

particular illness. Self-efficacy refers to the level of confidence that one owns to accomplish the desired behavior to obtain the outcome successfully. In other words, the ability of HBM to be used by an individual to prevent dengue through a good preventive measure (Siddiqui et al., 2016).

2.9 Prevention Practices of Dengue

A study conducted in Phuanukoonnon et al. (2006) in Thailand cited that the best way to control mosquitoes is by eradicating them at their immature stage. Madzlan et al. (2016) cited that the best and effective method implemented widely to control dengue cases is abolishing mosquitoes during their larval stage using abate.

The high occurrence of dengue cases is due to an increase in mosquito breeding sites. The main three attributes involved in the transmission of dengue are virus, mosquito vectors, and human host (Sairi et al., 2016). Thus, to control the outbreak, the chain of transmission must be cut off via abolishing the breeding sites. Hassan et al. (2016) mentioned that the best method is ovitrap surveillance that helps manage dengue vectors. Besides, Wong et al. (2015) stated that socio-demographic characteristics, beliefs, and practices about dengue have an impact on dengue prevention and control.

The intervention phase – prevention practices is considered successful when knowledge and vector control practices are understood, adopt, and applied by inhabitants in a community (Al-Dubai et al., 2013). Benelli et al. (2016) in their recent study, stated there is no viable vaccine or specific treatment available beyond mosquito avoidance through depending solely on effective vector control practices.

2.10 Health educational intervention

According to WHO (2004), an intervention is a series of activities aimed to change a process, course of action, or sequence of events in the interest of change one or several of their characteristics or behavior. They were widely used in public health to scrutinize a programme or policy designed that gives an impact on an illness or disease (WHO, 2004). A study by Ibrahim et al. (2009) cited that since there is no viable vaccine, the most sustainable integrated approach by preventing the transmission via controlling the principal vector, *Aedes aegypti*. Packierisamy et al. (2015) claimed that educational messages inoculated among the community significantly reduce larva indices compared to fogging activities targeting at adult mosquitoes.

One of the crucial intervention tools in encouraging behavior changes that leads to community participation in controlling dengue fever, especially the vector, is health education programmes (Ibrahim et al., 2009). Besides, a successful community-based strategy must be suitable and flexible to the local setting due to ecological, cultural, and social differences between the localities (Ibrahim et al., 2009). Ouédraogo et al. (2018) described that many community-level intervention findings lead to a reduction in vector densities. To date, the control of mosquitoes and eradicating the larval sites are the primary prevention practices with the assistance of campaigns and educational programs (Harapan et al., 2017).

Pre- and post-intervention evaluation of an educational programme for a sample of school and students of 593 respondents in Jeddah, Saudi Arabia, was undertaken by Usman et al. (2018) using a KAP survey. The KAP questionnaire consisted of 30 questions, of which eight were about attitude. This was a health education intervention studying using a random sample. Overall, the knowledge, attitude, and practices about dengue fever improved after educational intervention, though some were unable to follow

the proper practices. The findings deduce that good knowledge does not always lead to good practice (Usman et al., 2018).

Ibrahim et al. (2009) assessed KAP and developed an educational intervention programme in a stratified sampling of 3164 respondents that comprised of female students, teachers, and supervisors in Jeddah. The KAP questionnaire consisted of 50 questions, of which 30 questions were on knowledge, eight on attitudes, and 12 on practices. The overall mean pre-intervention knowledge and prevention score were 10.57 (±5.41), 8.34 (±2.71), and increased to 25.57 (±3.28), 10.85 (±1.56) during the post-intervention. The percentage of knowledge before and after the educational intervention is significantly based on occupation ($p < 0.001$). However, no statistical difference ($p > 0.05$) in the percentage of practice observed based on occupation. In terms of knowledge, the highest knowledge gain by students compared to the teachers and supervisors. The items used in health education brochures, small gifts with dengue fever educational messages, posters, stickers, and a CD-ROM contain lecture on DF and film session on DF. Health education program improved the percentage of participants with satisfactory knowledge from 0.1% to 57.0 % in the post-test in one week time.

Evaluation of the effectiveness of dengue and its prevention educational intervention with a small group was undertaken by Gupta et al. (2015) in Pune, India. The school children aged 8th to 10th were chosen randomly from English medium schools ($n= 204$). The educational intervention program was carried out twice, first right after the educational program and the second was 15 days after the program. The mean knowledge score for the pre-test is 12.11/22 and was increased to 15.41 and 15.25 for post-test one and post-test two, respectively. However, no significant difference between post-test one and post-test two shows that the students retain the dengue knowledge after 15 days.

A quasi-experimental community-based interventional study was conducted among 15 clusters from five slums/ slums like settlements in Delhi, India. Each household was selected randomly from each sub-cluster. The health education programme was performed through a partnership with the municipal bodies and non-governmental organizations and carried out for three months. Posters and banners were displayed at community, and audio messages were played in places with more people and printed educational material (in Hindi) were given to participants and asked to spread the message to the other people. Findings deduce that intervention resulted in a significant increase in knowledge and practice on personal protection (Kusuma et al.,2017). A study conducted in Burkina Faso used an Eco health intervention approach. These intervention concepts are pesticide-free dengue vector control and theoretical approach by using communication materials (Quedrago et al.,2018).

2.11 Treatment strategies and vaccine of dengue

Earlier days, there is no specific treatment for dengue other than protective measures and fluid therapy (Rajapakse et al., 2012). Due to practical difficulties in managing dengue infection, the main focus was on prevention of transmission by vector control which are divided into three categories, Physical (removal of breeding places), chemical (insecticides and larvicides), and biological (use of bacteria such as *Bacillus thuringiensis*). (Rajapakse et al., 2012; Rather et al., 2017).

The physical control consists of GIS Mapping of Dengue Foci, active Surveillance, determination of oviposition sites, community-based control program and education of prevention strategies. The GIS mapping has proven to be one of the most effective methods for locating dengue concentrations. Finding dengue foci and treating them with various preventative techniques can stop dengue transmission by identifying

dengue seri-positive cases within the study area (Gandhi et al., 2017). According to Kittayapong et al., 2008 research, GIS mapping not only improved community-based dengue intervention programs and surveillance, but also tracked the degree to which dengue had been successfully controlled in the mapped areas in which the water containers and bathroom sinks were shown to be the primary breeding habitats of *Aedes egypti* mosquitoes.

In order to prevent and control dengue, active surveillance shows rapid responses as well as vital data on risk assessment, outbreak response, program evaluation, and guidance (Rajapakse et al., 2012). Entomological and epidemiological linkages are provided through surveillance to aid in better planning and to understand the spatial distribution of dengue cases (WHO, 2012). Besides, the purpose of community-based control initiatives is to inform the local population of the steps needed to eradicate mosquito breeding grounds. It has been highlighted that the knowledge, education, and behavior of the people, determine the success of community-based strategies (Naing et al., 2011). Education acts as a foundation for a person's capacity to identify the vector presence and take correct preventive measures.

The biological control consists of Sterile Insect Technique (SIT), genetically modified mosquitoes, Wolbachia and use of larvivores fish and crustacean. The Sterile Insect Technique (SIT), which involves releasing a large number of sterile male mosquitoes to mate with wild females in order to reduce their reproductive capacity, is one such technique (Lacroix et al., 2012). Despite a few promising trials, the approach has not been widely used to combat mosquito vectors, in part because sterilizing radiation levels have a negative impact on insects.

A study using genetically modified mosquito was trialed in Malaysia. Theoretically, this technique will assist vectors in lowering dengue prevalence. However,

there are still unresolved ethical problems with releasing GM mosquitoes in large numbers (Azil et al., 2018). Due to this, the Wolbachia was initiated. A gram-negative bacteria called Wolbachia is naturally present in some insects and is inherited only from the mother (i.e. mother to offspring). While Wolbachia were not naturally present in *Ae. aegypti*, it was known that *Aedes albopictus* naturally harbored the bacteria. Through embryonic microinjection, the Wolbachia strains, which were originated from the fruit fly Drosophila melanogaster, were artificially introduced into the eggs of the *Ae aegypti*. Then, these strains of laboratory-produced *Ae. aegypti* are crossed with mosquitoes that were caught in the wild. The resultant generations are then applied to large-scale environment. Both genotypes have the capacity to prevent dengue virus transmission (Azil et al., 2018).

The chemical control comprised of use of insecticides, use of insect growth regulators (IGRs) and use of pheromones as "Attract and Kill" Approach. The cornerstone for managing these insect vectors is chemical insecticides. Chemical use, however, also poses concerns to human health and the environment, and it could result in insecticide resistance. Consequently, it is crucial to manage such insecticides properly (Berg et al., 2021).

Diverse chemical compounds known as insect growth regulators (IGRs) are extremely effective against mosquito and other insect larvae. By controlling or blocking biochemical pathways or processes necessary for insect growth and development, insecticides with growth-regulating qualities (IGR) may have a negative impact on insects. Some insects exposed to such substances may perish because of abnormal hormone regulation of cell or organ development. Other insects die either from an abnormal end to a developmental stage itself or from a prolonged exposure to other mortality factors during the developmental stage (susceptibility to natural enemies,

environmental conditions, etc.) (Tunaz and Ugyun, 2004). In addition, the pheromones have a long history of use in a variety of sectors, including integrated pest control (IPM). Nagpal et al, (2015) has shown the suppression of developmental stages from eggs to adults employing an integrated approach using pheromones.

In addition to general control measures, development of vaccines have provided efficient illness prevention and management. In year 2016, WHO-SAGE published a report which recommend considering the first dengue vaccine (Dengvaxia). Based on the WHO (2018), the CYD-TDV is the first dengue vaccine to receive US Food and Drug Administration approval. Dengvaxia is the brand name for chimeric yellow fever-dengue-tetravalent dengue vaccine (CYD-TDV). CYD-TDV is the recombinant, live, attenuated tetravalent dengue vaccine developed by Sanofi Pasteur (CYD-TDV), given as a 3-dose series on a 0/6/12-month schedule (Hassan et al., 2021). Alongside vector-control methodologies, a recently approved vaccine for dengue immunizes against all four serotypes (Tully and Griffiths, 2021). However, in Malaysia still not in recommendation as the safety profile still clinical and no studies conducted in Malaysia to show the vaccine's effectiveness in reducing dengue cases. The vaccination against dengue disease could change the paradigm of the existing surveillance and vector control in curbing economic and health burden of the disease (Craviato et al., 2014; Yeo and Shafie et al., 2018).

2.12 Summary

This chapter This chapter illustrates the dengue history, the past studies on knowledge, health belief and prevention practices as well as the current available treatment strategies including vaccines.

CHAPTER 3: METHODOLOGY

3.1 Introduction

This chapter describes the research methodology used to address the research questions of the current study. The chapter presents a comprehensive overview of the study design, study setting, study population and sampling, research instruments, procedures for data collection and data analysis, and ethical consideration.

3.2 Study design

This is a cross sectional pre and post study with no control group that aims to determine whether the utilization of dengue awareness calendar intervention improve the dengue knowledge, health belief and prevention practices. A quantitative questionnaire survey was used as a study tool in this study.

3.2.1 Stages of study design

This intervention study is preceded by a baseline survey, and the impact of the intervention was evaluated by conducting a post-interventional survey. The study was subdivided into three phases as follows.

i. In Phase one the enumerator administrated an interview survey using a questionnaire (Appendix A) that investigates the socio-demographic characteristics, experience of dengue fever, surrounding environment, knowledge, health belief, and prevention practices among Orang Asli. This phase is also known as baseline or pre-

intervention before conducting the educational intervention. The pilot study was carried out in this phase.

ii. Phase two involves with the intervention. The intervention is conducted using the printed educational material, a calendar. The calendar comprises information pertaining to the dengue, Aedes mosquitoes, symptoms, prevention, and active period. The educational intervention was performed to improve the Orang Asli knowledge and to engage in proper prevention practices.

iii. Phase three involves a repeated survey with the same set of the questionnaire (Appendix B) after the commencement of the educational intervention via telephone calls. This phase is known as post-intervention, obtained after the implementation of educational intervention.

3.3 Study Setting

The area chosen for this study is the state of Selangor which reported highest rate of dengue infection compared to other states in the federation of Malaysia (Department of Statistics, Malaysia 2020). It is situated on the southwest coast of Peninsular Malaysia (figure 3.1) and bounded to the north and east by the states of Perak and Pahang and the south by Negeri Sembilan and Melaka (Lee and Pradhan, 2007). Selangor covers a total area of 791,084 hectares, where 247,794 hectares are forested areas, and the remaining areas are non-forested areas (Aisyah A et al., 2015).

Figure 3.1: Map of Selangor (visit Malaysia)

Based on statistics provided by the Department of Orang Asli Development (JAKOA), there are seventy-four Orang Asli villages in seven districts out of 9 districts in Selangor (Appendix C). Table 3.1 illustrates the names of the villages selected for this study. The flow chart for village selection is further described in Figure 3.3.

Table 3.1: The total number of Orang Asli villages according to districts in Selangor.

No	District	Total number of villages	Name of Villages Selected for the study
1.	Hulu Selangor	16	Tun Abdul Razak Bukit Manchong
2.	Gombak	8	Km. 24
3.	Petaling	4	Bukit Lanjan
4.	Hulu Langat	9	Paya Lebar Donglai Baru
5.	Sepang	14	Bukit Bangkong
6.	Kuala Langat	20	Tanjung Sepat Bukit Tadom
7.	Klang	3	

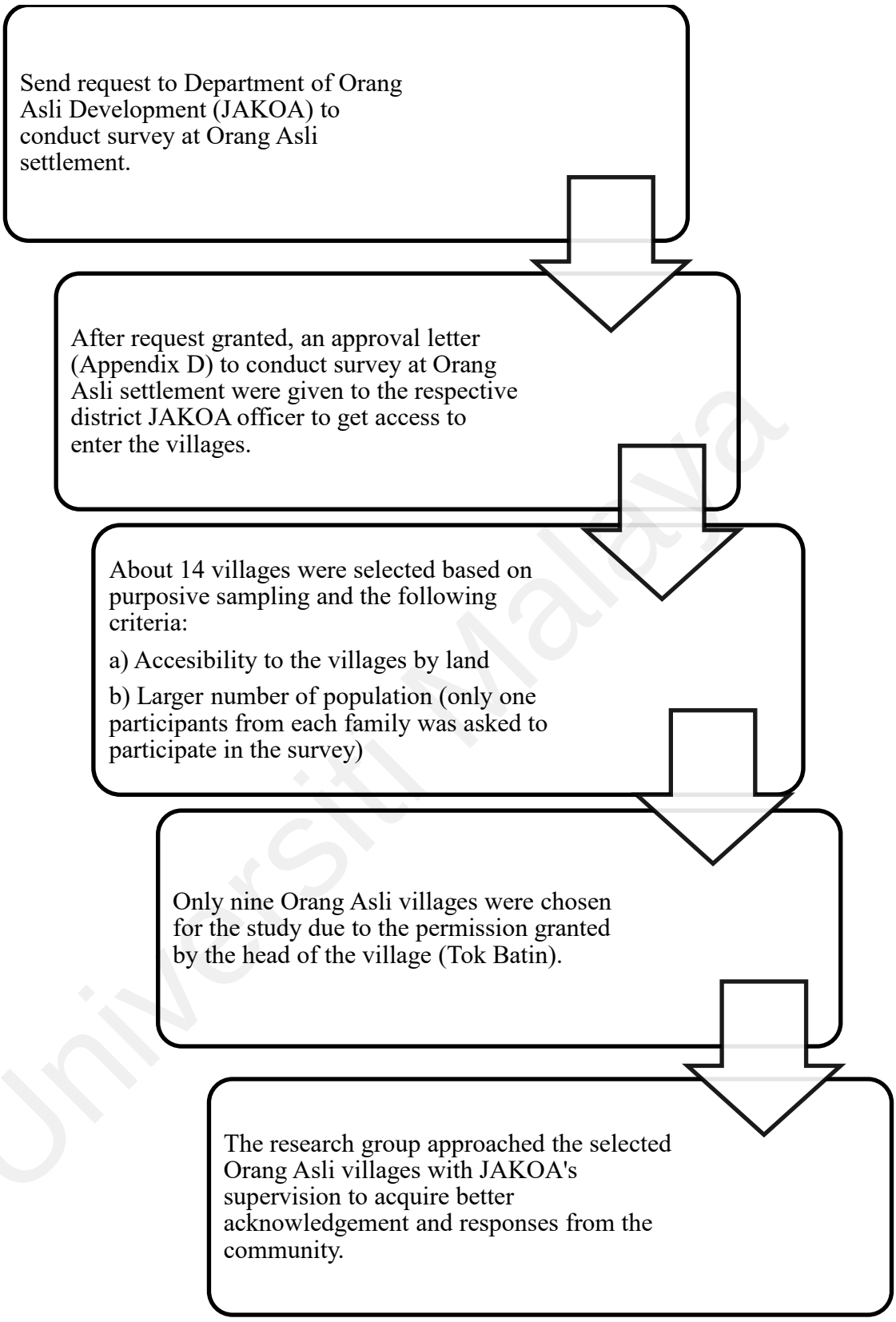

Figure 3.2 Flow chart of village selection

3.4 Study Population and sampling

The population of this study involves the Orang Asli respondents living in nine villages in Selangor that were selected according to the districts (Table 3.1). Each household in the selected village was approached. All the participants were randomly selected. Since the pre-and-post-intervention was assessed on the target population, they were matched based on the following inclusion criteria to achieve the homogeneity of the sample.

The inclusion criteria are based on previous studies that examined the KAP of dengue among Orang Asli in Malaysia (Chandren et al., 2015). Inclusion criteria: (i) Eligible participants aged ranging from 18 years old and above, (ii) living in the selected villages, (iii) willing to provide verbal informed consent and (iv) able to understand and comprehend Bahasa Melayu.

For phase I, only one person was surveyed from each household in the selected village. If there were more than one eligible person in a household, only one respondent was selected through another random drawing form. If the respondents refused to be interviewed or if the resident of the house was not present, it was regarded as a non-response.

For Phase III, the post-test was carried out with the same participants. The participants were contacted through the first three attempts, and calls were excluded if they did not go through after three attempts. Before being considered as no response, enumerators tried to call unsuccessful calls two more times on different days.

3.4.1 Sample Size

For calculation of the estimated sample size, JAKOA Malaysia was referred to obtain the number of Orang Asli population in Selangor. The total number of the Orang Asli population in Selangor is 17587.

The estimated sample size was calculated based on the most conservative expected dengue rate of 50% and a margin error of 5% with a 95% Confidence Interval (CI), based on the previous study conducted among Orang Asli in Peninsular Malaysia (Chandren et al,, 2015). Hence, the estimated sample size required for approximately 17587 Orang Asli for an accuracy level of 0.95 with a margin error of ±5.0% was 422.

The sample size was calculated using the formula for a single proportion, with an assumption of a confidence level of 95%, a 5% margin of error, and the most conservative expected rate of dengue of 50%. An additional 10% was added to the sample size calculated to account for potential missing values and invalid responses.

The formula used for sample size estimation: N= Z 2 * [(p) * (1-p)/ c 2], where Z = 1.96 for 95% CI; p = 0.5 for expected rate of dengue fever; and c = 0.05 margin of error.

The calculation is as following:

N = 1.96 * 1.96 [0.5(1 - 0.5) / (0.05 * 0.05)]

N = 1.96 * 1.96 [0.5(0.5) / (0.0025)] = 384

Adjustment for the size of the population was calculated based on this formula:

S = n / [1 + (n / population)]

S = 384 / [1 + (384 / 17587)] = 384

An extra 10% was added to the estimated sample size to account for potential missing values and invalid responses, and the final required sample size was 422.

3.5 Research Instrument

3.5.1 Study Intervention – Dengue Awareness Calendar

The intervention aimed to assist Orang Asli in utilizing the knowledge to change certain behaviors to protect themselves from dengue. Therefore, Social and Preventive Medicine, in collaboration with Tropical Infectious Disease and Research Education (TIDREC), invented a dengue awareness calendar to use for an educational intervention. The content of the calendar was developed by the experts specialized in epidemiology and infectious disease from the Social and Preventive Medicine and Tropical Infectious Disease Research and Education Centre (TIDREC). The calendar was designed by a graphic designer from Australia who specialize in the graphic designing and validated by experts specialized in, viruses, dengue fever and public health from the Microbiology Department, TIDREC, and the Social and Preventive Medicine. The dengue awareness calendar was provided in Bahasa Malaysia for a better understanding by the Orang Asli. It was distributed immediately after the pre-intervention assessment.

The dengue awareness calendar was designed in a form that it can be hung anywhere inside the house, so that the user can continuously see the messages displayed on the calendar. The information displayed on the calendar comprised of five key messages including (1) the knowledge on dengue, (2) Aedes mosquitoes' characteristics, (3) dengue transmission, (4) control measures to eliminate the mosquito breeding sites and (5) prevention of mosquito bites (Appendix E). The content created on each month is aimed to expose people to the seriousness of the disease, its spread, the vectors and their

characteristics, prevention and control measures to eliminate breeding ground and prevention of mosquito bites.

Table 3.2: Summary of the dengue awareness calendar (Appendix E)

No	Month	Content
1	January	Emphasizes the causes of dengue fever and its vector [K]
2	February	Explains the transmission of dengue fever from an infected person [K]
3	March	Explains the symptoms of dengue fever (DF), Dengue Haemorrhagic fever (DHF), and dengue shock syndrome. (DSS) [K]
4	April	Focuses the favourite sites for mosquito breeding [K, P]
5	May	Examine the prevention to be conducted before leaving for holiday [P]
6	June	The proper prevention practices among individuals to protect from dengue bite [P]
7	July	The proper prevention to eradicate the mosquito breeding sites. [P]
8	August	Elucidates the proper treatment to be given for dengue patients. [P]
9	September	Emphasize community roles in preventing dengue. [P]
10	October	Explains the active season of dengue presence and ways to prevent its breeding site. [K]
11	November	The vulnerable period of mosquito spreading [K]
12	December	Encouraging a community engagement in combating dengue fever [P]

3.5.2 Pre- and Post-intervention questionnaire

Two sets of same questionnaires were used in this study for both pre- and post-intervention surveys. These questionnaires were adapted and modified based on previously published study carried out in Peninsular Malaysia by Chandran et al (2015).

Based on the inputs provided by JAKOA, Orang Asli able to understand Bahasa Malaysia and therefore, the questionnaire was translated into Bahasa Malaysia (the

national language of Malaysia). This is to cater and facilitate better understanding of the survey questions by Orang Asli. In order to avoid any mistakes in the translation of the questionnaire, two bilingual experts translated each question from English to Bahasa Malaysia. Then, another two bilingual experts back translated the questionnaire which was carefully re-reviewed by the researchers, and necessary editing were made. Generally, questionnaires I (pre-intervention) and II (post-intervention) are the same. However, section A, B and C from questionnaire I is replaced with a new section A, B and C in questionnaire II. This part is further discussed below:

3.5.2.1 Questionnaire I (pre-intervention)

This questionnaire examines Orang Asli's socio-demographic characteristics, the experience of dengue, surrounding environmental factors, knowledge of dengue, health beliefs, and self-reported dengue prevention practices (refer to Appendix 1). This questionnaire comprises six sections as follows:

Section A: Socio- Demographic Data

The demographic characteristics include age, gender, ethnicity/tribe, educational level, occupational status, average monthly household income, and type of house. The rationale for including these data is to determine whether the selected variable will impact study participants' knowledge, health belief, and practices.

Section B: Dengue experience in community (3 items)

This section focuses on the respondent's experience with dengue fever and the frequency of the participant's family members or neighborhood residents hospitalized or experienced with dengue fever.

Section C: Mosquito problem in neighborhood area (3 items)

This section emphasizes the density of plants and vegetation, the density of mosquito in neighborhood, and the frequency of mosquito fogging. These questions were designed to evaluate whether these factors act as a barrier for the participants to combat the dengue.

Section D: Health belief towards dengue by using Health Belief Model constructs

Belief questions based on the several constructs of health belief model (HBM) were used to measure the participants' intentions and actions of battling the dengue occurrence. The questions were as follows:

I. Perceived severity referred to feelings concerning the seriousness of dengue, and it impacts to certain age group. Perceived severity was measured on a scale of 0-10, where a higher score indicates higher severity.

II. Perceived susceptibility asked how an individual is vulnerable to getting dengue. Perceived susceptibility was measured on a scale of 0-10, with higher score exhibits higher susceptibility.

III. Perceived barriers examined the perception of obstacles faced to prevent dengue (e.g., lack of community participation, lack of self-efficacy and lack of preventive measure). Perceived barriers were measured on a scale of 0 -10, with a higher scale shows greater barriers.

IV. Cues to action focused on encouragement or motivation to carry out dengue prevention practices (e.g., death, encouragement from NGO, neighborhood infected with dengue, enlightenment from mass media, sudden fogging by authorities). This part was

also measured on a scale of 0-10, whereby the higher scale shows greater motivation to carry out dengue prevention practices.

V. Self-efficacy measures the confidence level of an individual engaging in dengue prevention practices. The self-efficacy was measured by using a scale of 0-10, whereby a higher scale reflects higher confidence in performing the prevention practices.

The justification of including this construct is to evaluate the participants' intentions and actions in combating or hindering the occurrence of dengue as well as to perform a better prevention practice.

For scoring each health belief item, scale 0-5 is regarded as score 0 (i.e., low level severity) and scale 6-10 is regarded as score 1(i.e., high level severity) (Wong et al., 2015). The differences between post-intervention and pre-intervention health belief scores were also calculated. The difference was categorized into 1) post-intervention scores were same or lower than the pre-intervention scores (post ≤ pre) regard as no increment and 2) post-intervention scores were higher than the pre-intervention scores (post > pre) regard as has increment.

Section E: Knowledge test (40 items)

This section comprised of 40 items concerning knowledge on dengue and consisted of six parts as follows:

i. Knowledge about dengue and Aedes spp. Mosquito (10 items).

ii. Knowledge about the transmission of dengue (9 items).

iii. Knowledge about dengue prevention (5 items).

iv. Knowledge of signs and symptoms of dengue fever (7 items).

v. Knowledge of signs and symptoms of dengue hemorrhagic fever (DHF) (7 items).

vi. Knowledge about treatment, curability, and precaution measures for people infected with dengue (2 items)

Participants responses to these items were presented by (1) yes, (2) no, and (3) do not know. The statements were positively and negatively worded. For the analyses, positive items, if answered 'yes' was considered correct and scored "1" and if the answer was 'no' or 'do not know' is considered incorrect, scored "0". The negatively worded items (*) were reversely rated and re-coded during the data analysis process. The possible total knowledge scores varied from 0- 40 points. The higher scores representing a higher level of knowledge. As the knowledge scores followed a non-normal distribution, the scores were categorized based on the median split (Wong et al., 2015). In the pre-intervention, the knowledge scores were categorized into two groups: lower knowledge scores (11-26) and higher knowledge scores (27-36). Likewise, in the post-intervention, the knowledge scores were categorized into the lower knowledge scores (13-32) and higher knowledge scores (33-40). The differences between post-intervention and pre-intervention dengue knowledge scores were also calculated. The increment was categorized into a lower increment of knowledge score (0-6) and a higher increment of knowledge score (7-17).

Section F: Prevention practices of dengue (19 items).

In this section, the practices regarding dengue fever consist of three parts as follows:

i. Prevention of mosquito breeding sites (9 items).

ii. Prevention of mosquito bites (7 items)

iii. Prevention of dengue transmission (3 items).

The items were measured via four-point Likert scales with options such as not at all, rarely, sometimes, and often, which were assigned a point of 0,1,2 and 3, respectively. The responses for prevention practices were measured using four-point Likert scale such as (0) not at all, (1) rarely, (2) sometimes and (3) often. The possible total prevention scores ranged from 0- 57 points. The higher scores representing a higher level of prevention practices. The prevention scores were categorized based on the median split and therefore, in the pre-intervention, the prevention scores were categorized as (1) lower prevention practice scores (10-25) and (2) higher prevention practice scores (26-40). Meanwhile, in the post-intervention, the prevention scores were categorized as (1) lower prevention practice scores (21-43) and (2) higher prevention practice scores (44-57). The differences between post-intervention and pre-intervention dengue prevention practice scores were also calculated. The increment was categorized into a lower increment of prevention practice scores (0-17) and a higher increment of prevention practice scores (17-34).

3.5.2.2 Questionnaire II (post-intervention)

This questionnaire is the same as Questionnaire I and used in phase III (Refer to Appendix 2). Similar to Questionnaire I, this questionnaire comprises six sections with some sections replaced with the changes described below:

Section A: Mosquito problem in the neighborhood after the intervention phase. (2 items)

This section encompassed questions on inspecting the density of mosquito problems in neighborhood and frequency of fogging by authorities at the respective village.

Section B: Practices regarding on the use of dengue awareness calendar. (2 items)

The questions emphasize on respondent's behavior on the dengue awareness calendar whether the participants utilized it or not.

Section C: The Perception of Orang Asli on the dengue calendar (Appendix B).

The items in this section were used to explore the credibility, creativity, usefulness of the dengue awareness calendar for the participants. These items were measured using a four-point Likert scale with options such as strongly agree, agree, disagree, and strongly disagree.

Thus, this section is subdivided into few parts as follows:

i. The perception on the use of dengue calendar (3 items).

ii. Perception of the participants towards the content of the dengue calendar (2 items) in terms of comprehensive and accessible information.

iii. Perceptions of participants towards the design and illustration of the dengue calendar (7 items), including the creativity of the calendar.

3.6 Data Collection

Data collection involves the participants' outcomes of both pre- and post-interventions. The data of participants' knowledge, health belief, and practices regarding dengue was collected in phase I and phase III. Thus, to assist in phases one and three, seven enumerators were recruited and trained by the research team for the data collection process. The enumerators were research students, and they were briefed about the structure of the questionnaire and trained on how to approach an eligible respondent to participate in the study. The enumerators were informed about the purpose of the study, the principal investigator's contact number, and explain in detail the consent form.

In phase I (the pre-intervention phase), data collection was performed via the enumerator-administrated questionnaire. Before the start of the survey, an participants information sheet regarding the objective and methodology of the study was given to the participants (Appendix 6). Participants were reminded that participation in the survey is voluntary. Written informed consent of the participants was obtained (Appendix 5). The enumerators checked the completion of the questionnaires. The phase I study was conducted from July 2017 till December 2017, mostly during the weekends and public holidays. The reason for conducting interviews on weekends and public holidays is to make sure that the Orang Asli who are working are able to participate in the study.

For phase II, shortly after pre-intervention assessment, the calendar was distributed to each respondent. During the distribution of calendar, the enumerators briefly explained about the dengue calendar by each month and encourage them to engage in proper prevention activities, to ensure the effective dissemination of knowledge among the participants. The participants were encouraged to hang or display the calendar. At the same time, participants were asked to look at the calendar and perform the prevention activities. The participants were also informed that the post intervention assessment will

take place after 6 months via telephone calls. Upon the agreement of the participants, the telephone number was taken.

