Prevalence and risk factors of soil-transmitted helminth among minority indigenous community in Malaysia

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ABSTRACT
Soil-transmitted helminth (STH) infections occur via fecal-oral route. WHO has reported there are up to 90% of children from poor communities with inadequate hygiene and sanitation prone to at least one STH infection. In Malaysia, the indigenous community (Orang Asli) is the predominant communities prone to STH infections. Hence, this study was aimed to determine the prevalence of STHs infections among Orang Asli in Kampong Donglai Baru, Semenyih, Selangor. Questionnaires surveys were conducted to gather information on the risk factor associated with the Orang Asli community following with stool samples were collected from the villagers. Basic parasitology method, floatation technique was carried out to determine the type and burden of STHs. Total sample obtained from salt-sugar floatation method were sixty seven (n=67), with 64 (95.5%) were positive for STH infection. The prevalence of Trichuris trichiura was 85.9% (n=55) while Ascaris lumbricoides was 93.8% (n=60). Results shown majority of the villagers have double infection (79.7%, n=51). Several risk factors were found significantly associated (p<0.05) with Trichuris trichiura infection such as age factors, education level and frequency of hand washing. However, those risk factors were no significant associated with Ascaris lumbricoides infection. The study showed a higher prevalence rate of STH infection predominantly by Trichuris trichiura and Ascaris lumbricoides within a small group of the Orang Asli community, hence further prevention method like administration of antihelminthic drug is recommended.

INTRODUCTION
Soil transmitted helminth (STH) infection which taints human health are transmitted through the fecal-oral route among the poor around the world (Paige et al., 2017; Shumbej and Girum, 2019). The global prevalence of STH infections is approximately 2 billion people (Gordon et al., 2017; Pasaribu et al., 2019). It is caused by various species of parasitic worms like Ascaris lumbricoides, Trichuris trichiura, Strongyloides stercoralis, Schistosomiasis and hookworms such as Necator.
Americanus and Ancylostoma duodenale (Jourdan et al., 2018; Workineh et al., 2020).

Malaysia is considered as middle-income country in South-East Asia (Geik and Sidek, 2015). However, there is a minor group of people in this country known as Orang Asli whom has low household income and live in rural areas (Masron et al., 2013). Studies conducted in recent years reported a high prevalence of STH infections, which ranges from 90% and up to 100% among Orang Asli communities in the rural and remote west Malaysia (Ngui et al., 2015, 2011). Overall, T. trichiura is the most prevalent helminth in Malaysia (2.1% to 98.2%) followed by A. lumbricoides (4.6-86.7%) and hookworm is the least prevalent with 0-37.0% (Ahmed et al., 2011). The associated risk factors for this infection were open defecation, not using footwear, poor hand hygiene and close contact with domestic animals (Ahmed et al., 2011; Gall et al., 2017; Ngui et al., 2015).

Temuan tribe under Proto-Malay subtribe are classified as the second largest Orang Asli tribe in Peninsular Malaysia (Md-Zain et al., 2017). The Orang Asli community in Hulu Semenyih, Selangor, Malaysia are predominantly Temuan tribe (Said et al., 2012). Despite government effort to improve their lifestyle, they are still prone to STH infection. Hence, this study was conducted in a Temuan tribe village in Malaysia to investigate the current prevalence of STH infection in this community. The findings of this study will benefit the government in implementing more effective preventive measures from 2020 onwards.

**METHODOLOGY**

**Study location**

A cross-sectional study was conducted in Kg. Orang Asli Donglai Baru, Hulu Semenyih district, Selangor state, Malaysia, from July to December 2019. The village is located (3°06’54.0”N 101°54’38.1”E) 37.9 km from Kuala Lumpur, the capital city of Malaysia. Most of the villagers are dependent on untreated hill water for their daily use. Besides, the Malaysian government has provided free concrete houses, pour-flush toilets, and electricity supply to most of the homes. The village has two different geographical locations in which some of the houses are on the hill and some nearby the main road of Sungai Lalang. The population is about 150 people predominantly from the Temuan tribe living in about 20 residential houses (Figure 1 is adapted from Google Maps).

**Ethical approval**

Approval for the present study was applied from the Department of Orang Asli Development (JAKOA). During the meeting with the villagers, the parents and the children have been informed which their participation is voluntary, and therefore they can withdraw from the study at any time. To improve compliance, the householders were explained about the importance of this study and the objective of the study prior to sample and data collection. Moreover, written consent also gathered from head of households.

**Data collection**

The study protocol was approved by Human Ethical Committee of UniKL [UNIKL REC /2020/003] and Department of Aboriginal Affairs of Malaysia (JAKOA) [ref: JAKOA/PP.30.032,ld 46(95)], with prior consent from village leaders. Next, informed consent was obtained from each participants and parents of each children through verbal communication and voice recording.

