ORIGINAL ARTICLE

BOARDING SCHOOL: A SIMPLE APPROACH TO REDUCE SOIL TRANSMITTED HELMINTH INFECTIONS IN ORANG ASLI CHILDREN OF SUNGAI SIPUT, PERAK, 2017

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ABSTRACT

Soil transmitted helminth (STH) infection is a major public health concern among the indigenous children of Malaysia. Precarious living conditions at home including unavailability of water, drinking of contaminated water, poor sanitation and livestock presence, are known risk factors for the infection. In order to provide better living conditions, these children are enrolled in boarding schools. This study was conducted to determine whether boarding schools is a solution in reducing soil transmitted helminth infection among Orang Asli children in Sg Siput, Perak, Malaysia. An analytical cross-sectional study was conducted among 204 schoolchildren aged 7-17 years from three boarding schools in Sungai Siput, Perak from January to March 2017. Stool samples were collected and examined using direct smear and Kato-Katz technique. Information on sociodemographic and environmental conditions were collected using a modified Demographic Health Survey (DHS) questionnaire. Data analysis was done using IBM SPSS Statistics Processor 20.0.Out of a total of 204 children, only 48% (n= 97) were infected with at least one type of STH species which showed a reduced prevalence as compared to previous studies conducted among home dwelling schoolchildren with overall prevalence of 78-97%. Majority of the children had monoparasitism (31%; n=63) with moderate intensity by T trichuira (n=51, 25%). Univariate analysis shows that unavailability of water at home has a statistically significant association with STH infection among boarding school children (OR=0.73; 95% CI= 0.56-0.95 p=0.021). Multivariate analysis proves children who had unavailability of water at home has 2.1 times more likelihood of getting an STH infection (OR= 2.08; 95%CI= 1.07-4.07; p= 0.032).This study demonstrates a reduced STH prevalence among Orang Asli boarding school children as better living condition there limits the spread of STH infection among them.

Keywords: *Soil transmitted helminth, Helminthiasis, Environmental factors, Boarding school, Children, Orang Asli, Prevalence, Malaysia*

INTRODUCTION

Soil transmitted helminth infection are a group of parasitic intestinal parasites known to infect millions of people worldwide. It is one of the neglected tropical disease, mostly affecting children giving rise to detrimental consequences to their physical, nutrition and cognitive development.

According to World Health Organization (WHO), 24% of the worldwide population are infected with Soil Transmitted Helminth(STH) and these population are concentrated over Sub-Saharan Africa, the Americas, China and East Asia[1]. Among these, 270 million preschool-age children and more than 600million school-aged children live in areas endemic of this infectious disease and are at high risk of infection[1]. In India, reported prevalence for at least a single STH infection ranges from 13% to as high as 66%[2]. In Vietnam, it is extrapolated that in 2003, 44% of its population is affected by the most prevalent type of STH infection, A. *lumbricoides*[3]. Similarly from the 500 million people residing in Sub Saharan Africa, STH infection accounts for up to 85% of all neglected tropical diseases[4].

As its name suggests, soil transmitted helminth has a reservoir in the soil which can easily transmit to human either directly via ingestion of soil or penetration of skin[5]. There are three main types of STH which are *Trichuris trichiura*, *Ascaris lumbricoides* and hookworms (*Necator americanus* and *Ancylostoma duodenale)*.

In Malaysia, Orang Asli are most susceptible to this insidious parasitic infection. Orang Asli is a term which simply translates to 'original people' or the aboriginal. They consist of three large ethnic subgroups known as Semang (Negrito), Senoi and Proto-Malay, which are further divided into 18 smaller subgroups. The majority (86%) of Orang Asli lives in the rural area and due to this geopraphical disadvantage, their exposure to soil transmitted helminth (STH) infection increases[6].

A recent study shows that infection of STH among the Orang Asli tribes in Peninsular Malaysia was as high as 81% with a higher prevalence in children

less than 15 years old[7]. Long term infection by these parasites especially in children, may cause significant morbidity such as malnutrition and delayed cognitive development[8]. According to a study done in Malaysia, lack of toilets in residential areas as well as inaccessibility of clean water for consumption contributes to high prevalence of STH among schoolchildren[9]. Another study also suggested that individuals who have high intensity of STH infection not only has a higher risk of infection with different subtypes but is also seen as high risk source of environmental contamination[10]. Besides that, human to animal interaction is also associated with STH infection. According to a study among school children in Guizhou and Sichuan, China, possession of livestock explained 2% difference in infection rate between case and control groups[11].