Table 3.3 Date of Village Visits during the Study Period

Name of Village	The months the village visits made before the intervention survey	The months the village visits made after the intervention survey
Bukit Lanjan	July 2017	Feb 2018
Bukit Bangkong, Sepang	July 2017	Feb 2018
Bukit Tadom	Aug & Sept 2017	March & April 2018
Bukit Nanchong	Oct 2017	May 2018
Donglai Baru	May 2017	Jan 2018
Gombak Km24	Nov and Dec 2017	May, June, July 2017
Paya Lebar	June 2017	Jan and Feb 2018
Tanjung Sepat	Sept 2017	April & May 2018
Tun Abdul Razak	Dec 2017	May, June, and July 2018

For phase III, after six months of post-intervention, the same set of questionnaires was re-administered (post-intervention) to the same group of participants via telephone calls. The phase III study was carried out from February 2018 till July 2018. The same seven enumerators of phase I were provided with the training to conduct a telephone survey for data collection at this phase. The enumerators called the same respondents who have participated in phase 1 study and received a dengue awareness calendar. The duration of each session of the call is about 20 to 30 minutes. The telephone calls are made on weekdays after 5 pm and weekends, from morning till evening.

The duration of six months between the pre-and post-intervention is set to assess the respondents' behaviour towards the usage of the dengue awareness calendar and check whether their knowledge, health belief, and practices of dengue prevention have increased or remained unchanged. The reason for six months interval between pre- and post-

intervention was to ensure the knowledge retention among the participants that enable the change in KBP associated with health educational material to be measured.

3.7 Test Content Clarity

The pilot study was conducted to test the viability of the study in an actual setting. The final questionnaire was pilot tested with a group of 52 Orang Asli respondents and re-evaluated. The pilot study was conducted in Orang Asli villages, namely Paya Lebar and Donglai Baru. Participants were chosen via random sampling who have fulfilled the sampling inclusion criteria. The data collection for the pilot test was carried out in May 2017. These participants were part of the final responses and involved in the intervention.

3.8 Validity and reliability of data

According to Mohajan (2017), the validity and reliability were the most crucial part of the research methodology. According to Heale and Twycross (2015), validity in the quantitative method refers to the concept or research being measured accurately and the trustworthiness of the findings. On the other hand, reliability defines the precision of a research instrument to provide stable (Mohajan.,2017) and consistent results over time (Heale and Twycross., 2015; Taherdoost and Group, 2017). Reliability refers to the repeatability or replication of results achieved through a certain phenomenon (Bolarinwa., 2015). The most widely used internal consistency measure is the Cronbach Alpha coefficient (Mohajan.,2017).

In this study, the experts on dengue from the Tropical Infectious Disease Research and Education Centre (TIDREC) of University Malaya validated the questionnaire for relevance and clarity of the questions. The reliability of the questionnaire was tested

during a pilot study, and test findings are discussed below. The reliability analysis results were grouped as follows:

Table 3.4: The rating of Cronbach Alpha coefficient (Taherdoost and Group., 2017)

Cronbach Alpha Coefficient (α)	**Attributes**
0.90 and above	Excellent reliability
0.70 – 0.90	High reliability
0.50 – 0.70	Moderate reliability
0.50 and below	Low reliability

Table 3.5: Reliabilities of research instrument based on sections

Measures	**Alpha (α) [N=52]**	**Alpha (α) [N=557]**
Knowledge on Dengue fever	0.927	0.904
Prevention Practices	0.682	0.698
Perceived Severity	0.865	0.817
Perceived Susceptibility	0.702	0.802
Perceived Barriers	0.637	0.885
Cues to Action	0.722	0.840
Self-Efficacy	0.900	0.902

3.9 Data Analysis

All the statistical analyses were performed with the Statistical Package for Social Sciences (SPSS) version 23.0 (SPSS; Chicago, IL, USA). The non-responses and irrelevant answers were treated as missing values and excluded from the analysis.

Data were checked for normality (Shapiro-Wilk) prior to analysis. Descriptive statistics in terms of frequency (n), percentage (%), median and interquartile range (IQR) were used to express the data. The Wilcoxon signed rank test was used to compare the

pre and post-intervention's dengue knowledge score, beliefs score and prevention practice scores. The socio-demographic, knowledge, health belief and prevention practices variables were compared using Chi-square test and results at $p < 0.05$ were considered significant in the univariate analysis. The variables were entered into multivariable binary logistics regression analysis using a simultaneously forced entry model (enter method), to determine the factors influencing the increment in knowledge score, differences in health belief and increment in prevention practices score. Odds ratio (OR), 95% confidence intervals (95%Cl) and p-values were calculated for each independent variable. The model fit was assessed using the Hosmer-Lemeshow goodness of fit test (Hosmer and Lemeshow, 2004). The level of significance was set at $p < 0.05$.

Table 3.6: Summary of the statistical analysis plan

No	Sub-sections of questionnaire	Statistical Analysis
1.	Socio-Demographic data, dengue experience and environmental factors of respondents	Descriptive – frequency and proportion.
2.	Level of Knowledge on dengue	Descriptive – frequency and proportion. Inferential Statistics- Chi square & crosstab (univariate analysis) & Multivariable Binary Logistics Regression. Wilcoxon Signed-Rank test for changes from pre- to post-intervention.
3.	Health Belief - regarding dengue fever	Descriptive – frequency and proportion. Inferential Statistics- Chi square & crosstab (univariate analysis) & Multivariable Binary Logistics Regression. Wilcoxon Signed-Rank test for changes from pre- to post-intervention.
4.	Dengue Prevention Practices	Descriptive – frequency and proportion. Inferential Statistics- Chi square & crosstab (univariate analysis) & Multivariable Binary Logistics Regression. Wilcoxon Signed-Rank test for changes from pre- to post-intervention.
5.	The response of Orang Asli on Dengue Calendar	Descriptive – frequency and proportion.

3.10 Ethical Consideration of the study

The ethical approval was attained from the Medical Ethics Committee of the University Malaya Medical Centre, Kuala Lumpur (MEC Ref. No: 20161115-4602). The study also received a permission from the Department of Orang Asli Development (JAKOA) to conduct the survey and carry out the intervention at the Orang Asli villages in Selangor. Each representative of JAKOA assisted the study team to visit the respective villages and head of the village due to the cultural reasons and the sensitivity towards visitors from the outside.

All the Orang Asli in the village were given a detailed explanation about the study and invited to participate on voluntary basis. Participants' information forms and consent forms (Appendix F) were given to the respondents who have volunteered to sign and participate in the study. The participants were also informed about the post-intervention survey after six months which was performed via telephone calls. The participants anonymity and confidentiality were assured throughout the study. They were assured that all the data and information collected will be kept confidential and only accessible to the researcher. Tokens of appreciation were provided for their willingness to participate and contribute to the study.

3.11 Summary

This chapter presents detailed descriptions of the methodology and design used to investigate the study. The research concepts, study setting, instruments, procedures, and statistical analysis are described comprehensively.

CHAPTER 4: RESULTS

4.1 Introduction

This chapter presents the results of the two components of this study. Firstly, this section provides a quantitative analysis of the main findings of the pre-intervention among the Orang Asli in Selangor. Secondly, a quantitative analysis of the difference of post-and pre-intervention among the same respondents was presented.

In the pre-intervention, descriptive analyses of socio-demographic characteristics of respondents, the experience of previous dengue fever, surrounding environment, fogging frequency, level of dengue knowledge, health beliefs towards dengue, prevention practices of dengue were presented. In the post-intervention, descriptive analyses of the level of knowledge, health belief towards dengue fever, prevention practices of dengue fever, and the attitude exhibited towards the intervention were presented. Subsequently, this section presented an analysis on the differences between the level of knowledge, health beliefs, and prevention practices of dengue fever between pre- and post-interventions.

In this chapter, descriptive statistics in terms of frequencies and percentages were applied to illustrate the demographics, environment, knowledge items, health beliefs, and prevention practices. The chi-square and multivariate binary logistics regression models were used to determine the significance between the independent variables (demographic, experiences of dengue fever, surrounding environmental factors, fogging frequency) and the dependent variables (increment in knowledge score, differences in health beliefs, and increment in practices score).

4.2 Response rate

This survey was carried out from July 2017 until July 2018 at nine selected Orang Asli villages in Selangor. The participants were chosen randomly. A total of 609 Orang Asli responded to the survey out of 17000 total number of Orang Asli in Selangor.

Table 4.1: Response rate of participants based on Orang Asli villages

Name of Village	Total number of populations	Number of participants participated in the survey N (%)
Bukit Lanjan	635	17 (2.8)
Bukit Bangkong, Sepang	689	28 (4.6)
Bukit Tadom	537	110 (18.1)
Bukit Manchong	633	55 (9.0)
Donglai Baru	412	23 (3.8)
Gombak Km24	903	127 (20.9)
Paya Lebar	153	29 (4.8%)
Tanjung Sepat	575	97 (15.9)
Tun Abdul Razak	657	123 (20.2)
Total	**5194**	**609**

4.3 Socio-demographic characteristics

The socio-demographic characteristics of the participants in this study have been displayed in Table 4.2. Firstly, the proportion of the participants were distributed in three age groups, i.e., '18 to 30 years old (35.3%), '31 to 50 years old (44.7%), and above 50 years old (20.0%). Among the study participants, 59.1% were females (n=360), whereas male participants were 249 (40.9%). The number of females was higher because most of them were the housewives. Majority of the participants were from Temuan tribe (n=359, 58.9%), followed by Mahmeri tribe (n = 127, 20.9%), and others (n = 123, 20.2%), comprised of 'Jakun' (3.25%), 'Semelai' (8.13%), 'Semai' (36.6%) dan 'Temiar'

(52.0%). About half of the participants attained secondary education (n=291, 47.8%), followed by 38.8% (n=236,) of the participants completed their primary education. Meanwhile 13.5% (n = 82) of them had no formal education.

Of the total respondents, less than half of the participants (n = 242; 39.7%) were housewives. About 33.3% (n=203) were manual workers and the group "others" consist of those belongs to 'professional or managerial occupation' (n=10, 6.1%), 'student' (n=1, 0.6%), 'retired' (n=17, 10.4%) and 'village workers' (n=136, 82.9%) categories. Approximately 475 out of 609 reported as having a monthly income with about 60.8% (n = 289) having a monthly household income below RM 1000, and (n= 186, 39.2%) of households have a monthly income of RM1000 and above. Most of the participants live in a village house (n= 578, 94.9%) whereas only 31 participants live in flat dwellings (5.1%).

Table 4.2: Socio demographic characteristics of participants

Details	Frequency, n (%)
Socio-demographic data	
Age group (years old)	
18-30	215 (35.3)
31-50	272 (44.7)
>50	122 (20.0)
Gender	
Male	249 (40.9)
Female	360 (59.1)
Tribe	
Temuan	359 (58.9)
Mahmeri	127 (20.9)
Others	123 (20.2)
Education	
No formal Education	82 (13.5)
Primary level	236 (38.8)
Secondary & above level	291 (47.8)
Occupation	
Manual worker	203 (33.3)
Housewife	242 (39.7)
Others	164 (26.9)

Monthly income (MYR) [N= 475]*	
1000 and below	289 (60.8)
> 1000	186 (39.2)
Type of House	
Village House	578 (94.9)
Flat House	31 (5.1)

*Total responses lower than the sample due to non-response

4.4 Experience of dengue and social environment

Table 4.3 illustrates the respondent's experience on dengue with 29 out of 609 participants self-reported as experienced dengue (4.8%). From these 29 respondents, majority of participants were hospitalized (n= 26, 89.7%). About 110 participants reported that their household members or neighborhoods had experienced dengue. This study also surveyed the surrounding environmental factors that facilitate the dengue outbreak in the villages such as the density of mosquitoes and fogging frequency related to dengue. Concerning the density of plants or vegetation near or around housing areas among only 578 participants, 37.4% of the participants reported moderate density (n=216), whereas 27.2% of them reported none or low vegetation density (n=157). About 254 of the study participants reported a moderate (41.7%) density of mosquitoes in the neighborhood whereas 21.5% (n= 131) of them reported severe density of mosquitoes in their neighborhood. Almost majority informed that there were none or rarely any fogging activities carried out by the municipality in their neighborhood [N=448, 73.6%].

Table 4.3: Dengue experience, surrounding environment, and fogging frequency

Details	Frequency, n (%)
Dengue Experiences	
Experience Dengue Before	
Yes	29 (4.8)
No	580 (95.2)
Hospitalized due to Dengue [N=29]	
Yes	26 (89.7)
No	3 (10.3)
Anyone in household or neighbourhood experience dengue	
Yes	110 (18.1)
No	499 (81.9)
Surrounding Environment and Fogging Frequency	
Density of plants or vegetation [N=578]	
None / Low	157 (27.2)
Moderate	216 (37.4)
A lot	205 (35.4)
Density of mosquitoes in neighbourhood	
None / Low	224 (36.8)
Moderate	254 (41.7)
Severe	131 (21.5)
Frequency of mosquito fogging	
None / Rarely	448 (73.6)
Occasionally / Often	161 (26.4)

4.5 Analysis of knowledge

4.5.1 Descriptive Analysis of Pre-intervention Knowledge Level

Table 4.4 shows the responses of the participants on their knowledge about dengue. Most of the participants were able to answer "Yes" for the questions on the 'General knowledge of dengue,' 'Prevention,' 'Symptoms such as high fever, chills, small red or purple spots' and 'Treatment' sections.

A large proportion answered correctly that dengue is transmitted by a mosquito (n= 560, 92.0%) and dengue virus is transmitted by the Aedes mosquito (n=554, 91.0%). Half of the participants managed to answer correctly for the statement 'Dengue may become Dengue hemorrhagic fever (DHF)' (n=388, 63.7%) and 'DHF can be fatal (n= 358, 58.8%). More than half of the participants answered correctly that dengue usually appears 4 to 7 days after someone had been bitten by a mosquito (n= 401. 65.8%). In terms of knowledge on the prevention, most of them answered correctly that weekly change of the stagnant water (n= 458, 75.2%), adding abate/chemical in the container (n=453, 74.4%) and covering water containers (n= 436, 71.6%) were among the prevention measures to combat the spread of dengue. Regarding signs and symptoms of dengue, 87.0% (n=530) and 80.6% (n=491) of the participants voted for high fever more than five days and chills, respectively. In addition, 56.5% (n= 344) answered eye pain as one of the signs and symptoms of dengue. Meanwhile, 76.0% (n= 463) answered correctly that small red or purple spots under the skin were the signs and symptoms of DHF. Besides, less than one third answered correctly that blood in stool (n= 195, 32.0%) and blood in urine (n= 192, 31.5%) as the symptoms of DHF. Regarding the treatment and curability of dengue, 73.2% (n= 446) opted 'yes' for the statement 'Immediate treatment can only prevent complications and death'.

Table 4.4: Responses for knowledge (pre-intervention)

Knowledge Items	N (%)	
General Knowledge of Dengue	**Correct**	**Incorrect**
Dengue is transmitted by mosquito	560 (92.0)	49 (8.0)
Dengue virus is transmitted by Aedes mosquito	554 (91.0)	55 (9.0)
Dengue may become Dengue Haemorrhagic Fever	388 (63.7)	221 (36.3)
Dengue Haemorrhagic Fever can be fatal	358 (58.8)	251 (41.2)
Dengue Haemorrhagic Fever usually occurs to people who had several dengue infections	253 (41.5)	356 (58.5)
Aedes mosquito have black and white stripes on its leg and body	447 (73.4)	162 (26.6)
Aedes mosquito breeds in clean and stagnant water	403 (66,2)	206 (33.8)
Aedes mosquitoes prefers to live in the house or building rather than in natural wetlands	298 (48.9)	311 (51.1)
Aedes mosquito prefer to live in places with lot of plants*	213 (35.0)	396 (65.0)
Aedes mosquitoes mainly bite during dusk and dawn	425 (69.8)	184 (30.2)
Transmission of Dengue	**Correct**	**Incorrect**
The Aedes mosquito bitten an infected person can spread it to another person	249 (40.9)	360 (59.1)
Dengue usually appears 4 to 7 days after someone had bitten by mosquito	401 (65.8)	208 (34.2)
Dengue disease can be transmitted from an infected person		
Touching*	360 (59.1)	249 (40.9)
Air *	370 (60.8)	239 (39.2)
Body fluid (saliva, semen and sweat) *	319 (52.4)	290 (47.6)
Blood	272 (44.7)	337 (55.3)
Aedes mosquito eggs can contain dengue virus	231 (37.9)	378 (62.1
A person whom infected with dengue cannot obtain the infection again*	371 (60.9)	238 (39.1)
Dengue epidemic occurs only during rainy season*	339 (55.7)	270 (44.3)
Prevention	**Correct**	**Incorrect**
Weekly change the stagnant water	458 (75.2)	151 (24.8)
Adding abate / chemical in the container	453 (74.4)	156 (25.6)
Covering water containers	436 (71.6)	173 (28.4)
Emptying or drying out containers.	423 (69.5)	186 (30.5)
Proper disposal of items that can retain water.	410 (67.3)	199 (32.7)
Symptoms of Dengue	**Correct**	**Incorrect**
High Fever (> 5 days)	530 (87.0)	79 (13.0)
Chills	491 (80.6)	118 (19.4)
Rash	443 (72.7)	166 (27.3)
Eyes pain	344 (56.5)	265 (43.5)
Joint pain	447 (73.4)	162 (26.6)
Headache	412 (67.7)	197 (32.3)

Nausea and vomiting	421 (69.1)	188 (30.9)
Symptoms of Dengue Haemorrhagic Fever	**Correct**	**Incorrect**
Small red or purple spots under the skin	463 (76.0)	146 (24.0)
Bleeding in the nose	309 (50.7)	300 (49.3)
Bleeding in gums	323 (53.0)	286 (47.0)
Blood in stool	195 (32.0)	414 (68.0)
Blood in urine	192 (31.5)	417 (68.5)
Shortness of breath	314 (51.6)	295 (48,4)
Dizziness or fainting.	360 (59.1)	249 (40.9)
Treatment	**Correct**	**Incorrect**
There is no medication to treat dengue	292 (47.9)	317 (52.1)
Immediate treatment can only prevent complications and death.	446 (73.2)	163 (26.8)

*Negatively worded items

4.5.2 Association between socio-demographic characteristics, dengue experience, and environmental factors and total knowledge score of pre-intervention

The level of knowledge was measured by the summation of the entire knowledge items. The total knowledge scores were not normally distributed and thus, data was analyzed categorically using the median split. The median total knowledge score for the overall sample was 26.0 [IQR: 19.0 – 30.0] out of a possible score of 40. The level of knowledge was categorized into two groups: scores 0-26 indicate lower knowledge level and score 27-40 indicates higher knowledge level. The univariate analysis was carried out using the Chi-square test to examine the association of the factors (the socio-demographic characteristics, dengue experience, environmental factors) and the outcome variable (total knowledge score) between the study participants.

Table 4.5 exhibits univariate analysis where the outcome variable of the model was total knowledge score versus the independent variables such as the socio-demographic characteristics, dengue experience and environmental factors. Based on table 4.5, 328 participants had a range of total dengue knowledge scores of 11 to 26, indicating a low knowledge level. In comparison, 281 participants had a range of total dengue knowledge scores of 27 to 36, indicating a high knowledge level. Univariate analysis showed six significant differences across the factors.

The significant variables of univariate analysis are age, tribes, education, type of occupation, average monthly household income, and density of plants or vegetation in the neighborhood.

A multivariate binary logistic regression analysis with six significant characteristics in the univariate analysis was conducted for scores 27-36 vs. scores 11 - 26. Four significant associations were revealed. The significant variables were tribe, education level, monthly income, and density of plants or vegetation in the neighborhood. The total knowledge scores of dengue were associated with tribe whereby Temuan (OR = 0.357, 95%CI= 0.169-0.755) and Mahmeri (OR = 0.356, 95%CI= 0.153-0.827) were significantly less likely to have higher dengue knowledge scores of 27-36 compared to the reference group (others). Education level also observed to have a significant association with total knowledge scores by which no formal (OR=0.05, 95 % CI= 0.001-0.022) or primary level (OR=0.032, 95 % CI =0.017-0.062) education were less likely to have higher dengue knowledge scores compared to the reference group (secondary and above level). In addition, monthly income less than RM1000 with an odd ratio of 2.45 (95% CI= 1.322 – 4.523) is less likely to have a higher knowledge score than income more than RM1000. Participants with none or low density of vegetation and plants were significantly less likely (OR=0.611, 95% CI= 0.309 – 1.207) to have higher total dengue knowledge scores than the reference group (a lot). In the test for goodness of fit, the Chi-square value for the Hosmer-Lemeshow test was 3.380 with a significance level of 0.908 ($p>0.05$), implying a good fit.

Table 4.5: Association between socio-demographic characteristics, dengue experience, and environmental factors of the study participant with total knowledge score pre-intervention

Details	Univariate analysis			Multivariate Binary Logistics Regression
	Total knowledge score (0-40) items scale			Total knowledge score 27-36 *vs.* 11-26
(A)Socio Demographic Data	11-26 (Low score) (n = 328)	27-36 (High score) (n = 281)	*p- value*	Adjusted OR (95%CI)
Age group (years old)				
18-30	109 (50.7)	106 (49.3)		0.686 (0.313 – 1.503)
31-50	138 (50.7)	134 (49.3)	0.008	0.972 (0.464 – 2.039)
sss>50	81 (66.4)	41 (33.6)		Reference
Gender				
Male	124 (49.8)	125 (50.2)		
Female	204 (56.7)	156 (43.3)	0.099	
Tribe				
Temuan	211 (58,8)	148 (41.2)		0.357 (0.169 – 0.755) **
Mahmeri	74 (58.3)	53 (41.7)	0.00	0.356 (0.153 – 0.827) *
Others	43 (35.0)	80 (65.0)		Reference
Education				
No formal	80 (97.6)	2 (2.4)		0.05 (0.001 – 0.022) ***
Primary level	191(80.9)	45 (19.1)	0.00	0.032 (0.017 – 0.062) ***
Secondary & above level	57 (19.6)	234 (80.4)		Reference
Occupation				
Manual workers	88 (43.3)	115 (56.7)		0.832 (0.425 – 1.630)
Housewife	138 (57.0)	104 (43.0)	0.001	0.502 (0.250 – 1.011)
Others	102 (62.2)	62 (37.8)		Reference
Monthly income (MYR) [N=475]				
1000 and below	183 (63.3)	106 (36.7)	0.00	2.445 (1.322 – 4.523) **
> 1000	79 (42.6)	107 (57.5)		Reference
(B) Dengue Experiences				
Had Dengue Before				
Yes	17 (58.6)	12 (41.4)	0.704	
No	311(53.6)	269 (46.4)		
(C) Environmental Factors				
Density of plants or vegetation				
None / Low	104 (64.2)	58 (35.8)		0.611 (0.309 – 1.207) **
Moderate	118 (51.1)	119 (48.9)	0.008	1.044 (0.584 – 1.863)
A lot	106 (49.1)	110 (50.9)		Reference

Density of mosquitoes in neighbourhood			
None / Low	124 (55.4)	100 (44.6)	
Moderate	131 (51.6)	123 (48.4)	0.632
Severe	73 (55.7)	58 (44.3)	
Frequency of mosquito fogging			
None / Rarely	239 (53.3)	209 (46.7)	
Occasionally / Often	89 (55.3)	72 (44.7)	0.713

*P < 0.05, **P < 0.01, ***P < 0.001. Hosmer and Lemeshow test, c2(8) = 3.380, P = 0.908; Cox & Snell R2 = 0.427; Nagelkerke R2 = 0.572. OR, odds ratio; CI, confidence interval; –, not applicable in the multivariate analysis

4.5.3 Descriptive Analysis of Post-intervention Knowledge Level

Table 4.6 shows the responses of the participants for knowledge about dengue post-intervention. Most of the participants answered correctly for 'General knowledge of dengue,' 'Prevention of dengue,' 'Transmission of dengue,' 'Signs and symptoms of dengue and Dengue hemorrhagic fever (DHF)' and 'Treatment.'

The majority of the participants managed to answer correctly that dengue is transmitted by a mosquito (n= 569, 93.4%), dengue virus is transmitted by the Aedes mosquito (n=560, 92.0%), and Aedes mosquitoes have black and white stripes on its leg and body (n=519, 85.2%). Likewise, more than half of the participants (n= 363,59.6%) answered correctly for the statement 'Aedes mosquito prefer to live in places with a lot of plants.' In addition to the transmission of dengue, 83.1% of participants can identify blood as the source of dengue transmission from an infected person. Pertaining to the knowledge on the prevention, most of them answered correctly for all the statements of 'covering water containers' (n= 536, 88.0%), 'adding abate/chemical in the container' (n=523, 85.9%), 'weekly change of the stagnant water' (n= 522, 85.7%), 'emptying or drying out containers' (n= 515, 84.6%) and ' proper disposal of items that can retain water (n=507, 83.3%). On the other hand, looking into the signs and symptoms of dengue, a large portion of participants answered correctly for the high fever more than five days,

chills, rash, and joint pain with 91.8% (n=559), 85.1% (n=518), 80.0% (n=487) and 78.8% (n- 480) respectively. In addition, 84.9% of the participants answered that small red or purple spots under the skin as signs and symptoms of DHF (n= 517). Besides, 71.9% and 71.1% responded correctly for bleeding in the nose and gums, respectively. Referring to the knowledge on treatment, 87.2% and 69.8% opted 'yes' for the statement of 'Immediate treatment can only prevent complications and death' and 'there is no medication to treat dengue', respectively.

Table 4.6: Responses of knowledge post educational intervention

Knowledge Items	**N (%)**	
General Knowledge of Dengue	**Correct**	**Incorrect**
Dengue is transmitted by mosquito	569 (93.4)	40 (6.6)
Dengue virus is transmitted by Aedes mosquito	560 (92.0)	49 (8.0)
Dengue may become Dengue Haemorrhagic Fever	443 (72.7)	166 (27.3)
Dengue Haemorrhagic Fever can be fatal	448 (73.6)	161 (26.4)
Dengue Haemorrhagic Fever usually occurs to people whom had several dengue infections	393 (64.5)	216 (35.5)
Aedes mosquito have black and white stripes on its leg and body	519 (85.2)	90 (14.8)
Aedes mosquito breeds in clean and stagnant water	499 (81.9)	110 (18.1)
Aedes mosquitoes prefers to live in the house or building rather than in natural wetlands	436 (71.6)	173 (28.4)
In ad	363 (59.6)	246 (40.4)
Aedes mosquitoes mainly bite during dusk and dawn	473 (77.7)	136 (22.3)
Transmission of Dengue		
The Aedes mosquito bitten an infected person can spread it to another person	339 (55.7)	270 (44.3)
Dengue usually appears 4 to 7 days after someone had bitten by mosquito	497 (81.6)	112 (18.4)
Dengue disease can be transmitted from an infected person		
Touching*	488 (80.1)	121 (19.9)
Air *	464 (76.2)	145 (23.8)
Body fluid (saliva, semen and sweat) *	425 (69.8)	184 (30.2)
Blood	506 (83.1)	103 (16.9)
Aedes mosquito eggs can contain dengue virus	380 (62.4)	229 (37.6)
A person whom infected with dengue cannot obtain the infection again*	427 (70.1)	182 (29.9)
Dengue epidemic occurs only during rainy season*	402 (66.0)	207 (34.0)

Prevention		
Weekly change the stagnant water	522 (85.7)	87 (14.3)
Adding abate / chemical in the container	523 (85.9)	86 (14.1)
Covering water containers	536 (88.0)	73 (12.0)
Emptying or drying out containers.	515 (84.6)	94 (15.4)
Proper disposal of items that can retain water.	507 (83.3)	102 (16.7)
Symptoms of Dengue		
High Fever (> 5 days)	559 (91.8)	50 (8.2)
Chills	518 (85.1)	91 (14.9)
Rash	487 (80.0)	122 (20.0)
Eyes pain	364 (59.8)	245 (40.2)
Joint pain	480 (78.8)	129 (21.2)
Headache	478 (78.5)	131 (21.5)
Nausea and vomiting	478 (78.5)	131 (21.5)
Symptoms of Dengue Haemorrhagic Fever		
Small red or purple spots under the skin	517 (84.9)	92 (15.1)
Bleeding in the nose	438 (71.9)	171 (28.1)
Bleeding in gums	433 (71.1)	178 (28.9)
Blood in stool	360 (59.1)	249 (40.3)
Blood in urine	350 (57.5)	259 (42.5)
Shortness of breath	415 (68.1)	194 (31.9)
Dizziness or fainting.	428 (70.3)	181 (29.7)
Treatment		
There is no medication to treat dengue	425 (69.8)	184 (30.2)
Immediate treatment can only prevent complications and death.	531 (87.2)	78 (12.8)

*Negatively worded items

4.5.4 Association between socio-demographic characteristics, dengue experience, and environmental factors and total knowledge score of post- intervention

The total knowledge scores were not normally distributed and thus, data was categorized based on the median split. The median total knowledge score for the overall sample was 32.0, [IQR: 26.0 – 36.0] out of a possible score of 40. The level of knowledge was categorized into two levels where a score of 0-32 indicates a lower knowledge level, and a score of 33-40 indicates a higher knowledge level. The univariate analysis was carried out by using a Chi-square test to examine the association between analysis of factors (the socio-demographic characteristics, dengue experience, environmental factors) and outcome variable (total knowledge score) between the study participants.

Table 4.7 exhibits univariate analysis where the outcome variable of the model is total knowledge scores versus the independent variables such as the socio-demographic

characteristics, dengue experience and environmental factors. Based on table 4.7, 308 participants had a range of total dengue knowledge scores 13 to 32, indicating a lower knowledge level, while 301 of participants had a range of total dengue knowledge scores of 33 to 40, indicating a high knowledge level. Univariate analysis showed six significant differences across the factors. The significant variables of univariate analysis were age, tribes, education, type of occupation, average monthly household income, and density of plants or vegetation in the neighborhood.

Significant associations in the univariate analysis that had a p-value less than 0.05 were selected and included in the multivariate binary logistic model. A multivariate binary logistic regression analysis with six significant characteristics in the univariate analysis was conducted for scores 33-40 vs. scores 13-32. Three significant associations were revealed. The significant variables were education level, monthly income, and density of plants or vegetation in the neighborhood. The total knowledge scores of dengue were associated with the education level whereby no formal (OR = 0.008, 95%CI= 0.002-0.035) and primary level (OR = 0.045, 95%CI=0.025-0.083) educations were significantly less likely to have higher dengue knowledge scores of 33-40 compared to the secondary or above level. The monthly income of more than RM1000 was significantly more likely (OR = 2.587, 95%CI= 1.501 – 1.582) to perceive higher knowledge scores of 33-40 as compared to the reference group (less than RM1000). Participants who have reported moderate density (OR=2.470, 95% CI= 1.201 – 5.078) and a lot of vegetation or plants (OR=2.315, 95%CI= 1.143- 4.691) were significantly more likely to have high total dengue knowledge scores of 33 to 40 compared to the reference group (none). In the test for goodness of fit, the Chi-square value for the Hosmer-Lemeshow test was 5.495 with a significance level of 0.704 ($p>0.05$), implying a good fit.

