CHAPTER III

MATERIALS AND METHODS

3.1 THE COUNTRY'S PROFILE

Malaysia is located in Southeast Asia, between longitudes 100^{o} and 120^{o} east and latitudes formed by the equator and 7^{o} north. It comprises 13 states namely Johor, Kedah, Kelantan, Melaka, Negeri Sembilan, Pahang, Perak, Perlis, Pulau Pinang, Sabah, Sarawak, Selangor and Terengganu; and federal territories which comprises Kuala Lumpur, Putrajaya and Labuan (Figure 3.1). Kuala Lumpur is the capital city with a population of approximately 2.6 million people. With a distance of 644 kilometers, the South China Sea separates the states of Sabah, Sarawak (on the island of Borneo) and the Federal Territory of Labuan from Peninsular Malaysia.

The total land area of the country is 330,252 km^2. Peninsular Malaysia (West Malaysia), 131,598 km^2, is bordered by Thailand in the north and Singapore in the south. Sarawak (East Malaysia) shares its frontiers with Kalimantan in Indonesia and the Sultanate of Brunei Darul Salam. The country has a tropical climate with a temperatures ranging from $21^{o}C$ to $35^{o}C$ throughout the year. Relative humidity can reach to 95% with annual rainfall average of 200 cm a year. The growth rate of country is 1.7%/year with crude birth rate, crude death rate and infant mortality rate of 18.0%, 4.5% and 6.7%, respectively. The proportions of males to females are 50.9% to 49.1% respectively.

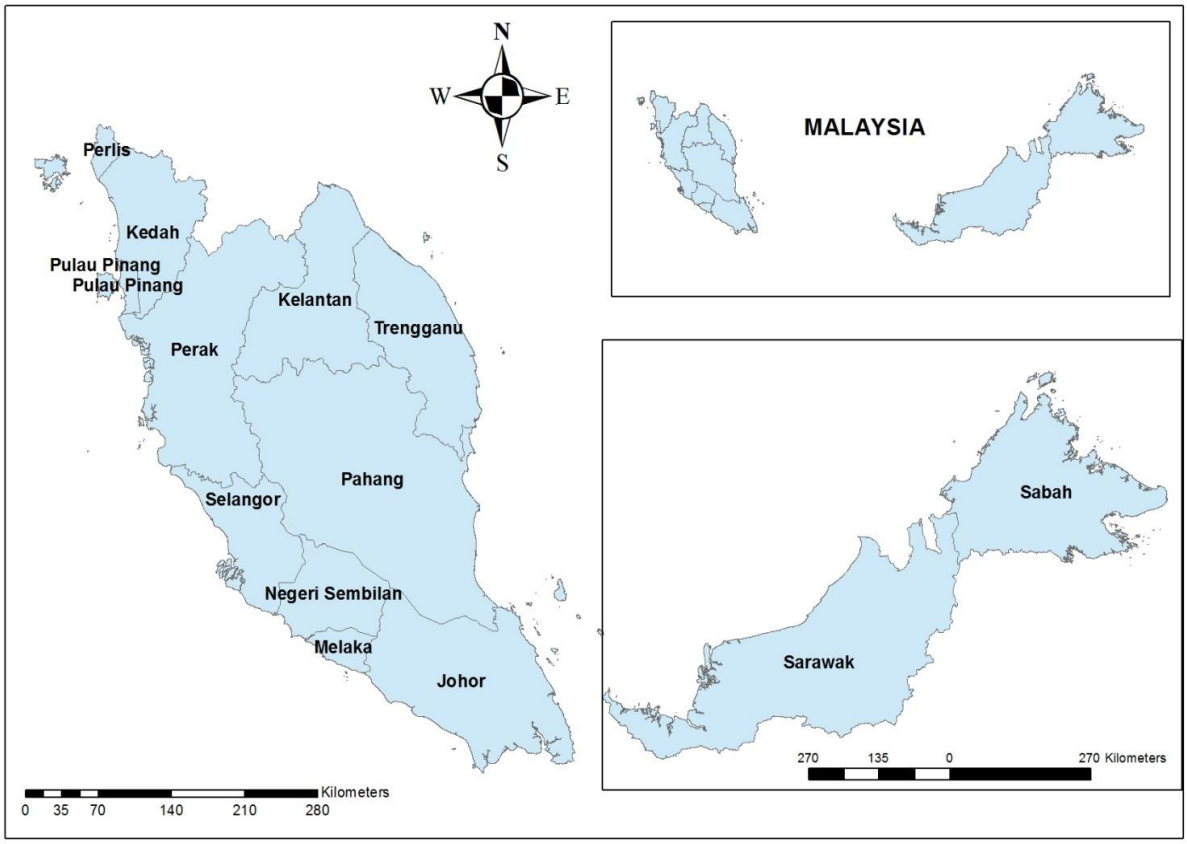

FIGURE 3.1: A geographical map of Malaysia (created using the Esri ArcMap 10.2.1 software).

The official language of Malaysia is Bahasa Malaysia (modified form of the Malay language), however, English is the second language. According to the last census (2010), the total population of the country is 28,334,135 people (Department of Statistics, 2014). Malaysia has a unique multi-ethnic and multi-cultural society. The major ethnic groups in the country are; Malay (50.4%), Chinese (23.7%), Indians (7.1%), other non-Malay indigenous people (11.0%) and others including the Orang Asli (6%).

3.2 ORANG ASLI POPULATION

The name "Orang Asli" is a Malay term which translated as 'original people' or 'first people'. It is a collective term introduced by anthropologists for the 18 ethnic subgroups in Peninsular Malaysia that generally are classified under three main groups; Negrito, Senoi and Proto-Malay (Figure 3.2).

Orang Asli population grew from 54,033 in 1969 to 92,529 in 1994, at a rate of almost 2.3% per year. In 2004, they numbered 149,512, representing 0.6% of the national population. While the national poverty rate has been reduced to 6.5 percent, the rate for Orang Asli remained at a high 76.9 percent. The official statistics also classify 35.2% of the Orang Asli as poor; compared to 1.4 percent nationally (Department of Statistics, 2014).

Medical services and health care for Orang Asli are provided by Jabatan Kemajuan Orang Asli (JAKOA), previously known as Jabatan Hal-Ehwal Orang Asli (JHEOA), which comprised 125 treatment centers (designated locations where a mobile clinic visits periodically), 20 transit centers, and 10 health clinics (JHEOA/Gombak Hospital, 2005). Low socioeconomic status and poverty lead to IDA, VAD and malnutrition, and all are found among Orang Asli communities (Osman and Zaleha, 1995; Al-Mekhlafi *et al.,* 2005a; 2008b; Nor Aini *et al.,* 2007; Ngui *et al.,* 2012). Moreover, several studies conducted among Orang Asli showed that intestinal parasitic infections are still highly endemic in their communities (Anuar *et al.,* 2014; Al-Mekhlafi *et al.,* 2006; 2007; Ngui *et al.,* 2011). Orang Asli had 53.6% of the malaria cases recorded in Peninsular Malaysia in the early 2000s (Jeyakumar, 1999; JHEOA/Gombak Hospital, 2005). However, a tremendous reduction in the number of malaria cases among Orang Asli was achieved by the National Malaria Control Programme. According to the Ministry of Rural and Regional Development, infant

mortality rate among the Orang Asli in the year 2004 was 9% compared to the national average of 5.9% (MRRD, 2005).

