ORIGINAL ARTICLE

The Prevalence of Soil-Transmitted Helminths Infection and Its Association with Anaemia Among Refugee School Children in The Klang Valley, Malaysia

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ABSTRACT

Introduction: Soil-transmitted helminths (STHs) are considered one of the neglected parasitic diseases that cause major health problems and other related complications. The aim of this study was to determine the prevalence of STHs and anaemia among school children of little-known refugee communities in Malaysia. **Methods:** A cross-sectional study was conducted among 148 refugee school children in the Klang Valley, Malaysia, from 2017 to 2019. Data were collected using a questionnaire, in addition to haemoglobin testing while faecal samples were screened for STHs eggs using the formalin-ether concentration technique. **Results:** The result showed that the prevalence of STHs in this study was 37.2%. Trichuris trichiura infection was the most prevalent (46.4%) followed by Ascaris lumbricoides (44.9%) and hookworms (8.7%). About 37.8 % of the respondents were found to be anaemic. Binary logistic regression showed significant infection with STHs complicated with anaemia (AOR: 3.67, 95 % CI 1.595-8.5). **Conclusion:** The evidence from this study suggests proper and strategic interventions to reduce morbidity. An alternative and efficient system is needed to provide the schoolchildren with basic care for sanitation and health provision. It is recommended that voluntary clinics provided by non-government organisations focus on counselling and advice on personal hygiene of the children.

Keywords: Soil-transmitted helminths, Prevalence, Malaysia, Refugees, Anaemia

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INTRODUCTION

In tropical and subtropical regions, parasitic infections are still a heavy burden on the health sector. The authorised management is concerned with limiting their endemicity as well as the complications in these countries (1, 2). Soil-transmitted helminths (STHs) infection is known globally as one of the commonest parasitic infections (3). Four main species cause this infection; i.e. *Ascaris lumbricoides* (roundworm), *Trichuris trichiura* (whipworm), *Ancylostoma duodenale* and *Necator americanus* (hookworms) (3). The World Health Organsation (WHO) has categorised STH infections as one of the neglected tropical diseases (1, 2). Globally, the infection has spread widely, affecting about two billion people across different age groups (5). Worldwide, the latest estimate of the morbidity index reveals that the highest infection is *A lumbricoides* (807-1221million) followed by *T trichiura* (604-795 million) (3, 6) and hookworms (576-740 million) (6).

Regionally, South and Southeast Asian countries, including Malaysia, are endemic to STHs. Data from the latest review reveal that approximately 70 % of the infection with STHs occur in Asia (7). The range of prevalence in these countries from the latest data is 12 to 18% (7). In Malaysia, substantial research work has been done among disadvantaged communities such as the *Orang Asli* (indigenous) community as well as in the traditional villages and urban areas to estimate the overall national prevalence of STHs (8). The results from the latest research among *Orang Asli* show that the highest prevalence is *Trichuris trichiura* (76.6 %), followed by hookworms (26.4 %) and then by *Ascaris lumbricoides* (19.1%), with an alarmingly high overall prevalence of 81.7% (9). In a comparative study between indigenous people living in the jungle and those resettled at the town periphery, the prevalence of STHs is significantly higher among those living in the jungle, with 91.3% versus 83.1 % among the resettled group (10).

From these findings, it can be concluded that although the country has witnessed rapid urban development and improvement in all health and hygiene services, the prevalence of STH infections recorded is still high among the disadvantaged communities (8).

STH infection is transmitted mainly through a faecal-oral route by ingestion of infective eggs of *Ascaris lumbricoides* and *Trichuris trichiura* or penetration of the skin by infective larvae of the hookworm (3). For cycle continuity and infection to be endemic in a specific area, continued contamination of the environment due to inappropriate disposal of human waste in the environment and a conducive environment with the presence of moisture and a hot climate are needed (11-13). Other than that, transmission is multifactorial, exacerbated by lack of personal hygiene and poverty.

In Malaysia, there are communities which are more susceptible to these worms' infestations, and also to the occurrence of recurrence and prolonged infection due to harsh socio-economic conditions. These communities include *Orang Asli* communities living near the jungle (10). Other than these communities, there are other marginalised communities in Malaysia such as refugees of different nationalities who are staying temporarily in Malaysia (14, 15).