Table 4.7: Association between socio-demographic characteristics, dengue experience, and environmental factors of a study participants with total knowledge score of post-intervention

Details	Univariate analysis			Multivariate Binary Logistics Regression
Details	Total knowledge score			Total knowledge score 33-40 *vs.* 13-32
(A)Socio Demographic Data	13-32 (Low score) (n = 308)	33-40 (High score) (n = 301)	*p - value*	Adjusted OR (95%CI)
Age group (years old)				
18-30	103 (47.9)	112 (52.1)		Reference
31-50	126 (46.3)	146 (53.7)	0.002	1.568 (0.857 – 2.867)
>50	79 (54.8)	43 (35.2)		1.032 (0.450 – 2.367)
Gender				
Male	122 (49.0)	127 (51.0)		
Female	186 (51.7)	174 (48.3)	0.564	
Tribe				
Temuan	197 (54.9)	162 (45.1)		0.993 (0.474 – 2.079)
Mahmeri	65 (51.2)	62 (48.6)	0.004	1.459 (0.608 – 3.504)
Others	46 (37.4)	77 (62.6)		Reference
Education				
No formal	79 (96.3)	3 (3.7)		0.008 (0.002 – 0.035) ***
Primary level	184 (78.0)	52 (22.0)	0.00	0.045 (0.025 – 0.083) ***
Secondary & above level	45 (15.5)	246 (84.5)		Reference
Occupation				
Manual worker	86 (42.4)	117 (57.6)	0.007	0.621 (0.302 – 1.278)
Housewife	128 (52.1)	116 (47.9)		0.767 (0.372 – 1.582)
Others	96 (58.5)	68 (41.5)		Reference
Monthly income (MYR) [N=475]				
1000 and below	200 (69.2)	89 (30.8)	0.00	Reference
> 1000	50 (25.9)	136 (73.1)		2.587 (1.501 – 1.582) **
(B) Dengue Experiences				
Had Dengue Before				
Yes	14 (48.3)	15 (51.7)	0.851	
No	294 (50.7)	286 (49.3)		
(C) Environmental Factors				
Density of plants or vegetation				
None / Low	100 (61.7)	62 (38.3)		Reference

Moderate	110 (47.6)	121 (52.4)	0.004	2.470 (1.201 – 5.078) *
A lot	98 (45.4)	118 (54.6)		2.315 (1.143 – 4.691) *
Density of mosquitoes in neighbourhood				
None / Low	113 (50.4)	111 (49.6)		
Moderate	126 (49.6)	128 (50.4)	0.849	
Severe	69 (52.7)	62 (47.3)		
Frequency of mosquito fogging				
None / Rarely	223 (49.8)	225 (50.2)		
Occasionally / Often	85 (52.8)	76 (47.2)	0.521	

*P < 0.05, **P < 0.01, ***P < 0.001. Hosmer and Lemeshow test, c2(8) = 5.495, P = 0.704; Cox & Snell R2 = 0.456; Nagelkerke R2 = 0.608. OR, odds ratio;CI, confidence interval; –, not applicable in the multivariate analysis

4.5.5 Descriptive analysis of increment in knowledge score

Table 4.8 shows the increment in the knowledge of dengue pre- and post-intervention. In terms of general knowledge of dengue, increase of 24.6%, 23% and 22.7% of knowledge was seen for the statement of 'Aedes mosquito prefer to live in places with a lot of plants', 'Dengue Haemorrhagic Fever usually occurs to people who had several dengue infections,' and 'Aedes mosquitoes prefer to live in the house or building rather than in natural wetlands', respectively. Regarding the transmission of dengue, 38.4% increase in the knowledge was observed for the statement most participants know that blood was the source of transmission of dengue from an infected person. In addition, 24.5% increase in the knowledge was eminent when the participants understand that the Aedes mosquito eggs can contain the dengue virus. On the other hand, 27.1% and 26.0% increase in the knowledge level of participants was visible in relation to the signs and symptoms of DHF for blood in stool and blood in urine, respectively.

Table 4.8: Difference in knowledge scores between post- and pre-interventions

Knowledge Items	N (%)		%
General Knowledge of Dengue	**Pre-Intervention**	**Post-Intervention**	**Differences (Post - Pre)**
Dengue is transmitted by mosquito	560 (92.0)	569 (93.4)	1.4
Dengue virus is transmitted by Aedes mosquito	554 (91.0)	560 (92.0)	1.0
Dengue may become Dengue Haemorrhagic Fever	388 (63.7)	443 (72.7)	9.0
Dengue Haemorrhagic Fever can be fatal	358 (58.8)	448 (73.6)	14.8
Dengue Haemorrhagic Fever usually occurs to people whom had several dengue infections	253 (41.5)	393 (64.5)	23.0
Aedes mosquito have black and white stripes on its leg and body	447 (73.4)	519 (85.2)	`11.8
Aedes mosquito breeds in clean and stagnant water	403 (66,2)	499 (81.9)	15.7
Aedes mosquitoes prefers to live in the house or building rather than in natural wetlands	298 (48.9)	436 (71.6)	22.7
Aedes mosquito prefer to live in places with lot of plants*	213 (35.0)	363 (59.6)	24.6
Aedes mosquitoes mainly bite during dusk and dawn	425 (69.8)	473 (77.7)	7.9
Transmission of Dengue			
The Aedes mosquito bitten an infected person can spread it to another person	249 (40.9)	339 (55.7)	14.9
Dengue usually appears 4 to 7 days after someone had bitten by mosquito	401 (65.8)	497 (81.6)	15.8
Dengue disease can be transmitted from an infected person			
Touching*	360 (59.1)	488 (80.1)	21.0
Air *	370 (60.8)	464 (76.2)	15.4
Body fluid (saliva, semen and sweat) *	319 (52.4)	425 (69.8)	17.4
Blood	272 (44.7)	506 (83.1)	38.4
Aedes mosquito eggs can contain dengue virus	231 (37.9)	380 (62.4)	24.5
A person whom infected with dengue cannot obtain the infection again*	371 (60.9)	427 (70.1)	9.2
Dengue epidemic occurs only during rainy season*	339 (55.7)	402 (66.0)	10.3
Prevention			
Weekly change the stagnant water	458 (75.2)	522 (85.7)	10.5

Adding abate / chemical in the container	453 (74.4)	523 (85.9)	11.5
Covering water containers	436 (71.6)	536 (88.0)	16.4
Emptying or drying out containers.	423 (69.5)	515 (84.6)	15.1
Proper disposal of items that can retain water.	410 (67.3)	507 (83.3)	16.0
Symptoms of Dengue			
High Fever (> 5 days)	530 (87.0)	559 (91.8)	4.8
Chills	491 (80.6)	518 (85.1)	4.5
Rash	443 (72.7)	487 (80.0)	7.3
Eyes pain	344 (56.5)	364 (59.8)	3.3
Joint pain	447 (73.4)	480 (78.8)	5.4
Headache	412 (67.7)	478 (78.5)	10.8
Nausea and vomiting	421 (69.1)	478 (78.5)	9.4
Symptoms of Dengue Haemorrhagic Fever			
Small red or purple spots under the skin	463 (76.0)	517 (84.9)	8.9
Bleeding in the nose	309 (50.7)	438 (71.9)	21.2
Bleeding in gums	323 (53.0)	433 (71.1)	18.7
Blood in stool	195 (32.0)	360 (59.1)	27.1
Blood in urine	192 (31.5)	350 (57.5)	26.0
Shortness of breath	314 (51.6)	415 (68.1)	16.5
Dizziness or fainting.	360 (59.1)	428 (70.3)	11.2
Treatment			
There is no medication to treat dengue	292 (47.9)	425 (69.8)	21.9
Immediate treatment can only prevent complications and death.	446 (73.2)	531 (87.2)	14.0

*Negatively worded items

4.5.6 Association between socio-demographic characteristics, dengue experience and environmental factors and increment in total knowledge scores.

The increment in knowledge scores was obtained by deducting the knowledge scores of pre-interventions from the knowledge scores of the post-intervention. The increment in total knowledge score was not normally distributed and thus, data was analyzed categorically by using the median as the cut-off point. The median total knowledge score for the overall sample was 6.0 [IQR: 4.0 – 8.0]. The level of knowledge was categorized into two levels where scores 0-6 indicate lower increment in knowledge levels and scores 7-17 indicates higher increment in knowledge levels. The univariate

analysis was carried out by using Chi-square test to examine the association between analysis of factors (the socio-demographic characteristics, dengue experience, environmental factors) and outcome variables (increment total knowledge score) among the study participants.

Table 4.9 exhibits univariate analysis where outcome variable of the model was the increase total knowledge score versus the independent variables such as the socio-demographic characteristics, dengue experience and environmental factors. Based on table 4.7, 367 participants had a range of total dengue knowledge scores 0-6, indicating lower increment in knowledge scores whereas 242 of participants had a range of total dengue knowledge scores of 7 to17, indicating higher increment in knowledge scores. Univariate analysis showed three significant differences across the factors. The significant variables of univariate analysis are tribes, education, and average monthly household income.

Significant associations in the univariate analysis that had a p-value less than 0.05 were selected and included in the multivariate binary logistic model. A multivariate binary logistic regression analysis with six significant characteristics in the univariate analysis was conducted for score 7-17 vs. score 0-6. Three significant associations were revealed. The significant variables were tribes, education level, and monthly income. The tribe 'Temuan' (OR = 2.286, 95%CI= 1.211 – 4.315) and 'Mahmeri' (OR=1.579, 95%CI = 1.570 – 6.468) were significantly more likely to have a higher increment in knowledge score compared to the reference group (others). In terms of education level, secondary and above levels (OR= 4.095, 95%CI=2.350 – 7.134) were significantly more likely to have higher increment in knowledge scores than participants who attained no formal education. The monthly income of more than RM1000 was significantly more likely (OR = 8.478 95%CI= 4.937 – 14.558) to record a higher increment in knowledge score of 7-

17 than the reference group (participants earn less than RM1000). In the test for goodness of fit, the Chi-square value for the Hosmer-Lemeshow test was 4.983 with a significance level of 0.662 (p>0.05), implying a good fit.

Table 4.9: Association between socio demographic characteristics, dengue experience and environmental factors of study participant with increment in total knowledge score

Details	Univariate analysis			Multivariate Binary Logistics Regression
	Increment in knowledge score			Increment knowledge score for 7-17 *vs* 0-16
(A)Socio Demographic Data	0-6 (Lower increment) (n = 367)	7-17 (Higher increment) (n = 242)	*p* - Value	Adjusted OR (95%CI)
Age group (years old)				
18-30	127 (59.1)	88 (40.9)		
31-50	160 (58.8)	112 (41.2)	0.407	
>50	80 (65.6)	42 (34.4)		
Gender				
Male	158 (63.5)	91 (36.5)		
Female	209 (58.1)	151 (41.9)	0.206	
Tribe				
Temuan	216 (60.2)	143 (39.8)		2.286 (1.211 – 4.315) *
Mahmeri	66 (52.0)	61 (48.0)	0.022	3.196 (1.579 – 6.468) **
Others	85 (69.1)	38 (30.9)		Reference
Education				
No formal	61 (74.7)	21 (25.6)		Reference
Primary level	120 (50.8)	116 (49.2)	0.00	1.540 (0.713 – 3.327)
Secondary & above level	186 (63.9)	105 (36.1)		4.095 (2.350 – 7.134) ***
Occupation				
Manual worker	127 (62.6)	76 (37.4)		
Housewife	143 (59.1)	99 (40.9)	0.715	
Others	97 (59.1)	67 (40.9)		
Monthly income (MYR) [N=475]				
1000 and below	222 (76.8)	67 (23.2)	0.000	Reference
> 1000	82 (44.1)	104 (55.9)		8.478 (4.937 – 14.558) ***
(B) Dengue Experiences				
Had Dengue Before				
Yes	17 (58.6)	12 (41.4)	0.848	
No	350 (60.3)	230 (39.7)		

(C) Environmental Factors			
Density of plants or vegetation			
None / Low	104 (64.2)	58 (35.8)	
Moderate	135 (58.4)	96 (41.6)	0.482
A lot	128 (59.3)	88 (40.7)	
Density of mosquitoes in neighbourhood			
None / Low	129 (57.6)	95 (42.4)	
Moderate	152 (59.8)	102 (40.2)	0.321
Severe	86 (65.6)	45 (34.4)	
Frequency of mosquito fogging			
None / Rarely	275 (61.4)	173 (38.6)	
Occasionally / Often	92 (57.1)	59 (42.9)	0.349

*P < 0.05, **P < 0.01, ***P < 0.001. Hosmer and Lemeshow test, c2(8) = 4.983, P = 0.662; Cox & Snell R2 = 0.186; Nagelkerke R2 = 0.256. OR, odds ratio CI, confidence interval; –, not applicable in the multivariate analysis

4.6 Analysis of Health Beliefs

Table 4.10 The frequency and percentage of agreement score responses on the health beliefs in pre-and post-intervention

Details	**Frequency, n (%)**	
(D) Health Belief Model	**Pre - intervention**	**Post - intervention**
Perceived Severity		
Seriousness of dengue to all age group		
0 – 5	140 (23.0)	61 (10.0)
6 -10	469 (77.0)	548 (90.0)
Perceived Susceptibility		
Worried about the likelihood of getting infected with dengue		
0 – 5	260 (42.7)	249 (40.9)
6 – 10	349 (57.3)	360 (59.1)
Perceived Barriers		
Concern about the lack of community participations, lack of self-efficacy and lack of preventive measure		
0 – 5	292 (47.9)	243 (39.9)
6 – 10	317 (52.1)	366 (60.1)
Cues to Action		
Motivation to prevent dengue e.g., death, encouragement from NGO, neighbourhood infected with dengue, enlightenment from mass media, sudden fogging by authorities		
0 – 5	307 (50.4)	112 (18.4)
6 – 10	302 (49.6)	497 (81.5)
Self-Efficacy		
Confidence level to prevent dengue		
0 – 5	86 (14.1)	61 (10.0)
6 – 10	523 (85.9)	548 (90.0)

4.6.1 The level of perceived dengue severity (pre-intervention)

The level of perceived dengue severity was assessed by scale of 0-10. The majority of the Orang Asli participants had higher perceived severity of dengue (level of severity 6-10) (n=469, 77.0%), and only a minority (23.0%) of the participants had lower perceived severity of dengue (level of severity 0-5) (n=140).

The univariate analysis of the association between independent factors, namely socio-demographic characteristics, dengue experience, environmental factors, total pre-intervention median dengue knowledge score, and the outcome variable (the level of perceived severity of dengue), has been illustrated in Table 4.11. There was a significant difference ($p<0.05$) in the perceived severity scale by age group, gender, education, type of occupation, average monthly household income, the density of plants or vegetation, and density of mosquitoes in the neighborhood.

A multivariate binary logistic regression analysis with seven significant characteristics in the univariate analysis was conducted with the outcome variable was perceived severity of dengue scale of 6-10 versus scale of 0-5. Two significant associations were revealed. The level of perceived dengue severity was associated with education level, whereby secondary level or above were significantly more likely (OR = 2.728, 95%Cl= 1.309 – 5.685) to have a higher perceived severity of dengue (level of severity 6-10) compared to the reference group (no formal education). Likewise, participants who earn above RM1000 average monthly household income were significantly more likely (OR=9.115, 95% CI =3.981 – 20.870) to have a higher perceived severity of dengue (level of severity 6-10) compared to the reference group (less than RM1000). In the test for goodness of fit, the Chi-square value for the Hosmer-Lemeshow test was 13.646 with a significance level of 0.091 ($p>0.05$), implying a good fit.

Table 4.11: Association between socio-demographic characteristics, dengue experience and environmental factors of a study participant with perceived dengue severity in pre-intervention

Details	Univariate analysis			Multivariate Binary Logistics Regression
	The level of perceived severity			Perceived severity level 6-10 *vs.* 0-5
(A)Socio Demographic Data	0-5 (n = 140)	6-10 (n = 469)	*p* - Value	Adjusted OR (95%CI)
Age group (years old)				
18-30	48 (22.3)	167 (77.7)		1.111 (0.564 – 2.227)
31-50	53 (19.5)	219 (80.5)	0.024	1.205 (0.625 – 2.323)
>50	39 (32.0)	83 (68.0)		Reference
Gender				
Male	47 (18.9)	202 (81.1)		1.026 (0.519 – 2.028)
Female	93 (25.8)	267 (74.2)	0.050	Reference
Tribe				
Temuan	84 (23.4)	275 (76.6)		
Mahmeri	36 (28.3)	91 (71.7)	0.073	
Others	20 (18.3)	103 (83.7)		
Education				
No formal Education	30 (36.6)	52 (63.4)		Reference
Primary level	64(27.1)	172 (72.9)	0.00	1.846 (0.975 – 3.495)
Secondary & above level	46 (15.8)	245 (84.2)		2.728 (1.309 – 5.685) *
Occupation				
Manual worker	34 (16.7)	169 (83.3)		1.105 (0.560 – 2.180
Housewife	65 (26.9)	177 (73.1)	0.032	0.878 (0.419 – 1.837)
Others	41 (25.0)	123 (75.0)		Reference
Monthly income (MYR) [N=475]				
1000 and below	91 (31.5)	198 (68.5)	0.00	Reference
> 1000	7 (3.8)	179 (96.2)		9.115 (3.981 – 20.870) ***
(B) Dengue Experiences				
Had Dengue Before				
Yes	3 (10.3)	26 (89.7)	0.115	
No	137(23.6)	443 (76.4)		
(C) Environmental Factors				
Density of plants or vegetation				
None / Low	47 (29.0)	115 (71.0)		Reference
Moderate	58 (25.1)	173 (74.9)	0.009	1.076 (0.565 – 2.052)
A lot	35 (16.2)	181 (83.8)		1.115 (0.586 – 2.121)
Density of mosquitoes in neighbourhood				
None / Low	61 (27.2)	163 (72.8)		Reference

Moderate	60 (23.6)	194 (76.4)	0.022	0.902(0.512 – 1.588)
Severe	19 (14.5)	112 (85.5)		2.026 (0.977 – 4.202)
Frequency of mosquito fogging				
None / Rarely	104 (23.2)	344 (76.8)		
Occasionally / Often	36 (22.4)	125 (77.6)	0.913	
Pre- intervention knowledge Score				
11- 26	84 (25.6)	244 (74.4)	0.101	
27- 36	56 (19,9)	225 (80.1)		

*P < 0.05, **P < 0.01, ***P < 0.001. Hosmer and Lemeshow test, c2(8) = 13.646, P = 0.091; Cox & Snell R2 = 0.155; Nagelkerke R2 = 0.243. OR, odds ratio; CI, confidence interval; –, not applicable in the multivariate analysis

4.6.2 The level of perceived dengue severity (post-intervention)

Majority of the Orang Asli participants had a higher perceived severity of dengue (level of severity 6-10) (n=548, 90.0%) and only a minority (10.0%) of the participants had a lower perceived severity of dengue (level of severity 0-5) (n=61).

The univariate analysis of the association between independent factors, namely socio-demographic characteristics, dengue experience, environmental factors, total median dengue knowledge score, and the outcome variables (the level of perceived severity of dengue), have been illustrated in Table 4.11. The significant difference ($p<0.05$) in the perceived severity of dengue was reported for the age group, gender, education, type of occupation, average monthly household income, knowledge score after education intervention.

A multivariate logistic regression analysis with six significant characteristics in the univariate analysis was conducted for the scale 6-10 vs. the scale 0-5. No significant association was revealed. In the test for goodness of fit, the Chi-square value for the Hosmer-Lemeshow test was 9.145 with a significance level of 0.330 ($p>0.05$), implying a good fit

Table 4.12: Association between socio demographic characteristics, dengue experience and environmental factors of study participant with perceived severity of dengue in post intervention

Details	Univariate analysis			Multivariate Binary Logistics Regression
	The level of perceived severity			The level of severity for 6-10 *vs.* 0-5
(A)Socio Demographic Data	0-5 (n = 61)	6-10 (n = 548)	*p* - Value	Adjusted OR (95% CI)
Age group (years old)				
18-30	20 (9.3)	195 (90.7)		Reference
31-50	20 (7.4)	252 (92.6)	0.010	1.434 (0.588 – 3.497)
>50	21 (17.2)	101 (82.8)		1.471 (0.641 – 3.375)
Gender				
Male	14 (5.6)	235 (94.4)		1.933 (0.767 – 4.872)
Female	47 (13.1)	313 (86.9)	0.002	Reference
Tribe				
Temuan	39 (10.9)	320 (89.1)		
Mahmeri	12 (9.4)	115 (90.6)	0.665	
Others	10 (8.1)	113 (91.9)		
Education				
No formal	14 (17.1)	68 (82.9)		Reference
Primary level	30 (12.7)	206 (87.3)	0.002	1.390 (0.623 – 3.100)
Secondary & above level	17 (5.8)	274 (94.2)		1.590 (0.486 – 5.201)
Occupation				
Manual worker	10 (4.9)	193 (95.1)		1.157 (0.450 – 2.974)
Housewife	35 (14.5)	207 (85.5)	0.004	0.722 (0.294 – 1.770)
Others	16 (9.8)	148 (90.2)		Reference
Monthly income (MYR) [N=475]				
1000 and below	36 (12.5)	253 (87.5)	0.003	Reference
> 1000	8 (4.3)	178 (95.7)		2.059 (0.858 – 4.943)
(B) Dengue Experiences				
Had Dengue Before				
Yes	2 (6.9)	27 (93.1)	0.758	
No	59 (10.2)	521 (89.8)		
(C) Environmental Factors				
Density of plants or vegetation				
None / Low	21(13.0)	141 (87.0)		
Moderate	21 (9.1)	210 (90.9)	0.344	
A lot	19 (8.8)	197 (91.2)		

Density of mosquitoes in neighbourhood				
None / Low	24 (10.7)	200 (89.3)		
Moderate	26 (10.2)	228 (89.8)	0.773	
Severe	11 (8.4)	120 (91.6)		
Frequency of mosquito fogging				
None / Rarely	50 (11.2)	398 (88.8)		
Occasionally /Often	11 (8.8)	150 (93.2)	0.128	
Post-intervention knowledge score				
13-32	43 (14.0)	265 (86.0)	0.001	Reference
33-40	18 (6.0)	283 (94.0)		1.938 (0.767 – 5.259)

*P < 0.05, **P < 0.01, ***P < 0.001. Hosmer and Lemeshow test, c2(8) = 9.145, P =0.330; Cox & Snell R2 = 0.055; Nagelkerke R2 = 0.119. OR, odds ratio;CI, confidence interval; –, not applicable in the multivariate analysis

4.6.3 Statement of Perceived dengue severity

Perceived severity of dengue was assessed with three detailed questions. In pre intervention, 44% of participants "agree" that dengue does not always lead to death (n=268). However, in the post intervention, more than half of the participants of Orang Asli (55%) "disagree" that dengue does not always lead to death (n=338). In the post-intervention, slightly more than half of the Orang Asli participants "disagree" with the statement that dengue infection is only dangerous to children (n=331, 54.5%) or old aged people (n=370, 60.7%).

Table 4.13 Statement of Perceived Severity

Perceived Severity	Pre-intervention	Post-intervention
Dengue does not always lead to death.		
Strongly Agree	74 (12.2)	40 (6.6)
Agree	268 (44.0)	99 (16.3)
Disagree	212 (34.8)	338 (55.5)
Strongly disagree	56 (9.0)	132 (21.7)
Dengue infection is only dangerous to children		
Strongly Agree	58 (9.0)	24 (3.9)
Agree	324 (53.2)	124 (20.4)
Disagree	168 (27.6)	331 (54.4)
Strongly disagree	59 (9.7)	130 (21.3)
Dengue infection is only dangerous to old people		
Strongly Agree	79 (13.0)	41 (5.7)
Agree	270 (44.3)	84 (13.8)
Disagree	190 (31.2)	370 (60.8)
Strongly disagree	70 (11.5)	114 (18.7)

4.6.4 Association between socio-demographic characteristics, dengue experience, environmental factors, increase in total knowledge score and difference in the level of perceived severity of dengue

The difference in the level of perceived severity of dengue was obtained by subtracting score for the perceived severity of pre-intervention from the score for the perceived severity post-intervention.

Most of the Orang Asli participants had no increment in perceived severity of (n=518, 85.1%) and only a minority (14.9%) of the participants, have increment in perceived severity of dengue (n=91). The univariate analysis was carried out a using Chi-square test to examine the association between analysis of factors (the socio-demographic characteristics, dengue experience, environmental factors and increase in knowledge score) and outcome variables (differences in the level of perceived severity) among the study participants.

The univariate analysis of the association between independent factors, namely socio-demographic characteristics, dengue experience, environmental factors and increase dengue knowledge score, and the outcome variable (differences in level of perceived severity of dengue) has been described in Table 4.11. There was a significant difference ($p<0.05$) in the perceived severity of dengue by average monthly household income, the density of plants or vegetation, and the density of mosquitoes in the neighborhood.

A multivariate logistic regression analysis with seven significant characteristics in the univariate analysis was conducted. One significant association was revealed. Differences in the level of perceived dengue severity were associated with average monthly income. Participants who earn below RM1000 were significantly more likely (OR = 9.247, 95%Cl=3.609 – 23.692) to have no increment in perceived severity of

dengue compared to those earning more than RM1000. In the test for goodness of fit, the Chi-square value for the Hosmer-Lemeshow test was 1.999 with a significance level of 0.981 (p>0.05), implying a good fit.

Table 4.14: Association between socio-demographic characteristics, dengue experience and environmental factors of a study participant with the difference in perceived severity

Details	Univariate Analysis			Multivariate Binary Logistics Regression
	Difference in score of The perceived severity			The level of severity for have increment vs. no increment
(A)Socio Demographic Data	Have increment (n = 91)	No increment (n = 518)	*p* - Value	Adjusted OR (95% CI)
Age group (years old)				
18-30	31 (14.4)	184 (85.6)		
31-50	37 (13.6)	235 (86.4)	0.387	
>50	23 (18.9)	99 (81.1)		
Gender				
Male	35 (14.1)	214 (85.9)		
Female	56 (15.6)	304 (84.4)	0.645	
Tribe				
Temuan	53 (14.8)	306 (85.2)		
Mahmeri	26 (20.5)	101 (79.5)	0.059	
Others	12 (9.8)	111 (90.2)		
Education				
No formal	16 (19.5)	66 (80.5)		
Primary level	42 (17.8)	194 (82.2)	0.054	
Secondary & above level	33 (11.3)	258 (88.7)		
Occupation				
Manual worker	26 (12.8)	177 (87.2)		
Housewife	37 (15.3)	205 (84.7)	0.513	
Others	28 (17.1)	136 (82.9)		
Monthly income (MYR) [N=475]				
1000 and below	57 (19.7)	232 (80.3)	0.000	9.247 (3.609 – 23.692) ***
> 1000	5 (2.7)	181 (97.3)		Reference
(B) Dengue Experiences				
Had Dengue Before				
Yes	1 (3.4)	28 (96.6)	0.105	
No	90 (15.5)	490 (84.5)		

(C) Environmental Factors				
Density of plants or vegetation				
None / Low	28 (16.0)	136 (84.0)		Reference
Moderate	43 (18.6)	188 (81.4)	0.040	0.720 (0.355 – 1.461)
A lot	22 (10.2)	194 (89.8)		0.960 (0.457 – 2.016)
Density of mosquitoes in neighbourhood				
None / Low	41 (18.3)	183 (81.7)		Reference
Moderate	40 (15.7)	214 (84.3)	0.022	1.090 (0.587 – 2.028)
Severe	10 (7.6)	121 (92.4)		2.481 (1.001 – 6.148)
Frequency of mosquito fogging				
None / Rarely	65 (14.5)	383 (85.5)		
Occasionally / Often	28 (16.1)	135 (83.9)	0.608	
Increment in Knowledge Score				
0-6	54 (14.7)	313 (85.3)	0.908	
7-17	37 (15.3)	205 (84.7)		

*P < 0.05, **P < 0.01, ***P < 0.001. Hosmer and Lemeshow test, c2(8) = 1.999, P =0.981; Cox & Snell R2 = 0.084; Nagelkerke R2 = 0.156. OR, odds ratio; CI, confidence interval; –, not applicable in the multivariate analysis

4.6.5 Level of perceived susceptibility of dengue (Pre-intervention)

Majority of the Orang Asli participants had a higher perceived susceptibility of dengue (level of susceptibility 6-10) (n=349, 57.3%) and 42.7% of the participants had a lower perceived susceptibility of dengue (level of susceptibility 0-5) (n=260).

The univariate analysis of association between independent factors namely socio demographic characteristics, dengue experience, environmental factors and total median dengue knowledge score and the outcome variable (the level of perceived susceptibility) has been demonstrated in Table 4.15. There was a significant difference ($p<0.05$) in the level of perceived susceptibility by gender, tribes, level of education, type of occupation, density of mosquitoes, frequency of mosquito fogging and total median pre knowledge score.

A multivariate binary logistic regression analysis with seven significant characteristics in the univariate analysis was conducted for the scale 6-10 vs. the scale 0-5. Three significant associations were discovered (Table 4.15). The level of perceived susceptibility of dengue was associated with tribe whereby Temuan were significantly less likely (OR = .415, 95%CI =0.261 – 0.657) to have a higher perceived susceptibility of dengue compared to the reference group (others). Next, type of occupation was found to have a significant association, where manual workers were found to be significantly more likely to have higher perceived susceptibility of dengue (OR= 2.033, 95%CI =1.247 – 3.316) compared to the reference group. Likewise, participants who reported occasionally/ often mosquito fogging in the surrounding area were more likely to have higher perceived susceptibility of dengue (OR = 2.549, 95% CI =1.677 – 3.874) compared to the reference group (none/rarely). In the test for goodness of fit, the Chi-square value for the Hosmer-Lemeshow test was 9.976, with a significance level of 0.267 (p>0.05), implying a good fit.

Table 4.15: Association between socio demographic characteristics, dengue experience and environmental factors of study participant with the level of perceived susceptibility of dengue in pre-intervention

Details	Univariate analysis			Multivariate Binary Logistics Regression
	The level of perceived susceptibility			Perceived susceptibility level 6-10 *vs.* 0 -5
(A)Socio Demographic Data	0-5 (n = 260)	6-10 (n = 349)	*p* - Value	Adjusted OR (95%CI)
Age group (years old)				
18-30	100 (46.5)	116 (53.6)		
31-50	115 (42.3)	157 (57.7)	0.225	
>50	45 (36.9)	77 (63.1)		
Gender				
Male	85 (34.1)	164 (65.9)		1.481 (0.899 – 2.441)
Female	175 (48.6)	185 (51.4)	0.000	Reference
Tribe				
Temuan	191 (53.2)	168 (46.8)		0.415 (0.261 – 0.657) ***
Mahmeri	28 (22.0)	99 (78.0)	0.00	1.558 (0.842 – 2.883)
Others	41 (33.3)	82 (66.7)		Reference

Education				
No formal Education	45 (54.9)	37 (45.1)		1.117 (0.641 – 1.947)
Primary level	109 (45.2)	127 (53.8)	0.004	1.305 (0.680 – 2.505)
Secondary & above level	106 (36.4)	185 (63.6)		Reference
Occupation				
Manual worker	57 (28.1)	146 (71.9)		2.033 (1.247 – 3.316) *
Housewife	120 (49.6)	122 (50.4)	0.00	1.360 (0.820 – 2.256)
Others	83 (50.6)	81 (49.4)		Reference
Monthly income (MYR) [N=475]				
1000 and below	134 (46.4)	155 (53.6)	0.638	
> 1000	82 (44.1)	104 (55.9)		
(B) Dengue Experiences				
Had Dengue Before				
Yes	11 (37.9)	18 (62.1)	0.702	
No	249(42.9)	331 (57.1)		
(C) Environmental Factors				
Density of plants or vegetation				
None / Low	74 (45.7)	88 (54.3)		
Moderate	86 (37.2)	145 (62.8)	0.103	
A lot	100 (46.3)	116 (53.7)		
Density of mosquitoes in neighbourhood				
None / Low	82(36.6)	142 (63.4)		Reference
Moderate	106 (41,7)	148 (58.3)	0.003	0.867 (0.579 – 1.298)
Severe	72 (55.0)	59 (45.0)		0.504 (0.311 – 0.818)
Frequency of mosquito fogging				
None / Rarely	208 (46.4)	240 (53.6)	0.001	Reference
Occasionally / Often	52 (32.3)	109 (57.7)		2.549 (1.677 – 3.874) ***
Pre-intervention knowledge score				
11- 26	158 (48.2)	170 (51.8)	0.004	1.257 (0.787 – 2.009)
27- 40	102 (36.3)	179 (63.7)		Reference

*P < 0.05, **P < 0.01, ***P < 0.001. Hosmer and Lemeshow test, c2(8) = 9.976, P = 0.267; Cox & Snell R2 = 0.146; Nagelkerke R2 = 0.196. OR, odds ratio;CI, confidence interval; –, not applicable in the multivariate analysis

4.6.6 Level of perceived susceptibility of dengue (post-intervention)

The Orang Asli participants had higher perceived susceptibility of dengue (level of susceptibility 6-10) (n=249, 40.9%) and 59.1% of the participants had lower perceived susceptibility of dengue (level of susceptibility 0-5) (n=360).