FIGURE 3.2: Distribution of various Orang Asli tribes and subgroups in Peninsular Malaysia

3.3 STUDY DESIGN

An open-label controlled intervention trial (Trial Registration: clinicaltrials.gov; identifier: NCT01640626) was carried out to evaluate the impact of the developed health education package in controlling STH infections among Orang Asli school children in two primary schools in Lipis district, Pahang, Malaysia. The schools were assigned to serve as either an intervention or control group. At baseline, a cross-sectional study was conducted with all participating children being screened for STH infections in order to establish their eligibility in regard to taking part in the intervention study. Children from both schools were dewormed before the commencement of the intervention part of the study. The package was then provided to children in the intervention school only, with children from both schools being recalled for follow-up examinations over the next 6 months. The time frame was set at 6 months based on previous studies among these communities, which revealed that by 6 months of complete deworming the prevalence and intensity of STH infections were almost similar to pre-treatment levels (Al-Mekhlafi *et al.*, 2008b; Ahmed *et al.*, 2011). The study was carried out between January 2012 to October 2013.

3.4 STUDY AREA

This study was carried out in the selected Orang Asli schools in Lipis, Pahang state, about 220 km northeast of Kuala Lumpur. Lipis has a total population of 87,200 people. The climate is equatorial with hot-humid conditions and rainfall throughout the year. Most of the houses in the Orang Asli area are made of wood or bamboo with inadequate sanitary facilities. Moreover, there are many new houses in the Orang Asli area provided by the government made of bricks and concrete. More than half of the houses have no piped water supply. Although long-distance water pipes are found at many houses, but the water is not always available. However, the villages are located

alongside rivers which are the main source of water for daily activities. The majority of the people in the villages work as labourers in palm oil and rubber plantations or are engaged in the selling of forest products, to earn a living.

This study was conducted in two Orang Asli areas namely Pos Betau and Kuala Koyan in Lipis district (Figure 3.3). Pos Betau, is located in a valley region about 70 km from the town of Kuala Lipis and 220 km from Kuala Lumpur. It consists of 18 villages: Sarang, Samut, Sentoi, Lanchang, Kijek, Limau, Chekai, Sat, Kuala Kenip, Ulu Kenip, Kuala Milot, Ulu Milot, Simoi, Jelengok, Bertam Baru, Kabang Baru, Belida and Kuala Tual. On the other hand, Kuala Koyan is located about 50 km from Kuala Lipis and 200 km from Kuala Lumpur. It consists of two villages; Kuala Koyan and Tanjung Gahai. Orang Asli population in these areas are from Senoi group. The villages have a population of homogenous nature with similar socioeconomic, cultural and environmental background. Most of the children in these villages go around barefooted (APPENDIX B). The children play and swim or have their bath in the rivers, which is also considered their preferred sites for defecation. Besides that, their personal hygienic practices are poor.

There are two primary schools in these areas namely, Sekolah Kebangsaan Kuala Koyan (SKKK) and Sekolah Kebangsaan Pos Betau (SKPB) (APPENDIX A). Both schools were selected purposively based on the findings of previous surveys and after discussion with the health officers in the Department of Orang Asli Development (JAKOA). The distance between these 2 schools is about 50 km; therefore, interactions between students and teachers were not possible. Previous studies showed that the prevalence of intestinal helminthic infections among Orang Asli children in Lipis, Pahang was high (Al-Mekhlafi *et al.*, 2007; Ngui *et al.*, 2011; Nasr *et al.*, 2013a).

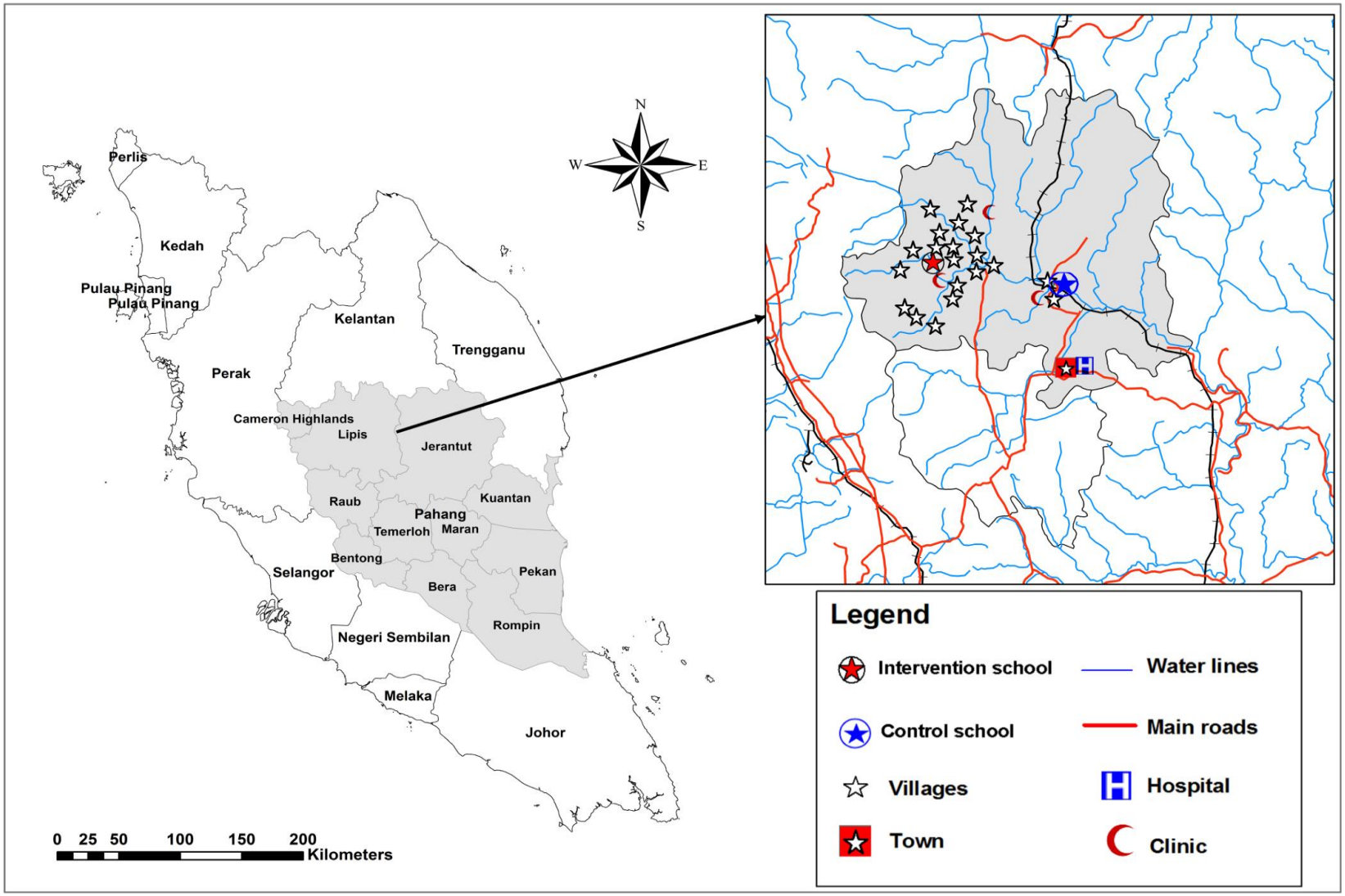

FIGURE 3.3: A geographic map of P. Malaysia showing the location of the schools and villages involved in the study. The map was created using the Esri ArcMap 10.2.1 software.

3.5 STUDY POPULATION

In both schools, all children who fulfilled the selection criteria were invited to participate in the study. Sekolah Kebangsaan Kuala Koyan is located in Kuala Koyan (SKKK), Lipis, Pahang with 17 teachers and a total enrolment of 167 school children. Sekolah Kebangsaan Pos Betau (SKPB) is located in Pos Betau, Lipis, Pahang with 25 teachers and more than 600 pupils. The school children were from 18 villages around the schools. Although the total enrolment of the schools was 783 pupils (167 SKKK and 616 SKPB), only 650 present during sampling visits. Of these children who were present, 498 children aged 6-12 years (252 males and 246 females) had agreed voluntarily to participate in this study (at baseline) and had met the selection criteria (delivered stool samples for examination, complete questionnaire and signed written consent by the guardian). However, only 317 children were involved in the intervention phase of this study (172 from SKPB and 145 from SKKK).