Next, questionnaires were distributed to the head of each household and stool samples were collected. Random sampling technique was used in this study, therefore no restriction of age, gender, job and level of education to the respondents. The villagers were interviewed in the Malay language about their self-hygiene, such as handwashing habits, usage of footwear whenever doing activities outside the house, their daily activity place, and the frequency of
Table 1: The sociodemographic data of respondents in Donglai Baru village

| Characteristics                     | Frequency (n) | Percentage (%) |
|--------------------------------------|---------------|----------------|
| **Demographic factor**               |               |                |
| **Gender**                           |               |                |
| Male                                 | 33            | 49.3           |
| Female                               | 34            | 50.7           |
| **Age group**                        |               |                |
| Babies (0-2)                         | 9             | 13.4           |
| Children (3-16)                      | 29            | 43.3           |
| Young adults (17-30)                 | 11            | 16.4           |
| Middle-aged adults (31-45)           | 9             | 13.4           |
| Old adults (Above 45)                | 9             | 13.4           |
| **Education**                        |               |                |
| Education                            | 24            | 35.8           |
| No education                         | 43            | 64.2           |
| **Occupation (n=28)**                |               |                |
| Working                              | 17            | 60.7           |
| Not working                          | 11            | 39.3           |
| **Behavioural factor**               |               |                |
| **Availability of toilet**           |               |                |
| Yes                                  | 53            | 79.1           |
| No                                   | 14            | 20.9           |
| **Daily activity place**             |               |                |
| Playing near housing area:           | 37            | 55.2           |
| Outside housing areas:              | 30            | 44.8           |
| **Wearing footwear (n=58)**          |               |                |
| Yes                                  | 50            | 86.2           |
| No                                   | 8             | 13.8           |
| **Handwashing habit (n=58)**         |               |                |
| Yes                                  | 57            | 98.3           |
| No                                   | 1             | 1.7            |
| **Drinking treated water**           |               |                |
| Yes                                  | 13            | 19.4           |
| No                                   | 54            | 80.6           |

boiling drinking water. Pre-testing of the questionnaire was carried out for 30 people and all questionnaires were checked for completeness and accuracy.

**Stool sampling and analysis**

The samples were collected in 60 mL sterile specimen containers containing 70% ethanol solution as preservative (Nisha et al., 2016). In helminths observation, stool samples were processed using floatation technique and McMaster was used for egg quantification (Nisha et al., 2016).

**Data analysis**

Data analysis was performed using SPSS version 22. The demographic socioeconomic and behavioural characteristics were treated as categorical variables. The association of STHs prevalence was tested with the demographic socioeconomic and behavioural factors by using Pearson’s Chi-square ($\chi^2$) test ($p$-value < 0.05).

**RESULTS**

**Sociodemographic characteristics**

A total of 67 participants voluntarily participated in this study. Out of them, 49.3% (n=33) were male, and 50.7% (n=34) were female respondents (Table 1). The mean age of the respondents participated was 19.67 years and majority of the participants were children age between 3-16 years old. Our survey indicated majority had no formal school.
Table 2: The prevalence of STH infections in Donglai Baru village

| Variables                      | Frequency of positive cases (n=64) | Prevalence (%) |
|--------------------------------|-----------------------------------|----------------|
| **STH species**                |                                   |                |
| *Trichuris trichiura*          | 55                                | 85.9           |
| *Ascaris lumbricoides*         | 60                                | 93.8           |
| Hookworms                      | 0                                 | 0.0            |
| **Types of infections**        |                                   |                |
| Single infection               | 13                                | 20.3           |
| Double infection               | 51                                | 79.7           |
| **Gender**                     |                                   |                |
| Male                           | 32                                | 50.0           |
| Female                         | 32                                | 50.0           |
| **Age group**                  |                                   |                |
| Babies (0-2)                   | 7                                 | 10.9           |
| Children (3-16)                | 31                                | 48.4           |
| Young adults (17-30)           | 10                                | 15.7           |
| Middle-aged adults (31-45)     | 8                                 | 12.5           |
| Old adults (Above 45)          | 8                                 | 12.5           |
| **Intensity of infection:**    |                                   |                |
| I. *Trichuris trichiura*       |                                   |                |
| Light                          | 20                                | 45.3           |
| Moderate                       | 32                                | 50.0           |
| Heavy                          | 3                                 | 4.7            |
| II. *Ascaris lumbricoides*     |                                   |                |
| Light                          | 40                                | 68.8           |
| Moderate                       | 19                                | 29.7           |
| Heavy                          | 1                                 | 1.6            |