The univariate analysis of the association between independent factors, namely socio-demographic characteristics, dengue experience, environmental factors and total median dengue knowledge score and the outcome variables (the level of perceived susceptibility of dengue), has been illustrated in Table 4.16. There was a significant difference ($p<0.05$) in the the level of perceived susceptibility by tribes, level of education and total median knowledge score.

A multivariate binary logistic regression analysis with three significant characteristics in the univariate analysis was conducted for the scale 6-10 vs. the scale 0-5. One significant association were reported (Table 4.15). The rate of perceived susceptibility of dengue was associated with tribe, Temuan (OR = 0.,574, 95%CI =0.362 – 0.912) and Mahmeri (OR = 0.282, 95%CI = 0.164 – 0.484) were significantly less likely to have higher perceived susceptibility of dengue compared to the reference group (others). In the test for goodness of fit, the Chi-square value for the Hosmer-Lemeshow test was 4.018, with a significance level of 0.674 ($p>0.05$), implying a good fit.

Table 4.16: Association between socio demographic characteristics, dengue experience and environmental factors of study participant with perceived susceptibility post-intervention

Details	Univariate analysis			Multivariate Binary Logistics Regression
	The level of perceived susceptibility			Perceived susceptibility level 6-10 *vs.* 0-5
(A)Socio Demographic Data	0-5 (n = 249)	6-10 (n = 360)	*p* - Value	Adjusted OR (95%CI)
Age group (years old)				
18-30	81 (37.7)	134 (62.3)		
31-50	115 (42.3)	157 (57.7)	0.480	
>50	53 (43.4)	69 (56.6)		
Gender				
Male	104 (41.8)	145 (58.2)		
Female	145 (40.3)	215 (59.7)	0.738	
Tribe				
Temuan	144 (40.1)	215 (59.9)		0.574 (0.362 – 0.912) *

Mahmeri	73 (57.5)	54 (42.5)	0.00	0.282 (0.164 – 0.484)***
Others	32 (26.0)	91 (74.0)		Reference
Education				
No formal	38 (46.3)	44 (53.7)		Reference
Primary level	111 (47.0)	125 (53.0)	0.007	1.056 (0.628 – 1.776)
Secondary & above level	100 (34.4)	191 (65.6)		1.646 (0.880 – 3.080)
Occupation				
Manual worker	88 (43.3)	115 (56.7)		
Housewife	96 (39.3)	247 (60.7)	0.669	
Others	65 (40.2)	98 (59.8)		
Monthly income (MYR) [N=475]				
1000 and below	137 (47.4)	152 (52.6)	0.072	
> 1000	72 (38.7)	114 (61.3)		
(B) Dengue Experiences				
Had Dengue Before				
Yes	10 (34.6)	19 (65.5)	0.563	
No	239(41.2)	341 (58.8)		
(C) Environmental Factors				
Density of plants or vegetation				
None / Low	66 (40.7)	96 (59.3)		
Moderate	95 (41.1)	136 (58.9)	0.996	
A lot	88 (40.7)	128 (59.3)		
Density of mosquitoes in neighbourhood				
None / Low	99 (44.2)	125 (55.8)		
Moderate	108 (42.5)	146 (57.5)	0.063	
Severe	42 (32.1)	89 (67.9)		
Frequency of mosquito fogging				
None / Rarely	188 (42.0)	260 (58.0)	0.401	
Occasionally / Often	61 (37.9)	100 (62.1)		
Post-intervention Knowledge Score				
13-32	138 (45.0)	170 (55.2)	0.048	Reference
33-40	111 (36.8)	190 (63.1)		0.997 (0.635 – 1.565)

*P < 0.05, **P < 0.01, ***P < 0.001. Hosmer and Lemeshow test, c2(8) = 4.018, P = 0.674; Cox & Snell R2 = 0.052; Nagelkerke R2 = 0.071. OR, odds ratio; CI, confidence interval; –, not applicable in the multivariate analysis

4.6.7 Statement of perceived dengue susceptibility

The perceived susceptibility of dengue was assessed with four detailed questions (Table 4.18). In post intervention, nearly half of the Orang Asli participants "agree" to the statement that "Unlikely to get dengue because I carry out proper mosquito prevention practices" (n=304, 49.0%) and "unlikely to get dengue because my housing area is clean" (n=347, 57.0%). However, about 63.4% participants "disagree" to the statement that "Unlikely to get dengue because my body is strong" (n=325).

Table 4.17: Statements to perceived dengue susceptibility

Perceived Susceptibility	N(%)	
Unlikely to get dengue because there are no dengue cases in one's neighbourhood.		
Strongly Agree	294 (48.3)	101 (15.5)
Agree	256 (42.0)	235 (38.6)
Disagree	55 (9.0)	223 (36.6)
Strongly disagree	4 (0.7)	50 (8.2)
Unlikely to get dengue because I carry out proper mosquito prevention practices		
Strongly Agree	278 (45.6)	122 (20.0)
Agree	271 (44.5)	304 (49.9)
Disagree	58 (9.5)	160 (26.3)
Strongly disagree	2 (0.3)	23 (3.8)
Unlikely to get dengue because my body is strong		
Strongly Agree	251 (41.2)	92 (15.1)
Agree	226 (37.3)	136 (22.3)
Disagree	109 (17.9)	325 (63.4)
Strongly disagree	23 (3.8)	56 (9.2)
Unlikely to get dengue because my house surrounding is clean		
Strongly Agree	284 (46.6)	94 (15.4)
Agree	288 (47.3)	347 (57.0)
Disagree	36 (5.7)	136 (22.3)
Strongly disagree	2 (0.3)	32 (5.3)

4.6.8 Association between socio-demographic characteristics, dengue experience, environmental factors, increase in total knowledge score and difference in the level of perceived susceptibility of dengue

The difference in the level of perceived susceptibility was obtained by subtracting the score of perceived susceptibility of pre-intervention from that of the post-intervention. Majority of the Orang Asli participants had no increment in perceived susceptibility (n=495, 81.3%) and only a minority (n=114,18.7%) of the participants have increment in perceived susceptibility. The univariate analysis was carried out by using a Chi-square test to examine the association between analysis of factors (the socio-demographic characteristics, dengue experience, environmental factors and increase in knowledge score) and outcome variable (differences in the level of perceived susceptibility) among the study participants.

The univariate analysis of association between independent factors, namely socio demographic characteristics, dengue experience, environmental factors and increase dengue knowledge score and the outcome variable (differences of the level of perceived susceptibility) has been demonstrated in Table 4.17. There was a significant difference ($p<0.05$) in the perceived severity score by tribe, average monthly household income, density of mosquitoes in neighborhood and frequency of mosquito fogging.

A multivariate logistic regression analysis with four significant characteristics in the univariate analysis was conducted. Four significant associations were revealed. The tribe Mahmeri (OR= 0.210, 95%CI=0.085 – 0.519) was found significantly more likely to have no increment in perceived susceptibility compared to the reference group. Likewise, participants earn more than RM1000 were significantly less likely (OR = 1.638, 95% CI=1.020 – 2.632) to have no increment in perceived susceptibility after post-intervention than those earning below than RM1000. Participants whom had severe (OR=

0.483, 95%CL= 0.258 -0.906) density of mosquito disturbance were significantly less likely to have no increment in perceived susceptibility of dengue than the reference (none/low). Participants who reported occasionally/often fogging carried out by municipal were significantly more likely (OR = 2.906, 95%CI= 1.590 – 5.312) to have no increment in perceived susceptibility of dengue than the reference group. In the test for goodness of fit, the Chi-square value for the Hosmer-Lemeshow test was 12.372with a significance level of 0.135 (p>0.05), implying a good fit.

Table 4.18: Association between socio demographic characteristics, dengue experience and environmental factors of study participant with difference in perceived susceptibility

Details	Univariate analysis			Multivariate Binary Logistics Regression
	Difference in score of The rate of susceptibility			The level of susceptibility for have increment vs. no increment
(A)Socio Demographic Data	Have increment (n = 114)	No increment (n = 495)	*p* - Value	Adjusted OR (95%CI)
Age group (years old)				
18-30	50 (23.3)	165 (76.7)		
31-50	45 (16.5)	227 (83.5)	0.103	
>50	19 (15.6)	103 (84.4)		
Gender				
Male	41 (16.5)	208 (83.5)		
Female	73 (20.3)	287 (79.7)	0.247	
Tribe				
Temuan	81 (22.6)	278 (77.4)		1.057 (0.585 – 1.912)
Mahmeri	8 (6.3)	119 (93.7)	0.000	4.771 (1.926 – 11.820) **
Others	25 (20.3)	98 (79.7)		Reference
Education				
No formal	19 (23.2)	63 (76.8)		
Primary level	39 (16.5)	197 (83.5)	0.393	
Secondary & above level	56 (19.2)	235 (80.8)		
Occupation				
Manual worker	34 (16.7)	169 (83.3)		
Housewife	50 (20.7)	192 (79.3)	0.566	
Others	30 (18.3)	134 (81.7)		
Monthly income (MYR) [N=475]				

1000 and below	51 (17.6)	238 (82.4)	0.049	Reference
> 1000	47 (25.3)	139 (74.7)		0.610 (0.380 – 0.980) *
(B) Dengue Experiences				
Had Dengue Before				
Yes	5 (17.2)	24 (82.8)	1.000	
No	109 (18.8)	471 (81.2)		
(C) Environmental Factors				
Density of plants or vegetation				
None / Low	30 (18.5)	132 (81.5)		
Moderate	39 (16.9)	192 (83.1)	0.563	
A lot	45 (20.8)	171 (79.2)		
Density of mosquitoes in neighbourhood				
None / Low	32 (14.3)	192 (85.7)		Reference
Moderate	43 (16.9)	211 (83.1)	0.001	0.855 (0.484 – 1.512)
Severe	39 (29.8)	92 (70.2)		0.483 (0.258 – 0.906)*
Frequency of mosquito fogging				
None / Rarely	95 (21.2)	353 (78.8)		Reference
Occasionally / Often	19 (11.8)	142 (88.2)	0.009	2.906 (1.590 – 5.312) **
Increment in Knowledge Score				
0-6	66 (18.0)	301 (82.0)	0.596	
7-17	48 (19.8)	194 (80.2)		

*P < 0.05, **P < 0.01, ***P < 0.001. Hosmer and Lemeshow test, c2(8) = 2.245, P = 0.134; Cox & Snell R2 = 0.085; Nagelkerke R2 = 0.134. OR, odds ratio; CI, confidence interval; –, not applicable in the multivariate analysis

4.6.9 Level of perceived barriers to prevent dengue (pre- intervention)

Level of perceived dengue barriers was assessed with the scale of 0-10. of 1 -10. Half of the study participants reported have higher perceived barriers to prevent dengue (level of barrier 6-10) (n=317, 52.1%), meanwhile the remaining 47.9% of the participants reported lower perceived barriers to prevent dengue (level of barriers 1-5) (n=292).

Table 4.19 exhibits the univariate analysis of association between independent factors such as sociodemographic characteristics, dengue experience, environmental factors and total dengue knowledge score and the outcome variable (the level of perceived

barriers to prevent dengue). There was a significant difference ($p<0.05$) in the perceived barriers by gender, tribes, highest education attainment, type of occupation, average monthly household income, density of plants or vegetation and knowledge score.

A multivariate logistic regression analysis with seven significant characteristics in the univariate analysis was conducted. Four significant association were revealed (Table 4.17). Gender was significantly associated with the perceived barrier to prevent dengue, where the male participants were significantly more likely (OR = 2.057, 95%CI= 1.179 – 3.592) had higher perceived barrier to prevent dengue (level of barrier 6-10) to performing dengue prevention practice as compared to female participants. Manual workers (OR= 2.882, 95% CI = 1.686 – 4.926) and housewives (OR = 1.883, 95%CI = 1.001 – 3.545) were found significantly more likely to perceive higher barrier in preventing dengue compared to the reference group (others).Participants who reported having a lot density of plants or vegetation were more likely (OR= 2.207, 95% CI = 1.286 – 3.787) had higher perceived barrier to prevent dengue compared to the none/low category. Likewise, participants who reported to acquire knowledge scores of 27-40 were significantly more likely (OR = 2.531, 95%CI= 1.465 – 4.372) had higher perceived barrier to prevention dengue compared to the reference group (knowledge score 11-26). In the test for goodness of fit, the Chi-square value for the Hosmer-Lemeshow test was 10.099 with a significance level of 0.255 ($p>0.05$), implying a good fit.

Table 4.19: Association between socio demographic characteristics, dengue experience, environmental factors and knowledge score of study participant with perceived barriers to prevent dengue in pre intervention

Details	Univariate analysis			Multivariate Binary Logistics Regression
	The level of l Barrier in prevention dengue			Perceived barrier level 6-`0 vs. 0-5
(A)Socio Demographic Data	0-5 (n = 292)	6-10 (n = 317)	*p* - Value	Adjusted OR (95%CI)
Age group (years old)				
18-30	110 (51.2)	195 (48.8)		
31-50	125 (46.0)	147 (54.0)	0.497	
>50	57 (46.7)	65 (53.3)		
Gender				
Male	91 (36.5)	158 (63.5)		2.057 (1.179 – 3.592)*
Female	201 (55.8)	159 (44.2)	0.000	Reference
Tribe				
Temuan	191 (53.2)	168 (46.8)		Reference
Mahmeri	47 (37.0)	80 (63.0)	0.004	1.471 (0.890 – 2.434)
Others	54 (43.9)	69 (56.1)		1.097 (0.620 – 1.941)
Education				
No formal Education	52 (63.4)	30 (36.8)		Reference
Primary level	131 (55.5)	105 (44.5)	0.00	1.154 (0.599 – 2.223)
Secondary & above level	109 (37.5)	102 (62.5)		1.121 (0.507 – 2.491)
Occupation				
Manual worker	59 (29.1)	144 (70.9)		2.882 (1/686 – 4.926) ***
Housewife	133 (55.0)	109 (45.0)	0.000	1.883 (1.001 – 3.545) *
Others	100 (61.0)	64 (39.0)		Reference
Monthly income (MYR) [N=475]				
1000 and below	158 (54.0)	133 (46.0)	0.000	Reference
> 1000	69 (37.1)	117 (62.9)		1.417 (0.897 – 2.238)
(B) Dengue Experiences				
Had Dengue Before				
Yes	14 (48.3)	15 (51.7)	1.000	
No	278 (47.8)	302 (52.1)		
(C) Environmental Factors				
Density of plants or vegetation				
None / Low	104 (64.2)	58 (35.8)		Reference
Moderate	105 (45.5)	126 (54.5)	0.000	1.477 (0.861 – 2.536)
A lot	83 (38.4)	133 (61.6)		2.207 (1.286 – 3.787)*
Density of mosquitoes in neighbourhood				

None / Low	103 (46.0)	121 (54,0)		
Moderate	124 (48.8)	130 (51.2)	0.752	
Severe	65 (49.6)	66 (50.4)		
Frequency of mosquito fogging				
None / Rarely	213 (47.5)	235 (52.5)		
Occasionally / Often	79 (49.1)	82 (50.9)	0.783	
Pre- intervention knowledge score				
11-26	197 (60.1)	131 (39.9)		Reference
27-36	95 (33.8)	317 (52.1)	0.000	2.531 (1.465 – 4.372) **

*P < 0.05, **P < 0.01, ***P < 0.001. Hosmer and Lemeshow test, c2(8) = 10.099, P = 0.255; Cox & Snell R2 = 0.191; Nagelkerke R2 = 0.255. OR, odds ratio;CI, confidence interval; –, not applicable in the multivariate analysis

4.6.10 Level of perceived barriers to prevent dengue (post- intervention)

More than half of the study participants had higher perceived barrier in preventing dengue (level of barrier 6-10) (n=366, 60.1%) and the remaining 39.9% of the participants had lower perceived barrier in preventing dengue (level of barrier 0-5) (n=243).

Table 4.20 shows the univariate analysis of association between independent factors namely socio demographic characteristics, dengue experience, environmental factors and total dengue knowledge score and the outcome variable (the level of perceived barriers to prevent dengue). There was a significant difference ($p<0.05$) in the perceived barrier for tribes, highest education attainment, type of occupation, average monthly household income, density of plants or vegetation and knowledge score.

The six significant characteristics in the univariate analysis were included in the multivariate logistic regression analysis for the scale 6-10 vs. the scale 0-5. Three significant association were discovered (Table 4.20). The tribe 'Temuan' were found significantly less likely OR= 0.398, 95%CI = 0.218 – 0.728 had higher perceive barrier to prevent dengue compared to the reference (others). Average household monthly income was found to be significantly associated with the perceived barrier of dengue preventive practices. The participants who earn more RM1000 were significantly more

likely (OR = 1.630, 95%CI=1.033 – 2.571) had higher perceived barriers to prevent dengue compared to the reference group (monthly income of less than RM1000). Participants who have reported having high density of plants or vegetation more likely (OR=1.685, 95% CI = 0.998 – 2.844) had higher perceived barriers to prevent dengue compared to the none/low category. In the test for goodness of fit, the Chi-square value for the Hosmer-Lemeshow test was 3.428 with a significance level of 0.905 (p>0.05), implying a good fit.

Table 4.20: Association between socio demographic characteristics, dengue experience, environmental factors and knowledge score of study participant with perceived barriers to prevent dengue

Details	Univariate analysis			Multivariate Binary Logistics Regression
	The level of Barrier			The level of barrier for 6-10 *vs.* 0-5
(A)Socio Demographic Data	0-5 (n = 243)	6-10 (n = 366)	*p* - Value	Adjusted OR (95%CI)
Age group (years old)				
18-30	83 (38.6)	132 (61.4)		
31-50	110 (40.4)	162 (59.6)	0.885	
>50	50 (41.0)	72 (59.0)		
Gender				
Male	91 (36.5)	158 (63.5)		
Female	152 (42.2)	208 (57.8)	0.178	
Tribe				
Temuan	169 (47.1)	190 (52.9)		0.398 (0.218 – 0.728) *
Mahmeri	38 (29.9)	89 (70.1)	0.00	0.792 (0.391 – 1.605)
Others	36 (29.3)	87 (70.7)		Reference
Education				
No formal Education	37 (45.1)	45 (54.9)		Reference
Primary level	113 (47.9)	123 (52.1)	0.001	0.593 (0.323 – 1.087)
Secondary & above level	93 (32.0)	198 (68.0)		0.776 (0.367 – 1.641)
Occupation				
Manual worker	63 (31.0)	140 (69.0)		1.645 (0.973 – 2.7812)
Housewife	105 (43.4)	137 (56.6)	0.006	1.138 (0.687 – 1.884)
Others	76 (46.7)	89 (54.3)		Reference
Monthly income (MYR) [N=475]				
1000 and below	134 (46.4)	155 (53.6)	0.000	Reference
> 1000	51 (27.4)	135 (72.6)		1.630 (1.033 – 2.571) *

(B) Dengue Experiences				
Had Dengue Before				
Yes	16 (55.2)	13 (44.8)	0.119	
No	227 (39.1)	353 (60.9)		
(C) Environmental Factors				
Density of plants or vegetation				
None / Low	78 (48.1)	84 (51.9)		Reference
Moderate	95 (41.1)	136 (58.9)	0.007	0.968 (0.578 – 1.622)
A lot	70 (32.4)	146 (67.6)		1.685 (0.998 – 2.844) *
Density of mosquitoes in neighbourhood				
None / Low	83 (37.1)	141 (62.9)		
Moderate	113 (44.5)	141 (55.5)	0.144	
Severe	47 (35.9)	84 (64.1)		
Frequency of mosquito fogging				
None / Rarely	173 (38.6)	275 (61.4)		
Occasionally / Often	70 (43.5)	91 (56.5)	0.302	
Post-intervention knowledge score				
13-32	143 (46.4)	165 (53.7)		Reference
33-40	101 (33.2)	201 (66.8)	0.001	1.448 (0.833 – 2.518)

*P < 0.05, **P < 0.01, ***P < 0.001. Hosmer and Lemeshow test, c2(8) = 3.428, P = 0.905; Cox & Snell R2 = 0.112; Nagelkerke R2 = 0.152. OR, odds ratio; CI, confidence interval; –, not applicable in the multivariate analysis

4.6.11 Statements in perceived barriers to prevent dengue

Perceived barriers to prevent dengue were further assessed with three detailed questions in Table 4.22. In post intervention, slightly more than half participants "agree" to the statement that "lack of community participation in taking preventive measure against dengue is a barrier for you to prevent dengue" (n=326, 53.5%), "lack of self-efficacy in taking preventive measures against dengue is a barrier for you to prevent dengue" (n=326,53.7%) and "lack of preventive measures from authorities is a barrier for you to prevent dengue" (n=29.4, 46.6%).

Table 4.21: Statements to perceived barriers to prevent dengue

Perceived Barriers	**N (%)**	
Lack of community participation in taking preventive measure against dengue is a barrier for you to prevent dengue.		
Strongly Agree	5 (0.8)	33 (5.4)
Agree	35 (5.7)	326 (53.5)
Disagree	108 (17.7)	119 (19.5)
Strongly disagree	461 (75.7)	131 (21.5)
Lack of self-efficacy in taking preventive measures against dengue is a barrier for you to prevent dengue.		
Strongly Agree	10 (1.6)	31 (5.1)
Agree	38 (6.2)	327 (53.7)
Disagree	140 (23.0)	130 (21.3)
Strongly disagree	421 (69.1)	121 (19.9)
Lack of preventive measures from authorities is a barrier for you to prevent dengue.		
Strongly Agree	11 (1.8)	35 (5.7)
Agree	17 (2.8)	294 (46.6)
Disagree	212 (34.8)	170 (27.9)
Strongly disagree	369 (60.6)	120 (19.7)

4.6.12 Association between socio-demographic characteristics, dengue experience, environmental factors, increase in total knowledge score and difference in the level of perceived barrier to prevent dengue

The difference between the perceived barriers before and after the interventions was obtained by subtracting the score for the perceived barriers of pre-intervention from the score for the perceived barriers post-intervention. Majority of the participants had no increment in perceived barriers (n=490, 80.5%) and only minority (19.5%) of the participants have increment in perceived barriers to prevent dengue (n=119). The univariate analysis was carried out by using Chi-square test to examine the association between analysis of factors (the socio-demographic characteristics, dengue experience, environmental factors, increase in knowledge score) and outcome variable (differences in the level of perceived barriers) between the study participants.

The univariate analysis of the association between independent factors such as socio demographic characteristics, dengue experience, environmental factors and increase in the dengue knowledge score and the outcome variable (differences of the level of perceived barriers) has been displayed in Table 4.21. There was a significant difference ($p<0.05$) in the perceived barrier to prevent dengue by gender and type of occupation.

A multivariate logistic regression analysis was conducted with two significant characteristics in the univariate analysis. One significant association was revealed in the multivariate analysis. Differences in the level of perceived barrier to prevent dengue was associated with type of occupation. The manual workers were found significantly more likely (OR= 1.994, 95%CI=1.1.25 – 3.546) to have no increment in perceived barrier to prevent dengue compared to reference group (others). In the test for goodness of fit, the Chi-square value for the Hosmer-Lemeshow test was 0.012 with a significance level of 1.000 ($p>0.05$), implying a good fit.

Table 4.22: Association between socio demographic characteristics, dengue experience and environmental factors of study participant with differences in the perceived barriers

Details	Univariate analysis			Multivariate Binary Logistics Regression
	Difference in score of Perceived barrier			The level of barrier for have increment vs. no increment
(A)Socio Demographic Data	Have increment (n=119)	No increment (n = 490)	*p* - Value	Adjusted OR (95% CI)
Age group (years old)				
18-30	48 (22.3)	167 (77.7)		
31-50	50 (18.4)	222 (81.6)	0.425	
>50	21 (17.2)	101 (82.8)		
Gender				
Male	36 (14.5)	213 (85.5)		1.522 (0.856 – 2.708)
Female	83 (23.1)	277 (76.9)	0.009	Reference
Tribe				
Temuan	66 (18.4)	293 (81.6)		
Mahmeri	22 (17.3)	105 (82.7)	0.201	
Others	31 (25.2)	92 (74.8)		
Education				
No formal	22 (26.8)	60 (73.2)		
Primary level	42 (17.8)	194 (82.2)	0.192	
Secondary & above level	55 (18.9)	236 (81.1)		
Occupation				
Manual worker	25 (12.3)	178 (87.7)		1.994 (1.125 – 3.536) *
Housewife	55 (22.7)	187 (77.3)	0.006	1.314 (0.761 – 2.267)
Others	39 (23.8)	125 (76.2)		Reference
Monthly income (MYR) [N=475]				
1000 and below	54 (18.7)	235 (81.3)	0.480	
> 1000	40 (21.5)	146 (78.5)		
(B) Dengue Experiences				
Had Dengue Before				
Yes	4 (13.8)	25 (86.2)	0.630	
No	115 (19.8)	465 (80.2)		
(C) Environmental Factors				
Density of plants or vegetation				
None / Low	40 (24.7)	122 (75.3)		
Moderate	46 (19.9)	185 (80.1)	0.072	
A lot	33 (15.3)	183 (84.7)		
Density of mosquitoes in neighbourhood				
None / Low	42 (18.8)	182 (81.3)		

Moderate	47 (18.5)	207 (81.5)	0.548
Severe	30 (22.9)	101 (77.1)	
Frequency of mosquito fogging			
None / Rarely	92 (20.5)	356 (79.5)	
Occasionally / Often	27 (16.8)	134 (83.2)	0.354
Increment in Knowledge Score			
0-6	67 (18.3)	300 (81.7)	0.348
7-17	52 (21.5)	190 (78.5)	

*P < 0.05, **P < 0.01, ***P < 0.001. Hosmer and Lemeshow test, c2(8) = 0.012, P = 1.000; Cox & Snell R2 = 0.021; Nagelkerke R2 = 0.033. OR, odds ratio;CI, confidence interval; –, not applicable in the multivariate analysis

4.6.13 Level of perceived cues to action to prevent dengue (pre-intervention)

The cues to action or health promoting behaviour questions were evaluated by assigning in the scale of 0-10. Slightly more than half of the study participants had higher perceived cues to action to prevent dengue (level of cues to action 6-10) (n= 317, 52.1%) whereas 47.9% (n = 292) had lower perceived cues to action to prevent dengue (level of cues to action 1-5).

Table 4.23 demonstrate the univariate analysis of the association between independent factors sociodemographic characteristics, dengue experience, environmental factors and total dengue knowledge score and the outcome variable (level of perceived cues to action to prevent dengue). There was a significant difference ($p<0.05$) in the perceived cues to action to prevent dengue by gender, tribes, highest education attainment, type of occupation, monthly income, density of plants or vegetation, and total knowledge score.

The seven significant characteristics in the univariate analysis were included in the multivariate logistic regression analysis for perceived cues to action to prevent dengue scale 6-10 (higher perceived cues to action to prevent dengue vs. score 0-5 (lower perceived cues to action to prevent dengue). Four significant association were revealed. The perceived cues to action to prevent dengue was associated with gender (OR= 2.057,

95%CI= 1.179 – 3.592) where females were found to be significantly less likely to have higher perceived cues to action to prevent dengue compared to the reference group (Male). Participants whose occupation was manual worker (OR = 2.882, 95%CI = 1.686 – 4.926) or housewives (OR= 1.883, 95%CI = 1.001 – 3.545) were significantly more likely to have higher perceived cues to action to prevent dengue compared to the reference group (others).

Density of mosquitoes in neighborhood was found to be significantly associated with perceived cues to action to prevent dengue where moderate group significantly less likely (OR = 2.207, 95%CI=1.286 – 3.787) to have higher perceived cues to action to prevent dengue compared to the reference group (severe). The total knowledge score was significantly associated where 27-36 scores imply more likely (QR = 2.531, 95%CI=1.465- 4.372) to have higher perceived cues to action to prevent dengue compared to the reference group (score 11-26). In the test for goodness of fit, the Chi-square value for the Hosmer-Lemeshow test was 10.099 with a significance level of 0.258 (p>0.05), implying a good fit.

Table 4.23: Association between sociodemographic characteristics, dengue experience, environmental factors and knowledge score of study participant with level of cues to action pre intervention

Details	Univariate analysis			Multivariate Binary Logistics Regression
	Level of perceived cues to action			The level of cues to action 6-10 *vs.* 0-5
(A)Socio Demographic Data	0-5 (n = 292)	6-10 (n = 317)	*p* - Value	Adjusted OR (95%CI)
Age group (years old)				
18-30	110 (51.2)	105 (48.8)		
31-50	125 (46.0)	147 (54.0)	0.497	
>50	57 (46.7)	65 (53.3)		
Gender				
Male	91 (36.5)	158 (63.5)		Reference
Female	201 (65.8)	159 (44.2)	0.00	2.057 (1.179 – 3.592) *
Tribe				
Temuan	191 (53.2)	168 (46.8)		Reference
Mahmeri	47 (37.0)	80 (63.0)	0.004	1.472 (0.890 – 2.434)

Others	54 (43.9)	69 (56.1)		1.097 (0.620 – 1.941)
Education				
No formal Education	52 (63.4)	30 (36.6)		Reference
Primary level	131 (55.5)	105 (44.5)	0.00	1.154 (0.599 – 2.223)
Secondary & above level	109 (37.5)	182 (62.5)		1.121 (0.607 – 2.481)
Occupation				
Manual worker	59 (29.1)	144 (70.9)		2.882 (1.686 – 4.926) ***
Housewife	133 (55.0)	109 (45.0)	0.00	1.883 (1.001 – 3.545) *
Others	100 (61.0)	64 (39.0)		Reference
Monthly income (MYR) [N=475]				
1000 and below	156 (54.0)	133 (46.0)	0.00	Reference
> 1000	69 (37.1)	117 (62.9)		1.417 (0.897 – 2.238)
(B) Dengue Experiences				
Had Dengue Before				
Yes	14 (48,3)	16 (51.7)	1.000	
No	278 (47.9)	302 (52.1)		
(C) Environmental Factors				
Density of plants or vegetation				
None / Low	104 (64.2)	58 (35.8)		1.477 (0.861 – 2.536)
Modethe rate	105 (45.5)	126 (54.5)	0.00	2.207.(1.286 – 3.787)*
A lot	83 (38.4)	133 (61.6)		Reference
Density of mosquitoes in neighbourhood				
None / Low	103 (46.6)	121 (54.0)		
Modethe rate	124 (48.8)	130 (51.2)	0.752	
Severe	65 (49.6)	66 (50.4)		
Frequency of mosquito fogging				
None / Rarely	213 (47.5)	235 (52.5)		
Occasionally / Often	79 (49.1)	82 (50.9)	0.783	
Pre-intervention knowledge score				
11-26	197 (60.1)	131 (39.9)		Reference
27-36	95 (33.9)	186 (66.2)	0.000	2.531 (1.465- 4.372) **

*P < 0.05, **P < 0.01, ***P < 0.001. Hosmer and Lemeshow test, c2(8) = 10.099, P = 0.258; Cox & Snell R2 = 0.191; Nagelkerke R2 = 0.263. OR, odds ratio;CI, confidence interval; –, not applicable in the multivariate analysis

4.6.14 Level of perceived cues to action to prevent dengue (post-intervention)

The perceived cues to action to prevent dengue were assessed by using the scale of 0 -10. Slightly more than half of the study participants had higher perceived cues to action to prevent dengue (level of cues to action 6-10) (n= 497, 81.6%) and about 112 (18.4%) of them had lower perceived cues to action to prevent dengue (level of cues to action 0-5).

