Tropical Biomedicine 26(2): 110–122 (2009)

REVIEW PAPER

Intestinal parasitic infections amongst Orang Asli (indigenous) in Malaysia: Has socioeconomic development alleviated the problem?

Lim Y.A.L.[1*], Romano N.[1], Colin N.[2], Chow S.C.[3] and Smith H.V.[4]
[1]Department of Parasitology, Faculty of Medicine, University of Malaya, 50603 Kuala Lumpur, Malaysia.
[2]Center for Orang Asli Concerns, PO Box 3052, 47590 Subang Jaya, Malaysia.
[3]School of Science, Monash University, Jalan Lagoon Selatan, Bandar Sunway, 46150 Selangor Darul Ehsan, Malaysia.
[4]Scottish Parasite Diagnostic Laboratory, Stobhill Hospital, Glasgow G21 3UW, Scotland, UK.
E-mail: limailian@um.edu.my
Received 14 April 2009; received in revised form 14 July 2009; accepted 15 July 2009

Abstract. Orang Asli are the indigenous minority peoples of peninsular Malaysia. Despite proactive socioeconomic development initiated by the Malaysian Government in upgrading the quality of life of the Orang Asli communities since 1978, they still remained poor with a current poverty rate of 76.9%. Poverty exacerbates the health problems faced by these communities which include malnourishment, high incidences of infectious diseases (eg. tuberculosis, leprosy, malaria) and the perpetual problem with intestinal parasitic infections. Studies reported that the mean infection rate of intestinal parasitic infections in Orang Asli communities has reduced from 91.1% in 1978, to 64.1% in the subsequent years. Although the results was encouraging, it has to be interpreted with caution because nearly 80% of studies carried out after 1978 still reported high prevalence (i.e. >50%) of soil-transmitted helminthiases (STH) among Orang Asli communities. Prior to 1978, hookworm infection is the most predominant STH but today, trichuriasis is the most common STH infections. The risk factors for intestinal parasitic infections remained unchanged and studies conducted in recent years suggested that severe STH infections contributed to malnutrition, iron deficiency anaemia and low serum retinol in Orang Asli communities. In addition, STH may also contribute to poor cognitive functions and learning ability. Improvements in socioeconomic status in Malaysia have shown positive impact on the reduction of intestinal parasitic infections in other communities however, this positive impact is less significant in the Orang Asli communities. In view of this, a national parasitic infections baseline data on morbidity and mortality in the 18 subgroups of Orang Asli, will assist in identifying intervention programmes required by these communities. It is hope that the adoption of strategies highlighted in the World Health Organisation-Healthy Village Initiatives (WHO-HVI) into Orang Asli communities will ensure the whole mechanism of delivery and empowerment by the government agencies become more efficient and productive in alleviating intestinal parasitic infections in these communities.

INTRODUCTION

Orang Asli, the indigenous minority peoples of peninsular Malaysia comprises of at least 18 distinct cultural-linguistic groups (officially classified under Negrito, [i.e., Kensiu, Kintak, Jahai, Lanoh, Mendriq and Batek] , Senoi [i.e., Semai, Temiar, Jah Hut, Chewong, Mah Meri and Semoq Beri] and Aboriginal Malay [i.e., Temuan, Semelai, Jakun, Orang Kanaq, Orang Kuala and Orang Seletar]). The Malaysian government is aware that the Orang Asli is the most impoverished and marginalized and has made efforts to improve the living standards of Orang Asli communities by initiating

comprehensive socioeconomic development programmes since 1978 by providing modern facilities such as village resettlement, building of rural roads, provision of electricity and water supply, social amenities, as well as easier access to education (Ministry of Rural and Regional Development Malaysia, 2005). These provisions should create the impetus to uplift their socioeconomic status and, in turn, facilitate the reduction of intestinal parasitic infections, which are endemic and associated with poverty. Despite these proactive actions in upgrading the quality of life of the Orang Asli communities, they still remained poor with a current poverty rate of 76.9%. Poverty exacerbates the health problems faced by these communities which include malnourishment, high incidences of infectious diseases (eg. tuberculosis, leprosy, malaria) and the perpetual problem with intestinal parasitic infections (Baer, 1999). Studies carried out after these socio-economic developments have constantly reported high prevalence of intestinal parasitic infections in Orang Asli communities, with some communities reaching 100% prevalence (Al-Mekhlafi *et al.*, 2005; 2007a). The prevalence of ascariasis, trichuriasis and hookworm, the three most commonly reported intestinal parasite infections, range from 4.6 to 70%, 3.1 to 98.2% and 3 to 95.2%, respectively (Nevin, 1938; Dissanaike *et al.*, 1977; Al-Mekhlafi *et al.*, 2005).

To date, over 20 studies have been carried out on intestinal parasitic infections amongst Orang Asli. However, there is no attempt to collate and analyze these data systematically, and, more importantly, to assess whether socioeconomic progress has significant impact in reducing intestinal parasitic infections in these communities. Given the high endemicity of intestinal parasitism in this indigenous minority, continued collection and collation of baseline data for intestinal parasitic infections are fundamental in developing effective intervention strategies and policy formulations that will benefit and empower every group of Orang Asli in the future. Therefore, the objectives of this article were to review the available data/information on intestinal parasitic infections amongst the Orang Asli, to identify knowledge gaps and to provide recommendations in the pursuit of improved prevention and control strategies.