Table 3: WHO classification on severity of infection for *T. trichiura* and *A. lumbricoides* according to eggs per gram of faeces (e.p.g)

| Infection                  | Light                      | Moderate                   | Heavy                    |
|----------------------------|---------------------------|----------------------------|--------------------------|
| *Trichuris trichiura*      | 1-999 epg                 | 1,000-9,999 epg            | >10,000 epg              |
| *Ascaris lumbricoides*     | 1-4,999 epg               | 5,000-49,000 epg           | >50,000 epg              |

For the availability of toilets, the majority of them had proper toilets (79.1%; n=53). We saw good respond for footwear usage and good hand hygiene practice, 86.2% (n=50) and 98.3% (n=57) respectively. However, only 19.4% of the respondent were drinking boiled water daily.

Prevalence of soil-transmitted helminth (STH) infections

Overall, there were two STH have been found in this village; namely; *Trichuris trichiura* and *Ascaris lumbricoides*. Out of 67 participants, 64 (96%) were positive for at least one STHs been infected (Figure 2). The prevalence of *T. trichuria* and *A. lumbricoides* were 85.9% (n=55) and 93.8% (n=60) respectively. We found 13 participants with a single infection of STH (20.3%), 51 participants with double infection (79.7%), and there are no participants with triple infection been diagnosed (Table 2).

For *T. trichiura*, we found most of the villagers had light (45.3%; n=29) to moderate (50.0%; n=32) infections. However, the majority of the villagers had light infections of *A. lumbricoides* with 68.8% (n=44) of intensity. The intensity of STH infections were classified into light, moderate and heavy infections in Table 3, based on WHO guidelines (*WHO, 2011*).

The risk factor associated with STH infections

The risk factor associated with STH diseases con-
Table 4: The risk factor for soil-transmitted helminth (STH) infections among Orang Asli

| Risk factors | Frequency (n=64; (%)) | T. trichiura | A. lumbricoides | X² | T. trichiura | A. lumbricoides |
|--------------|-----------------------|--------------|----------------|----|--------------|----------------|
| Demographic  |                       |              |                |    |              |                |
| Gender       |                       |              |                |    |              |                |
| Male         | 29 (45.3)             | 29 (45.3)    |                | 0.474 | 0.613       |
| Female       | 26 (40.6)             | 31 (48.4)    |                | 0.273 | 0.634       |
| Age          |                       |              |                |    |              |                |
| 0-2          | 5 (7.8)               | 6 (9.4)      |                | 0.273 | 0.634       |
| 3-16         | 28 (43.8)             | 30 (46.9)    |                | 0.273 | 0.634       |
| 17-30        | 7 (10.9)              | 9 (14.1)     |                | 0.273 | 0.634       |
| 31-45        | 7 (10.9)              | 7 (10.9)     |                | 0.273 | 0.634       |
| 46 and above | 8 (12.5)              | 8 (12.5)     |                | 0.273 | 0.634       |
| Education    |                       |              |                |    |              |                |
| Education    | 20 (31.3)             | 21 (32.8)    |                | 0.707 | 1.000       |
| No education | 35 (54.7)             | 39 (60.9)    |                | 0.707 | 1.000       |
| Occupation   |                       |              |                |    |              |                |
| Working      | 14 (51.9)             | 15 (55.6)    |                | 1.000 | 1.000       |
| Not working  | 10 (37.0)             | 10 (37.0)    |                | 1.000 | 1.000       |
| Behavioural factors |       |              |                |    |              |                |
| Availability of toilet | Yes | 42 (65.6) | 48 (75.0) | 0.670 | 0.206       |
| No           | 13 (20.3)             | 12 (18.8)    |                | 0.670 | 0.206       |
| Daily activity place | Playing near housing area | 28 (43.8) | 33 (51.6) | 0.483 | 0.333       |
| Outside housing areas |     | 27 (42.2) | 27 (42.2) |                | 0.483 | 0.333       |
| Wearing footwear (n=57) | Yes | 42 (73.7) | 46 (80.7) | 0.577 | 1.000       |
| No           | 8 (14.0)              | 8 (14.0)     |                | 0.577 | 1.000       |
| Handwashing habit (n=57) | Yes | 49 (86.0) | 53 (93.0) | 1.000 | 1.000       |
| No           | 1 (1.8)               | 1 (1.8)      |                | 1.000 | 1.000       |
| Drinking treated water (n=57) | Yes | 12 (18.8) | 12 (18.8) | 0.672 | 1.000       |
| No           | 43 (67.2)             | 48 (75.0)    |                | 0.672 | 1.000       |

cerning socio-demographic factors among Orang Asli were examined using univariate analysis. Pearson's Chi-square test was used to test the association of demographic and behavioural factors with STH infections (T. trichiura and A. lumbricoides). For T. trichiura, we found age, education, and handwashing habit were significantly associated with 0.005, 0.028, and 0.001 respectively. Meanwhile, there were no significant association between A. lumbricoides and all risk factors (p-value < 0.05). Table 4 demonstrates the association of these factors with STH infections.