Table 4.24 illustrate the univariate analysis of the association between independent factors such as sociodemographic characteristics, dengue experience, environmental factors and total dengue knowledge scores and the outcome variable (level of perceived cues to action to prevent dengue). There was a significant difference ($p<0.05$) in the perceived cues to action to prevent dengue by gender, tribes, highest education attainment, type of occupation, monthly income and total knowledge score.

The six significant characteristics in the univariate analysis were included in the multivariate logistic regression analysis for perceived cues to action to prevent dengue scale 6-10 vs. scale 0-5. Two significant associations were revealed. The perceived cues to action to prevent dengue were associated with tribe where Temuan (OR= 0.224, 95%CI= 0.077 – 0.655) and Mahmeri (OR = 0.179, 95%CI= 0.057 – 0.566) were found to be significantly less likely to have perceived cues to action to prevent dengue compared to the reference group (others). The total knowledge score was significantly associated with the perceived cues to action to prevent dengue where the scores of 33-40 more likely (QR = 2.287, 95%CI= 1.089 – 4.807) to have higher perceived cues to action to prevent dengue compared to the reference group (scores of 13-32). In the test for goodness of fit, the Chi-square value for the Hosmer-Lemeshow test was 9.125 with a significance level of 0.332 ($p>0.05$), implying a good fit.

Table 4.24: Association between socio demographic characteristics, dengue experience, environmental factors and knowledge score of study participant with perceived cues to action to prevent dengue post- intervention

Details	Univariate analysis			Multivariate Binary Logistics Regression
	Level of perceived cues to Action			The level of perceived cues to action for 6-10 *vs.* 0-5
(A)Socio Demographic Data	0-5 (n = 112)	6-10 (n = 497)	*p* - Value	Adjusted OR (95%CI)
Age group (years old)				
18-30	39 (18.1)	176 (81.9)		
31-50	43 (15.8)	229 (84.2)	0.114	
>50	30 (24.6)	92 (75.4)		
Gender				
Male	34 (13.7)	215 (86.3)		1.207 (0.592 – 2.461)
Female	78 (21.7)	282 (78.3)	0.014	Reference
Tribe				
Temuan	78 (21.7)	281 (78.3)		0.224 (0.077 – 0.655) **
Mahmeri	26 (20.5)	101 (79.5)	0.001	0.179 (0.057 – 0.566) **
Others	8 (6.5)	115 (93.5)		Reference
Education				
No formal Education	25 (30.5)	57 (69.5)		Reference
Primary level	50 (21.2)	186 (78.8)	0.000	1.788 (0.921 – 3.474)
Secondary & above level	37 (12.7)	254 (87,3)		1.347 (0.560 – 3.242)
Occupation				
Manual worker	22 (10.3)	181 (89.2)		1.925 (0.958 – 3.868)
Housewife	57 (23.6)	185 (76.4)	0.002	0.738 (0.362 – 1.504)
Others	33 (20.1)	131 (79.9)		Reference
Monthly income (MYR) [N=475]				
1000 and below	60 (20.8)	229 (79.2)	0.036	Reference
> 1000	24 (12.9)	162 (87.1)		1.045 (0.571 – 1.914)
(B) Dengue Experiences				
Had Dengue Before				
Yes	7 (24.1)	22 (75.9)	0.459	
No	105 (18.1)	475 (81.9)		
(C) Environmental Factors				
Density of plants or vegetation				
None / Low	34 (21.0)	128 (79.0)		
Moderate	36 (15.6)	195 (84.4)	0.350	
A lot	42 (19.4)	174 (80.6)		
Density of mosquitoes in neighbourhood				
None / Low	49 (21.9)	175 (78.1)		
Moderate	42 (16.5)	212 (83.5)	0.237	

Severe	21 (16.0)	110 (84.0)			
Frequency of mosquito fogging					
None / Rarely	89 (19.9)	359 (80.1)			
Occasionally / Often	23 (14.3)	138 (85.7)	0.124		
Post-intervention knowledge score					
13-32	77 (25.0)	231 (75.0)		Reference	
33-40	35 (11.6)	266 (88.4)	0.000	2.287	(1.089 – 4.807)*

*P < 0.05, **P < 0.01, ***P < 0.001. Hosmer and Lemeshow test, c2(8) = 9.125, P = 0.332; Cox & Snell R2 = 0.083; Nagelkerke R2 = 0.136. OR, odds ratio;CI, confidence interval; –, not applicable in the multivariate analysis

4.6.15 Statement on perceived cues to action to prevent dengue

Perceived cues to action to prevent dengue were further assessed with three detailed questions in Table 4.26. In post intervention, more than half participants "agree" to the statement that "enlightenment from mass media about dengue encourage you to carry out the prevention" (n=391, 64.2%), "fogging by the authorities encourage you to carry out dengue prevention" (n=375,61.6%) and "if there is a case of dengue reported in your neighborhood, it will encourage you to carry out dengue prevention" (n=361, 59.3%).

Table 4.25: Statements on perceived cues to action to prevent dengue

Cues to Action	**N (%)**	
Enlightenment from mass media about dengue encourage you to carry out the prevention.		
Strongly Agree	11 (1.8)	39 (6.4)
Agree	63 (10.3)	391 (64.2)
Disagree	238 (39.1)	95 (15.6)
Strongly disagree	297 (48.8)	84 (13.8)
Fogging by the authorities encourage you to carry out dengue prevention.		
Strongly Agree	22 (3.6)	50 (8.2)
Agree	14 (2.3)	375 (61.6)
Disagree	325 (54.4)	115 (18.9)
Strongly disagree	248 (40.7)	59 (11.3)
If there is a case of dengue reported in your neighbourhood, it will encourage you to carry out dengue prevention.		
Strongly Agree	8 (1.3)	72 (11.8)
Agree	13 (2.1)	361 (59.3)
Disagree	318 (52.2)	92 (15.1)
Strongly disagree	270 (44.3)	84 (13.8)

4.6.16 Association between socio-demographic characteristics, dengue experience, environmental factors, increase in total knowledge score and difference in the level of perceived cues to action to prevent dengue

The difference in the level of perceived cues to action to prevent dengue is obtained by subtracting the score of cues to action of the post-intervention with the score of cues to action of the pre-intervention. Slightly more than half of the Orang Asli participants reported no increment in perceived cues to action to prevent dengue (n=404, 66.3%) and about 33.7% (n=205) of the participants have increment in perceived cues to action to prevent dengue.The univariate analysis was carried out by using Chi-square test to examine the association between the independent factors (the socio-demographic characteristics, dengue experience, environmental factors, increase in knowledge score) and outcome variables (differences in the perceived cues to action to prevent dengue) between the study participants.

The univariate analysis of association between independent factors namely sociodemographic characteristics, dengue experience, environmental factors and increase dengue knowledge score and the outcome variable (differences of the perceived cues to action to prevent dengue) has been displayed in Table 4.25. There was a significant difference ($p<0.05$) in the cues to action score by tribe, level of education, density of plants and vegetation, density of mosquitoes in neighborhood and difference in knowledge score.

A multivariate logistic regression analysis with five significant characteristics in the univariate analysis was conducted. Two significant association were revealed in the analysis. Differences in the perceived cues to action to prevent dengue was associated with tribe where Mahmeri were found to be significantly less likely (OR= 0.507, 95%CI=0.555 – 1.463) to have no increment in the perceived cues to action compared to

reference group (other tribe). Participants with no formal (OR= 0.522, 95%Cl= 0.304-0.897) and primary level (OR= 0.499, 95%Cl= 0.340- 0.733) were significantly less likely to have no increment in the perceived cues to action compared to reference group (secondary and above level). Participants whom had moderate density of plants or vegetation (OR= 1.584, 95%Cl= 1.010-2.484) were significantly more likely to have no increment in perceived cues to action. Participants whom had higher increment of knowledge score 0-6 were found more likely to have no increment in perceived cues to action to prevent dengue compared to reference group (7-17). In the test for goodness of fit, the Chi-square value for the Hosmer-Lemeshow test was 9.170 with a significance level of 0.328 (p>0.05), implying a good fit.

Table 4.26: Association between socio demographic characteristics, dengue experience and environmental factors of study participant with difference in cues to action

Details	Univariate analysis			Multivariate Binary Logistics Regression
	Difference in the score of perceived cues to action			The level of perceived cues to action for have increment vs. no increment
(A)Socio Demographic Data	Have increment (n=205)	No increment (n = 404)	*p* - Value	Adjusted OR (95%CI)
Age group (years old)				
18-30	72 (33.5)	143 (66.5)		
31-50	93 (34.2)	179 (65.8)	0.961	
>50	40 (32.8)	82 (67.2)		
Gender				
Male	79 (31.7)	170 (68.3)		
Female	126 (35.0)	234 (65.0)	0.433	
Tribe				
Temuan	115 (32.0)	244 (68.0)		0.901 (0.555- 1.463)
Mahmeri	59 (46.5)	68.0 (53.5)	0.001	0.507 (0.289-0.890) *
Others	31 (25.2)	92 (74.8)		Reference
Education				
No formal	32 (39.0)	50 (61.0)		0.522 (0.304- 0.897) *
Primary level	100 (42.4)	136 (57.6)	0.000	0.499 (0.340- 0.733) ***
Secondary & above level	73 (25.1)	218 (74.9)		
Occupation				

Manual worker	58 (28.6)	145 (71.4)		
Housewife	84 (34.7)	158 (65.3)	0.127	
Others	63 (38.4)	101 (61.6)		
Monthly income (MYR) [N=475]				
1000 and below	106 (36.7)	183 (63.3)	0.845	
> 1000	66 (35.5)	120 (64.5)		
(B) Dengue Experiences				
Had Dengue Before				
Yes	9 (31.0)	20 (69.0)	0.843	
No	196 (33.8)	384 (66.2)		
(C) Environmental Factors				
Density of plants or vegetation				
None / Low	68 (42.0)	94 (58.0)		Reference
Moderate	72 (31.2)	159 (68.8)	0.032	1.584 (1.010 – 2.484) *
A lot	65 (30.1)	151 (69.9)		1.590 (0.994 – 2.542)
Density of mosquitoes in neighbourhood				
None / Low	90 (40.2)	134 (59.8)		1.214 (0.810 – 1.820)
Moderate	81 (31.9)	173 (68.2)	0.017	1.532 (0.906 – 2.591)
Severe	34 (26.0)	97 (74.0)		Reference
Frequency of mosquito fogging				
None / Rarely	157 (35.0)	291 (65.0)		
Occasionally / Often	48 (29.8)	113 (70.2)	0.244	
Increment in Knowledge Score				
0-6	107 (29.2)	260 (70.8)	0.005	1.541 (1.076 – 2.207) *
7-17	98 (40.5)	144 (59.5)		Reference

*P < 0.05, **P < 0.01, ***P < 0.001. Hosmer and Lemeshow test, c2(8) = 9.170, P = 0.328; Cox & Snell R2 = 0.071 Nagelkerke R2 = 0.098. OR, odds ratio;CI, confidence interval; –, not applicable in the multivariate analysis

4.6.17 Level of perceived self-efficacy towards dengue prevention (pre-intervention)

Level of self-efficacy for dengue prevention practices was assessed on the scale of 0 -10. Less than half of the Orang Asli participants had higher perceived self-efficacy in the prevention of dengue (level of self-efficacy 6-10) (n=523, 85.9%) and the remaining 14.1% (n = 86) have lower perceived self-efficacy in the prevention of dengue (level of self-efficacy 0-5).

Table 4.27 shows the univariate analysis of the association between independent factors namely socio demographic characteristics, dengue experience, environmental factors and total median knowledge score, and the outcome variable (level of perceived self-efficacy in the prevention of dengue. There was a significant difference ($p<0.05$) in the perceived self-efficacy in the prevention of dengue by gender, tribe, highest educational attainment, and total knowledge score.

The four significant characteristics in the univariate analysis were included in the multivariate logistic regression analysis for perceived self-efficacy in the prevention of dengue on the scale of 6-10 vs. 0-5. One significant association was revealed in the multivariate analysis. Perceived self-efficacy in the prevention of dengue was associated with total knowledge score, where scores of 33-40 more likely (QR = 1.947, 95%CI =1.004- 3.774) to have higher perceived self-efficacy in the prevention of dengue compared to reference group (scores of 13-32). In the test for goodness of fit, the Chi-square value for the Hosmer-Lemeshow test was 11.932 with a significance level of 0.103 ($p>0.05$), implying a good fit.

Table 4.27: Association between socio demographic characteristics of study participant with self –efficacy score pre-intervention

Details	Univariate analysis			Multivariate Binary Logistics Regression
	The level of perceived self-efficacy			Perceived self-efficacy 6-10 vs. 0-5
(A)Socio Demographic Data	0-5 (n = 86)	6-10 (n = 523)	*p* - Value	Adjusted OR (95% CI)
Age group (years old)				
18-30	34 (15.8)	181 (84.2)		
31-50	36 (12.9)	237 (87.1)	0.649	
>50	17 (13.9)	105 (86.1)		
Gender				
Male	24 (9.6)	225 (90.4)		1.828 (1.089 – 3.071)
Female	62 (17.2)	298 (82.8)	0.009	Reference
Tribe				
Temuan	63 (17.5)	295 (92.5)		Reference
Mahmeri	12 (9.4)	115 (90.8)	0.014	1.767 (0.904 – 3.454)
Others	11 (8.9)	112 (91.1)		1.947 (0.970 – 3.907)

Education				
No formal Education	19 (23.2)	63 (76.8)		Reference
Primary level	37 (16.7)	199 (84.3)	0.009	1.414 (0.748 -2.674)
Secondary & above level	30 (10.3)	261 (89.7)		1.391 (0.629 – 3.077)
Occupation				
Manual worker	20 (9.9)	183 (90.1)		
Housewife	37 (15.3)	205 (94.7)	0.081	
Others	29 (17.7)	135 (82.3)		
Monthly income (MYR) [N=475]				
1000 and below	43 (14.9)	248 (85.1)	0.690	
> 1000	25 (13.4)	161 (86.6)		
(B) Dengue Experiences				
Had Dengue Before				
Yes	3 (10.3)	26 (89.7)	0.786	
No	83 (14.3)	497 (85.7)		
(C) Environmental Factors				
Density of plants or vegetation				
None / Low	25 (15.4)	137 (84.6)		
Moderate	33 (14.3)	198 (85.7)	0.789	
A lot	28 (13.0)	188 (87.0)		
Density of mosquitoes in neighbourhood				
None / Low	24 (10.7)	200 (89.3)		
Moderate	39 (15.4)	215 (84.6)	0.154	
Severe	23 (17.6)	108 (92.4)		
Frequency of mosquito fogging				
None / Rarely	83 (14.1)	385 (85.9)		
Occasionally / Often	23 (14.3)	138 (85.7)	1,000	
Pre-intervention knowledge score				
11-26	61 (18.6)	267 (81.4)		Reference
27-36	25 (8.9)	256 (91.1)	0.001	1.947 (1.004- 3.774) *

*P < 0.05, **P < 0.01, ***P < 0.001. Hosmer and Lemeshow test, c2(8) = 11.932, P = 0.103; Cox & Snell R2 = 0.041; Nagelkerke R2 = 0.074. OR, odds ratio;CI, confidence interval; –, not applicable in the multivariate analysis

4.6.18 Level of perceived self-efficacy towards dengue prevention (post-intervention)

In the post-intervention, less than half of the Orang Asli participants had higher perceived self-efficacy in the prevention of dengue (level of self-efficacy 6-10) (n=548, 90.0%) whereas the remaining 10.0% (n = 61) have lower perceived self-efficacy in the prevention of dengue (level of self-efficacy 0-5).

Table 4.28 shows the univariate analysis of the association between independent factors such as socio demographic characteristics, dengue experience, environmental factors and total median knowledge score, and the outcome variable (perceived self-efficacy in the prevention of dengue). There was a significant difference ($p<0.05$) in the perceived self-efficacy in the prevention of dengue by gender, tribe, type of occupation and total knowledge score.

The four significant characteristics in the univariate analysis were included in the multivariate logistic regression analysis for perceived self-efficacy in the prevention of dengue on the scale of 6-10 vs. 0-5. Two significant associations were revealed (Table 4.28). The perceived self-efficacy in the prevention of dengue were associated with tribe where the others tribe's category was found significantly more likely (OR = 5.143, 95%CI= 1.792 -14.764) to have higher perceived self-efficacy in the prevention of dengue compared to the Temuan tribe. Type of occupation was significantly associated with perceived self-efficacy in the prevention of dengue where housewives significantly less likely (QR = 0.307, 95%CI=0.106 – 0.889) to have higher perceived self-efficacy in the prevention of dengue compared to the reference group (others). In the test for goodness of fit, the Chi-square value for the Hosmer-Lemeshow test was 12.481 with a significance level of 0.131 ($p>0.05$), implying a good fit.

Table 4.28: Association between socio demographic characteristics of study participant with self–efficacy score post- intervention

Details	Univariate analysis			Multivariate Binary Logistics Regression
	The level of perceived self-efficacy			Perceived self-efficacy level 6-10 *vs.* 0-5
(A)Socio Demographic Data	0-5 (n = 61)	6-10 (n = 548)	*p* - Value	Adjusted OR (95%CI)
Age group (years old)				
18-30	17 (7.9)	198 (92.1)		
31-50	31 (11.4)	241 (88.6)	0.429	
>50	13 (10.7)	109 (89.3)		
Gender				
Male	11 (4.4)	238 (95.6)		1.622 (0.622 – 4.227)
Female	50 (13.9)	310 (86.1)	0.000	Reference
Tribe				
Temuan	50 (13.9)	309 (86.1)		Reference
Mahmeri	7 (5.5)	120 (94.5)	0.001	1.972 (0.847 – 4.594)
Others	4 (3.3)	119 (96.7)		5.143 (1.792 -14.764) *
Education				
No formal Education	12 (14.6)	70 (85.4)		
Primary level	28 (11.9)	208 (88.1)	0.068	
Secondary & above level	21 (7.2)	270 (92.8)		
Occupation				
Manual worker	9 (3.9)	195 (96.1)		Reference
Housewife	41 (16.9)	201 (83.1)	0.000	0.307 (0.106 – 0.889) *
Others	12 (7.3)	152 (92.7)		0.686 (0.258 – 1.825)
Monthly income (MYR) [N=475]				
1000 and below	35 (12.1)	254 (87.9)	0.058	
> 1000	12 (6.5)	174 (93.5)		
(B) Dengue Experiences				
Had Dengue Before				
Yes	1 (3.4)	28 (96.6)	0.345	
No	60 (10.3)	520 (89.7)		
(C) Environmental Factors				
Density of plants or vegetation				
None / Low	18 (11.1)	144 (88.9)		
Moderate	26 (11.3)	205 (88.7)	0.425	
A lot	17 (7.9)	199 (92.1)		
Density of mosquitoes in neighbourhood				
None / Low	22 (9.8)	202 (90.2)		
Moderate	28 (10.2)	228 (89.8)	0.988	

Severe	13 (9.9)	118 (90.1)		
Frequency of mosquito fogging				
None / Rarely	48 (10.7)	400 (89.3)		
Occasionally / Often	13 (8.1)	148 (91.9)	0.444	
Post-intervention knowledge Score				
13-32	39 (12.7)	269 (87.3)		Reference
33-40	22 (7.3)	279 (92.7)	0.031	1.535 (0.865- 2.725)

*P < 0.05, **P < 0.01, ***P < 0.001. Hosmer and Lemeshow test, c2(8) = 7,184, P = 0.410; Cox & Snell R2 = 0.067; Nagelkerke R2 = 0.141. OR, odds ratio;CI, confidence interval; –, not applicable in the multivariate analysis

4.6.19 Statement in perceived self-efficacy towards dengue prevention

Perceived self-efficacy towards dengue prevention eere further assessed with three detailed questions in Table 4.29. In post intervention, nearly 60% participants "agree" to the statement that "they will be more confident to dengue prevention practices if people in their surrounding areas do so" (n=376, 61.7%), "encouraged by the authorities about dengue prevention activities, you will be more confident to do it" (n=370,60.8%) and "if there is a case of dengue reported in your neighborhood, you will be more confident to do the dengue prevention" (n=402, 66.0%).

Table 4.29: Statements of perceived self-efficacy in preventing dengue

Perceived Self-Efficacy	**N (%)**	
If people in your surrounding area carry out dengue prevention practices, you will be more confident to do so.		
Strongly Agree	6 (1.0)	78 (12.8)
Agree	133 (21.8)	376 (61.7)
Disagree	121 (19.9)	42 (6.9)
Strongly disagree	349 (57.3)	113 (18.6)
If you are encouraged by authorities about dengue prevention activities, you will be more confident to do it.		
Strongly Agree	8 (1.3)	95 (15.6)
Agree	173 (28.4)	370 (60.8)
Disagree	139 (22.8)	43 (7.1)
Strongly disagree	289 (47.5)	101 (16.6)
If there is any case of dengue in your neighborhood, you will be more confident to do prevention.		
Strongly Agree	36 (5.9)	107 (17.6)
Agree	269 (44.2)	402 (66.0)
Disagree	92 (15.1)	30 (4.9)
Strongly disagree	212 (34.8)	70 (11.5)

4.6.20 Association between socio-demographic characteristics, dengue experience, environmental factors, increase in total knowledge score and difference in the level of perceived self-efficacy in the prevention of dengue.

The difference in the level of perceived self-efficacy in the prevention of dengue is obtained by subtracting the score of self-efficacy in the post-intervention with the score of self-efficacy in the pre-intervention. Slightly more than half of the Orang Asli participants had no increment (n=546, 89.7%) and only a minority about (10.3%) of the participants have increment in the perceived self-efficacy in the prevention of dengue (n=63). The univariate analysis was carried out by using Chi-square test to examine the association between analysis of factors (the socio-demographic characteristics, dengue experience, environmental factors, increase in knowledge score) and outcome variable (differences in the level of perceived self-efficacy in the prevention of dengue) between the study participants.

The univariate analysis of association between independent factors namely socio demographic characteristics, dengue experience, environmental factors and increase dengue knowledge score and the outcome variable (differences level of perceived self-efficacy in the prevention of dengue) has been displayed in Table 4.29. There was no any significant difference ($p<0.05$) found.

Table 4.30: Association between socio demographic characteristics, dengue experience and environmental factors of study participant with difference in self-efficacy

Details				Multivariate Binary Logistics Regression
	Difference in score of The level of self-efficacy			
(A)Socio Demographic Data	Have increment (n = 63)	No increment (n = 546)	*p* - Value	Adjusted OR (95%CI)
Age group (years old)				
18-30	26 (12.1)	189 (87.9)		
31-50	26 (9.6)	246 (90.4)	0.571	
>50	11 (9.0)	111 (91.0)		

Gender			
Male	22 (8.8)	227 (91.2)	
Female	41 (11.4)	319 (88.6)	0.345
Tribe			
Temuan	42 (11.7)	317 (88.3)	
Mahmeri	10 (7.9)	117 (92.1)	0.405
Others	11 (8.9)	112 (91.1)	
Education			
No formal Education	13 (15.9)	69 (84.1)	
Primary level	25 (10.6)	211 (89.4)	0.160
Secondary & above level	25 (8.6)	266 (91.4)	
Occupation			
Manual worker	18 (8.9)	185 (91.1)	
Housewife	22 (9.1)	220 (90.9)	0.194
Others	23 (14.0)	141 (86.0)	
Monthly income (MYR) [N=475]			
1000 and below	28 (9.7)	261 (90.3)	0.540
> 1000	22 (11.8)	164 (88.2)	
(B) Dengue Experiences			
Had Dengue Before			
Yes	3 (10.3)	26 (89.7)	1.000
No	60 (10.3)	520 (89.7)	
(C) Environmental Factors			
Density of plants or vegetation			
None / Low	20 (12.3)	142 (87.7)	
Moderate	23 (10.0)	208 (90.0)	0.603
A lot	20 (9.3)	196 (90.7)	
Density of mosquitoes in neighbourhood			
None / Low	19 (8.5)	205 (91.5)	
Moderate	28 (11.0)	226 (89.0)	0.483
Severe	16 (12.2)	115 (87.8)	
Frequency of mosquito fogging			
None / Rarely	48 (10.7)	409 (89.3)	
Occasionally / Often	16 (9.3)	146 (90.7)	0.763
Increment in Knowledge Score			
0-6	36 (9.5)	332 (90.5)	0.419
7-17	28 (11.6)	214 (88.4)	

*P < 0.05, **P < 0.01, ***P < 0.001.

4.7 Analysis on Prevention Practices

4.7.1 Descriptive Analysis of Pre-intervention Prevention Practices

The responses for dengue preventive practices are illustrated in Table 4.31. The options for dengue prevention practices were assessed in four-Likert scale consists of "Not at all", "Rarely", "Sometimes" and "Often".

A large proportion answered "often" to the practices of cleaning up surrounding housing area (n= 277, 45.5%) and use of mosquito coil, electric mosquito mat, liquid vaporizer, mosquito bulb or mosquito trap (n 217. 35.6%). About 47.1 % opted "sometimes" for the preventive practices of changing stored water (n= 287). However, half of the participant answered "Not at all" for taking mosquito prevention measures before going for a long holiday (n= 308, 60.6%).

Table 4.31: Responses for Dengue preventive practices items in the pre – intervention

Practices Item	**Number (%)**			
	Not at all	**Rarely**	**Sometimes**	**Often**
Cover all water containers	77 (12.6)	181 (29.7)	260 (42.7)	91 (14.9)
Change stored water	88 (14.4)	142 (23.3)	287 (47.1)	92 (15.1)
Put abate/ chemical in water storage containers	214 (35.1)	190 (31.2)	156 (25.6)	49 (8.0)
Examine for mosquito larval	158 (25.9)	177 (29.1)	187 (30.7)	87 (14.3)
Clear out debris in drain or roof gutters	136 (22.3)	232 (38.1)	163 (26.8)	78 (12.8)
Proper disposal of items	63 (10.3)	284 (46.6)	167 (27.4)	95 (15.6)
Proper disposal of household garbage	34 (5.6)	235 (38.6)	212 (34.8)	128 (21.0)
Clean up surrounding housing area	3 (0.5)	94 (15.4)	235 (38.6)	277 (45.5)

Take mosquito preventive measures before going on long holidays	308 (60.6)	165 (27.1)	91 (14.8)	45 (7.4)
Sleep in mosquito net or have mosquito screens on windows	65 (10.7)	125 (20.5)	206 (33.8)	213 (35.0)
Use mosquito coil, electric mosquito mat, liquid vaporizer, mosquito bulb or mosquito trap	46 (7.6)	129 (21.2)	217 (35.6)	217 (35.6)
Spraying dark places with an insecticidal spray	79 (13.0)	212(34.8)	198 (32.5)	120 (19.7)
Use mosquito repellent on body	399 (65.5)	128 (21.0)	66 (10.8)	16 (2.6)
Avoid dark areas in the home where there is no light or wind	222 (36.5)	208 (34.2)	143 (23.5)	36 (5.9)
Wear long- sleeved shirts and pants	84 (13.8)	240 (39.4)	235 (38.6)	50 (8.2)
Wear bright color clothes	159 (26.1)	289 (47.5)	122 (20.0)	39 (6.4)
Take measures to prevent mosquitoes from biting a dengue patient	235 (38.6)	158 (25.9)	119 (19.5)	97 (15,9)
Put a dengue patient under bed nets	251 (41.2)	140 (23.0)	91 (14.9)	127 (20.9)
Avoid sexual intercourse with spouse IF he/she infected with dengue	485 (79.6)	58 (9.5)	33 (5.4)	33 (5.4)

4.7.2 Association between socio-demographic characteristics, dengue experience, environmental factors, health beliefs and median dengue pre-intervention total knowledge score with median dengue total preventive score of pre-intervention

The self-reporting prevention practices is measured by summation of the entire prevention item. Each item is scaled on point. The score points were allocated for the options of preventive measures "0" for 'not at all'; "1" for 'rarely'; "2" for 'sometimes' and "3" for 'often'. The total practices items were measured resulting with possible scores ranging from 0 to 57. The higher the score shows the better dengue preventive practices. Throughout the samples, the median score of total dengue preventive practices of pre-intervention for overall participants was 25.0 [21.0 – 29.0] out of possible score of 57, with higher median scores indicating better performance of dengue preventive practices.

Based on the table, slightly more than half of the participants (n = 321, 52.7%) had total dengue prevention practices score 26 to 40 while 288 (47.2%) of participants had total dengue prevention practices score of 10 - 25. The univariate analysis was carried out by using Chi-square test to examine the association between the socio-demographic characteristics, dengue experience, environmental factors, health beliefs and median dengue of total knowledge score with median dengue total preventive score of the study participants during the pre-intervention.

Table 4.32 illustrates the univariate analysis demonstrating the median dengue preventive practice score versus the socio-demographic characteristics, dengue experience, environmental factors, health belief and median dengue total knowledge score. Based on table 4.32, 321 had a range of total dengue self- reporting prevention scores of 26 to 45, resembling good prevention practices. Meanwhile, 288 of participants had a range of total dengue self-reporting prevention scores of 10 – 25, exhibiting low

prevention practices. Univariate analysis showed 11 significant differences across the factors.

Significant associations in the univariate analysis that had a p-value less than 0.05 were selected and included in the multivariate model. The significant variables of univariate analysis are age group, tribes, highest education attainment, average monthly household income, frequency of mosquito fogging, perceived severity, perceived susceptibility, perceived barriers, cues to action, self-efficacy and median dengue total knowledge score.