The disparities in health and economics of the Orang Asli with the rest of Malaysian citizen are obvious. 76.9% of the Orang Asli live below the poverty line[12]. Average life expectancy also differs by 20 solid years while infant mortality rate among the Orang Asli is as high as 51.7 per 1000 live birth[13].

In order to close this gap, the Government of Malaysia has built boarding schools as an initiative to improve educational opportunities for the Orang Asli children as well as to improve their health status. Better environmental and hygienic conditions in boarding schools should warrant better living prospect for the children as compared to the exposure they get at home. As suggested by previous studies, cleaner environmental conditions may lead to a reduced prevalence of STH infection among the boarding school dwellers.

Therefore, the objective of this study is (i) to investigate the prevalence and intensity of STH infection among Orang Asli children attending boarding school (ii) to determine the socio demographic characteristics of the children attending boarding schools in Perak and its association with STH infection (iv) to identify the association between water source, availability of proper sanitation facilities and livestock presence with STH infection.

METHODS

Study population

This is an analytical cross-sectional study, done in the state of Perak, Northwest of Peninsular Malaysia, home for 53,299 Orang Asli[14]. In the state of Perak and Kedah itself, there are 28 Orang Asli schools with a total of 4978 students ranging from kindergarten to 12 years of age[14]. The Orang Asli of Perak holds second place for being the most impoverished after Orang Asli in Pahang with a total of 2828 people earning below the poverty line[14]. Sungai Siput is located in the city of Kuala Kangsar and covers about 61% of the total area of the city.

In Sungai Siput, there are three major boarding schools in which data collection was done which are SMK Bawong, SK Kampung Kenang and SMAR Nurul Hidayah. The study sample were selected based on purposive sampling method with proportionate allocation. The minimum sample size required for this study was calculated using Open Epi Sample Size Calculator. Based on the study by Ngui et al, the most significant proportion of STH infection among Orang Asli (majorly aged less than 12 years old) with regards to lack of safe water supply is 86.8% as compared to those with safe water supply at 62.4%[15].

Sampling method

Based on the prevalence above, with the power of 90% and 95% of confidence interval, the total sample size calculated is 204 children including 33% non-response rate as seen in a study done in Pos Sederut, Pahang and a 18% non-eligibility rate which is estimated from a study done in Satak, Raub, Pahang[16,17].

This study included three boarding schools with a total of 589 students. From the 186 students from SK Kampung Kenang, 150 from SMAR Nurul Hidayah and 253 from SMK Bawong, based on their proportionate allocation, *64* number of children were selected from SK Kampung Kenang, *52* from SMAR Nurul Hidayah and *88* from SMK Bawong *as* shown in Figure 1.

Data collection

For stool sample collection, each participant was given a sample container with a spatula attached, in which on the external surface of each container is marked with their participant's registration number. A demonstration on proper stool sampling method was done and the participants were given 3 days to return the samples. Polystyrene boxes containing ice packs were placed at the multipurpose hall of each school, handled by research assistants assigned there, available throughout the day from 7am to 10 pm. Students were asked to return the collection bottles immediately after passing of stool.

For the purpose of transport, the unpreserved specimens were properly sealed and cold packs were used in order to keep the specimens cold for the 3- hour drive to the Department of Parasitology, University Kebangsaan Malaysia, for examination by trained laboratory personnel using direct microscopy and Kato-Katz technique. For every positive specimen under direct microscopy, another examination using Kato Katz technique followed to examine the