The number of refugees registered with the United Nations High Commissioner for Refugees Malaysia (UNHCR) is 158,510 (14). A considerable number of these refugees are children born in Malaysia. Around 33,000 of the refugees from Myanmar are below the age of 18 years, however, in addition there is a large number of undocumented refugees (16).

Refugees reside in Malaysia after being accepted on humanitarian grounds, but Malaysia is actually one of the countries that has not signed the Refugee Convention (17, 18). Therefore, its role remains confined to receiving refugees from the humanitarian point of view, without the availability of clear lines that define and regulate their lives, issues, rights and demands in the country (17).

Their lives in the country are subjected to much uncertainty (19). To begin with, they have difficulties accessing essential living demands, and also difficulties in accessing appropriate education and health care services due to their poor financial situations (20) and have to pay as unsubsidised foreigners and not as settled residents (stateless migrants).

Anaemia, due to parasitic infection is considered multifactorial, which is related mainly to iron deficiency and malnutrition (21). It could be the result of blood loss caused by STHs infection through the feeding by worms (hookworms) on blood and tissue or due to adherence of worms to the mucosa (*T trichiura*). Blood lose is more severe in a situation of heavy infection (21-23).

Anaemia is manifested clinically mainly by pallor, which has been reported in many studies (24, 25). In addition, pallor is included in the WHO guidelines for STHs preventive chemotherapy as one of the clinical signs of dysentery caused by *T trichiura* infection (26). A significant correlation between STHs and anaemia has been documented in previous studies such as Darlan and Kaban's (2016) study (P= 0.027) and Odds Ratio 3.08 (CI 95; 0.026-0.041) (27).

Hence, this study was conducted to determine the extent of the spread of the four nematodes worms in the age group most vulnerable to infection, that is, children. This study also aimed to determine the degree of the clinical effect of the infection through haemoglobin testing. The respondents were from one of the marginalised communities, refugee school children. Baseline information provided by this study among refugee school children in Malaysia could provide beneficial background based on which specific measures and prevention programmes could be proposed.

MATERIALS AND METHODS

Study Design, location, sampling population and sample size

A cross-sectional study was carried out over a period of two years (2017 to 2019) in four selected volunteer refugee schools in the Klang Valley, Malaysia. The selection of the study area was based on the information obtained from non-governmental organisations (NGOs) about the accumulation of refugee populations. The schools were selected by snowball sampling technique where there was difficulty finding the potential participants' schools due to the absence of formal official registration lists of these types of schools.

The selection of participants was subjected to the willingness of school management, parents and students to participate in this study. This study was designed to estimate the prevalence of soil-transmitted helminths, anaemia and the association between them within 5% true prevalence and 95% confidence level. The power of the study was determined at 80%. The precise sample size was calculated for each objective separately based on previous publications (9). Based on an anticipated 10% non-response rate, the actual sample size for this study was 125. However, 148 participants took part in this study. Purposive sampling was utilised in this study as random sampling was not applicable due to the presence of a few students in each school with irregular school attendance.

The schools included were either established by non-governmental organisations (NGOs) or by volunteers from the refugee community themselves. School finance depends mainly on donations and the staff in schools are all volunteers. Additionally, these schools are located in rented houses instead of official school buildings with variations in capacity and financial capability. Students' database was obtained from the manager of each school. This study included four volunteer schools: Al-Ansar school, The Alternative Education Centre Cinta Syria

Malaysia, The Darul-Eslah Academy for Rohingya, and Madrasa Al-Hramin Tahfize for Rohingya. The schools were chosen by snowball method, which is a type of non-probability sampling technique. This method was implemented because simple random sampling technique was not possible. In this area, all schools were scattered and a list of the available schools could not be obtained.

Al-Ansar school is located in Ampang, in the state of Selangor, in a two-story shop lot. It was established in 2015 by Rizq Al-Rahman NGOs. The school has six classes with a total of 85 students from Myanmar and Somalia but only 35 students were attending classes at the time of this survey. The school used a blended curriculum taught by volunteer teachers from Malaysia, Myanmar, America, Sudan, and Somalia.

The Alternative Education Centre Cinta Syria Malaysia was established by Cinta Syria Malaysia NGOs in 2018 in Bangi, Selangor state. Located in a rented three-storey shop lot, it has seven classrooms. The school has 43 Syrian students who are taught by teachers from Malaysia, Syria Yemen, and Palestine. They follow the IGCSE Cambridge curriculum.