3.5.1 Selection of participants (Inclusion criteria)

- Aged 6-11 years (according to birth date on birth certificate).
- No severe and/or chronic illness such as acute respiratory tract infections, mental retardation and neurological deficits.
- Agreed to participate and gave a written informed consent signed by parent.

3.5.2 Sample size

The minimum sample size required for this study was calculated according to the formula provided by Lwanga and Lemeshow (1991). A sample size of 280 children (including 20% attrition loss or lost by follow-up), 140 per intervention arm was estimated to give the study at least 80% power at 5% significance to detect a 10% difference in the prevalence of STH infections and intensity between the intervention group and the control group. This calculation assumed that 70% of children have

intestinal parasitic infections (Al-Mekhlafi *et al.*, 2007; Ngui *et al.*, 2011; Nasr *et al.*, 2013a). At baseline survey, a total of 498 children participated in the study and delivered their fecal samples for examination. Subsequently, a total of 317 children were involved in the intervention phase of this study (172 from SKPB and 145 from SKKK).

The formula used for sample size calculation was:

$$n = \frac{2\times (Z\ (1-\alpha/2) + Z\ (1-\beta/2))^2}{\Delta 2}$$ (Greenberg *et al.*, 2001)

Where: -

n = number of participants required in each intervention group.

Z (1-α/2) = percentage point of the normal distribution for statistical significance (0.05).

Z (1-β/2) = percentage point of the normal distribution for power (80%).

Δ= standardized difference.

3.6 DATA COLLECTION AND EMPIRICAL METHODS

Development of the health education package was carried out from January to December 2012. The baseline data collection included screening eligibility, questionnaires for knowledge, attitude, and practices (KAP) towards STH, and demographic, socioeconomic and environmental factors were conducted in between January and March 2013. The intervention study for evaluating the package was conducted between April and October 2013 with a monthly assessment and follow-up**.**

3.7 DEVELOPMENT OF HEALTH EDUCATION LEARNING PACKAGE (HELP)

3.7.1 Package name

The health education package developed by this study was abbreviated by the acronym HELP (**H**ealth **E**ducation **L**earning **P**ackage). The package consisted of many items including a comic book, posters, sanitary bag, nursery video songs, drawing activity, puppet show and teacher's guide book to STH. Moreover, an aid kit consisting of slippers, soap and nail clipper was also provided to children to help them to practice what they learn throughout the project. All these items were to deliver important health messages on STH infections impacts, transmission and prevention. The introduction of these health messages was based on continuous learning by the teachers and researchers and follow-up over 6 months. It was found that the most effective method of skill development is learning by doing; involving target population in active, participatory experiences, rather than passive ones. Hence, the learning process of the current project was also done by the children who were empowered as educators and health messengers to their families, and siblings in their villages.

3.7.2 Development process

At the beginning, several conceptual models were created to ensure that the efforts covered all possible situations. Thus, the development process relied on the PRECEDE-PROCEED Model (PPM) (Green, 1974). Applying PPM to the present study, the model suggests starting the process with diagnostic planning to evaluate cultural, behavioral, environmental and educational factors that may influence the efforts to control STH infections. Hence, group discussions were held with experts from the field of Parasitology, Public Health, Education, Psychology, and School Health, as well as the Department of Orang Asli Development (JAKOA), staff from Education office, and

other researchers. A household survey that included household observations, infrastructure assessment, and group discussions with school children, parents, teachers, and health clinic personnels were also conducted. In addition, group discussions were held with the animation design experts and animation production companies in Kuala Lumpur, Malaysia.

The Health Belief Model (HBM) was also considered in the present study to identify individuals and cultural beliefs about the susceptibility of Orang Asli people to STH infections and to assess their attitude towards the severity of infections and the benefits of deworming. Moreover, the possible barriers to deworming and to the elimination of STH from these communities were also investigated. Furthermore, the self-efficacy of these people was also explored and found to be minimal. However, after many discussion sessions on the feasibility of preventing STH infections and on the possible positive impacts on the health and future of their children these people showed good interest and willingness to participate in the study activities.

The importance of the target population's beliefs and attitudes about diseases, especially how these beliefs may influence perceived capabilities and approaches towards preventing STH infections, and whether or not providing health education would actually be an effective means of reducing their risk of such infections were also considered. These factors are crucial in order to develop a package that will meet the needs of the target population, as they will allow the research team to properly assess ways to actively encourage these people to participate effectively in the overall efforts.

Hence, the development of HELP was conducted in three phases as follows:

i. Identification of the key risk factors of STH infections among Orang Asli children.

This was done through an intensive review of the previous epidemiological studies conducted among Orang Asli communities. Moreover, there were visits to many Orang Asli communities in different states and reported the presence of some risk factors by direct observations and by group discussions with Orang Asli residents at the visited areas. Pooled risk factors identified in the previous studies and confirmed by the observations were then analyzed to identify the key risk factors.

Several previous studies were conducted in rural Malaysia which showed that poverty (low household monthly income), being aged below 10 years, lack of toilet facilities, lack of safe drinking water in a household were the significant risk factors of STH infections (Norhayati *et al.,* 1997a; Al-Mekhlafi *et al.,* 2007; Ngui *et al.,* 2011; Ahmed *et al.,* 2011). Moreover, low educational levels of parents, poor personal hygiene including not washing hands before eating and/or after defecation, and not washing fruits and vegetables before consumption were also identified as significant risk factors of intestinal parasitic infections among Orang Asli people (Mahdy *et al.,* 2007; Ngui *et al.,* 2011; Ahmed *et al.,* 2012). These coupled with lack of health education and poor personal hygiene aggravate the spread of infections (Chan, 1997; Bethony *et al.,* 2006; Nasr *et al.,* 2013a). Moreover, other risk factors such as walking barefooted when outside the house and geophagia have been identified in previous studies conducted in Malaysia and abroad (Rai *et al.,* 2000; Luoba *et al.,* 2005; Nasr *et al.,* 2013a). During the visits to the villages and schools, it was observed that about half of the houses lacked functioning toilet and/or a lack of clean tap water. It was also observed that many residents have long finger nails and did not cut their nails periodically. Interestingly, it was found that most Orang Asli children practice open defecation and preferred to defecate in the rivers, including those who have access to fully functioning toilets in their homes.

It was noted a high number of non-biting flies in these communities. Flies have been identified as mechanical vectors of intestinal parasitic infections (Thyssen *et al.,* 2004). Moreover, Sulaiman *et al.,* (1988) studied the role of some adult flies as carriers of human helminths eggs in Malaysia and reported that the dominant fly species *Chrysomya megacephala*, collected from rural areas, carried eggs of *A. lumbricoides, T. trichiura* and hookworm and also the filariform infective larvae of hookworm on their external body surface and in the gut lumen.

ii. List of health messages to be delivered to the target population

The key health messages were formulated according to the identified key risk factors. The messages were simple in order to ensure they would be properly understood by the target population. It was found that most of the risk factors were related to personal hygiene, while only some were related to demographic and socioeconomic factors. Hence, HELP messages focused on the personal hygiene practices while demographic factors (such as age group < 10 years) were only used for recommending intensification of control measures among certain age groups. Overall, the key messages for prevention created for the present study were:

1. Washing hands before eating

2. Washing hands with soap after playing with soil

3. Washing hands with soap after using toilet

4. Wearing slippers or shoes when going outside

5. Avoiding open (indiscriminate) defecation

6. Washing vegetables and fruits before consumption

7. Drinking clean (boiled) water

8. Covering food from flies

9. Cutting nails periodically

iii. Identification of means to deliver the messages to the target population

The key health messages were integrated into the health education learning package which involved a workshop for teachers, teacher's guide book on STH, posters, a comic book, drawing activities, a sanitary bag, puppet show, 2 nursery video songs, and group discussions. The comic book, posters, sanitary bag and video songs were designed and produced by Animagis Sdn Bhd, Malaysia. At the beginning, the decision was made on a known character or mascot to be displayed across all publications and means in order to reinforce and reiterate the important health massages to pupils.