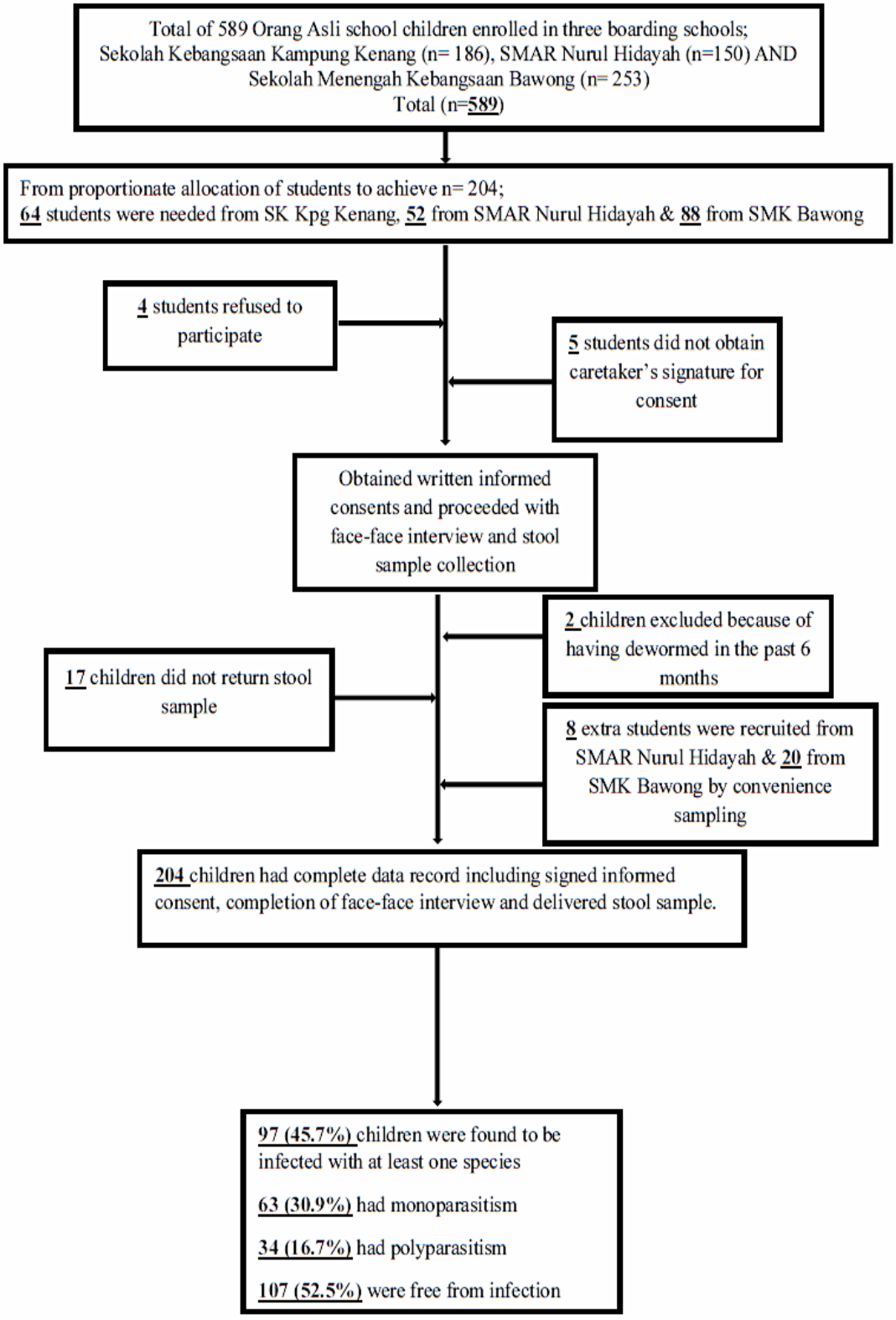

Figure 1: Flowchart of participant selection and outcome

stool sample for egg count which estimated the intensity of STH infection recorded as eggs per gram of stool. During analysis, the intensity of infection was then categorised into light, moderate or heavy infection based on the criteria proposed by World Health Organisation[18].

In terms of the questionnaire, The Demographic Health Survey (DHS) Questionnaire which is a validated questionnaire was utilised[19]. For the purpose of this study, some parts of this questionnaire were modified in which certain questions that was irrelevant to the research question were eliminated. The entire document was then translated into Malay using back-back translation method and later a pilot study was conducted among 39 schoolchildren of SK (Asli) Bukit Cheding, Banting, Kuala Langat, Selangor, a state west coast of Malaysia. From this pilot study, one item from the original DHS

questionnaire was removed in order to achieve a Cronbach Alpha of 0.6. as suggested by The British Psychological Steering Committee on Test Standards (1977)[20].