The Darul-Eslah Academy for Rohingya also located in Ampang, was established in 2006 by volunteers from the Rohingya community. The school has 111 Rohingya students, and there were 72 students attending the school at the time of this survey. It contains five classrooms and uses the Malaysian national curriculum and more concentration is placed on religious classes. At the time of the survey the students were taught by Rohingya teachers.

Madrasa Al-Hramin Tahfize for Rohingya is also located in Ampang, and was established by a Rohingya teacher. It is located on the second floor of a very small rented two-storey shop lot. It contains two classes and has 30 students, all of whom are Rohingya from Myanmar. The school has religious and English classes and the two teachers at the time of the survey were Rohingya from Myanmar.

When visiting the schools it was noticed that most of the students belonged to poor families or families with limited income and this was evident especially in two schools where students' clothes, shoes, and their stationery indicated poor conditions. In addition, the lack of appropriate school furniture and modern bathrooms was also noted. Moreover, some of these schools provided free meals from donors during the study time, while groups of NGOs provided some basic food items such as rice, oil, sugar, and the like and which the parents of the students would come to collect happily and gratefully.

The eligibility screening was carried out among the students according to inclusion and exclusion criteria. The inclusion criteria for this study were: all refugee children between the ages of five and 17 years who could understand the English or Malay language. Non-refugee students (citizens or legal and illegal migrant students), those who had any medical or physical problems, and those who had received anti-helminthic drugs less than a month earlier were excluded.

Ethical approval for this study was obtained from the Medical Research Ethics Committee of Universiti Putra Malaysia (Ref No. JKEUPM-2018-181). Informed written consent was signed by parents of participants after full explanation about the study.

Questionnaire

A structured pictorial questionnaire based on previous studies was used in this study (28, 29). The questionnaire was divided into three sections with a total of 29 items. Section One included physical assessment of the participants; Section Two focused on socio-demographic and hygiene risk factors, while Section Three pertained to medical Information of the participants. Pictures were added to each question to make it easy for participants to understand. The part on demographic characteristics only is presented in the current work. It was prepared in both Malay and English. The participants were interviewed in the presence of their parents by the researchers.

Sample collection and parasitological analysis

After completing the interview, each participant was asked to collect a thumb-sized faecal sample using a scoop attached to the cover of a clean, wide-mouth screw-cap labelled plastic container. A piece of magazine paper was given to each participant to use for defecation to avoid contamination of the sample by urine or toilet content. An explanation was given to participants and their parents on how to collect the sample. In addition, parents were advised to monitor the sample collection. The collected samples were preserved in 10% formalin then transported to the parasitology laboratory of the Faculty of Medicine and Health Sciences, Universiti Putra Malaysia. Only a few of the participants failed to provide samples, and they were excluded from the study.

The faecal samples were screened under a different power of a light microscope after concentration technique according to the World Health Organisation (WHO) methodology (30). Approximately 1 g of faecal sample was mixed with 10 ml of 10% formalin and 4 ml ethyl acetate in 15 ml centrifuge tube. The samples were then centrifuged at 2,200 rpm for 10 minutes. After centrifugation, four layers were seen in the tube, composed of ethyl acetate, debris, formalin, and pellets containing parasites. A drop of the pellet was taken and stained with Lugol's iodine on a clean glass slide. The slide was examined under a light microscope at 10 x and 40 x magnification for helminths ova detection.

Three slides were prepared from each faecal sample by staining them with iodine stain. The identification of the STHs eggs was dependent on morphological appearance referring to the gold standard set by WHO, and Communicable Disease Control and Prevention Atlas (30).

Haemoglobin Blood Testing

Haemoglobin HB rapid finger-prick blood testing was carried out using a calibrated analyser (hemoCue HB201+ Anghom Sweden). The equipment was calibrated according to the international reference method for haemoglobin detection depending on standardised operating procedure reference provided by the manufacture. The anaemia assessment was done based on the WHO ranges for children, while degree of anaemia classification was done according to the degree of haemoglobin reduction. It is considered mild "when the HB concentration was between 10.0 and 10.9 g/dL for children under five years of age and between 11.0 and 11.4 g/dL for children five years of age and above". Moderate anaemia is "when the HB concentration is between 7.0 and 9.9 g/dL for children under five years of age and between 8.0 and 10.9 g/dL for children five years of age and above." Severe anaemia is "when the HB concentration is less than 7 g/dl for children under five years of less than 8 g/dL for children five years of age and above" (31,32).