A. WORKSHOP FOR TEACHERS

It is believed that teachers act as the best health educators to their pupils, as most of the children highly respect their teachers and follow their instructions, a truism which is more obvious in rural areas where teachers receive admiration from the whole community. In the present study, a 100% response rate was achieved from classes in which the teachers distributed the fecal containers to the children before personally giving them their instructions. Thus, involvement of teachers in any school-based health education programmes is crucial.

In this study, the concepts related to STH and HELP were provided to the teachers from the intervention school (SKPB) in the form of a half-day workshop which involved the following (APPENDIX G):

i. Knowledge assessment

A structured questionnaire on the knowledge of teachers towards STH infections was administered at the beginning of the workshop to assess their prior knowledge (APPENDIX G). The same questionnaire was administered again to them after 3 months to assess the impact of HELP on their KAP. A similar

questionnaire was distributed in the control school (SKKK) at baseline and after 3 months.

ii. Scientific lectures

Lectures were given to teachers by professors from the Department of Parasitology, University of Malaya. The lectures involved definition of STH infection, mode of transmission, risk factors, signs and symptoms, complications and adverse effects, anthelmintic drugs properties and administration, and the measures of prevention and control. Moreover, HELP was introduced to the teachers with further training being provided to help the teachers understand how to assist in the introduction and follow-ups of the package.

iii. Teacher's guide booklet

A teacher's guide to STH booklet (APPENDIX N) was designed and produced for the teachers. The booklet covered all the basic concepts of STH infections. The teachers' booklet guide contained 15 coloured pages, questions and answers concerning knowledge about STH, life cycles, epidemiology, burden of STH on children, risk factors with pictures from the Orang Asli communities, practical and easy demonstrated ways for prevention and control. The booklet was distributed to the teachers as part of their induction into the HELP programme.

iv. Microscopy session

Slides with the eggs of different STH species were shown to the teachers by light microscopes brought from the Department of Parasitology, University of Malaya.

v. Session on gross worm specimens

Gross specimens of the adult worms of different STH species from the Department of Parasitology, University of Malaya were shown to the teachers. An open discussion on the gross specimen was held.

vi. Poster session

Scientific posters on the life cycles and impact of different STH species from the Department of Parasitology, University of Malaya were fixed at the workshop venue. All teachers took turns to view, ask and comment on the posters.

B. POSTERS

Three posters were produced to convey the main health messages relating to STH (APPENDIX L). Two posters focused on the most important messages which are washing hands before eating/after using the toilet/after playing with soil, and wearing shoes when going outside. The third poster covered all the nine health messages in an attractive circular design. The posters were fixed on the walls all over the school (class rooms, computer and audiovisual labs, library, canteen, main hall, clinic room, staircase and toilets). In addition to this, large stands displaying the three posters were placed at different strategic locations within the school. Furthermore, each child was given copies of the three posters and was instructed to fix them at his/her house. This was aimed to distribute the knowledge about STH to other family members including parents and preschool children. The research team visited randomly selected houses to check that the posters were fixed in households. The posters were distributed again to children after 3 months. During the project period, the status of the posters was checked regularly and spoilt posters were replaced. Volunteer students from each class were encouraged to help in distributing and fixing the posters.

C. COMIC BOOK

A comic book story (APPENDIX M) was created and designed by the research team and experts from the production company (Animagis Sdn Bhd). The comic book consists of 19 coloured pages, designed and printed to appeal to Orang Asli children in a brief, simple and attractive way so as to help them recognize the risk factors, consequences and preventive measures with regard to STH infections. The design of the cartoon characters, practices, school building, background and environment (bushes, a river and houses) reflects the Orang Asli culture.

The scenario is about two friends in a school; Alif, the healthy child and Atan who is infected with STH. The story explains the effects of STH infection on Atan's school attendance, cognitive function, and on his educational achievement. Atan was suffering from abdominal cramps and drowsiness. He always bit his nails. He did not know that he might acquire STH infections through the contaminated nails or fingers. Thus, the teacher advised Atan to stop this bad habit and informed him that he should cut his nails regularly. The third character in the story is Zibiru, a known cartoon character (biru in Malay language means blue). He came from another planet to help his friends and to give advice to Orang Asli children about STH. When Zibiru investigated Atan's gut with his x-ray vision power, he saw a lot of worms inside Atan's gut. So, he educated Atan on how to prevent STH infections, focusing again on the nine health messages. Atan's health and school performance subsequently improved after he followed Zibiru's advice.

Besides the story, the lyrics of two nursery songs were provided on the internal covers of the comic book. This was to help the children memorize the lyrics whilst at the same time being appealing so as to encourage the reciting and singing of the songs.

Moreover, two pages at the end of the book contained activities related to STH; centred around having the children mark the correct hygienic practices and colouring of pictures to help them remember the lessons taught in the comic. Both pages again reminded the children about the messages of preventing STH. The children were instructed to keep the comic book in their schoolbags and to bring it to school every day. Extra copies were also kept in the library for the weekly group activities. The teachers were encouraged to frequently discuss the comic with the children, to help them relate to the characters and concepts presented within.

D. NURSERY VIDEO SONGS

Two animated nursery video songs were produced by the the present study with help from Animagis Sdn Bhd using the same characters displayed in the comic book and posters. The tunes used in both songs were chosen to fit the Orang Asli culture, in order to make them acceptable and enjoyable for the Orang Asli children.

In the first song, Zibiru, the cartoon character, plays on his guitar whilst singing in order to educate the children about how to wash their hands properly; have a soap ready, wash the hands with soap, rub the outer and inner surface of your hands with the soap, rub your fingers and nails with the soap, use water to wash the soap thoroughly, then use a tissue or towel to dry your hands.

The second song resembles the comic book's characters and story. It describes the mode of transmission of STH, effects of STH on school attendance and performance, as well as how to prevent STH through healthy personal hygiene practices (the nine messages again).

The songs were installed into the computers in the school computer lab (30 desktops) and in the library. For the first viewing, all children were shown the video songs in the library. Then, the teachers followed-up with them and helped them to

memorize and recite the songs through a weekly show at the computer lab. As mentioned earlier, the lyrics of the two nursery songs were provided on both sides of the internal cover of the comic book.

The songs are available online via YouTube:

1st song: http://www.youtube.com/watch?v=aBy2TPEQquMandfeature=youtu.be

2nd song: http://www.youtube.com/watch?v=UNd3Q89EaH8

E. DRAWING ACTIVITY

Drawing has proven to be an effective method to dig up into the belief system of young children (Pridmore and Bendelow, 1995). In the present study, the drawing activity was carried out at baseline and after 3 months. At both schools (SKKK and SKPB), plain A4 paper was distributed to the children and they were instructed to draw what they think or know about the intestinal worms that infect humans, and how to prevent themselves from getting such infections.

F. PUPPET SHOW

Acting and 'fun' activity such as watching a puppet show is an excellent way of teaching. It is act as a powerful tool for providing health education (UNICEF, 2002; Gilbert *et al.*, 2011; Snel *et al.*, 2002). Nowadays, special courses using puppet show are designed for nursery and primary school teachers in many countries as these courses equip teachers to be more confident, effective and actively engaging in the classroom. Acting, theatre and puppet activities help children of all ages focus and develop an understanding of specific issues, which in turn improves related knowledge and skills. Puppets have been used to educate children on different topics such as HIV,

schistosomiasis, dental health and how to maintain a healthy life style (Synovitz, 1999; Wolmarans and De Kock, 2009).