**DISCUSSION**

Soil-transmitted helminth (STH) infection (especially T. trichiura and A. lumbricoides) is existing among Orang Asli community. The cases on morbidity of STH infections among this community has remained over the past 100 years despite many improvement efforts from the Malaysian government (Nasr et al., 2013). Previous reports indicated lack of proper personnel hygiene practice like using toilets for defecations, poor hand hygiene and not taking deworming drugs contributed to the continuous STH occurrence among the Orang Asli. Additionally, the anti-helminthic drug treated villagers like Orang Asli are prone to be re-infected with STH infection due to their contaminated environment and poor hygiene practice (Nasr et al., 2020).

The prevalence of STH infections in this study was 96% (n=64). This rate of infection is higher than previous study from Ethiopia with 70.3% cases been reported (Tekalign et al., 2019). In this study, the prevalence of T. trichiura (85.9%) and A. lumbricoides infections (93.8%) were contrary to the previous findings in Ethiopia, with 66.8% (n=252) infection of T. trichiura, which higher than A. lumbricoides infection 16.4% (n=62) (Tekalign et al., 2019). However, the sample size were higher in Ethiopia. In this study, hookworms were not detected, as this may be due to the nature of the soil in the study location which is non-loamy soil where the hookworm unable to survive (Nisha et al., 2016).

We found double infection was higher than the single infection with 79.7% (n=51) and 20.3% (n=13) respectively. This findings is identical to a report
in 2013, which majority of respondents had double infection of *A. lumbricoides* and *T. trichiura* with 62.7% (Debalke et al., 2013). For the egg intensity with reference to WHO guidelines, we found light infection was 45.3% (n=29), and moderate infection (50.0%; n=32) *T. trichiura* and light infections (68.8%; n=44) for *A. lumbricoides*. These were contrary to the previous study in 2019, which the Orang Asli had moderate to heavy infection with 65.6% and 53.6% among children and adults respectively (Muslim et al., 2019).

Table 4 shows the risk factors for STH infections among Orang Asli. In this study, we found all the sociodemographic as well as behaviour risk factors were not associated (p<0.05) with STH infections (*T. trichiura* and *A. lumbricoides*). This study is quite similar to previous study (univariate analysis) in Malaysia, in which gender (p= 0.31), occupation (p=0.48), handwashing habit (before eating (p=0.97); after defecation (p=0.52); and after contact with soil (p=0.12)) were not significant associated with STH infections (Muslim et al., 2019). In contrast, Workineh and colleagues reported risk factors like educational grade (level 1-4) and no handwashing habit before eating were significantly associated with STH infections (*T. trichiura* and *A. lumbricoides*) with p=0.03 and p=0.006 respectively (Workineh et al., 2020). In addition, Yang et al., also reported usage of river water was significantly associated to *Ascaris lumbricoides* (Yang et al., 2018).

We found hand hygiene was not significantly associated to *T. trichiura* infection. However, as *T. trichiura* infection is spread via fecal oral route, the fertile eggs deposited in nails of the Orang Asli could lead to this infection. Hence, good hand hygiene using provision of soaps will aid in reducing this infection. A contrary observation was found in a study which investigated the relatedness between children and mothers (caregiver) with poor hand hygiene habit for STH infection (Novianty et al., 2018). In contrary with our results, Studies detected significant associations between the gender, occupation, availability of toilet, wearing footwear, handwashing habit and drinking treated water for STH infections (Nasr et al., 2013; Strunz et al., 2014; Worrall et al., 2016)

**Study limitation**

This study has a few potential limitations. First the sample size was small with only 67 participants. Majority were reluctant to participate due to cultural belief and unwillingness to give stool samples for observation. Next, we only use a single method which uses floatation fluids for eggs observation and egg burden estimation. This could reduce our chances of observing other parasite with different specific gravity. The fact that the stool were given in limited amount, it was impossible to try various technique to detect various other helminths.

**CONCLUSIONS**

In the nutshell, the study showed a higher prevalence rate of STH infection predominantly by *Trichuris trichiura* and *Ascaris lumbricoides* within a small group of the Orang Asli community. Common basic practices like lack of proper hand washing habit and usage of toilet were significantly related to this infection. We strongly suggest health education campaign and routine chemotherapy to aid in the reduction of STH infection in this Orang Asli villagers.

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**Conflict of interest**

The authors declare that they have no conflict of interest for this study

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