For each sampling, individual participants had their analysis done in a confidential setup. This was done to prevent other participants from feeling apprehensive about the procedure. Precautions were taken in terms of sterilisation and avoidance of excessive bleeding or pain. HB results of less than 11 g/dl are considered anaemic and further analysis of the severity of anaemia is conducted according to the degree of haemoglobin reduction (31).

Data Analysis

Data were analysed using Statistical Package for Social Sciences, IBM SPSS version 25. Descriptive analysis, and the association between variables and predictors of infection are analysed and presented in the respective tables.

RESULTS

General Characteristics of Participants

A total of 148 participants agreed to participate in this study. The median age (IQR) for participants was eight (4). In this study, both genders were equally enrolled (n=74; 50%). The majority of the participants were in the age group below or equal to 10 years of age (79.7%). The majority of them were Rohingyan (75.7%), and the others were Syrians (16.9%) and Somalians (7.4%) (Table I).

Table I: Description of General Characteristics of the Participants

Variable	Study group N= 148	
	n	**%**
Age group (years)		
≤ 10 years	118	79.7
>10 years	30	20.3
Gender		
Male	74	50
Female	74	50
Ethnicity		
Rohingya	112	75.7
Non Rohingya	36	24.3

Table II: Distribution of Anemia according to Gender and Age Group

Variable	Anemic n, (%)
Gender	
Male (n=74)	23 (31.1)
Female (n=74)	33 (44.6)
≤ 10 years old (n=118)	43 (36.5)
>10 years old (n=30)	13 (43.3)

Distribution of Anaemia among the Participants

Table II shows the distribution of anaemia among the participants based on gender and age groups. The results show that the overall prevalence of anaemia in this study was 37.8 %. The Haemoglobin (HB) levels ranged from 7.7 g/dl to 14.5 g/dl and the mean HB (SD) was 11.3 (1.3). Of all the participants, about 27 % had mild anaemia. There was no incidence of severe anaemia among the participants. The majority of the anaemic were females (44.6 %) and 10 years old or below (36.5%).

Overall Prevalence of STHs

This study revealed the prevalence of STHs to be 37.2 % among refugee school children (55 out of 148). It was found that *Trichuris trichiura* was the most prevalent nematodes detected (n = 32 [46.4 %]) followed by *Ascaris lumbricoides* (n = 31 [44.9 %]) and hookworms (n = 6 [8.7%]). Single infection was most abundant, i.e. 74.5%, compared to multiple infections (polyparasitism). Multiple infections were in the form of double infection only. The highest prevalence (78.6 %) of double infections was found for both *Ascaris lumbricoides* with *Trichuris trichiura*, followed by infection of both *Trichuris trichiura* with hookworms (14.3%) and by both *Ascaris lumbricoides* with hookworms (7.1 %) (Table III).

Association between Anaemia and Soil-transmitted Helminths

This study showed that 31 (55.4 %) of infected respondents were anaemic while 24 (26.1%) of infected respondents were not anaemic. The study showed a significant moderate positive association between

Table III: Prevalence of STHs According to Species

Soil-transmitted Helminths (n=148)	Single Infection		Single Infection and Mixed Infection	
	Frequency	%	Frequency	%
Positive (n=148)	55	37.2		
Ascaris lumbricoides (n=55)	19	34.5	31	44.9
Trichuris trichiura (n=55)	19	34.5	32	46.4
Hookworms (n=55)	3	5.5	6	8.7
Mixed infection* (n=55)	14	25.5		

*Mixed infection; *Ascaris* + *Trichuris trichiura*; n = 11, *Ascaris* + hookworms; n = 1, *Trichuris* + hookworms; n = 2

infection with STHs and anaemia at df (1) = (95% CI= 1.399 and 3.219, p = 0.001, φ = 0.29). Further analysis of the association between anaemia and species of STHs revealed significant moderate positive association between infection with *Trichuris trichiura* and anaemia (p = 0.001, φ =0.27). In addition, binary logistic regression revealed significant infection with STHs complicated with anaemia (AOR: 3.67, 95 % CI 1.595-8.5) (Tables IV and V).