A multivariate linear regression analysis was conducted to assess the factors (socio-demographic characteristics, dengue experience, environmental factors, health beliefs, and median dengue total knowledge score) with median dengue total preventive practices score. The eleven significant characteristics in the univariate analysis were included in the multivariate logistic regression analysis. Four significant association were revealed. The median total dengue preventive practices score was associated with tribe whereby Mahmeri (OR= 0.456, 95% CI =0.208–1.002) was found to be significantly less likely to have higher dengue preventive practices compared to the reference group (others). Likewise, participants who obtained primary level (OR = 2.552, 95%CI = 1.125-5.785) and secondary or above level (OR = 9.039, 95%CI = 3.520 – 23.214) were significantly more likely to have higher perceived dengue preventive practices compared to the reference group (no formal education). Participants with higher perceived susceptibility (score 6-10) towards dengue was significantly more likely (OR= 1.891, 95% CI= 1.146 – 3.116) to perform good dengue preventive practices compare to reference (the lower of perceived susceptibility (score of 0-5)). Participants who score 26-36 total dengue knowledge score were significantly more likely (OR= 2.694 95% CI=1.509 – 4.808) to execute a better dengue preventive practice compared to the

participants who had lower dengue knowledge score. In the test for goodness of fit, the Chi-square value for the Hosmer-Lemeshow test was 7.514 with a significance level of 0.482 (p>0.05), implying a good fit.

Table 4.32: Association between socio demographic characteristics of study participant with prevention practices score pre -intervention.

Details		Univariate analysis			Multivariate Binary Logistics Regression
		Total Prevention practices score			Dengue prevention practices score 26-45 *vs.* 10-25
(A)Socio Demographic Data	n (%)	10-25 (n = 288)	26-40 (n = 321)	*p* - Value	
Age group (years old)					
18-30	215 (35.3)	87 (40.5)	128 (59.5)		Reference
31-50	272 (44.7)	128 (47.1)	144 (52.9)	0.003	0.817 (0.482 – 1.385)
>50	122 (20.0)	73 (59.8)	49 (40.2)		0.650 (0.328 – 1.280)
Gender					
Male	249 (40.9)	122 (49.0)	127 (51.0)		
Female	360 (59.1)	166 (46.1)	194 (53.9)	0.509	
Tribe					
Temuan	359 (58.9)	185 (51.5)	174 (48.5)		0.638 (0.319 – 1.276)
Mahmeri	127 (20.9)	67 (52.8)	60 (47.2)	0.00	0.456 (0.208– 1.002) *
Others	123 (20.2)	36 (29.3)	87 (70.7)		Reference
Education					
No formal Education	82 (13.5)	71 (86.6)	11 (13.4)		Reference
Primary level	236 (38.8)	156(66.1)	80 (33.9)	0.00	2.552 (1.125 – 5.785) *
Secondary & above level	291 (47.8)	61 (21.0)	230 (79.0)		9.039 (3.520 – 23.214) ***
Occupation					
Manual worker	203 (33.3)	84 (41.4)	119 (58.6)		
Housewife	242 (39.7)	120 (49.6)	122 (50.4)	0.112	

Others	164 (26.9)	84 (51.2)	80 (48.8)		
Monthly income (MYR) [N=475]					
1000 and below	289 (47.5)	171 (59.2)	118 (40.8)	0.00	Reference
> 1000	186 (30.5)	58 (31.2)	128 (68.8)		1.606 (0.943 - 2.735)
(B) Dengue Experiences					
Had Dengue Before					
Yes	29 (4.8)	14 (48.3)	15 (51.7)	1.000	
No	580 (95.2)	274 (47.2)	306 (52.8)		
(C) Environmental Factors					
Density of plants or vegetation					
None / Low	162 (26.6)	84 (51.9)	78 (48.1)		
Moderate	231 (37.9)	99 (42.9)	132 (57.1)	0.190	
A lot	216 (35.6)	105 (49.6)	111 (51.4)		
Density of mosquitoes in neighbourhood					
None / Low	224 (36.8)	105 (46.9)	119 (53.1)		
Moderate	254 (41.7)	117 (46.1)	137 (53.9)	0.715	
Severe	131 (21.5)	66 (50.4)	65 (49.6)		
Frequency of mosquito fogging					
None / Rarely	448 (73.6)	227 (50.7)	221 (49.3)	0.006	Reference
Occasionally / Often	161 (26.4)	61 (32.9)	100 (62.1)		2.705 (1.548 – 4.728)
D) Pre- Intervention Knowledge Score					
11-26	328 (53.9)	226 (68.9)	102 (31.4)	0.00	Reference
27-36	281 (46.1)	62 (22.1)	219 (77.9)		2.694 (1.509 – 4.808) **
E) Health Beliefs Perceived Severity					
0 – 5	140 (23.0)	83 (59.3)	57 (40.7)	0.001	Reference
6 -10	469 (77.0)	205 (43.7)	264 (56.3)		1.360 (0.731 – 2.531)

Perceived Susceptibility					
0 – 5	260 (42.7)	154 (59.2)	100 (40.8)	0.00	Reference
6 - 10	349 (57.3)	134 (38.4)	215 (61.6)		1.891 (1.146 – 3.116) *
Perceived Barriers					
0 – 5	292 (47.9)	169 (57.9)	123 (42.1)	0.00	Reference
6 – 10	317 (52.1)	119 (37.5)	198 (62.5)		1.090 (0.657-1.808)
Cues to Action					
0 – 5	292 (47.9)	185 (60.3)	122 (39.7)	0.00	Reference
6 - 10	317 (52.1)	103 (34.1)	199 (65.9)		1.088 (0.658 – 1.798)
Self-Efficacy					
0 – 5	86 (14.1)	56 (65.1)	30 (34.9)	0.00	Reference
6 – 10	523 (85.9)	232 (44.4)	291 (55.6)		1.760 (0.866-3.577)

*P < 0.05, **P < 0.01, ***P < 0.001. Hosmer and Lemeshow test, c2(8) = 7.514, P = 0.482; Cox & Snell R2 = 0.338; Nagelkerke R2 = 0.451. OR, odds ratio;CI, confidence interval; –, not applicable in the multivariate analysis

4.7.3 Descriptive analysis of post-intervention prevention practices

Majority of the participants answered “often” to the practices of cleaning up surrounding housing area (n= 467, 76.7%), use of mosquito coil, electric mosquito mat, liquid vaporizer, mosquito bulb or mosquito trap (n= 76. 78.2%) and spraying dark places with an insecticidal spray (n= 432, 70.9%). Slightly more than half of the participants chose the option ‘sometimes’ for the preventive practices of avoiding dark areas in the home (n= 338, 55.5%), wear bright colours (n= 342, 56.2%) and use mosquito repellents on body (n= 322, 52.9%). About 48.6 % opted “not at all” for the preventive practices of taking mosquito prevention measures before going for a long holiday (n= 296).

Table 4.33: Responses for Dengue preventive practices items post- intervention

Practices Item	Number (%)			
	Not at all	Rarely	Sometimes	Often
Cover all water containers	24 (3.9)	61 (10.0)	136 (22.3)	388 (63.7)
Change stored water	27 (4.4)	40 (6.6)	155 (25.5)	387 (63.5)
Put abate/ chemical in water storage containers	57 (11.0)	141 (23.2)	231 (37.9)	170 (27.9)
Examine for mosquito larval	42 (6.9)	61 (10.0)	198 (32.5)	308 (50.0)
Clear out debris in drain or roof gutters	30 (4.9)	85 (14.0)	177 (29.1)	317 (52.1)
Proper disposal of items	27 (4.4)	92 (15.1)	185 (30,4)	305 (50.1)
Proper disposal of household garbage	8 (1.3)	51 (8.4)	119 (19.5)	431 (70.8)
Clean up surrounding housing area	2 (0.3)	35 (5.7)	105 (17.2)	467 (76.7)
Take mosquito preventive measures before going on long holidays	245 (40.2)	88 (14.4)	161 (26.4)	115 (18.9)
Sleep in mosquito net or have mosquito screens on windows	21 (3.4)	49 (8.0)	168 (27.6)	371 (60.9)
Use mosquito coil, electric mosquito mat, liquid vaporizer, mosquito bulb or mosquito trap	5 (0.8)	21 (3.4)	107 (17.6)	476 (78.2)
Spraying dark places with an insecticidal spray	8 (1.3)	37 (6.1)	132 (21.7)	432 (70.9)
Use mosquito repellent on body	31 (5.1)	104 (17.1)	322 (52.9)	152 (25.0)
Avoid dark areas in the home where there is no light or wind	37 (6.1)	79 (13.0)	338 (55.5)	155 (25.5)

Wear long- sleeved shirts and pants	8 (1.3)	67 (11.0)	317 (52.1)	217 (35.6)
Wear bright color clothes	16 (2.6)	67 (11.0)	342 (56.2)	184 (30.2)
Take measures to prevent mosquitoes from biting a dengue patient	44 (7.2)	54 (8.9)	190 (31.2)	321 (52.7)
Put a dengue patient under bed nets	54 (8.9)	62 (10.2)	213 (35.0)	280 (46.0)
Avoid sexual intercourse with spouse IF he/she infected with dengue	296 (48.6)	37 (6.1)	183 (30.0)	93 (15.3)

4.7.4 Association between socio-demographic characteristics, dengue experience, environmental factors, Health Beliefs and median dengue total knowledge score with median dengue total preventive score during the post-intervention.

The total practices items were resulted in possible scores ranging from 0 to 57. The higher the scores, the better the dengue preventive practices. Throughout the samples, the median score of the total dengue preventive practices for overall participants was 43.0 [36.0 – 48.0] out of possible score of 57, with higher scores indicating better performance of dengue preventive practices.

According to the table below, slightly less than half of the participants (n = 301) had a range of total dengue self- reporting prevention score 44 to 57 while 308 of participants had a range of total dengue self- reporting prevention score of 21 - 43. The univariate analysis was carried out by using Chi-square test to examine the association between the socio-demographic characteristics, dengue experience, environmental factors, Health Beliefs and median dengue of total knowledge score with median dengue total preventive score of the study participants in the post-intervention.

Table 4.34 displays univariate analysis where outcome variable of the model is median dengue preventive practice score versus the socio-demographic characteristics, dengue experience, environmental factors, health belief and median dengue total knowledge score. Based on the table, 301 (49.4%) had a range of total dengue self-reporting prevention score of 44 to 57, resembling good prevention practices. About 308 (50.5%) of participants had a range of total dengue self-reporting prevention score of 21 – 43, exhibiting low prevention practices. Univariate analysis showed 11 significant differences across the factors. Significant associations in the univariate analysis that had a p-value less than 0.05 were selected and included in the multivariate model. The significant variables of univariate analysis are tribes, highest attainment of education, type of occupation, average monthly household income and density of plants or vegetation, perceived severity, perceived susceptibility, perceived barriers, cues to action, self-efficacy, and median dengue total knowledge score post intervention.

A multivariate linear regression analysis was conducted to assess the factors (socio-demographic characteristics, dengue experience, environmental factors, health beliefs, and median dengue total knowledge score) with median dengue total preventive practices score. The eleven significant characteristics in the univariate analysis were included in the multivariate logistic regression analysis. Six significant association were revealed. The median total dengue preventive practices score was associated with tribe where the others category (OR = 2.749, 95%CI=1.361- 5.554) was found to be significantly more likely to have higher dengue preventive practices compared to the reference group (Temuan). In addition, participants whom obtained primary level (OR = 7.212, 95%CI = 2.597- 20.027) and secondary or above level (OR = 12.005, 95%CI = 3.935 – 36.637) were significantly more likely to have higher perceived dengue preventive practices compared to the reference group (no formal education). Participants with higher perceived severity (score 6-10) of dengue were significantly more likely

(OR= 3.169, 95% CI=1.039 – 9.663) to perform good dengue preventive practices compared to the reference (score 0-5). The cues to action of dengue with the scores of 6-10 significantly more likely (OR= 5.990, 95% CI = 2.587 – 13.354) to carry out good dengue preventive practices compared to the reference group (score 0-5). Participants who score 36-40 in total dengue knowledge had two times higher odds of executing a better dengue preventive practice (OR= 2.249 95% CI=1.237 – 4.087), than those who scored 24 – 35 in total dengue knowledge score. In the test for goodness of fit, the Chi-square value for the Hosmer-Lemeshow test was 8.519, with a significance level of 0.384 (p>0.05), implying a good fit.

Table 4,34: Association between socio demographic characteristics of study participant with prevention practices score post intervention.

Details	n (%)	Univariate analysis			Multivariate Binary Logistics Regression
		Total Prevention practices score			Prevention practices score of 44-57 *vs*. 21-43
(A)Socio Demographic Data		21-43 (n = 308)	44-57 (n = 301)	*p* - Value	
Age group (years old)					
18-30	215 (35.3)	99 (46.0)	116 (54.0)		
31-50	272 (44.7)	141 (51.8)	131 (48.2)	0.198	
>50	122 (20.0)	68 (55.7)	54 (44.3)		
Gender					
Male	249 (40.9)	115 (46.2)	134 (53.8)	0.083	
Female	360 (59.1)	193 (53.6)	167 (46.4)		
Tribe					
Temuan	359 (58.9)	213 (59.3)	145 (40.7)		Reference
Mahmeri	127 (20.9)	60 (47.2)	67 (52.8)	0.00	1.186 (0.672 – 2.088)
Others	123 (20.2)	35 (28.5)	88 (71.5)		2.749 (1.361-5.554) *
Education					

No formal Education	82 (13.5)	77 (93.9)	5 (6.1)		Reference
Primary level	236 (38.8)	144 (61.0)	92 (39.0)	0.00	7.212 (2.597 – 20.027) ***
Secondary & above level	291 (47.8)	87 (29.9)	204 (70.1)		12.005 (3.935 - 36.637) ***
Occupation					
Manual worker	203 (33.3)	79 (38.9)	124 (61.1)		Reference
Housewife	242 (39.7)	144 (59.5)	98 (40.5)	0.00	0.599 (0.340 – 1.056)
Others	164 (26.9)	85 (51.8)	79 (48.2)		1,230 (0.675 – 2.243)
Monthly income (MYR) [N=475]					
1000 and below	289 (47.5)	180 (62.3)	109 (37.7)	0.00	Reference
> 1000	186 (30.5)	63 (33.9)	123 (66.1)		1.465 (0.888 – 2.417)
(B) Dengue Experiences					
Had Dengue Before					
Yes	29 (4.8)	12 (41.4)	17 (58.6)	0.345	
No	580 (95.2)	296 (51.0)	284 (49.0)		
(C) Environmental Factors					
Density of plants or vegetation					
None / Low	162 (26.6)	97 (59.9)	65 (40.1)		Reference
Moderate	231 (37.9)	108 (46.8)	123 (53.2)	0.022	1.288 (0.694 – 2.392)
A lot	216 (35.6)	103 (47.7)	113 (52.3)		1.151 (0.622 – 2.131)
Density of mosquitoes in neighbourhood					
None / Low	224 (36.8)	118 (52.7)	106 (47.3)		
Moderate	254 (41.7)	122 (48.0)	132 (52.0)	0.564	
Severe	131 (21.5)	68 (51.9)	63 (48.1)		
Frequency of mosquito fogging					
None / Rarely	448 (73.6)	228 (50.9)	220 (49.1)	0.854	
Occasionally / Often	161 (26.4)	80 (49.7)	81 (50.3)		

D) Post-Intervention Knowledge Score					
24 -35	323 (53.0)	218 (70.8)	90 (29.2)	0.00	Reference
36- 40	281 (47.0)	90 (29.9)	211 (70.1)		2.249 (1.237 – 4.087) *
E) Health Beliefs					
Perceived Severity					
0 – 5	61 (10.0)	52 (85.2)	9 (14.9)	0.00	Reference
6 -10	548 (90.0)	256 (46.7)	292 (53.3)		3.169 (1.039 – 9.663) *
Perceived Susceptibility					
0 – 5	249 (40.9)	152 (61.0)	97 (39.0)	0.00	Reference
6 - 10	360 (59.1)	156 (43.3)	204 (56.7)		1.340 (0.828 – 2.169)
Perceived Barriers					
0 – 5	243 (39.9)	154 (63.4)	89 (36.6)	0.00	Reference
6 – 10	366 (60.1)	154 (42.1)	212 (57.9)		1.153 (0.690-1.926)
Cues to Action					
0 – 5	112 (18.4)	97 (86.6)	15 (13.4)	0.00	Reference
6 - 10	497 (81.5)	211 (42.5)	286 (57.5)		5.990 (2.687 – 13.354) ***
Self-Efficacy					
0 – 5	61 (10.0)	52 (85.2)	9 (14.8)	0.00	Reference
6 – 10	548 (90.0)	256 (46.7)	292 (53.3)		3.350 (1.161 – 9.669) *

*P < 0.05, **P < 0.01, ***P < 0.001. Hosmer and Lemeshow test, c2(8) = 8.519, P = 0.384; Cox & Snell R2 = 0.347; Nagelkerke R2 = 0.463. OR, odds ratio; CI, confidence interval; –, not applicable in the multivariate analysis

4.7.5 Association between socio-demographic characteristics, dengue experience and environmental factors, differences in health beliefs, increment in total knowledge score and increment in total preventive scores.

The increase in dengue preventive practice score is obtained by deducting the prevention practices score of the post - intervention from the pre-intervention. The increase in total prevention practice score was not normally distributed thus, data was

analysed categorical by using the median split as the cut-off point. The median total prevention practice score for the overall sample was 16.0, [IQR: 11.0 – 22.0]. The level of prevention practices was categorised into two levels where scores of 0-16 indicate lower increment in prevention practice score and scores of 17-34 indicates higher increment in prevention practice score. The univariate analysis was carried out using Chi-square test to examine the association between analysis of factors (the socio-demographic characteristics, dengue experience, environmental factors, difference in health belief and increase total knowledge score) and outcome variable (increase in dengue prevention practices) between the study participants.

Table 4.35 highlights the univariate analysis of the increment in dengue prevention practices versus the independent variable such as the socio-demographic characteristics, dengue experience, environmental factors, difference in health belief and increment total knowledge score. About 298 participants had a range of total dengue knowledge scores of 17-34 that indicate higher increment in prevention practices score. About 311 of participants had a range of total dengue knowledge score of 0 to16 that indicate a lower increment in prevention practices score. Univariate analysis showed nine significant differences across the factors.

Significant associations in the univariate analysis that had a p-value less than 0.05 were selected and included in the multivariate model. The significant variables of univariate analysis are gender, tribes, highest attainment of education, type of occupation, average monthly household income, perceived severity, perceived susceptibility, cues to action and increment in the total knowledge score.

A multivariate binary logistic regression analysis with nine significant characteristics in the univariate analysis was conducted for the scores 17-34 vs. score 0-16. Six significant association were revealed. The significant variables are tribes,

education level, type of occupation, difference in perceived severity, difference perceived susceptibility and increase in total knowledge score. The tribe 'Temuan' were significantly less likely (OR = 0.444, 95%CI= 0.254 – 0.777) to have higher increment in prevention practices score compare the reference group (other tribe). The housewives were significantly less likely (OR = 0.535, 95%CI= 0.289 – 0.950) to perceive a higher increment in dengue prevention practices score of 17-34 compared to reference group (other occupation category). Compared to participants with non-formal education, those with primary education level and secondary education or above level have higher odds [(OR= 2.627, 95%CI= 1.338 – 5.160); OR =2.263, 95%CI = 1.126 – 4.550 respectively] of higher increment in dengue preventive practices score (17-34). Participants with higher dengue knowledge score (7-17) were more likely (OR= 2.390, 95% CI = 1.521 – 3.757, p<0.001) to have higher increment in dengue prevention practices score compared to those scored lower total knowledge score. Participants with no increment in perceived severity (OR= 0.349, 95%CI = 1.521- 3.757, p<0.05) and no increment perceived susceptibility (OR= 0.474, 95%CI = (0.286 – 0.785, p<0.00) were significantly less likely to have higher increment in dengue prevention practices score. In the test for goodness of fit, the Chi-square value for the Hosmer-Lemeshow test was 10.584, with a significance level of 0.226) (p>0.05), implying a good fit.

Table 4.35: Association between socio demographic characteristics, dengue experience and environmental factors, health belief and increment in knowledge score of study participant with increment in total preventive score

Details	n (%)	Univariate analysis			Multivariate Logistics Regression
		Increment in prevention score			Increment in prevention practices score of 17-34 *vs.* 0-16
(A)Socio Demographic Data		0-17 (n = 311)	17-34 (n = 298)	*p* - Value	
Age group (years old)					

18-30	215 (35.3)	112 (52.1)	103 (47.9)		
31-50	272 (44.7)	138 (50.7)	134 (49.3)	0.924	
>50	122 (20.0)	61 (50.0)	61 (50.0)		
Gender					
Male	249 (40.9)	108 (43.4)	141 (56.6)		1.357 (0.790 – 2.329)
Female	360 (59.1)	203 (56.4)	157 (43.6)	0.002	Reference
Tribe					
Temuan	359 (58.9)	202 (56.3)	157 (43.7)		0.444 (0.254 – 0.777) *
Mahmeri	127 (20.9)	53 (41.7)	74 (58.3)	0.007	0.608 (0.312 – 1.184)
Others	123 (20.2)	56 (45.5)	67 (54.5)		Reference
Education					
No formal Education	82 (13.5)	58 (70.7)	24 (29.3)		Reference
Primary level	236 (38.8)	108 (45.8)	128 (54.2)	0.00	2.627 (1.338 – 5.160) *
Secondary & above level	291 (47.8)	145 (49.8)	146 (50.2)		2.263 (1.126 – 4.550) *
Occupation					
Manual worker	203 (33.3)	88 (43.3)	116 (56.7)		1.113 (0.663 – 1.870)
Housewife	242 (39.7)	144 (59.5)	98 (40.5)	0.002	0.535 (0.289 – 0.950) *
Others	164 (26.9)	79 (48.2)	85 (51.8)		Reference
Monthly income (MYR) [N=475]					
1000 and below	289 (47.5)	161 (55.7)	128 (44.3)	0.019	Reference
> 1000	186 (30.5)	83 (44.6)	103 (55.4)		1.142 (0.706 – 1.851)
(B) Dengue Experiences					
Had Dengue Before					
Yes	29 (4.8)	18 (62.1)	11 (37.9)	0.257	
No	580 (95.2)	293 (50.5)	287 (49.5)		
(C) Environmental Factors					
Density of plants or vegetation					
None / Low	162 (26.6)	89 (54.9)	73 (45.1)		

Moderate	231 (37.9)	118 (51.1)	113 (48.9)	0.426	
A lot	216 (35.6)	104 (48.1)	112 (51.9)		
Density of mosquitoes in neighbourhood					
None / Low	224 (36.8)	117 (52.2)	107 (47.8)		
Moderate	254 (41.7)	127 (50.0)	127 (50.0)	0.888	
Severe	131 (21.5)	67 (51.1)	64 (48.9)		
Frequency of mosquito fogging					
None / Rarely	448 (73.6)	225 (50.2)	223 (49.8)		
Occasionally / Often	161 (26.4)	86 (53.4)	75 (46.6)	0.520	
D) Increment in Knowledge Score					
0-6	367 (60.1)	220(59.9)	147 (40.1)	0.00	Reference
7-17	242 (39.9)	91 (37.6)	151 (62.4)		2.390 (1.521 – 3.757) ***
E) Differences in health beliefs					
Perceived Severity					
Have increment`	91 (14.9)	29 (31.9)	62 (68.1)	0.00	Reference
No increment	518 (85.1)	282 (54.4)	236 (45.6)		0.349 (0.184 – 0.662) **
Perceived Susceptibility					
Have increment`	114 (18.7)	44 (38.6)	70 (61.4)	0.004	Reference
No increment	495 (81.3)	267 (53.9)	228 (46.1)		0.474 (0.286 – 0.785) *
Perceived Barriers					
Have increment`	119 (19.5)	53 (44.5)	66 (55.5)	0.125	
No increment	490 (80.5)	258 (52.7)	232 (47.3)		
Cues to Action					
Have increment`	205 (33.7)	88 (42.9)	117 (57.1)	0..005	Reference
No increment	404 (66.3)	223 (55.2)	181 (44.8)		0.694 (0.448 – 1.076)
Self-Efficacy					

Have increment`	63 (10.3)	27 (42.9)	36 (57.1)	0.185
No increment	546 (89.7)	284 (52.0)	262 (48.0)	

*P < 0.05, **P < 0.01, ***P < 0.001. Hosmer and Lemeshow test, c2(8) = 10.584, P = 0.226; Cox & Snell R2 = 0.153; Nagelkerke R2 = 0.205. OR, odds ratio;CI, confidence interval; –, not applicable in the multivariate analysis

4.8 Analysis of Orang Asli Perception on Dengue Awareness Calendar

Majority of the participants answered "strongly agree" to the size of the dengue calendar as suitable to hang inside the house (n= 215, 35.3%) and agreed that the dengue calendar plays a vital role as a tool to create awareness (n= 214. 35.1%). About 65% participants "agree" that the size of the font used in the dengue calendar is suitable to read by all age groups (n=396). Only 15 out of 609 participants had difficulties with the design of the dengue calendar which makes it hard to look for the provided information (2.5%).

Table 4.36: Response towards Dengue Calendar items

Item	Number (%)			
	Strongly Agree	Agree	Disagree	Strongly disagree
Perception towards Dengue calendar				
The dengue calendar plays role as source to create awareness.	214 (35.1)	323 (53.0)	72 (11.8)	-
The dengue calendar is beneficial for you in carrying out the dengue prevention practices	175 (28.7)	378 (62.1)	39 (6.4)	17 (2.8)
The dengue calendar motivates you to carry out the prevention	188 (30.9)	362 (59.4)	38 (6.2)	21(3.4)
Perception towards the content of dengue calendar				
The information provided in the dengue calendar is clear and easy to understand	180 (29.6)	384 (63.1)	21(3.4)	24 (3.9)
The information provided in the dengue calendar is comprehensives	187 (30.7)	372 (61.1)	27 (4.4)	23 (3.8)

Perception towards the design and illustration of dengue calendar				
The illustration attracts you to read the content of dengue calendar	154 (25.3)	389 (63.9)	40 (6.6)	26 (4.3)
The illustration makes you feel wanted to look at the dengue calendar for more than one time in a month	178 (29.2)	366 (60.1)	48 (7.9)	17 (2.8)
The size of the dengue calendar is suitable to put inside the house whether hang or not	215 (35.3)	359 (58.9)	15 (2.5)	20 (3.3)
The design of the dengue calendar ease you to look up for the provided information	168 (27.6)	382 (62.7)	44 (7.2)	15 (2.5)
The size of the font used in the dengue calendar is suitable to read by all age groups	180 (29.6)	396 (65.0)	14 (2.3)	19 (3.1)
The color of the font used in the dengue calendar is suitable to read by all age groups	202 (33.2)	347 (57.0)	38 (6.2)	22 (3.6)
The type of font used in the dengue calendar is suitable to read by all age groups	206 (33.8)	358 (58.8)	10 (1.7)	35 (5.7)

4.9 Overall Comparison of the variables (Knowledge score, level of health beliefs and prevention practices score)

The table below summarizes the median and interquartile range (IQR) of dengue knowledge score, health beliefs towards dengue agreement score and dengue prevention practices scores during the pre- and post-interventions. Overall, all variables' scores showed an increase from pre- to post-interventions. The median score of dengue knowledge had increased significantly from 26.0 in the pre-intervention to 32.0 in the post-intervention ($p<0.001$). The median score of dengue prevention practices had increased significantly from 24.0 in the pre-intervention to 43.0 in the post-intervention. Insignificant differences were observed for perceived susceptibility and perceived barrier in preventing dengue.

Table 4.37: Wilcoxon Signed Rank test for dengue knowledge score , the level of health beliefs and prevention score in the pre- and post- intervention

Variable	**Pre-test Med (IOR)**	**Post-test Med (IOR)**	**Z-value**	**p-value**
Knowledge Score	26.0 [19.0- 30.0]	32.0 [26.0- 36.0]	21.20	0.00*
Health Beliefs				
Perceived severity	10.0 [8.0-10.0]	10.0 [9.0- 10.0]	4.45	0.00*
Perceived Susceptibility	6.0 [4.0-8.0]	6.0 [4.0- 8.0]	0.28	0.779
Perceived barriers	6.0 [3.0- 8.0]	6.0 [4.0- 8.0]	1.29	0.199
Cues to action	5.0 [4.0- 9.0]	6.0 [4.0- 8.0]	3.48	0.001*
Self-efficacy	8.0 [6.0- 10.0]	8.0 [7.0- 10.0]	3.54	0.00*
Prevention Practices Score	24.0 [21.0- 29.0]	43.0 [36.0- 48.0]	21.22	0.00*

Med =Median IQR= Inter-quartile range

CHAPTER 5: DISCUSSION AND LIMITATION

5.1 Introduction

This chapter discusses the findings of the current study. The present study consists of three significant components investigating dengue knowledge, health beliefs, and prevention practices. Each section in this chapter begins with a discussion on the findings of this study. The discussion adds supportive evidence for the findings to corroborate the effectiveness of implementing an educational intervention to reduce the dengue fever incidence.

5.2 Socio-demographic of the study participants

Demographic factors such as gender, age, literacy, socio-economic status, and household income level influence the risk of dengue transmission (Alobuia et al., 2015; Siddiqui et al., 2016). Among 609 participants, there were more female respondents compared to the male respondents. In this study, the Temuan tribe had the greatest number of respondents while, the Jakun tribe had the least number of respondents. There was a difference in number of respondents according to their subgroups because the Orang Asli live scattered in Peninsular Malaysia and villages were selected based on purposive sampling.

Education is every human's right, and education has the power to enhance self-development and increase the standard of living (Nordin et al., 2020). Education is the main priority in the Orang Asli's development program (Kardooni et al.,2014). The government of Malaysia has implemented that every Orang Asli should be given equal education similar to the other Malaysians (Nordin et al., 2020). The majority of the

participants in this study attained secondary level education, likewise reported in a study conducted among Orang Asli in Peninsular Malaysia that found less than 20% attained secondary level education (Kardooni et al., 2014).

The percentage of Orang Asli employed in the professional and managerial category in this study is very small – less than 2% of total respondents. This is because most of the SPM leavers (the highest secondary education of Malaysia) working in factories and company than pursuing their education. The majority of participants participated in the study is housewives, this could be explained by the common cultural status among Orang Asli in that a wife's duty is to stay at home and take care of home and children well-being (Kardooni et al., 2014).

5.3 Dengue experience and social environment

The study findings revealed that a minority of participants have self-reported dengue fever, in line with research conducted among Orang Asli in Peninsular Malaysia (Chandren et al., 2015) and a study in the slums of Delhi, India where only 8% of household reported one diagnosed dengue case (Daude et al., 2017). The small number of self-reported dengue fever may show that Orang Asli was unaware of the disease or recovered without any treatment (Chandren et al., 2015). Hence, Orang Asli must be educated regarding the signs and symptoms of the disease and informed to seek early treatment to avoid further complications or fatalities.

Regarding the surrounding environment, participants live in the housing area surrounded with moderate density of plants and vegetation. A study conducted among Orang Asli in Penisular Malaysia reported that most of the Orang Asli people in Malaysia live at the forest fringes where the surroundings of their housing area had low density of

plants and vegetation (Chandren et al., 2015). In addition, a local study carried out among the Malaysian students who have been tested for dengue fever highlighted that the absence of vegetation in the surrounding environment had the highest proportion of dengue IgG presence (82.1%) compared with those reporting a high vegetation density in the surrounding environment (77.1%) (Wong et al., 2014). Thus, moderate, or low density of plants and vegetation do not reduce the chance of getting dengue. It is recommended to emphasize dengue can occur in any place and does not necessarily happen in areas with a high density of plants.