Data analysis

Data was entered and analysed using IBM SPSS Statistics Processor 20.0. Descriptive analysis is presented in percentages in order to exhibit clearly the prevalence of STH infection based on their sociodemographic and risk factors. In univariate analysis, Pearson chi-squared (χ^2) and Fischer exact test were used to determine the statistically significant risk factors to the dependent variable. P value of <0.05 is used, in which odds ratio (OR) and 95% confidence interval (CI) are documented in the respective tables. In order to determine the predictors of STH infection, all variables that showed association with p≤0.25 in the univariate analysis were retained for modelling by multivariate logistic regression as suggested by Bendel and Afifi[21]. A p-value of <0.05 in the final model indicated a significant variable.

RESULTS

Descriptive analysis

Overall, almost half of the students, (48%, n=97) of the participants were tested positive to be infected by at least one type of STH species. The most predominant infection is T. *trichiura* (45%), followed by A. *lumbricoides* (14%) and hookworm infection only infected 2.0% of the study sample.

With regards to the intensity of infection, all three types of STH infections exhibits light to heavy infections. The worm burden of T. *trichiura* was the most with a quarter of the children showing infection of moderate intensity (n=51, 25%) followed by light infection at 18% and heavy at only 2% as presented in Table 1.

Table 1: Prevalence and intensity of infection among Orang Asli boarding school children in Sg Siput, Perak

Intensity	Type of infection					
	Trichuriasis		Ascariasis		Hookworm	
	n	%	n	%	n	%
Light	36	17.6	16	7.8	3	1.5
Moderate	51	25.0	12	5.9	1	0.5
Heavy	4	2.0	-	-	-	-
Overall	91	44.6	28	13.7	4	2.0

Furthermore, based on this population, single infection (n= 63, 31%) were the most common, followed by double infections (n=33, 16%) and lastly, with only one person having triple infection (0.5%). The most predominant single infection is T. *trichiura* with 61 (30%) students having infected with T. *trichiura* only while for dual infection, the combination of T. *trichiura* and A. *lumbricoides* are the most eminent (n= 30, 15%) among other dual infections as presented in Table 2.

Two hundred and four Orang Asli boarding school children with a mean age of 13.9 (standard deviation, SD= 1.73) participated in this study.

The following table (Table 3) depicts the sociodemographic characteristics of these children.

Analytic analysis

With regards to sociodemographic and environmental risk factors, only two variables are significantly associated with STH by univariate analysis that is “mothers with primary education” (OR=1.43; 95% CI= 0.63-3.24 p=0.044) and “unavailability of primary water source” (OR=0.73; 95% CI= 0.56-0.95 p=0.021). The results are represented in Table 4.

Based on multivariate logistic regression analysis, children who had unavailability of water at home has 2.1 times more likelihood of getting an STH infection among the Orang Asli boarding school children (OR= 2.08; 95%CI= 1.07-4.07; p= 0.032).

Table 2: Monoparasitism and polyparasitism among boarding schoolchildren in Sg Siput, Perak

Type of infection	n	%
Monoparastism	63	30.9
T. *trichiura*	61	29.9
Hookworms	2	1.0
Polyparasitism		
Two species (total)	33	16.2
T. *trichiura* & A. *lumbricoides*	30	14.7
A. *lumbricoides* & Hookworms	3	1.5
Three species	1	0.5

Table 3: General characteristics of Orang Asli boarding school children in Sg Siput, Perak

Sociodemographic factors	n	%
Age[a]		
7-9 years old	5	2.5
10-12 years old	31	15.2
13-15 years old	139	68.1
16-17 years old	29	14.2
Gender		
Male	76	37.3
Female	128	62.7
Children education level		
Primary School	36	17.6
Secondary School	168	82.4
Place of residence		
Within Perak	183	95.3
Outside Perak	9	4.7
Mother's education level		
Informal education	43	25.4
Primary education	96	56.8
Secondary education	30	17.8
Father's education level		
Informal education	39	26.2
Primary school	74	49.7
Secondary school	36	24.2