Table IV: Association between Soil-transmitted Helminths and Anaemia

Clinical manifestation (n = 148)	STHs		*p*	Prevalence Ratio	95 % CI	
	Positive n (%)	**Negative n (%)**			**Lower**	**Upper**
Anaemia						
Yes	31 (55.4)	25 (44.6)	0.001*	2.123	1.399	3.219
No	24 (26.1)	68 (73.9)				

*$p < 0.05$= statistically significant, ([a]*p*) = Chi square

Table V: Association between Anemia and STHs species

Parasite species	Anemia		p	Prevalence Ratio	95 % CI	
	Yes (n=56) n (%)	**No (n=92) n (%)**			**lower**	**upper**
Ascaris lumbricoides						
Positive (n=31)	15 (48.4)	16 (51.6)	0.17	1.381	0.781	3.869
Negative (n=117)	41 (35)	76 (65)				
Trichuris trichiura						
Positive (n=32)	20 (62.5)	12 (37.5)	0.001*	2.016	1.637	8.381
Negative (n=116)	36 (31)	80 (69)				
Hookworms						
Positive (n=6)	4 (66.7)	2 (33.3)	0.146 [a]	1.821	0.613	19.552
Negative (n=142)	52 (36.6)	90 (63.4)				

*$p < 0.05$= statistically significant, ([a]*p*) = Fisher's Exact Test

DISCUSSION

The current study revealed that STHs infection is still endemic in Malaysia. It is one of the major parasitic infections among communities that live in harsh socio-economic and poor hygienic conditions. Refugee communities are in the same situations in which they have difficulty paying for medical services. They also have difficulties in fulfilling the essential daily needs which make them ignore such conditions and not to look for treatment. Lack of educational programmes among the refugee communities leads to less knowledge about the methods of protection and consequences of infection. Therefore, more attention should be given to include them in health education programmes in the country.

In the current study the overall prevalence rate of STHs is 37. 2%, which is considered somewhat low compared to the results of previous studies in Malaysia in general, and among the indigenous community, in particular. For example, we present here some prevalence results from previous studies conducted recently: 62.9% (32), 50.4 % (33), 81.7 % (9), 72.7 % (23), and 91.3 % (10). The differences between the results obtained from the current study, and those of previous studies in the country, which were conducted mainly among the indigenous population, are attributable to the differences in culture, behaviour and lifestyle. The reasons contributing to the prevalence could be linked to environmental factors, such as the fact that the indigenous population primarily resides in rural areas and on the fringes of the jungle. Besides, they lack of knowledge about proper hygiene behaviour, and this is compounded by the absence of proper facilities such as sewage disposal systems (32). In addition, their habit of using unboiled river water, unhygienic toilet practice as well as the absence of a toilet in most of the houses lead to greater exposure to the risk factors of STH infection. All the above-mentioned factors are in contrast to those of the sample population, who have settled with the help of non-governmental organisations in areas around the Klang Valley in Malaysia and who have proper hygiene measures such as proper sewage and garbage disposal as well as the availability of clean piped water and proper toilets.

This study showed that *T trichiura* is the most prevalent nematodes that infect children in the studied community. This finding parallels that of previous studies done in the local Malaysian context but there are no previous data related to the refugee community in Malaysia (9, 23, 34, 35). Only a few studies have reported *A lumbricoides* and hookworms as the highest infestation in STHs infection (33, 34). The factor that might be involved in the high prevalence of *T. trichiura* is the use of only one anthelminthic treatment regimen instead of a combination of treatments. *T trichiura* has been found to be less sensitive to one drug regimen, which has been used in deworming in such communities (36, 37). A study by Norhayati et al. (38) showed that the cure rates for *A lumbricoides* and hookworm were 97% and 93.1% respectively but it was low for *T trichiura* (5.5%) after 400 mg albendazole was given to the infected respondents. The result reported by Norhayati et al. (38) indicated no significant impact on *T trichiura* with the treatment dose

used, the reason being the resistance of *T trichiura* to the 400 mg albendazole.

Another reason for the high prevalence of *Trichuris trichiur*a could be the population included in the study. According to WHO (26), the peak ages of the infection by both *Trichuris trichiura* and *Ascaris lumbricoides* range from five to 14 years.

In addition, rarely detected hookworms could be due to the low burden of infection in the area. In the current study even though 54.1 % of the children walked around barefooted, results showed no significant association between the prevalence of the infection and this habit. Other studies have also shown similar results where there was the lowest prevalence for hookworms in Malaysia (23, 34, 35). In one study among the *Orang Asli* population, the prevalence of hookworms was higher, at 26.2 % (10). The infection was higher among the adults, and the reason could be related to their outdoor activities. Muslim et al. (10) found that hookworm infection was higher among the inland jungle villagers than among the resettled groups of *Orang Asli*, and the results showed significant association of the prevalence of intestinal parasitic infection with walking barefooted (p= 0.04), which might be related to the exposure to infective larvae in the soil.