In the present study, a puppet show was prepared at the Department of Parasitology, University of Malaya using good quality set pieces and well crafted glove/hands puppets. First, the puppet show scenario script was written in English language and then translated to Malay language. At the intervention school, the children were divided into 3 groups, according to their classrooms, to attend and watch the puppet show. It was observed that many pupils joined the puppet show again with the other groups to watch it carefully with great interest. The school children were happy to watch the show, remaining silent during the production and bursting into joyful applause at the end of the show (APPENDIX H).

The main core of the story in the puppet show once again revolved around the transmission and prevention of STH. Four characters were involved in the act; one of them was feeling sick (Farah), her friend (Salman) advised her to see a doctor and examine for STH infections. Then, the show starts to educate the sick pupil how the worms enter the human body and the main important personal hygiene practices that are involved in the prevention (the 9 health messages). The third character (Shahaida) joined the show and asked to repeat the main ways of prevention. The fourth character (Rudi) contributed with a funny role as when he heard the discussion about STH, he was so angry towards the worms and he shouted; tell me where are the worms? I will destroy them with this stick. But, he was educated and learned from his friends that prevention cannot be by this method, and he needs to follow the instructions given for ways of prevention. If infected, he should take the proper anthelmintic drug.

Overall, the HELP-puppet show was well-received, inexpensive, and easy to produce in terms of implementation and in training the children to re-perform it. The

theater and hand puppets can be purchased for a one-time cost of approximately 50 USD after which they can be used regularly for several years. Many children from different classes, selected at the village level, were trained to perform the show by themselves with the same script and were instructed to perform it and extend the information about STH to their families in the villages.

G. AID KIT

Generally, poverty prevails in Orang Asli communities, thus providing advice and health education might not be enough to achieve a significant reduction in the prevalence and intensity of STH infections. This could be because poorer families, especially those comprised more than 7 members, simply cannot afford soap or shoes for their children. This was the reason behind the limited success of many control programmes in other countries (Mascarini-Serra, 2011). A previous study investigated the barriers related to wearing shoes in rural Ethiopia, which revealed many practical and social barriers that prevented the desire for wearing shoes from being translated into actual practice (Ayode *et al.*, 2013).

These barriers include financial constraints, the unsuitability of available shoes for certain activities, poor knowledge and thus a poor understanding of the adverse consequences that can result due to not wearing shoes, and difficulty in finding appropriate shoe size. The study also observed that although children were usually encouraged to wear shoes at school, they were often dissuaded, sometimes forcibly, from wearing them after school time when they are engaged in housework or play. It was observed similar practices among the Orang Asli communities. When questioned, the parents highlighted that they did not allow their children to wear school shoes at home or in the village in order for it to be more durable. During the survey, it was found that most of the houses did not have nail clipper or hand soap.

Within this context and as a reflection on the abbreviation of this package ("HELP"), each child was given a sanitary bag which contained slippers, hand soap and nail clipper together with the comic book and posters.

H. SANITARY BAG

A medium size sanitary bag was designed for this package and distributed to all children taking part in the programme. The nine health messages on the mode of transmission and prevention of STH were displayed on both sides of the bag. This was done so as to help reinforce and reintroduce the messages to children through multiple means.

The components of HELP are shown in Figure 3.4.

FIGURE 3.4: The components/items of HELP.

3.8 EVALUATION OF HELP TO CONTROL STH INFECTIONS

A flow chart for the data collection process involved in the evaluation of the developed package is shown in Figure 3.5.

3.8.1 Questionnaire survey

The parents of children were interviewed face-to-face in their home so as to fill up a pre-tested questionnaire adopted from a previous study (Nasr *et al.,* 2013a). The questionnaire was designed in two parts (APPENDIX J). The first part centred around demographic, socioeconomic and environmental data, as well as personal hygiene, habits, and health status. The second part revolved around the KAP towards STH. Questions in the knowledge section were designed to test the understanding of respondents on the subject of STH. These were open-ended questions, without multiple-choice answers, as such options can result in guessing and therefore give a false impression as to the knowledge of the population. Questions on the attitude were designed to investigate the prevailing attitudes, beliefs and misconceptions of the population about STH. Questions in the practice section were designed to assess the practices of the population with regard to STH. These also were open-ended questions.

Two research assistants from JAKOA and from the Department of Parasitology, University of Malaya were trained on how to administer the questionnaire for the purpose of this study. During the interviews, observations were made on the personal hygiene of the children and household cleanliness in general, including the availability of functioning toilets, piped water, cut nails, the use of footwear when outside the house, as well as general hand and clothes cleanliness.