[a] categorised according to level of schooling set by Ministry of Education, Malaysia

Table 4: Univariate analysis of sociodemographic and environmental factors with STH prevalence

Sociodemographic factors	STH presence		STH absence		Total		Odds ratio	95% CI	p-value
	n	%	n	%	n	%			
Education level									
Primary	16	16.5	20	18.7	36	17.6	1.07	0.77-1.49	0.681[b]
Secondary	81	83.5	87	81.3	168	82.4			
Gender									
Male	36	37.1	40	37.4	76	37.3	1.01	0.77-1.31	0.968[b]
Female	61	62.9	67	62.6	128	62.7			
Hometown									
Within Perak	87	95.6	96	95.0	183	95.3	0.94	0.52-1.72	1.000[c]
Outside of Perak	4	4.4	5	5.0	9	4.7			
Mother's education level									
Informal education	27	32.9	15	17.2	42	24.9	0.56	0.21-1.44	0.044[b]
Primary education	40	48.8	57	65.5	97	57.4	1.43	0.63-3.24	
Secondary education	15	18.3	15	17.2	30	17.8	1[d]		
Father's education level (category)									
Informal education	21	28.8	17	22.4	38	25.5	0.65	0.26-1.62	0.630[b]
Primary education	36	49.3	39	51.3	75	50.3	0.87	0.39-1.93	
Secondary education	16	21.9	20	26.3	36	24.2	1[d]		
Primary source of drinking water									
Treated†	90	95.7	99	92.5	189	94.0	0.79	0.52-1.20	0.336[b]
Untreated‡	4	4.3	8	7.5	12	6.0			
Unavailability of primary water source*									
Yes	54	65.1	48	48.0	102	55.7	0.73	0.56-0.95	0.021[b]
No	29	34.9	52	52.0	81	44.3			
Ensuring safe drinking water at home									
Yes	83	90.2	88	90.7	171	90.5	1.03	0.63-1.67	0.906[b]
No	9	9.8	9	9.3	18	9.5			
Steps to ensure safe water at home									
Boils water									
Yes	83	88.3	84	84.8	167	86.5	0.87	0.61-1.25	0.483[b]
No	11	11.7	15	15.2	26	13.5			
Strain with cloth									
Yes	16	17.0	12	12.1	28	14.5	0.81	0.52-1.28	0.334[b]
No	78	83.0	87	87.9	165	85.5			
Water filter									
Yes	3	3.2	3	3.0	6	3.1	0.98	0.43-2.19	1.000[c]
No	91	96.8	96	97.0	187	96.9			
Stand and settle									
Yes	3	3.2	6	6.1	9	4.7	1.32	0.813-2.14	0.499[c]
No	91	96.8	93	93.9	184	95.3			
Type of facility at home									
Proper toilet	82	84.5	92	86.0	174	85.3	1.06	0.72-1.55	0.771[b]
No facility	15	15.5	15	14.0	30	14.7			
Presence of livestock at home									
Yes	54	55.7	69	64.5	123	60.3	1.20	0.90-1.58	0.199[b]
No	43	44.3	38	35.5	81	39.7			

†Treated: piped water, tanker truck and bottled water, ‡Untreated water: tube well/bore hole, dug well, water from spring, rain water and surface water, [b] Pearson chi-squared test (χ^2)
[c] Fischer exact test, [d] Logistic regression

DISCUSSION

Magnitude of the study

This study sets out to assess the prevalence and intensity of STH infection among Orang Asli boarding school children and to see its association with environmental risk factors such as source of drinking water, improper sanitation and presence of livestock around the household.

This study has shown that 48% of the study population were found to be positive of at least one type of STH infection with T. *trichiura* being the most predominant species of infection at 46%. The overall infection rate found in this study is rather small as compared to other previous studies done among school aged children in various parts of Malaysia such as Terengganu, Pahang and Perak, reporting overall prevalence ranging from 78%-97% as depicted in the graph below[22-26].