5.4 Knowledge on dengue pre and post intervention

The knowledge of dengue was investigated in six domains such as the general understanding of dengue and DHF, the transmission of dengue, prevention, signs and symptoms of dengue, signs, and symptoms of DHF, and treatment.

More than 60% of the participants in this study were aware about the knowledge on prevention practices. They were aware of common practices of weekly changing the stagnant water, covering water containers, drying containers, proper disposal of items and using Abate. The use of Abate was found effective to reduce *Aedes Aegypti* in water holding containers (Koenraadt et al.,2006).

In this study, most of the participants were aware that the Aedes spp mosquitoes transmit dengue, similar to a study carried out among the public in Malaysia (Wong et al., 2015). More than half of the total participants were able to identify Aedes mosquito bites during the dusk and dawn. This finding is in line with the studies conducted in Pakistan by Itrat et al. (2008), who reported that the respondents could identify the mosquito transmitting dengue bite during sunset or sunrise. This is in contrast with the

study conducted among rural residents in Philippines (Yboa et al., 2013), rural and slum communities in India (Malhotra et al., 2014), healthy population of highland and lowland communities in Central Nepal (Dhimal et al.,2014) who reported majority number of participants unaware the unique biting time of the mosquitoes.

The findings showed an increase in knowledge scores from pre- to post-intervention. A notable improvement was observed for the questions that tested on the general understanding of dengue. Nearly 82% of participants correctly answered that mosquito breeds in clean and stagnant water. The previous study among the urban, semi-urban, and rural communities in Malaysia also supported the findings that the stagnant water is the primary source of mosquito breeding (Al-Dubai et al., 2013).

In addition, increment in knowledge level was observed mainly for the questions that tested the knowledge regarding the transmission of dengue. The pre-intervention questionnaire revealed that the participants had the misconception that dengue can be transmitted via air, touch, or body fluid. However, an increase in the percentage of participants who disagree with those options suggests that providing the dengue awareness calendar led the participants to identify that transmission of dengue via blood and spread it to the others.

In both pre-and post-intervention, most of the participants correctly identified fever as the symptom of dengue fever in consistent with the other findings (Alves et al., 2015; Hairi et al., 2003; Usman et al., 2018). However, half of the participants cited symptoms like pain in the eyes, blood in stool, and urine, which shows that calendar is able to improve their knowledge on symptoms of severe forms of dengue. Insufficient knowledge of the signs and symptoms of dengue can lead one to confuse dengue with other illnesses. Thus, good knowledge of the signs and symptoms of dengue is required to identify the disease and seek an early treatment (Malhotra et al., 2014).

The median total knowledge score of dengue for the overall participants in pre-intervention was 26.0 [19.0-30.0] out of 40 increased to 32.0 [26.0- 36.0] in post-intervention. The improvement in scores clearly shows that the dengue awareness calendar able to increase the level of knowledge on dengue, its vector, transmission, symptoms, and preventive measure. This study aligns with other health educational studies that knowledge level increased when the study participants were provided with health educational materials and programs (Ibrahim et al., 2009; Kusuma et al., 2016; Usman et al., 2018; Hanklang et al., 2018; ABhirami and Zuharah, 2020).

The median knowledge score of the overall participants is 26.0 [19.0-30.0] out of possible score of 40. The multivariable binary logistic regression findings reveal that that the Orang Asli need more awareness on dengue. In terms of education, participants with no formal education and primary level have lowest total knowledge score, therefore an outreach education intervention should be provided to improve the knowledge level on dengue. This study also identified that participants who had monthly income more than RM1000 had higher knowledge score. People with good economic statues may have better access and reliable information. Further, participants with none or low density of plants /vegetations reported to have lower knowledge score.

After the educational intervention, there is notable increase in knowledge score 32.0 [26.0- 36.0] out of 40 items. The regression findings shows that higher education level have higher knowledge score. The monthly income of more than RM1000 also seen to have higher knowledge score. The reason could be the information in the dengue awareness calendar which further improve the participants knowledge level especially on the transmission of dengue. This is due to the more than 88% participants agree that the information provided in the dengue calendar is easy to understand. Participants who had

more plants or vegetations have higher knowledge score which shows the dissemination of the information in the calendar have reached the participants successfully.

In the multivariable analysis of increment in knowledge score shows the tribe, educational level and income were independent predictors. The majority number of participants where from tribe Temuan whom had higher increment in knowledge score. This shows that the dengue awareness calendar should be applied to all other tribe , as this will improve their awareness on dengue.

Findings in this study suggested that participants with an educational attainment of secondary and above level had higher increment in knowledge scores than with low education attainment, similar to study by in Malaysia (Ikhwan Zaini et al., 2019), Pakistan (Itrat et al., 2008). Thus, it is recommended to do on-site teaching with campaigns for primary or illiterate participants to accelerate their understanding on the dengue.

Further, the participants with higher income have higher increment in knowledge score. This implies that dengue awareness calendar needs to target on the Orang Asli community with less income to improve their knowledge. Hence, it is apparent that the socio-economic factors exert a significant impact on facilitating an increase in dengue knowledge (Wong et al., 2015).

5.5 Health beliefs on dengue pre and post intervention

The Health Belief Model (HBM) is a widely known theory in health education and promotion (Glanz et al., 2008) and study clearly support the HBM as a disease avoidance or disease protective model (Galloway, 2003). A minimal number of studies applied this model to explain the change of behavior regarding prevention of dengue

(Siddiqui et al.,2016). The socio-demographic characteristics includes age, gender, income, ethnic and educational background associated with the model.

Perceived severity is an individual perception about seriousness or severity of the illness if contracted or left untreated (Galloway, 2003). Findings concerning the perception of severity show a significant increase in perceived severity after the intervention. This finding aligns with a study carried out by Usman et al. (2018) where the study participant expressed fear about dengue. However, the findings of this study disagree with a study conducted among the urban, semi-urban, and rural communities in Malaysia found an alarming number of respondents had less fear of dengue (Al-Dubai et al., 2013). In addition, to a study conducted the household with high, middle and low incidence of dengue fever reported that only half of the participants perceived dengue fever as a sever disease (Liu et al., 2021).

In this study, secondary level education and above perceived higher severity. This finding suggests that the primary and lower-level group people underestimated the risk of dengue. Therefore, Orang Asli with lower-level education should be taught that dengue fever is a serious illness, and it is important to avoid the exposure to dengue. Not only that, participants with higher socio-economic showed a greater concern for dengue by scoring it as more severe problem compared to those from lower socio-economic. This differential attitude shows a lack of awareness. Therefore, an robust intervention to increase knowledge concerning dengue is required to increase understanding on the perceived severity of dengue.

The findings of the multivariate analysis suggest a significant association of increment in perceived severity of dengue with the monthly household income. In this study, participants who earn less than RM1000 have no increment in perceived severity of dengue. Thus, future research is recommended to explore the factor hindering the low

socio-economic participants to perceived severity of dengue and also to implement a program to show the impact of dengue on human lives.

Perceived susceptibility measures personal risk or susceptibility contracting a disease or illness (Galloway, 2003). The greater perceived susceptibility, the higher the likelihood of engaging in behaviors to decrease the risk, and this perception provokes people to carry out prevention. In this study, the perception of susceptibility to dengue showed that even though many were worried about the likelihood of being infected with dengue, relatively less than half of the participants viewed themselves as at low risk of becoming infected with dengue. In the self-reported dengue cases among the respondents, only 29 out of 609 respondents had experienced dengue fever. Therefore, many presume that there is a low chance of them getting the disease. This is inconsistent with a study conducted by Usman et al. (2018) where the study participant expressed fear about dengue.

However, it is notable that there is no significant difference in perceived susceptibility. This finding is consistent with the previous study conducted in Malaysia that removing larva is a waste of time (Al-dubai et al., 2013; Usman et al., 2018). Nevertheless, this finding was not consistent with a previous study carried out in Pakistan where participants considered themselves at risk of infecting with dengue (Itrat et al., 2008). A study by Becker (1974) quoted that "one's intention to self-care is influenced by his or her perception of vulnerability and the severity of disease outcomes" (Rakhshanderou et al., 2020). This indicates the importance of interventions to enhance the risk perception among Orang Asli, as high-risk perception translates into protective behaviors

The multivariate analysis findings found significant correlations of difference in perceived susceptibility of dengue among the monthly household income, the density of

mosquito, and fogging. Participants that reported none/low or moderate density of mosquito disturbance were less likely to have perceived higher susceptibility to contracting dengue. This could be as the Orang Asli assumes that fewer plants or vegetation in the surrounding have a lower chance of getting dengue fever, which leads to lower perceived susceptibility. However, the density of plants or vegetation in the surroundings does not affect dengue fever as the Aedes mosquito can be found both indoors and outdoors (Chandren et al., 2015).

Perceived barriers refer to the cost to the individual includes inconvenience, pain, expensive materials, and time consuming that limits a person to engage in the proper health related measures (Galloway, 2003). Generally, the perceived effectiveness of the interventions in controlling dengue prevention as more related to the environment cleaning, covering water containers and planting herbs tree to avoid mosquito biting. However, the barriers or costs hindering the dengue prevention activities prevail over these benefits (Phuanukoonnon et al., 2006). The barriers to prevention actions come mainly from the listed control practices promoted on the calendar which are hard to practice or expensive to implement. For instance, the use of mosquito repellent or insecticidal spray and mosquito nets does require certain amount of cost to purchase. This show that the perceived barrier to prevention may serve as a demotivator for carrying out prevention measures and may deter behavior intention to practice, thus leading to an increased incidence of dengue (Wong et al., 2014).

The multivariate findings of perceived barriers in preventing dengue revealed the independent risk factor associated to tribe, monthly income, and density of plants and vegetations. The barriers to control or prevent dengue come mainly from incompatible control practices promoted in calendar. The findings from the multivariate analysis, occupation was found as a significant correlate of perceived barriers to prevent dengue.

Manual workers were less likely to perceive higher barriers to prevent dengue. This could be attributed to the fact that the unemployed or housewives spend a lot of time at home and carry out household cleaning activity to get rid of mosquito breeding sites (Kardooni et al., 2014).

Perceived self-efficacy is considered a vital motivational source and is an indicator of the ability of individuals to organize themselves in pursuit of specific goals. Participants perceived high self-efficacy in taking measures to prevent dengue. Thus, the findings are consistent with the study carried out in Malaysia (Wong et al., 2015). Study shows that individuals with a high level of perceived self-efficacy have a greater commitment to engaging in activities at a time of challenges and difficulties and spent more time and effort on such activities (Wong et al., 2015).

Cues to action provoke one's to follow a behavior due to certain circumstances. The highest increment in cues to action highlights the calendar's role in motivating respondents to perform better protection actions to curb the disease. Nonetheless, the calendar can increase the health belief among the Orang Asli, and it is essential to retain these beliefs. Thus, this study recommended the use of the calendar as one of the national programmes to combat dengue outbreak among the marginalized rural-dwelling communities.

The multivariate analysis revealed that manual workers and housewives were independent predictors of higher cues to action to prevent dengue. This could be because working adults are more likely to be involved in health campaigns and education in their workplace and have more information on dengue (Selvarajoo et al., 2020). Housewives have higher motivation to carry out prevention practices to prevent dengue because as they look after the cleanliness of the house (Hiremath et al., 2019). The density of mosquito in neighborhood is one of the predictors of perceived cues to action in

preventing dengue. A study conducted in slums in Delhi, India shows that 64% to 75% respondents have higher perception of mosquito nuisance at home, office and public spaces. The abundance of mosquito is highly related with extreme fear of dengue infection among households (Daude et al.,2017).

In addition, the increment in knowledge score significantly correlated with the cues to action. According to the study conducted in Malaysia in 2015 (Wong et al) use the theory Health Belief Model hypothesized that participants who had high level of knowledge score have interest in seeking information about dengue. This could be because of individual experience with dengue, they might receive more information and prompt them to prevent dengue. This can further be assessed in the study where participants with fewer increments in knowledge score were less likely to perceive higher cues to action in preventing dengue. This might be due to participants with fewer knowledge scores being less confident to carry out prevention anytime and anywhere.

5.6 Prevention practices of dengue on pre and post intervention

Regarding prevention practices, there was an increase in practices performed often by the participants from pre-intervention to post-intervention. The participants started to undertake 12 out of 19 practices often when evaluated during the post-intervention. Higher practice levels attained in this study due to items listed under practice level were related to daily practices for controlling mosquito nuisance (Abhirami and Zuharah., 2020; Dhimal et al., 2014).

This is a positive sign that the dengue awareness calendar has an imperative effect on participants. Similar to the finding of Usman et al. (2018) in Saudi Arabia, the majority of participants are taking action against mosquito breeding sites in post-intervention.

From less than 20% in pre-intervention, an increase to more than 70% of participants was witnessed in the practices such as proper disposal of household garbage, covering all water containers, and changing stored water to eliminate the mosquito-breeding site. This shows that the message display on the measures to avoid mosquito breeding grounds in the calendar shows a positive influence among the community in increasing their knowledge on proper mosquito control. This is align with a study conducted in Peurto Rico to investigate the impact of dengue programs where exposure to the posters have increased proportion of water storage containers to protected from mosquitos (Winch et al.,2002).

Regarding the prevention of mosquito bites, participants often use mosquito coil to drive away the mosquito from biting as also reported in India, Malaysia, Philippines, and Pakistan (Malhotra et al., 2014, Hairi et al., 2003; Yboa et al., 2013; Itrat et al., 2008). The reason of mosquito coil as often practices could be due to the advertising over the media. Since it is impossible to eliminate all larval habitats, most of the educational material mentioned spraying of aerosol insecticides inside the house (Winch et al.,2002; Chandren et al., 2015). This is also similar in this study where participants revealed that they have started to spray dark places with an insecticidal spray often during the post-intervention. This is align to a study conducted in Peurto Rico where exposure to the posters have increased the indoor used of aerosol insecticides (Winch et al., 2002) Nonetheless, this finding was not in line with a study conducted among the rural residents in Philippines and also rural and slum communities in India where participants did not use any insecticidal sprays as they considered this prevention was an expensive practice considering most of them have limited financial capabilities (Yboa et al., 2013;Malhotra et al.,2014).

Based on the study findings, the least improvement was seen in using the mosquito repellent and wearing bright-colored clothing to avoid mosquito bites. It is worrying that most of the Orang Asli work in the forest and are prone to dengue fever. Yet, they are unaware of the abundance of mosquitoes in the wilderness, and the Aedes mosquito is attracted to dark colors more than bright colors. Similar findings were reported among the school students who wear light-colored clothing to avoid mosquito bite in the schools in Malaysia (Abhirami and Zuharah et al.,2020).

It is important to note that based on the findings, it shows that participants do not practices in avoiding sexual intercourse with a spouse infected with dengue fever. Hence, it is recommended that future studies with education emphasize this issue and enhance their awareness to minimize the risk of dengue fever transmission.

Prevention practices are the most significant aspect to curb the dengue disease starting from home. The result of this study shows an increase in "often" practices among the participants after post-intervention. It was observed that educational intervention had established a good prevention practice among the study community. Intervention in terms of education on dengue is the main factor of a successful dengue control programme (Naing et al., 2011). The findings of this study show that good knowledge leads to better prevention practices (Naine et al., 2011, Hairi et al., 2003; Koenraadt et al., 2006).

The findings of the multivariate analysis suggest significant correlations of dengue prevention practices with the tribe, education level, occupation, perceived severity, cues to action, self-efficacy, and knowledge level of dengue after health education intervention. However, a study conducted in rural population in Malaysia shows no significant association between prevention practices and socio-demographic; this is due to influence of tradition and culture (Hairi et al.,2003). A particularly noteworthy finding from the multivariate analysis shows that the higher education level

had a higher increment of practices score. It is important to note that education level plays a significant role in prevention activities (Wong et al., 2015: Zaini et al.,2019). Thus, it is recommended that the participants with lower increment in knowledge score should be given health education in more intensified on non-formal educators by using different approaches like on-site teaching by applying concrete action through health education activities (Harapan et al.,2017). Housewives have a lower likelihood to have an increment in preventive practices compared to the working people. This might be due to their role as a key person in the management of the house where cleaning is a regular task and does not necessarily imply recognizing the essence of dengue prevention. These findings do not align with the study carried out among households in Yogyakarta, Indonesia, where housewives were found to have the best dengue preventive practices (Sulistyawati et al., 2019). Therefore, it is essential to educate and encourage more housewives to operate proper prevention methods of dengue to protect their family members from dengue infection.

The multivariate findings from this study also show that participants who perceived higher severity and susceptibility during post-intervention than pre-intervention have higher odds of performing prevention practices at the post-intervention. The finding is consistent with the study conducted by Wong et al. (2015). Lastly, there is a significant positive association between increment in knowledge score and increment in prevention practices (Zaini et al., 2019). A good knowledge level prompts the participants to participate in better dengue prevention practices. Thus, it is vital to incorporate the Calendar with Testimonials from those who have lost a family member due to dengue and campaigns that can increase awareness, improve their beliefs, and prompt proper preventive measures. Hence, the study suggested that support from the government in terms of monetary is crucial as it could facilitate initiation, designing, and

implementing comprehensive educational programmes and dengue management throughout Malaysia.

5.7 Participants response on dengue awareness calendar

A correct convey of health information is deemed very important in controlling illness like malaria, dengue as well as ensuring the community to have adequate understanding of mechanism of infection, the signs and symptoms, attention required to prevent dengue and avoid fatalities (Khan and Manderson, 2007).

Dengue awareness calendar used as intervention in this study shows a good response among the study participants. The feature of the calendar is very colorful and very informative with the current dengue knowledge and prevention practices information. In addition, many participants agree that the information is very comprehensive, clear and easy to understand. Therefore, the future studies should encourage the usage of dengue awareness calendar intervention not only to other Orang Asli villages but for also for the wider community.

Majority of participants agree that the dengue awareness calendar motivates participants to perform prevention activities. This highlights the importance of incorporating the dengue awareness calendar one of the national programs in controlling dengue.

5.8 Impact of educational Intervention on Knowledge, Health Belief and Practices

For the past few decades, vector control methods to reduce mosquito breeding sites and density have remained the mainstay of preventing and controlling dengue fever. However, this approach is usually of questionable efficacy and is often inefficient due to the absence of active community involvement. Alternative approaches emerged in recent years, including genetically modified mosquitoes, biological control methods (such as Wolbachia), anti-viral drugs, and vaccines. The present study indicated that the comprehensive and intensified dengue calendar, as an intervention strategy, effectively improved the participants' knowledge, beliefs, and practices to reduce the mosquito density and curtail the dengue outbreak in their areas.

On a positive note, the present study improves knowledge, health beliefs, and practices after distributing the dengue awareness calendar to the participants. Our result also agreed with a quasi-experimental study reported among rural communities in Thailand where the intervention group (daily broadcast, dengue campaign, and group education) shows an increase in knowledge and practice, however, the control group remains insignificant (Hanklang et al.,2018). The daily broadcast among the rural communities helps them to hear the information every day and encourages them to clean the surrounding house and change stored water compared to those from the control group. Our analyses reveal strong evidence of using a dengue awareness calendar that plays a significant role as a medium in delivering content to the learners and increases awareness and knowledge of dengue, its vector, and prevention (Zaini et al., 2019). The significant increment in scores of pre-and post-interventions highlight the need to continue implementing health education intervention programs throughout the country as part of the national program. Continued involvement of community leaders and volunteers through the health system will help in sustaining the intervention effects.

On a important note, variety of health education methods have positive impact on knowledge, attitude and practices of dengue; for instance educational sessions were conducted through visual ads, flip charts and small group discussion among school children in Saudi Arabia (Usman et al., 2018); delivering of dengue booklet to flood prone school children on importance of preventing dengue during flood in Malaysia (Abhirami et al., 2020); a lecture by head of community medicine unit , a flex, posters, and video exhibition among upper secondary residential school in Malaysia (Al-Zurfi et al., 2015) The health educational intervention is a successful paradigm to be used to create awareness of dengue among community.

5.9 Implication and Contribution of the study findings

In a nutshell, this study provided a detailed description of the effectiveness of dengue awareness calendar intervention on knowledge, belief and practices. Up to date, this is the first study that evaluate the dengue awareness calendar. Therefore, the KBP reported in this study can be considered as the first baseline reported for the minority population, Orang Asli.

One of the major contributions of this study is the findings of the study can be applied as the evidence that indicates clear public health benefits. This enables the public health policy makers, health practitioners and educators to apply this intervention on dengue. The dengue awareness calendar concept can also In addition, this intervention can also incorporate in the national program of dengue control and outreach activities with Orang Asli throughout Malaysia.

5.10 Limitation of the study

This study had few limitations. Firstly, the selection of Orang Asli village was based on JAKOA approval on selective villagers, mainly based on accessibility by land transport and willingness of Tok batin to approve the request to visit their village. This, survey reflects responses from selected villagers of Orang Asli in Selangor, limiting the generalizability of results to the overall Orang Asli community in Selangor. This may result in selection bias because of the sample which was not representative of the overall Orang Asli population in Selangor since the Orang Asli living in more remote or inaccessible areas, small number of people were not surveyed.

Secondly, the self-reporting data may be subject to reporting bias towards socially desirable responses and behaviors might exist, besides the outcomes reported may differ from the actual behavior. In addition. this survey captures only some information about the participants and the findings may change over time.

Thirdly, the phase III intervention was evaluated 6 months after the distribution of the dengue awareness calendar intervention which has 12 months of a year. In addition, there is no monitoring or evaluation is conducted after providing the dengue awareness calendar to determine the usage of the calendar. Despite such limitation, the result of the study provides important findings that can be very beneficial to the law for policy makers for the need of dengue awareness calendar for dengue.

5.11 Recommendation for future research

While presenting crucial findings on the effectiveness of dengue awareness calendar, the existing limitation of the present study can be anticipated as the gaps to facilitate future research directions on this topic. In response to the limitation related to the purposive sampling selection of Orang Asli village, future studies should include villages situated at deep forest fringe area. In addition, future research should do qualitative research to explore the barriers and limitation on using the dengue awareness calendar. These findings may provide useful outcomes we believe would be valuable in guiding government and public health authorities.

Secondly, it is apparent the self-administrated questionnaire outcomes were subjective, which might have produced false positive responses. We had no means of confirming whether the participants often practice of cleaning the housing area, thus future research should include direct household observation to validate these results. Additionally, while only those participating in the pre-intervention survey were asked to complete the post intervention survey and the demographic information was collected only in the pre intervention survey. Thus, there is the possibility that the individuals completing the post-intervention survey may have differed from those completing the pre-intervention survey. Therefore, future research should capture the socio demographic data in post intervention survey to identify any possible changes in the outcome of the analysis.

Thirdly, the intervention period of 6 months is limited to access the calendar which consists of 12 months of information on dengue, nevertheless the dengue awareness calendar intervention was successful in disseminating information over a short period of assessment time whereby there is improvement in knowledge and prevention practices score. The studies suggest future research to increase the intervention period to

determine the retention of knowledge and also prevention activities. There is no proper monitoring on the usage of dengue awareness calendar intervention; therefore, it is recommended the future study to include bimonthly telephone assessment or direct observation to their household to check and encourage the participants to utilize the calendar. Despite such limitation, the findings is very beneficial to the law and policymakers for the need of educational intervention not only for dengue but also for other infectious disease.

CHAPTER 6: CONCLUSION

This study achieved a comprehensive understanding of knowledge, health beliefs and prevention practices of Orang Asli in selected villagers in Selangor.From this study, several conclusions could be inferred that have paramount implications for implementing dengue awareness calendar. Firstly, the findings indicate that the level of knowledge about dengue fever were moderate and significantly improved after post intervention. Among the general knowledge items assessed, most of the respondents had good knowledge about prevention of dengue and least knowledge on the sign and symptoms of dengue hemorrhagic fever and transmission mode of dengue.

In the multivariate analysis, the tribe "Temuan" and "Mahmeri" were found more likely to have higher increase in knowledge score when compared to the other tribe. Participants with secondary and above level were found more likely to have increment in knowledge score compared to participants with no formal education. Participants with monthly income more than RM1000 were more likely to have higher increment in knowledge score compared to participants with monthly income less than RM1000.

Regarding the health beliefs, the level of perceived severity of dengue fever was high among the Orang Asli participants. In evaluating the difference of post-intervention and pre-intervention shows that participants earn below than RM1000 were less likely to have increment in perceived severity of dengue compared to those earning more than RM1000.

The level of perceived susceptibility towards dengue fever among participants was high. In the multivariate analysis of evaluating the difference of post-intervention and pre-intervention reveals that Mahmeri was found significantly less likely to have increment compared to other tribe. Participants earn more than RM1000 were found to

have no increment in perceived susceptibility compared to those earning below than RM1000. Participants that reported severe density of mosquito disturbance were significantly less likely to have increment in perceived susceptibility compared to none/low density of mosquito disturbance. Participants who reported occasionally or often fogging carried out by municipal were significantly less likely to increment in perceived susceptibility of dengue than the none/ rarely fogging.

In the context of perceived barriers to prevent dengue, more than half participants reported higher barrier to prevent dengue. In the multivariate analysis evaluating the difference of post-intervention and pre-intervention on perceived barriers to prevent dengue reveals that manual workers were found significantly less likely to have increment in perceived barrier to prevent dengue.

In the context of cues to action, most of the participants had higher cues to action in post intervention compared to pre-intervention. In the multivariate analysis of evaluating the difference of post-intervention and pre-intervention on perceived cues to action to prevent dengue reveals that the tribe Mahmeri were found to be significantly less likely to have increment in perceived cues to action to prevent dengue compared to other tribe. Participants with no formal and primary level were significantly less likely to have no increment in the perceived cues to action compared to reference group (secondary and above level). Participants who had moderate density of plants or vegetation were significantly more likely to have no increment in perceived cues to action. Participants who had higher increment of knowledge score 0-6 were found more likely to have no increment in perceived cues to action to prevent dengue compared to reference group (7-17).

Approximately, more than 80% participants perceived self-efficacy in the prevention of dengue. In the multivariate analysis of post-intervention of perceived self-

efficacy in the prevention of dengue, the others tribe's category was found to have higher perceived self-efficacy in the prevention of dengue compared to the Temuan tribe. The housewives were found to have lower perceived self-efficacy in the prevention of dengue compared to other category of occupation.

The total dengue prevention practices score of participants improved significantly after post intervention. In the multivariable analysis of increment in prevention practices score reveals that the tribe 'Temuan' were found to have higher increment in prevention practices score than other tribe. The housewives were found to have less increment in dengue prevention practices score of than other occupation category. Participants with primary education level and secondary education or above level have higher increment in dengue preventive practices score compared to non-formal education. Participants with higher increment in dengue knowledge score (7-17) were found to have higher increment in dengue prevention practices score compared to those scored lower total knowledge score. Participants with high perceived severity and high perceived susceptibility (in post-intervention than pre-intervention were significantly found to have higher increment in dengue prevention practices score.

The study's major novelty was achieved as the KBP of Orang Asli improved after the implementation of dengue awareness calendar. Majority of the participants agreed that the content of the calendar is very comprehensive and clear and easy to understand. In addition, the illustration and design are ease to look for information. In conclusion, the dengue awareness calendar encourages Orang Asli to contemplate and enhance their knowledge and perform better prevention activities, thus able to reduce the bite of mosquito bite. This dengue awareness calendar can be introduced to the current national dengue control activities.

REFERENCES

Abdullah, J., Borhan, M. A.-A., & Ahmad, C. B. (2015). Orang Asli Resettlement in Urban Environment at Bukit Lanjan, Selangor, Malaysia. *Procedia - Social and Behavioral Sciences*, *201*(February), 71–79. https://doi.org/10.1016/j.sbspro.2015.08.132

Ahbirami, R., & Zuharah, W. F. (2020). School-based health education for dengue control in kelantan, malaysia: Impact on knowledge, attitude and practice. PLoS Neglected Tropical Diseases, 14(3), 1–23. https://doi.org/10.1371/journal.pntd.0008075

Abu Bakar S, Lim YAL (2011) Urbanization and the spread of dengue to rural populations in Malaysia (Abstract 11.095). International Society for Infectious Diseases – Neglected Tropical Diseases 2011 meeting, Boston, MA, USA. 8–10 July 2011. Available: http://ntd.isid.org/downloads/NTD_FinalProgram.pdf. Accessed 18 October 2013.

Abd-Jamil, J., Ngui, R., Nellis, S., Fauzi, R., Lim, A. L. Y., Chinna, K., Khor, C. S., & Abubakar, S. (2020). Possible Factors Influencing the Seroprevalence of Dengue among Residents of the Forest Fringe Areas of Peninsular Malaysia. Journal of Tropical Medicine, 2020. https://doi.org/10.1155/2020/1019238

Aisyah, A., Shahrul, A. B., Zulfahmie, M. Z. M., Sharifah Mastura, S. A., & Mokhtar, J. (2015). Deforestation analysis in Selangor, Malaysia between 1989 and 2011. *Journal of Tropical Forest Science*. https://doi.org/10.1177/107754602023518

Al-Delaimy, A. K., Al-Mekhlafi, H. M., Lim, Y. A. L., Nasr, N. A., Sady, H., Atroosh, W. M., & Mahmud, R. (2014). Developing and evaluating health education learning package (HELP) to control soil-transmitted helminth infections among Orang Asli children in Malaysia. *Parasites and Vectors*, *7*(1), 1–18. https://doi.org/10.1186/1756-3305-7-416

Al-Dubai, S. A., Ganasegeran, K., Mohanad Rahman, A., Alshagga, M. A., & Saif-Ali, R. (2013). Factors affecting dengue fever knowledge, attitudes and practices among selected urban, semi-urban and rural communities in Malaysia. *Southeast Asian Journal of Tropical Medical Public Health, 44*(1):37-49

Al-Zurfi, B. M. N., Fuad, M. D. F., Abdelqader, M. A., Baobaid, M. F., Elnajeh, M., Ghazi, H. F., … Abdullah, M. R. (2015). Knowledge, attitude and practice of dengue fever and heath education programme among students of Alam Shah science school, Cheras, Malaysia. *Malaysian Journal of Public Health Medicine*, *15*(2), 69–74.