Polyparasitism was reported in this study in which a form of double infection, had the highest prevalence of co-infection of *T trichiura* with *A lumbricoides* (78.6%). This was followed by co-infection of *T trichiura* with hookworms (14.3%). Lastly, the co-infection of *A lumbricoides* and hookworms represented 7.1%. This result is the same as that of the study conducted among the *Orang Asli* population in peninsular Malaysia (71.4%). The co-infection of both *Ascaris* and *Trichuris* showed the highest prevalence which could be due to their similar route of infection (39). There were no multiple infections (more than two) in this study in contrast with previous research by Elyana et al. (35) that reported overall mono-intestinal parasitic infection of 71.9 % versus 26.6 % multiple-intestinal parasitic infection among the participants. In the study among children, 20.8% of *Orang Asli* children living in or on the fringe of the jungle had multiple-intestinal parasitic infections whereas among the resettled group, 17.6% had multiple-parasitic infections (10).

Based on the current study results, an annual bulk deworming therapy as suggested by the WHO for areas with prevalence higher than 20 % and below 50% is recommended among refugee populations. In addition, the results of this study indicate an urgent need to deliver health screening and education programmes among this population. The baseline data provided by this study would be helpful to facilitate effective planning of such programmes which should include both deworming and education on effective preventive measures and strategies to address the issue of STHs infection among members of the refugee community.

The role of STHs in causing anaemia is multifactorial, and related to the complexity of processes and complication (21). The current study revealed that anaemia is a health problem among the refugee participants and the prevalence of anaemia was 37.8%. As has been mentioned earlier, the majority of those fund to be anaemic were females (44.6%) and children below 10 years old (36.5%). This result is almost similar to that of another local study among the indigenous population in Sarawak, with 36.7 % prevalence (33). Consistent with the current study, the anaemia showed gender and age dependency where it was more in females (39.8%) than males (32.9%). The prevalence was also highest among children between the ages of seven and 12 years (25.6 %). This was followed by children aged a year to six years (13.6%) and then teenagers aged 13 to 17 years (5.6%).

This study revealed that there was a significant association between infection with *T trichiura* species and anaemia. A previous study also demonstrated an association between STHs and anaemia (33), since intestinal parasitic infection including STHs was significantly associated with anaemia, especially with hookworms (21, 40) and *T trichiura* (33, 41). This study demonstrated that there was no significant association between anaemia and hookworm's infection, and this could be due to the low prevalence of hookworms detected (8.7 %). This result is in agreement with another result in Ethiopia (22), where there was no significant association between anaemia and hookworms. In addition, there was also a very low intensity of hookworm infection.

This research showed that the prevalence of anaemia among the respondents is viewed as a public health concern. The affected respondents need medical treatment and follow up to avoid any effect on general health, growth and learning processes. The findings suggest also launching an education campaign on essential food elements that improve their haemoglobin levels. In addition, an initiative to provide free medication either by NGOs or local government health authorities to treat the affected children is highly recommended.

The limitation of this study includes the cross-sectional study design where the sequence of events was not demonstrated. Therefore, the evidence of a causal link was not established. However, the information from the study design is useful for the baseline information on the selected causal link. This would prompt the next step of the proposed study to be done in a stronger study design i.e. case control or cohort. Moreover, only one faecal sample was collected instead of the usual three faecal samples because it was inapplicable in the case of the selected study community to give repeated samples. The HemoCue portable equipment used to determine the

haemoglobin level was cost effective for identifying the presence of anaemia but without indicating the type of anaemia. Other methods of blood testing to detect type of anaemia were not applicable in field work as they required heavy, expensive equipment and additional trained people to work on them.

CONCLUSION

The findings of this study provide baseline information about refugee school children, and complications including anaemia among deprived refugee children resettled in Malaysia. This study may help people in authority to start taking action regarding this large number of neglected groups in the country. Improvement of their living conditions and their easy accessibility to health services will improve their health and help in the elimination or reduction of the overall prevalence of STHs among these communities in Malaysia. It is suggested that immediate health education campaign be started and deworming programmes are planned and implemented among them, not only in the Klang Valley but also in other parts of Malaysia where other such marginalised communities exist.

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