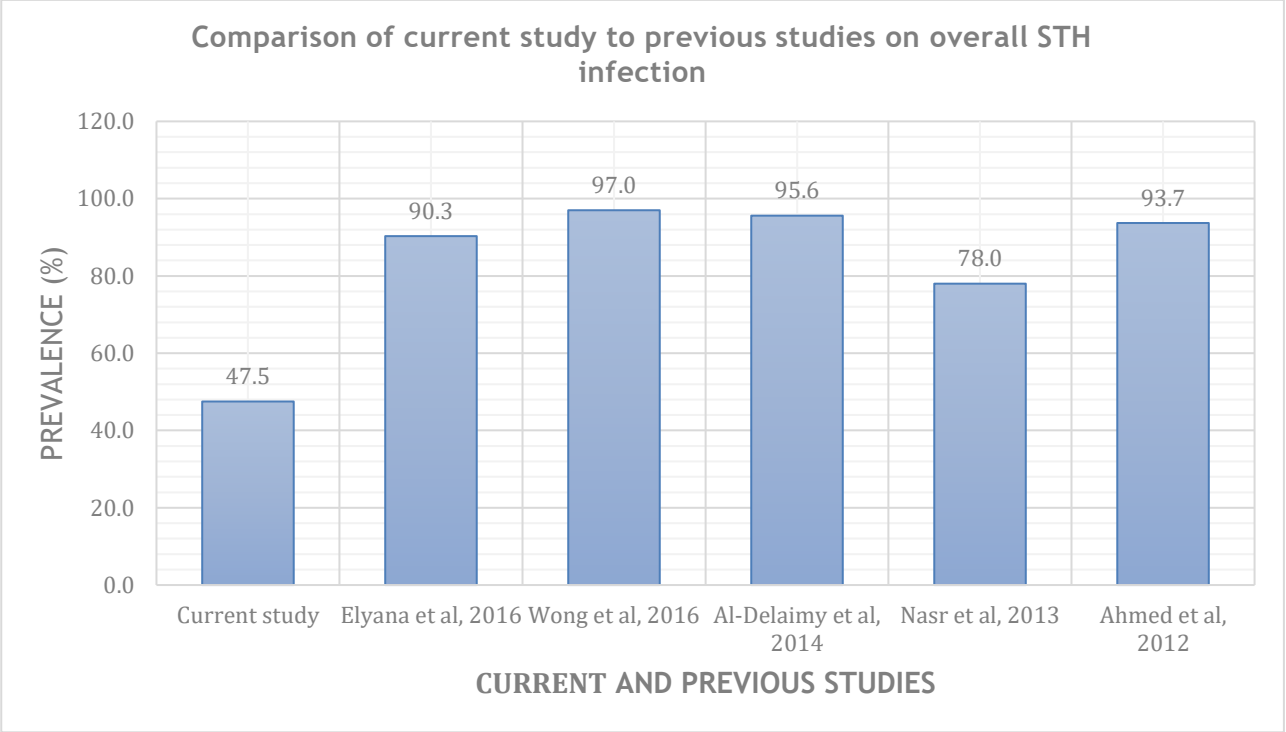

Figure 2: Comparison of current study to previous studies on overall STH infection among school aged children.

Cause-effect relationship

The reason behind this decrease in prevalence is most likely because these children reside in boarding schools. The better infrastructure and accommodation in boarding schools may have caused a shift in epidemiology which decreases exposure to risk factors of STH leading to a lower infection rate. Furthermore, adapting to better

lifestyle practices which are taught by non-aboriginal teachers may have led to the decrease in transmission of helminth among the school dwellers. One previous study done among school boarders in the Peruvian rainforest supports this and similarly, the study associated good environmental and hygiene standards in school and low exposure to risk factors at home, for the reduction in prevalence as compared to pupils living in towns and the rest of San Lorenzo community[27]. Another similar study done among Tarahumara tribe's boarding school in Northern Mexico also concluded that appropriate community-based strategies to improve household conditions may reduce the growth and transmission of parasites[28].