Alobuia, W. M., Missikpode, 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. https://doi.org/10.1016/j.aogh.2015.08.013

Alves, A. C., dal Fabbro, A. L., Passos, A. D. C., Carneiro, A. F. T. M., Jorge, T. M., & Martinez, E. Z. (2016). Knowledge and practices related to dengue and its vector: A community-based study from Southeast Brazil. Revista Da Sociedade Brasileira

de Medicina Tropical, 49(2), 222–226. https://doi.org/10.1590/0037-8682-0240-2015

Ajibola, L. S. A., Shohaimi, S., Adam, M. B., Nadzir, M. N. H. M., & Segun, O. E. (2018). Systematic review of knowledge, attitude, and practices regarding dengue in Malaysia. *Journal of Applied Pharmaceutical Science*, *8*(12), 80–91. https://doi.org/10.7324/JAPS.2018.81221

Appanna, R., Ponnampalavanar, S., Chai See, L. L., & Devi Sekaran, S. (2010). Susceptible and protective HLA Class 1 alleles against dengue fever and dengue hemorrhagic fever patients in a Malaysian population. *PLoS ONE*, *5*(9), 1–10. https://doi.org/10.1371/journal.pone.0013029

Arunachalam, N., Tyagi, B. K., Samuel, M., Krishnamoorthi, R., Manavalan, R., Tewari, S. C., … Petzold, M. (2012). Community-based control of Aedes aegypti by adoption of eco-health methods in Chennai City, India. Pathogens and Global Health, 106(8), 488–496. https://doi.org/10.1179/2047773212Y.0000000056

Benelli, G. (2016). Plant-mediated synthesis of nanoparticles: A newer and safer tool against mosquito-borne diseases? *Asian Pacific Journal of Tropical Biomedicine*, *6*(4), 353–354. https://doi.org/10.1016/j.apjtb.2015.10.015

Betancourt-Cravioto, M., Kuri-Morales, P., González-Roldán, J. F., & Tapia-Conyer, R. (2014). Introducing a Dengue Vaccine to Mexico: Development of a System for Evidence-Based Public Policy Recommendations. PLoS Neglected Tropical Diseases, 8(7). https://doi.org/10.1371/journal.pntd.0003009

Bhanu Vaishnavi G, Shobha C, Narahari MG, Kurian J, Lalremruata B, Laldinpuii E, Baby FS (2015) Study of impact of health education on knowledge, attitude and practice related to dengue fever. World J Pharm Pharm Sci 4210(10):748–761

Bolarinwa, O. (2015). Principles and methods of validity and reliability testing of questionnaires used in social and health science researches. *Nigerian Postgraduate Medical Journal*. https://doi.org/10.4103/1117-1936.173959

Bota, R., Ahmed, M., Jamali, M. S., & Aziz, A. (2014). Knowledge, attitude and perception regarding dengue fever among university students of interior Sindh. *Journal of Infection and Public Health*, *7*(3), 218–223. https://doi.org/10.1016/j.jiph.2013.11.004

Bujang, M. A., Adnan, T. H., Hashim, N. H., Mohan, K., Kim Liong, A., Ahmad, G., Bak Leong, G., Bavanandan, S., & Haniff, J. (2017). Forecasting the Incidence and Prevalence of Patients with End-Stage Renal Disease in Malaysia up to the Year 2040. International Journal of Nephrology. https://doi.org/10.1155/2017/2735296

Cardo, M. V., Rosín, P., Carbajo, A. E., & Vezzani, D. (2015). Artificial container mosquitoes and first record of Aedes aegypti in the islands of the Paran?? Lower Delta, Argentina. *Journal of Asia-Pacific Entomology*, *18*(4), 727–733. http://doi.org/10.1016/j.aspen.2015.09.002

Chandren, J. R., Wong, L. P., & AbuBakar, S. (2015). Practices of dengue fever prevention and the associated factors among the Orang Asli in Peninsular Malaysia. *PLoS Neglected Tropical Diseases*, *9*(8), 1–17. https://doi.org/10.1371/journal.pntd.0003954

Cheah, W. L., Chang, M. S., & Wang, Y. C. (2006). Spatial, environmental and entomological risk factors analysis on a rural dengue outbreak in Lundu District in Sarawak, Malaysia. *Asian Pacific Journal of Tropical Biomedicine., 23*(1):85-96.

Cheong, Y. L., Leitão, P. J., & Lakes, T. (2014). Assessment of land use factors associated with dengue cases in Malaysia using boosted regression trees. *Spatial and Spatio-Temporal Epidemiology*, *10*, 75–84. http://doi.org/10.1016/j.sste.2014.05.002

Chen, C., Nazni, W., Lee, H., & Sofian-Azirun, M. (2005). Susceptibility of Aedes aegypti and Aedes albopictus to temephos in four study sites in Kuala Lumpur City Center and Selangor State, Malaysia. *Asian Pacific Journal of Tropical Biomedicine., 22*(2):207-216.

Chen, H.-L., Hsiao, W.-H., Lee, H.-C., Wu, S.-C., & Cheng, J.-W. (2015). Selection and Characterization of DNA Aptamers Targeting All Four Serotypes of Dengue Viruses. *Plos One*, *10*(6), e0131240. https://doi.org/10.1371/journal.pone.0131240

Creswell, J. W. (2014). *Research Design : Qualitative, quantitative, and mixed methods approaches - 4th ed. SAGE Publication, Inc.* https://doi.org/10.1017/CBO9781107415324.004

Daudé, É., Mazumdar, S., & Solanki, V. (2017). Widespread fear of dengue transmission but poor practices of dengue prevention: A study in the slums of Delhi, India. PLoS ONE, 12(2), 1–12. https://doi.org/10.1371/journal.pone.0171543

Dick, O. B., San Martín, J. L., Montoya, R. H., Del Diego, J., Zambrano, B., & Dayan, G. H. (2012). Review: The history of dengue outbreaks in the Americas. *American Journal of Tropical Medicine and Hygiene*, *87*(4), 584–593. https://doi.org/10.4269/ajtmh.2012.11-0770

Dhimal, M., Aryal, K. K., Dhimal, M. L., Gautam, I., Singh, S. P., *et al.* (2014). Knowledge, Attitude and Practice Regarding Dengue Fever among the Healthy Population of Highland and Lowland Communities in Central Nepal. *PLoS One, 9*(7):e102028. doi: 10.1371/journal.pone.0102028

Effler, P. V., Pang, L., Kitsutani, P., Vorndam, V., Nakata, M., Ayers, T., … Gubler, D. J. (2005). Dengue fever, Hawaii, 2001-2002. *Emerging Infectious Diseases*, *11*(5), 742–749. https://doi.org/10.3201/eid1105.041063

Firdous, J., Mohamed, A., Al Amin, M., Ihsan, M., Faris 'Imadi, M., Hakim, M. K., … Muhamad, N. (2017). Knowledge, attitude and practice regarding dengue infection among Ipoh community, Malaysia. *Journal of Applied Pharmaceutical Science*, *7*(8), 099-103. https://doi.org/10.7324/JAPS.2017.70814

Galloway, R. D. (2003). Health promotion: causes, beliefs and measurements. Clinical Medicine & Research, 1(3), 249–258. https://doi.org/10.3121/cmr.1.3.249

George, L., Lenhart, A., Toledo, J., Lazaro, A., Han, W. W., Velayudhan, R., … Horstick, O. (2015). Community-Effectiveness of Temephos for Dengue Vector Control: A Systematic Literature Review. *PLoS Neglected Tropical Diseases*. https://doi.org/10.1371/journal.pntd.0004006

Gandhi, G., Chapla, J., Gujju Gandhi, C., & Reddya Naik, B. (2017). Data mapping of Vector Borne Disease with Geographical Information System & Global Position System technology: In tribal areas Khammam District, Telangana State. ~ 39 ~ International Journal of Mosquito Research, 4(2), 39–43.

Ghani, N. A., Shohaimi, S., Hee, A. K. W., Chee, H. Y., Emmanuel, O., & Ajibola, L. S. A. (2019). Comparison of knowledge, attitude, and practice among communities living in hotspot and non-hotspot areas of dengue in Selangor, Malaysia. Tropical Medicine and Infectious Disease, 4(1). https://doi.org/10.3390/tropicalmed4010037

Gladys, Sungkar S (2013) Effectiveness of health education on first aid of dengue haemorrhagic fever on school teachers in North Jakarta, 2011. eJKI 1(1):30–36

Gunasekara, T., Velathanthiri, V., Weerasekara, M., Fernando, S., Peelawattage, M., Guruge, D., & Fernando, S. (2012). Knowledge, attitudes and practices regarding dengue fever in a suburban community in Sri Lanka. *Galle Medical Journal*. https://doi.org/10.4038/gmj.v17i1.4355

Gupta, S., Patil, R., Kumar, A., & Wani, O. A. (2016). An Impact of Educational Intervention Programme Regarding Dengue and Its Prevention for Urban High School Children, Pune, Maharashtra. *International Journal of Scientific Research*, *4*(10), 100–102.

Hamid, M., Lugova, H., Mon, A., & Knight, V. (2015). Awareness and practice related to dengue infection among military cadets in Malaysia. *Journal of Behavioral Health*, *4*(2), 39. https://doi.org/10.5455/jbh.20150311072802

Hairi, F., Ong, C. H., Suhaimi, A., Tsung, T. W., bin Anis Ahmad, M. A.*, et al.* (2003). A knowledge, attitude and practices (KAP) study on dengue among selected rural communities in the Kuala Kangsar district. *Asia-Pacific Journal of Public Health, 15*(1):37-43.

Hanklang, S., Ratanasiripong, P., & Sivasan, S. (2018). Effectiveness of the intervention program for dengue hemorrhagic fever prevention among rural communities in Thailand: A quasi-experimental study. Journal of Health Research, 32(5), 352–363. https://doi.org/10.1108/JHR-08-2018-042

Harapan, H., Bustamam, A., Radiansyah, A., Angraini, P., Fasli, R., Salwiyadi, S., Bastian, R. A., Oktiviyari, A., Akmal, I., Iqbalamin, M., Adil, J., Henrizal, F., Groneberg, D. A., Kuch, U., & Muller, R. (2017). Dengue prevention: Confirmatory factor analysis of relationships between economic status, knowledge, attitudes and practice, vaccine acceptance and willingness to

participate in a study. Southeast Asian Journal of Tropical Medicine and Public Health, 48(2), 297–305.

Hasnan, A., Dom, N. C., Rosly, H., & Tiong, C. S. (2016). Quantifying the Distribution and Abundance of Aedes Mosquitoes in Dengue Risk Areas in Shah Alam, Selangor. *Procedia - Social and Behavioral Sciences*, *234*, 154–163. https://doi.org/10.1016/j.sbspro.2016.10.230

Hassan, J., Toh, T. H., Sivapunniam, S. K., Hasim, R., Ghazali, N. F., Sulaiman, S., Koh, M. T., Meyer, S., Toh, M. L., Zocchetti, C., Vigne, C., & Mascareñas, C. (2021). Immunogenicity and Safety of a Tetravalent Dengue Vaccine Administered Concomitantly or Sequentially with Quadrivalent Human Papillomavirus Vaccine in Boys and Girls 9-13 Years of Age in Malaysia: A Phase IIIb, Randomized, Open-label Study. Pediatric Infectious Disease Journal, 40(8), 774–781. https://doi.org/10.1097/INF.0000000000003164

Heale, R., & Twycross, A. (2015). Validity and reliability in quantitative studies. Evidence Based Nursing. https://doi.org/10.1136/eb-2015-102129

Hiremath, P., Chakrabarty, J., & Sequira, L. (2020). Video assisted education on knowledge and practices of house wives towards prevention of Dengue Fever at Gokak Taluk, Karnataka, India. International Journal of Health Promotion and Education, 58(5), 259–267. https://doi.org/10.1080/14635240.2019.1685900

Hollingsworth, T. D., Pulliam, J. R. C., Funk, S., Truscott, J. E., Isham, V., & Lloyd, A. L. (2014). Seven challenges for modelling indirect transmission: Vector-borne diseases, macroparasites and neglected tropical diseases. *Epidemics*, *10*, 16–20. https://doi.org/10.1016/j.epidem.2014.08.007

Ibrahim, N. K., Al-Bar, A., Kordey, M., & Al-Fakeeh, A. (2009). Knowledge, attitudes, and practices relating to Dengue fever among females in Jeddah high schools. *Journal of Infection and Public Health,* *2*(1):30-40. doi: 10.1016/j.jiph.2009.01.004.

Ikhwan Zaini, Z. I., Othman, H., Karim, N., Abd Rashid, N. A., Hisham Abas, M. B., Sahani, M., … Nordin, S. A. (2019). Knowledge and practices regarding Aedes control amongst residents of dengue hotspot areas in Selangor: A cross-sectional study. Sains Malaysiana, 48(4), 841–849. https://doi.org/10.17576/jsm-2019-4804-16

Itrat, A., Khan, A., Javaid, S., Kamal, M., Khan, H.*, et al.* (2008). Knowledge, awareness and practices regarding dengue fever among the adult population of dengue hit cosmopolitan. *PLoS One, 3*(7):e2620. doi: 10.1371/journal.pone.0002620

Jahan, N. K., Ahmad, M. P., Dhanoa, A., Meng, C. Y., Ming, L. W., Reidpath, D. D., … SyedHassan, S. (2016). A community-based prospective cohort study of dengue viral infection in Malaysia: the study protocol. *Infectious Diseases of Poverty*, *5*(1), 76. https://doi.org/10.1186/s40249-016-0172-3

Kalimuthu, K., Panneerselvam, C., Chou, C., Tseng, L. C., Murugan, K., Tsai, K. H., … Benelli, G. (2017). Control of dengue and Zika virus vector *Aedes aegypti* using the predatory copepod Megacyclops formosanus: Synergy with Hedychium

coronarium-synthesized silver nanoparticles and related histological changes in targeted mosquitoes. *Process Safety and Environmental Protection*, *109*, 82–96. https://doi.org/10.1016/j.psep.2017.03.027

Kardooni, R., Kari, F. B., Yahaya, S. R. B., & Yusup, S. H. (2014). Traditional knowledge of Orang Asli on forests in peninsular Malaysia. *Indian Journal of Traditional Knowledge*, *13*(2), 283–291.

Khun, S., & Manderson, L. (2007). Community and school-based health education for dengue control in rural Cambodia: A process evaluation. *PLoS Neglected Tropical Diseases*, *1*(3), 1–10. https://doi.org/10.1371/journal.pntd.0000143

Kittayapong, P., Yoksan, S., Chansang, U., Chansang, C., & Bhumiratana, A. (2008). Suppression of dengue transmission by application of integrated vector control strategies at sero-positive GIS-based foci. American Journal of Tropical Medicine and Hygiene, 78(1), 70–76. https://doi.org/10.4269/ajtmh.2008.78.70

Koenraadt, C. J., Tuiten, W., Sithiprasasna, R., Kijchalao, U., Jones, J. W., *et al.* (2006). Dengue knowledge and practices and their impact on *Aedes aegypti* populations in Kamphaeng Phet, Thailand. *American Journal of Tropical Medicine and Hygiene, 74*(4):692-700.

Kusuma, Y. S., Burman, D., Kumari, R., Lamkang, A. S., & Babu, B. V. (2019). Impact of health education based intervention on community's awareness of dengue and its prevention in Delhi, India. *Global Health Promotion*. https://doi.org/10.1177/1757975916686912

Lacroix, R., McKemey, A. R., Raduan, N., Kwee Wee, L., Hong Ming, W., Guat Ney, T., Siti Rahidah, A. A., Salman, S., Subramaniam, S., Nordin, O., Norhaida Hanum, A. T., Angamuthu, C., Marlina Mansor, S., Lees, R. S., Naish, N., Scaife, S., Gray, P., Labbé, G., Beech, C., … Murad, S. (2012). Open field release of genetically engineered sterile male Aedes aegypti in Malaysia. PLoS ONE, 7(8), 1–9. https://doi.org/10.1371/journal.pone.0042771

Lee, S., & Pradhan, B. (2007). Landslide hazard mapping at Selangor, Malaysia using frequency ratio and logistic regression models. *Landslides*, *4*(1), 33–41. https://doi.org/10.1007/s10346-006-0047-y

Leong, T. K. (2014). Knowledge , Attitude and Practice on Dengue among Rural Communities in Rembau and. *International Journal of Tropical Disease and Health*, *4*(7), 841–848.

Liu, H., Fang, C. J., & Xu, J. W. (2021). The health perceptions, dengue knowledge and control willingness among Dai ethnic minority in Yunnan Province, China. BMC Public Health, 21(1), 1–16. https://doi.org/10.1186/s12889-021-11864-9

Madzlan, F., Dom, N. C., Tiong, C. S., & Zakaria, N. (2016). Breeding Characteristics of Aedes Mosquitoes in Dengue Risk Area. *Procedia - Social and Behavioral Sciences*, *234*, 164–172. https://doi.org/10.1016/j.sbspro.2016.10.231

Malhotra, G., Yadav, A., & Dudeja, P. (2014). Knowledge, Awareness and Practices Regarding Dengue among Rural and Slum Communities in North Indian city,

India. *International Journal of Medical Science and Public Health*, *3*(3), 295. https://doi.org/10.5455/ijmsph.2013.181220132

Masud, M. A., Kim, B. N., & Kim, Y. (2017). Optimal control problems of mosquito-borne disease subject to changes in feeding behavior of Aedes mosquitoes. *BioSystems*, *156–157*, 23–39. https://doi.org/10.1016/j.biosystems.2017.03.005

Masui, H., Kakitani, I., Ujiyama, S., Hashidate, K., Shiono, M., & Kudo, K. (2016). Assessing potential countermeasures against the dengue epidemic in non-tropical urban cities. *Theoretical Biology and Medical Modelling*, *13*(1), 12. https://doi.org/10.1186/s12976-016-0039-0

Mia, M. S., Begum, R. A., Er, A. C., Abidin, R. D. Z. R. Z., & Pereira, J. J. (2013). Trends of dengue infections in Malaysia, 2000-2010. *Asian Pacific Journal of Tropical Medicine*, *6*(6), 462–466. https://doi.org/10.1016/S1995-7645(13)60075-9

Mejía, R., Ribó, A., Quinteros, E., López, A., Villegas, P., Vela, X. F., & Membreño, A. R. (2016). Knowledge Attitude and Practices Related on Prevention of Mosquito Borne Diseases and Sanitation Conditions in a Salvadoran Urban Community. *Occupational Diseases and Environmental Medicine*, *04*(04), 83–102. https://doi.org/10.4236/odem.2016.44010

Mohajan, H. K. (2017). TWO CRITERIA FOR GOOD MEASUREMENTS IN RESEARCH: VALIDITY AND RELIABILITY. *Annals of "Spiru Haret". Economic Series*. https://doi.org/10.26458/1746

Mohd-zaki, A. H., Brett, J., Ismail, E., Taherdoost, H., Group, H., George, L., … Sofian-Azirun, M. (2016). Factors affecting dengue prevention practices: Nationwide survey of the Malaysian public. *PLoS Neglected Tropical Diseases*, *10*(1), 347–357. https://doi.org/10.1016/j.apjtb.2015.10.015

Muhammad Azami, N. A., Salleh, S. A., Neoh, H. M., Syed Zakaria, S. Z., & Jamal, R. (2011). Dengue epidemic in Malaysia: Not a predominantly urban disease anymore. *BMC Research Notes, 4*:216. doi: 10.1186/1756-0500-4-216

Muller, D. A., Depelsenaire, A. C. I., & Young, P. R. (2017). Clinical and laboratory diagnosis of dengue virus infection. *Journal of Infectious Diseases*, *215*(Suppl 2), S89–S95. https://doi.org/10.1093/infdis/jiw649

Mustapha, R., Omar, M., Syed Hassanc, S. N., Yasin, R. M., & Salleh, N. M. (2010). Human capital development of Orang Asli youth: Supportive and suppressive factors. *Procedia - Social and Behavioral Sciences*, *7*(2), 592–600. https://doi.org/10.1016/j.sbspro.2010.10.080

Naing, C., Ren, W. Y., Man, C. Y., Fern, K. P., Qiqi, C.*, et al.* (2011). Awareness of dengue and practice of dengue control among the semi-urban community: a cross sectional survey. *Journal of Community Health, 36*(6):1044-1049. doi: 10.1007/s10900-011-9407-1.

Nagpal, B. N., Ghosh, S. K., Eapen, A., Srivastava, A., Sharma, M. C., & Singh, V. P. (2015). chikungunya , by using pheromone C21 with an insect growth regulator : Results of multicentric trials from 2007 – 12 in India. September, 224–231.

NikNadia, N. M. N., Sam, I. C., Khaidir, N., Ngui, R., Lim, Y. A. L., Goh, X. T., … Chan, Y. F. (2016). Risk factors for Enterovirus A71 seropositivity in rural indigenous populations in West Malaysia. *PLoS ONE*, *11*(2), 1–10. https://doi.org/10.1371/journal.pone.0148767

Pang, E. L., & Loh, H. S. (2016). Current perspectives on dengue episode in Malaysia. *Asian Pacific Journal of Tropical Medicine*, *9*(4), 395–401. https://doi.org/10.1016/j.apjtm.2016.03.004

Phuanukoonnon, S., Brough, M., & Bryan, J. H. (2006). Folk knowledge about dengue mosquitoes and contributions of health belief model in dengue control promotion in Northeast Thailand. *Acta Tropica,* *99*(1):6-14. doi: 10.1016/j.actatropica.2006.05.012.

Ouédraogo, S., Benmarhnia, T., Bonnet, E., Somé, P. A., Barro, A. S., Kafando, Y., … Ridde, V. (2018). Evaluation of effectiveness of a community-based intervention for control of dengue virus vector, Ouagadougou, Burkina Faso. *Emerging Infectious Diseases*, *24*(10), 1859–1867. https://doi.org/10.3201/eid2410.180069

Othman, C. N., Lamin, R. A. C., Farooqui, M., Sihab, N., & Said, S. M. (2012). Lifestyle Related Diseases amongst Orang Asli in Peninsular Malaysia-Case Study. *Procedia - Social and Behavioral Sciences*, *36*(June 2011), 383–392. https://doi.org/10.1016/j.sbspro.2012.03.042

Rajapakse, S., Rodrigo, C., & Rajapakse, A. (2012). Treatment of dengue fever. Infection and Drug Resistance, 5(1), 103–112. https://doi.org/10.2147/idr.s22613

Rakhshanderou, S., Maghsoudloo, M., Safari-Moradabadi, A., & Ghaffari, M. (2020). Theoretically designed interventions for colorectal cancer prevention: A case of the health belief model. BMC Medical Education, 20(1), 1–8. https://doi.org/10.1186/s12909-020-02192-4

Rather, I. A., Parray, H. A., Lone, J. B., Paek, W. K., Lim, J., Bajpai, V. K., & Park, Y. H. (2017). Prevention and control strategies to counter dengue virus infection. Frontiers in Cellular and Infection Microbiology, 7(JUL), 1–8. https://doi.org/10.3389/fcimb.2017.00336

Rav-Marathe, K., Wan, T. T. H., & Marathe, S. (2016). A Systematic Review on the Kap-O Framework for Diabetes Education and Research. *Medical Research Archives*, *4*(1), 1–21.

Rozilawati, H., Zairi, J., & Adanan, C. (2007). Seasonal abundance of Aedes albopictus in selected urban and suburban areas in Penang, Malaysia. *Tropical Biomedicine, 24*(1):83-94.

Rudnick, A., & Lim, T. W. (1986). Dengue fever studies in Malaysia. *Bulletins from the Institute for Medical Research, 23*:51-152.

Saré, D., Pérez, D., Somé, P.-A., Kafando, Y., Barro, A., & Ridde, V. (2018). Community-based dengue control intervention in Ouagadougou: intervention theory and implementation fidelity. *Global Health Research and Policy*, *3*(1), 1–11. https://doi.org/10.1186/s41256-018-0078-7

Sarti, E., L'Azou, M., Mercado, M., Kuri, P., Siqueira, J. B., Solis, E., … Ochiai, R. L. (2016). A comparative study on active and passive epidemiological surveillance for dengue in five countries of Latin America. *International Journal of Infectious Diseases*, *44*, 44–49. https://doi.org/10.1016/j.ijid.2016.01.015

Selvarajoo, S., Liew, J. W. K., Tan, W., Lim, X. Y., Refai, W. F., Zaki, R. A., Sethi, N., Wan Sulaiman, W. Y., Lim, Y. A. L., Vadivelu, J., & Vythilingam, I. (2020). Knowledge, attitude and practice on dengue prevention and dengue seroprevalence in a dengue hotspot in Malaysia: A cross-sectional study. Scientific Reports, 10(1), 1–13. https://doi.org/10.1038/s41598-020-66212-5

Shepard, D. S., Undurraga, E. A., & Halasa, Y. A. (2013). Economic and Disease Burden of Dengue in Southeast Asia. *PLoS Neglected Tropical Diseases*, *7*(2). https://doi.org/10.1371/journal.pntd.0002055

Shuaib, F., Todd, D., Campbell-Stennett, D., Ehiri, J., & Jolly, P. E. (2010). Knowledge, attitudes and practices regarding dengue infection in Westmoreland, Jamaica. *West Indian Medical Journal 59*(2):139-146.

Siddiqui, T. R., Ghazal, S., Bibi, S., Ahmed, W., & Sajjad, S. F. (2016). Use of the Health Belief Model for the Assessment of Public Knowledge and Household Preventive Practices in Karachi, Pakistan, a Dengue-Endemic City. *PLoS Neglected Tropical Diseases*, *10*(11), 1–15. https://doi.org/10.1371/journal.pntd.0005129

Skae, F. M. (1902). Dengue Fever in Penang. *British Medical Journal, 2*(2185):1581-1582.

Smith, C. E. (1956). The history of dengue in tropical Asia and its probable relationship to the mosquito Aedes aegypti. *Journal of Tropical Medicine and Hygiene 59*(10):243-251

Smith, L. B., Kasai, S., & Scott, J. G. (2016). Pyrethroid resistance in Aedes aegypti and Aedes albopictus: Important mosquito vectors of human diseases. *Pesticide Biochemistry and Physiology*, *133*, 1–12. https://doi.org/10.1016/j.pestbp.2016.03.005

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*(5), 347–357. https://doi.org/10.1016/j.jiph.2013.04.006

SyedHussain, T. P. R., Krishnasamy, D. S., & Hassan, A. A. G. (2017). Distribution and Demography of the Orang Asli in Malaysia. *International Journal of Humanities and Social Science Invention*, *6*(1), 40–45.

Sulistyawati, S., Astuti, F. D., Umniyati, S. R., Satoto, T. B. T., Lazuardi, L., Nilsson, M., Rocklov, J., Andersson, C., & Holmner, Å. (2019). Dengue vector control through community empowerment: Lessons learned from a community-based study in Yogyakarta, Indonesia. International Journal of Environmental Research and Public Health, 16(6). https://doi.org/10.3390/ijerph16061013.

Taherdoost, H., & Group, H. (2017). Validity and Reliability of the Research Instrument ; How to Test the Validation of a Questionnaire / Survey in a Research, (January 2016). https://doi.org/10.2139/ssrn.3205040

Thompson, F., & Caltabiano, M. L. (2010). The Health Belief Model and dengue fever preventative behaviours: A pilot programme. International Journal of Health Promotion and Education, 48(1), 9–19. https://doi.org/10.1080/14635240.2010.10708175

Tunaz, H., & Uygun, N. (2004). Insect growth regulators for insect pest control. Turkish Journal of Agriculture and Forestry, 28(6), 377–387. https://doi.org/10.3906/tar-0309-5

Udayanga, L., Gunathilaka, N., Iqbal, M. C. M., Pahalagedara, K., Amarasinghe, U. S., & Abeyewickreme, W. (2018). Socio-economic, Knowledge Attitude Practices (KAP), household related and demographic based appearance of non-dengue infected individuals in high dengue risk areas of Kandy District, Sri Lanka. BMC Infectious Diseases, 18(1), 1–14. https://doi.org/10.1186/s12879-018-2995-y

Um, S. (2019). Knowledge attitudes and practice of general population on dengue fever prevention. A cross-sectional household survey in rural Kampong Chhnang province. August 2019.

Usman, H. B., AlSahafi, A., Abdulrashid, O., Mandoura, N., Al Sharif, K., Ibrahim, A.,Shamia, M. (2019). Effect of Health Education on Dengue Fever: A Comparison of Knowledge, Attitude, and Practices in Public and Private High School Children of Jeddah. *Cureus*, *10*(12). https://doi.org/10.7759/cureus.3809

Van den Berg, H., Velayudhan, R., & Yadav, R. S. (2021). Management of insecticides for use in disease vector control: Lessons from six countries in asia and the middle east. PLoS Neglected Tropical Diseases, 15(4), 1–18. https://doi.org/10.1371/journal.pntd.0009358

Vikram, K., Nagpal, B. N., Pande, V., Srivastava, A., Saxena, R., Anvikar, A., … Paul, R. (2016). An epidemiological study of dengue in Delhi, India. *Acta Tropica*, *153*, 21–27. https://doi.org/10.1016/j.actatropica.2015.09.025

Wan Rozita, W., Yap, B., Veronica, S., Mohammad, A., & Lim, K. (2006). Knowledge, attitude and practice (KAP) survey on dengue fever in an urban Malay residential area in Kuala Lumpur. *Malaysian Journla of Public Health Medicine, 6*(2):62-67.

Wilson, A. L., Boelaert, M., Kleinschmidt, I., Pinder, M., Scott, T. W., Tusting, L. S., & Lindsay, S. W. (2015). Evidence-based vector control? Improving the quality of vector control trials. *Trends in Parasitology*, *31*(8), 380–390. https://doi.org/10.1016/j.pt.2015.04.015

Winch, P. J., Leontsini, E., Rigau-Perez, J. G., Ruiz-Perez, M., Clark, G. G., & Gubler, D. J. (2002). Community-based dengue prevention programmes in Puerto Rico: impact on knowledge, behaviour and residential mosquito infestation. Am. J. Trop. Med. Hyg, 67(4), 363–370.

Wong, L. P., Shakir, S. M. M., Atefi, N., & AbuBakar, S. (2015). Factors affecting dengue prevention practices: Nationwide survey of the Malaysian public. *PLoS ONE*, *10*(4), 1–16. https://doi.org/10.1371/journal.pone.0122890

Wong, L. P., AbuBakar, S., & Chinna, K. (2014). Community Knowledge, Health Beliefs, Practices and Experiences Related to Dengue Fever and Its Association with IgG Seropositivity. *PLoS Neglected Tropical Diseases*, *8*(5). https://doi.org/10.1371/journal.pntd.0002789

Woon, Y. L., Hor, C. P., Hussin, N., Zakaria, A., Goh, P. P., & Cheah, W. K. (2016). A Two-Year Review on Epidemiology and Clinical Characteristics of Dengue Deaths in Malaysia, 2013-2014. *PLoS Neglected Tropical Diseases*, *10*(5), 2013–2014. http://doi.org/10.1371/journal.pntd.0004575

WHO. (2004). *A Glossary of Terms for Community Health Care and Services for Older Persons*. *WHO center for Health Development*. https://doi.org/WHO/WKC/Tech.Ser./04.2

WHO. (2012). Global strategy for dengue prevention control 2012-2020. Available at http://reliefweb.int/sites/reliefweb.int/files/resources/9789241504034_eng.pdf#sthash.oMnLNHuN.dpuf.

Yeo, H. Y., & Shafie, A. A. (2018). The acceptance and willingness to pay (WTP) for hypothetical dengue vaccine in Penang, Malaysia: A contingent valuation study. Cost Effectiveness and Resource Allocation, 16(1), 1–10. https://doi.org/10.1186/s12962-018-0163-2

Yboa, B. C., & Labrague, L. J. (2013). Dengue Knowledge and Preventive Practices among Rural Residents in Samar Province, Philippines. *American Journal of Public Health Research, 1*(2):47-52.

Yussof, F. M., Hassan, A., Zin, T., Hussin, T. M. A. R., Kadarman, N., & Umar, R. (2018). Knowledge of dengue among students in Universiti Sultan Zainal Abidin (UNISZA), Terengganu, Malaysia and the influence of knowledge of dengue on attitude and practice. *Journal of Fundamental and Applied Sciences*, *9*(2S), 199. https://doi.org/10.4314/jfas.v9i2s.15