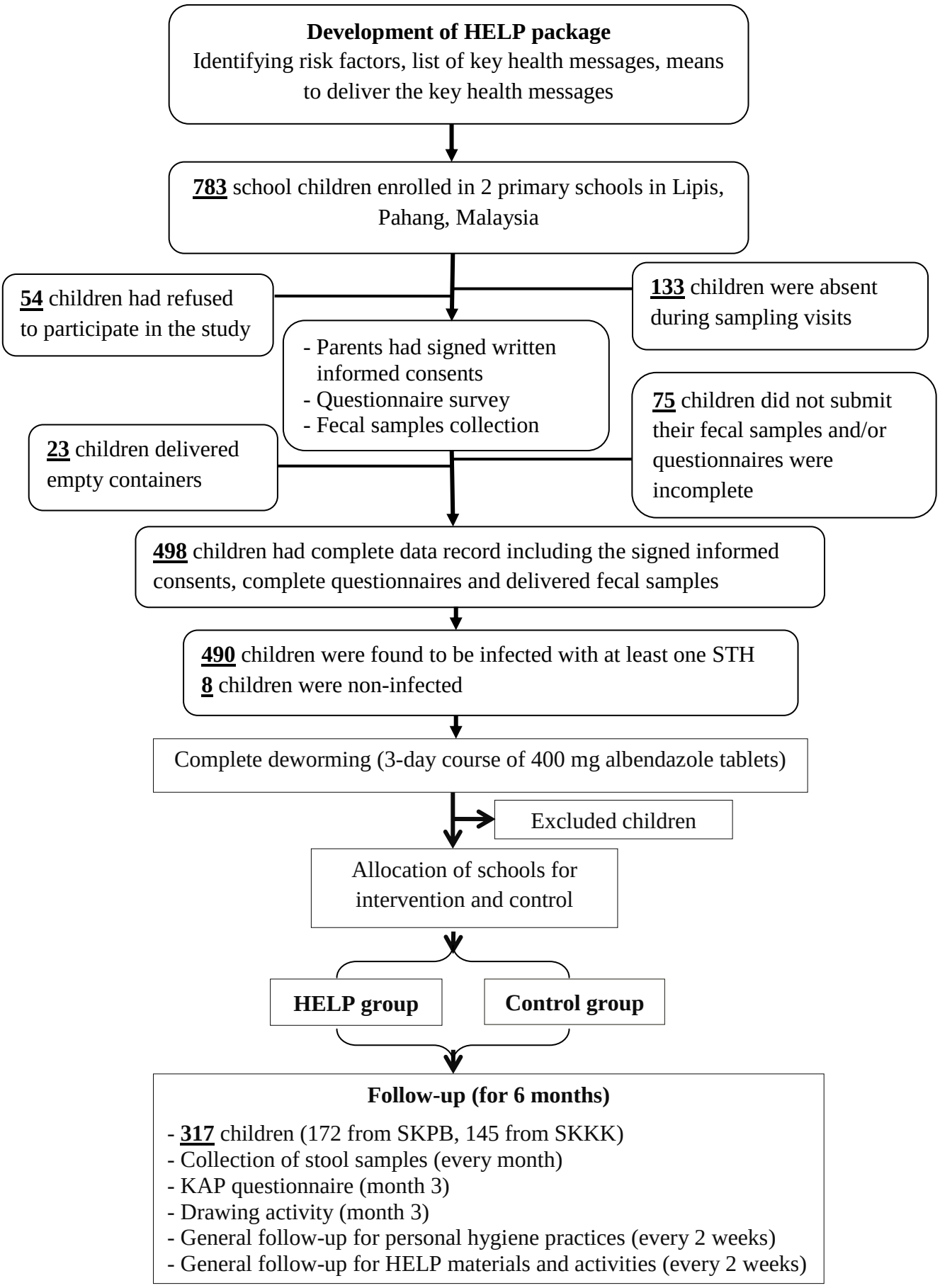

FIGURE 3.5: A flow chart of the study

Another questionnaire was distributed to teachers to evaluate their knowledge about STH (APPENDIX K). The questionnaire involved 23 items on the biodata of the respondent, socioeconomic and educational status and also on the prior knowledge about STH, source of information (if any), ways of transmissions, signs and symptoms, and measures of prevention. It also included questions about any personal history of STH infections and also on the knowledge about the infection rate among school children in the related school. These were open-ended questions, without multiple-choice answers and the questionnaires were self administered and collected after 15 minutes of distribution.

3.8.2 Fecal samples collection and examination

i. Collection of fecal samples

Eight fresh fecal samples were collected from each participant; at baseline, 12-14 days after treatment and then monthly for 6 months. The children were given a clearly labeled, wide mouth and screw-capped containers and were instructed to bring their early morning stool samples the next day. The collected samples were transported (within 5 hours of collection) in suitable cool boxes at temperature between 4 and 6^{o}C for examination at the stool processing laboratory in the Department of Parasitology, Faculty of Medicine, University of Malaya.

ii. Examination of fecal samples

The samples were examined using six different techniques; namely, direct smear, formalin-ether sedimentation, Kato-Katz, Harada Mori, trichrome stain, and modified Ziehl Neelsen stain techniques.

All the samples were screened first by direct smear technique. Then, formalin-ether sedimentation technique was used to increase the detection rates, especially when

the samples were negative by direct smear (Cheesbrough, 2005). For the estimation of intensity of STH infections, egg counting was done by the Kato-Katz technique (WHO, 2002). Harada Mori culture technique was done to detect hookworm larvae in light infections as described by Jozefzoon and Oostburg (1994). The larvae were collected and examined to distinguish between hookworm and *S. stercoralis* by the characteristic morphology of the larvae (i.e., presence of notched tail (filariform larva of *S. stercoralis*) or sharp tail (filariform larva of hookworm). For STH infections, positive samples were recorded according to species and the intensity of infection was recorded as eggs per g of stool (epg) and was graded as heavy, moderate, or light according to the criteria proposed by the World Health Organization (Table 3.1).

A suitable amount (approximately 10 g) of faeces was mixed thoroughly and fixed in polyvinyl alcohol (PVA) for the detection of intestinal protozoa (*Giardia* and *Entamoeba)* using trichrome staining technique (WHO, 1998). Moreover, fecal smears were prepared and stained with modified Ziehl Neelsen stain, according to Henriksen and Pohlenz (1981), for the detection of *Cryptosporidium* oocysts. Overall, the samples were considered as positive if the eggs/larvae/cysts/trophozoites/oocysts were detected using at least one of these techniques. For quality control, duplicate slides were prepared from 20% of the samples for each diagnostic technique and the slides were read by two different microscopists.

TABLE 3.1: Intensity thresholds for light, moderate, and heavy infections with *A. lumbricoides, T. trichiura* and hookworms (WHO, 2004)

Helminth	Light	Moderate	Heavy
Ascaris lumbricoides (Common roundworm)	1 – 4,999 epg	5,000 – 49,999 epg	≥50,000 epg
Trichuris trichiura (Whip worm)	1 – 999 epg	1,000 – 9,999 epg	≥10,000 epg
Hookworms (*Ancylostoma duodenale* and *Necator americanus)*	1 – 1,999 epg	2,000 – 3,999 epg	≥4,000 epg

iii. Re-examination after deworming

To check the efficacy of treatment and the status of STH infections after the deworming (3-day regime of albendazole 400 mg), fecal samples were collected from children after 12-14 days post treatment. All samples were examined for the presence of STH and all were found to be negative.

iv. Cure rate, re-infection rate and egg (intensity) reduction rate

Cure rate of STH infections was specified as the percentage of positive children who became negative after treatment. While the test of re-infection of each STH infections was based on children who were either initially uninfected or who had no parasite eggs in their fecal samples after complete deworming (Olsen *et al.*, 2003b).

Re-infection rate (RR), cure rate (CR) and egg reduction rate (ERR) of STH were calculated using the formulae below (Saathoff *et al.,* 2004; Al-Mekhlafi *et al.,* 2008b):

$$\mathbf{RR} = \frac{\text{\% prevalence after treatment}}{\text{\% prevalence before treatment}} \times 100$$

$$\mathbf{CR} = \frac{\text{\% prevalence before treatment - \% prevalence after treatment}}{\text{\% prevalence before treatment}} \times 100$$

$$\mathbf{ERR} = \frac{\text{Mean epg before treatment - Mean epg after treatment}}{\text{Mean epg before treatment}} \times 100$$

3.8.3 Deworming

i. Description of anthelmintic treatment

After baseline screening for the presence of intestinal parasitic infections, infected children were listed accordingly and received a 3-day course of 400 mg/daily albendazole tablets. Albendazole tablets, Zentel® (GlaxoSmithKline, London, UK) were ordered from the manufacturer's representatives in Malaysia and used for this study. The available tablets were of 200 mg each, enclosed in a sachet of two tablets. (APPENDIX D). Albendazole tablets were used for deworming in the present study because it has been found to be effective against these three main STH species (Albonico *et al.,* 2013; WHO/UNICEF, 2006), with cure rates of >95% for *A. lumbricoides* and hookworm. Previous studies among Orang Asli children recommended a 3-day course regimen to be used in order to achieve high cure rate particularly with moderate-to-heavy trichuriasis (Al-Mekhlafi *et al.,* 2008a; Ahmed *et*

al., 2011). Besides that, the orange flavor of these tablets encouraged the children to chew it before swallowing.

ii. Distribution and provision of anthelmintic treatment

Each child chewed the tablet before swallowing with some water, while being observed by a researcher, medical officer, and a teacher (Direct Observed Therapy). Then the child was asked to open his/her mouth to ensure complete swallowing of the tablets. At the beginning, some children spit the tablets out once they started to chew it, hence all children were provided chocolate wafer to chew with the tablets. The children were monitored for any complaint after receiving the tablets. There was no complaint from the children during the period of treatment.

iii. **Follow-up**

In order to assess the impact of HELP on the incidence and intensity of STH infections, fecal samples were collected at baseline and then every month for a period of 6 months. Similarly, KAP questionnaire was distributed to the parents of children and to the teachers at baseline and after 3 months.

The follow-up of HELP activities was performed regularly by visiting the school and villages every two weeks during which time students were reminded of what they had been taught about STH and were encouraged to practice what they had learned. HELP materials were checked and replaced when needed. HELP posters were fixed at the houses and there was a follow-up from the research team. For nail clipping, a weekly follow-up by the teachers was performed and recorded. The story concepts and scenario presented in the comic book were discussed twice a week by the teachers, once in the class room and once in the library. With regard to the video songs, students recited and sang both songs once a week in the computer lab. For the slippers, children were instructed to wear the slippers given to them in their villages, especially when

walking or playing outdoors. During many visits to the villages, the research members followed-up on these issues and distributed tokens/incentives to those following the instructions.