However, these findings challenge a recent study among Inland Jungle Villages (IJV) Negritos and those who had undergone resettlements under the Resettlement Plan Scheme (RPS) in which there was no significant difference found in the prevalence of STH infection among these two groups[29]. This study concluded that the hygiene practices of the aborigines especially open defecation with poor hand hygiene were main culprits to continuous and growing transmission of STH infection and poverty as well as overcrowding as seen in RPS vicinity created a suitable breeding ground for certain parasitic species. Although aboriginals were provided with better environmental commodities, they preferred to openly defecate rather than to use the toilets provided. However, with boarding school and children, it may be different as the governing bodies of the school has to adhere to specific standards of infrastructure and maintenance such as providing adequate toilets, wash basins, limitation of number of students and with teachers instilling proper hygiene practices among the children, the chain of transmission of helminth might have been broken, leading to

decreased prevalence of STH infection as seen in this study. Similarly, a case control study done in East Java proved that schoolchildren provided with combined latrine-education intervention resulted in a lesser prevalence of STH infection as compared to the control subgroup[30].

Prevalence of double infection by T. *trichiura* and A. *lumbricoides* is also lower (14.7%) in the current study as compared to other studies with prevalence of 18.9% and 20% respectively[31,32]. Nevertheless, to some extent, the Orang Asli children under this study might still not have a perfect hygiene practice as majorly are seen to have moderate intensity infection of *T. trichuira* when a light intensity would have been anticipated.

This study has also concluded that even though these children are enrolled in boarding schools, unavailability of water at their respective homes is a significant predictor for STH infection. This may be because these children do return to their homes in a fortnightly basis (over a weekend) thus re-exposing them to their native environment. Water regardless of source, becomes a necessity in order to reduce the prevalence of STH infection. This may be due to the importance of clean, functioning water which allows the children to practice hygienic habits such as hand hygiene, anal cleansing and cleaning of toilets which, according to previous studies, are all protective factors for intestinal parasitic infection[33].

By the same token, in terms of sociodemographic characteristics, children having mothers who at least have primary education showed a higher prevalence of STH infection as compared to those with informal and secondary education. This finding is surprising as it is contrary to previous literatures which concluded that informal education is associated with a higher rate of intestinal parasitic infection[34]. However, if these mothers do actually attend primary school but do not complete their education, due to the known high drop-out rates among the Orang Asli (enrolment of 45% into primary and only 11% continued to lower secondary), then probably a vague and incomplete primary education does associates with a higher infection rate[35].

Limitations

Other environmental risk factors investigated which are significant predictors in previous studies were not able to be re-proven in this study. This may be due to the limitation of the study itself in which questionnaires were answered by the children themselves. This may have led to recall bias as children under 18 years of age are ideally represented by a guardian/ parent in order to verify the information obtained. Nevertheless, as mentioned, the piloted questionnaires were made simple enough for answering by schoolchildren aided with pictures. Convenience sampling may have also contributed to biases as this study did not consider whether these children came from a rural village or resettlement vicinity which may affect the pool and intensity of STH studied among them prior to commencement of the study. In order to eliminate this bias, the children should ideally be given intervention to provide a controlled baseline of STH infection.

Besides that, this study relies on only two methods for analysis of the stool samples which are by direct smear and Kato- Katz technique. Direct smear which was used for its affordability and simplicity, became the main method of diagnosing helminth infection before proceeding with the Kato -Katz in order to determine the burden of infection in the study population. The traditional direct smear, although justifiable as efficient in detecting up to 93% of cases in previous studies, may cause a misdiagnosis as parasites in stools with high content of fat and debris may be missed[36-38]. Ideally, newer methods of analysis such as FLOTAC, Formol- Ether Sedimentation or Centrifugal Flotation is preferable or all samples should be examined using Kato-Katz technique in order to get a higher yield of parasites however will incur a higher cost.

CONCLUSION

Overall, this study found that there is a lower prevalence of STH infection among Orang Asli boarding school children in Sungai Siput, Perak as compared to previous studies among homebound Orang Asli children with unavailability of primary water source and mother's education level associated with higher infection rates. In the population under our study, we can conclude that boarding schools may be helpful in reducing the burden of STH infection among Orang Asli children. However, a nationwide study involving Orang Asli boarding school children needs to be done in order to prove this representation in order to provide better health for the Orang Asli of Malaysia.

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