3.8.4 Children as educators

With regard to the children's role as educators, children from intervention school were empowered as health messengers and instructed to extend the information about STH to their families, siblings, and friends from their villages. For instance, children were asked to educate their mothers on the importance of washing vegetables and fruits before consumption, and to keep reminding family members to wash their hands before eating. All the children were also instructed to fix the 3 posters at their homes and to explain them to their families. Moreover, after the puppet show the children were instructed to form groups and repeat the show and recite the songs to their families. Follow-up sessions were conducted in order to investigate and observe posters at villages setting, children wear shoes when they go outside, usage of the nail clippers and soap. A schematic diagram to summarize the roles of children as health agents is shown in Figure 3.6.

FIGURE 3.6: The role of children as health agents or health educators at their community.

3.9 DEFINITION OF VARIABLES

i. DEPENDENT VARIABLES:

STH infections	Ascariasis, trichuriasis and hookworm infections.
Ascaris infection	Presence of eggs of *Ascaris lumbricoides*- by Kato Katz or any other technique (Al-Mekhlafi *et al.,* 2007; Norhayati *et al.,* 1997a)
Trichuris infection	Presence of eggs (ova) of *Trichuris trichiura*– by Kato Katz or any other technique (Al-Mekhlafi *et al.,* 2007; Norhayati *et al.,* 1997a)
Hookworm infection	Presence of eggs (ova) of hookworms– by Kato Katz or any other technique (Al-Mekhlafi *et al.,* 2007; Norhayati *et al.,* 1997a)
Prevalence of STH infections	Number of infected children divided by number of examined children.
Incidence of STH infections	Number of STH new cases/re-infections after complete deworming.
Intensity of STH infections	It is calculated based on the number of eggs per gram faeces and estimated as mean eggs/gram (epg).
Intestinal polyparasitism	The concurrent infection or co-infections with 2 or more intestinal parasite species (Gibson *et al.,* 2011)
Intestinal monoparasitism	Infection with a single intestinal parasite species.
KAP	Knowledge, attitudes and practices towards STH infections (Acka *et al.,* 2010; Nasr *et al.,* 2013b)
Knowledge	Knowledge about helminths, transmission and prevention
Attitude	Perceptions on the severity of STH infections
Practices	Practices and actions to prevent STH infections and treatment

ii. INDEPENDENT VARIABLES:

Age	6-12 years (according to birth certificate). The difference between the child birth date and the date of participation
Gender	Male and female
Low father education	Father's formal education of less than 6 years (Al-Mekhlafi *et al.,* 2005a; Nasr *et al.,* 2013a).
Low mother education	Mother's formal education of less than 6 years (Al-Mekhlafi *et al.,* 2005a; Nasr *et al.,* 2013a).
Low household monthly income	Total monthly income of the family is below RM500 (RM3.00= 1 USD); the poverty income threshold in Malaysia (Department of Statistics Malaysia, 2014).
Large family size	The number of the family members is > 7 members, including the parents (Nasr *et al.,* 2013a).
Fathers' employment status	The employment status of fathers of participants; categorized as working and not working (Norhayati *et al.,* 1997a).
Mothers' employment status	The employment status of mothers of participants; categorized as working and not working (Norhayati *et al.,* 1997a).
Personal hygiene	This included many variables that reflected the personal hygiene practices such as hand washing before eating/after defecation/after playing with soil, vegetables/fruits washing before consumption, cutting nails periodically, wearing shoes when outside the house, boiling drinking water, etc. (Nasr *et al.,* 2013a; Anuar *et al.,* 2014)
Presence of toilet in the house	The availability of a functioning toilet facilities in the house (Nasr *et al.,* 2013a)

Presence of domestic animals	The presence of domestic animals (cats, dogs, cattle, birds) at the household (Ngui *et al.*, 2011; Nasr *et al.*, 2013a)
Presence of safe drinking water supply	Piped water as a source of drinking water (Ahmed *et al.*, 2011)
Indiscriminate defecation	Open defecation e.g. in the rivers, near houses, play grounds (Ngui *et al.*, 2011; Nasr *et al.*, 2013a)
Presence of infected family member	Presence of another family member infected with STH (Anuar *et al.*, 2014)

3.10 CONCEPTUAL FRAMEWORK

Intestinal helminthic infections including STH infections are influenced by many factors including demographic, socioeconomic, environmental and personal hygiene background. Previous previous studies from Malaysia and other countries have identified some determinants of these infections and showed that these factors involve low household monthly income (Knopp *et al.*, 2010), parents' employment status and education, number of household members (Nasr *et al.*, 2013a; Ahmed *et al.*, 2011; Al-Mekhlafi *et al.*, 2007), age and gender (Nasr *et al.*, 2013a; Ahmed *et al.*, 2011), absence of toilet in the house (Nasr *et al.*, 2013a; Ngui *et al.*, 2011; Asaolu and Ofoezie, 2003), and many other factors. On the other hand, previous studies have been carried out on the KAP towards helminth infections and these studies found that there were significant associations between KAP status and infections (Nasr *et al.*, 2013b; Acka *et al.*, 2010; Curtale *et al.*, 1998). From these studies, a conceptual framework was created to show the determinants of these infections and the importance of health education in the epidemiology and transmission of infections (Figure 3.7).

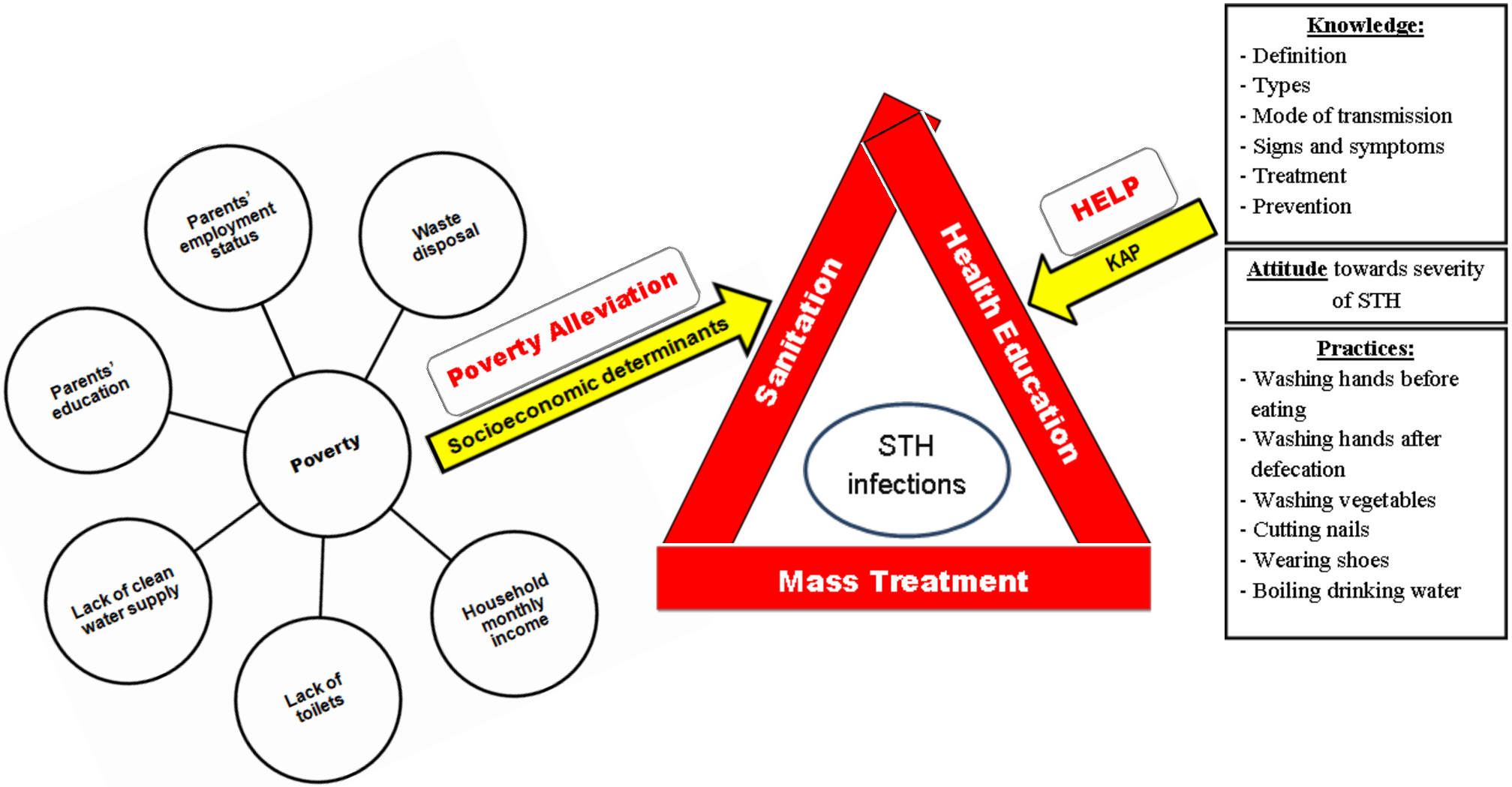

FIGURE 3.7: A conceptual framework for the determinants and control of STH showing the importance of health education.

3.11 DATA MANAGEMENT AND STATISTICAL ANALYSIS

Data were double-entered by two different researchers into Microsoft Office Excel 2007 spreadsheets. Then, a third researcher cross-checked the two data sets for accuracy and created a single data set. Data analysis was done by SPSS for WINDOWS (version 13.0; SPSS Inc, Chicago, IL). Only those participants who had complete data records, including results of intestinal parasites by the different methods and complete questionnaire, were retained for the final analyses. For descriptive analysis, e.g. prevalence of infections and illnesses, results was expressed in percentage, while mean (standard deviation; SD) or median (interquartile range; IQR) was used to present the quantitative data and results were presented in figures and tables. All quantitative variables were examined for normality by Kolmogorov-Smirnov Z test before analysis. Egg counts were found to be not normally distributed. However there are biological justifications for using the arithmetic mean rather than the median or geometric mean to express the egg counts of each STH species (Montresor, 2007; Albonico *et al.,* 2013). The analysis of STH re-infection was based on children who were either initially uninfected or who had no parasite eggs in their fecal samples after complete deworming (Olsen *et al.*, 2000).

For inferential statistics, the dependent variables were prevalence, incidence and intensities of infections while the independent variables were demographic factors (age, gender, and household size), socioeconomic factors (parents' educational and employment status, family monthly income, source of drinking water, presence of toilet in the house, having domestic animals in the households, and presence of infected family member), and personal hygiene practices (washing hands before eating and after defecation, washing fruits and vegetables before consumption, wearing shoes when outside, eating soil (geophagy), boiling drinking water, cutting nails periodically, and

indiscriminate defecation) as explanatory variables. All variables in the survey were coded in a binary manner as dummy variables. For example, *Trichuris* infections (positive = 1, negative = 0); gender (boys = 1, girls = 0); presence of toilet in the house (no = 1, yes = 0), and washing vegetables before eating (no = 1, yes = 0). Family size was categorized into two groups (≥ 7 and < 7 members), and age of participants was categorized into two groups that were below 10 years and ≥ 10 years according to previous studies conducted among Orang Asli (Al-Mekhlafi *et al.*, 2010; Ahmed *et al.*, 2011). Similarly, the household monthly income of < RM500 was considered as low income based on the poverty income threshold in Malaysia (Department of Statistics Malaysia, 2014). Odd ratios (ORs) and 95% confidence intervals (CIs) were computed for all variables. To adjust for multiple comparisons, critical significance thresholds was calculated for each factor group using the sequential Bonferroni correction (Holm, 1979).

On the other hand, each component of the KAP questionnaire was compared according to the STH infection status and the independent variables as well by Chi-square test or Fisher's exact test where applicable. In order to control the variation in number of children in households, weight cases, derived by the sampling fraction 1/ number of participated children from each family, was used to analyse the data for the impact of HELP on the KAP. To investigate the impact of the health education package on the STH infections, the prevalence of STH infections was compared between the intervention group (SKPB) and control group (SKKK) using Chi square test and intention-to-treat approach for data analysis was used. Similarly, Mann Whitney U test and Wilcoxon rank-sum test were used to compare the intensity of infections (mean epg) between the groups. In order to avoid bias and violation of power of the study due to missing data after randomization, intention-to-treat analysis was used to analyze the effects of interventions on STH re-infection (Wright and Sim, 2003). The assumption of

good or poor outcome by including patients with missing responses in the denominator but not the numerator was implicated when the re-infection rates were calculated (Hollis and Campbell, 1999).

Multivariable logistic regression model was performed to identify risk factors that were significantly associated with STH infections; coded as 1 = infected, 0 = not infected and with intestinal polyparasitism as well (1 = polyparasitism, 0 = monoparasitism or uninfected). The potential risk factors of ascariasis and hookworm infections were identified based on infection status at baseline while moderate-to-heavy trichuriasis were used for *Trichuris* infections as almost all children were infected.

In order to retain all possible significant associations, variables that showed an association with $P \leq 0.25$ were used in the logistic regression model as suggested by Bendel and Afifi (1977). Moreover, sex variable was also included in the multivariable analysis as it has been considered as an important behavioral modifying factor (Rabinowitz and Valian, 2000). Overall, 21 variables for STH and 15 variables for STH infections and intestinal polyparasitism met the inclusion criteria to the final models. Many explanatory variables were included separately in this study as there is limited preceding evidence to support inclusion of one factor before or instead of others. Moreover, the different personal hygiene practices are included separately in order to reflect distinct parasite transmission routes. Population attributable risk fraction (PARF) was calculated for significantly associated risk factors (Rockhill *et al.*, 1998). Significance was set at $P < 0.05$.

3.12 ETHICAL CONSIDERATION

The present study was carried out according to the guidelines laid down in the Declaration of Helsinki and all procedures involving human subjects were approved by the Medical Ethics Committee of the University of Malaya Medical Centre, Malaysia

(reference number: 932.7). Permission was also obtained from the Department of Orang Asli Development (reference number: JHEOA.PP.30.052 Jld. 6) and the Department of Education, Pahang (reference number: JPNP.SPS.UPP.600-2/6(80)). Before the commencement of the study, meetings were held with the heads of villages, headmasters and teachers of both schools to provide information about the objectives and protocol of the study and their consents were obtained. During fieldwork, the purpose and procedures of the study were explained to the children and their parents/guardians. Moreover, they were informed that their participation was voluntary and they could withdraw from the study at any time without citing any reason whatsoever. Written and signed or thumb-printed informed consent was obtained to conduct the study from parents *or* guardians on behalf of their children before starting the survey, and these procedures were approved by the Medical Ethics Committee of the University of Malaya Medical Centre. All the infected children were treated with a 3-day course of 400 mg albendazole tablets. Each child chewed the tablets with chocolate flavoured biscuits before swallowing them while being observed by a researcher and medical officer (direct observed therapy) (WHO, 2002). Albendazole is considered as the drug of choice for *Ascaris*, *Trichuris*, and hookworm infections and it is also effective for *Giardia* infection (Al-Mekhlafi *et al.,* 2013). Moreover, all results were submitted to relevant authorities for further follow-up.