MALAYSIAN GOVERNMENT'S SOCIOECONOMIC DEVELOPMENT PROGRAMMES

Since 1978, the Malaysian Government has been providing basic social infrastructure (e.g. potable water supplies, electricity, rubber plantation smallholdings and wooden houses) to almost every Orang Asli village located in the vicinity of existing towns and at the outskirts of traditional villages, the rationale being to provide the impetus and support for further socioeconomic developments for these Orang Asli communities. The government through the Department of Orang Asli Affairs (JHEOA) recognises the risk factors that augment intestinal parasitic infections include poverty, low education attainment, poor health awareness and the lack of basic amenities and have embarked on several comprehensive development programmes aimed at empowering these communities.

One of the most significant developments for the Orang Asli health service by the government was the establishment of the Gombak Hospital dedicated to serve the Orang Asli, in 1957. Managed by the Department of Aborigines (now known as Department of Orang Asli Affairs, JHEOA), its first medical director Dr. J Malcolm Bolton planned a hospital service where the patient could be accompanied by family, given that the primary fear of hospital treatment was leaving the familiar forest surroundings and the family (Bolton, 1973a; 1973b; Harrison, 2001). Benefits included better patient care and that the accompanying family members could be given medical examinations, especially for tuberculosis (Bolton, 1973a). The intention was to create a hospital that integrated with the Orang Asli life style and that could eventually be managed by the Orang Asli.

Besides that, a comprehensive health care programme has been suggested for the Orang Asli which includes family planning, periodic deworming and food supplements (including vitamins and minerals) (Chee, 1995). Under the health programme, a comprehensive coverage of basic health for Orang Asli communities has been prioritised, which includes the construction of health clinics, treatment centres and transit centres. In order to promote health awareness and to prevent the spread of infectious diseases, various programmes and services have been implemented (Jabatan Hal Ehwal Orang Asli, 2005). The Malaysian Ministry of Health (MOH) recognized that intestinal helminths are a major national public health problem and in 1974, MOH launched the National Worm Control Programme. This programme involved 1486 primary schools and more than 3,000,000 children received a single dose of 20 mg pyrantel pamoate at least annually (and, where possible, every 6 months) (Ministry of Rural and Regional Development Malaysia, 2005). While this programme focused on primary school children in all rural communities, Orang Asli children who fell into this category benefited from this programme.

However, since the launch of the National Worm Control Programme, several problems became apparent. These include the use of pyrantel pamoate which is not effective against hookworm or *Trichuris*, inadequate evaluation of deworming programme, poorly constructed toilets and standpipes and poor monitoring of the programme itself. It needs to be emphasized that this is not due to the inherent defect of the policy/programme (on contrary it is a sound policy/programme) rather it is poor planning and implementation (Mohd Tap, 1990) that need to be re-evaluated for these socioeconomic development strategies to have significant effect on poverty as well as the alleviation of parasitic infections.

Another major aspect in the Orang Asli development programme is education since it can bring about the social and economic changes required for a better quality of life. The Malaysian government has built hostels and primary schools to cater for the needs of Orang Asli communities, increased enrolment in primary, secondary and tertiary education and the number of Orang Asli students who successfully completed their studies at institutions of higher learning (Jabatan Hal Ehwal Orang Asli, 2004). It is imperative that educational programmes, including increased awareness of personal hygiene and environmental sanitation for Orang Asli communities be further intensified.

INTESTINAL PARASITIC INFECTIONS AMONGST ORANG ASLI

Prevalence

The earliest record of intestinal parasitic infections amongst Orang Asli was reported in 1938 (Nevin, 1938), and by 2007, there had been at least 19 further studies (Table 1). The socioeconomic development programmes initiated for the Orang Asli by the Malaysian government were implemented in 1978, and these provide us with the opportunity to investigate intestinal parasitic infections in the Orang Asli both prior to and after 1978. Before 1978, at least 6 studies suggested a great diversity of intestinal parasitic infections among the Orang Asli. These include protozoa (*Entamoeba histolytica*, *Entamoeba hartmanni*, *Entamoeba coli*, *Endolimax nana*, *Iodamoeba bütschlii*, *Dientamoeba fragilis*, *Giardia lamblia*, *Chilomastix mesnili*, *Trichomonas hominis*, *Balantidium coli* and *Isospora*) and nematodes (*Ascaris lumbricoides*, *Trichuris trichiura*, hookworm, *Strongyloides stercoralis* and *Enterobius vermicularis*) infections (Nevin, 1938; Polunin, 1953; Sandosham, 1953; Bisseru & Abdul Aziz, 1970; Dunn, 1972; Dissanaike *et al.*, 1977). The most common intestinal parasitic infections identified from these studies is STH (*A. lumbricoides*, *T. trichiura* and hookworm). Interestingly, no trematode or cestode infections were recorded. After 1978, at least 14 studies were performed primarily on nematode infections, notably ascariasis, trichuriasis and hookworm infection (Table 1). Studies reported after 1978 indicated that the intestinal parasites

Table 1. Chronological reports of helminth infections in Orang Asli communities in Malaysia

Year	No. examined	Percentage of infection (%)			Overall STH infection (%)	Reference
		Trichuris	*Ascaris*	Hookworm		
Before socioeconomic development activities commenced (i.e. 1978)						
1938	104	14.0	70.0	16.0	70.0*	Nevin, 1938
1953	131	3.1	4.6	90.8	90.8*	Polunin, 1953
1953	117	24.0	79.6	48.7	79.6*	Sandodsham, 1953
1970	100	80.0	69.0	51.0	93.0	Bisseru & Abdul Aziz, 1970
1972	1,273	57.2	39.1	68.7	91.3	Dunn, 1972
1977	126	80.9	47.6	95.2	99.2	Dissanaike *et al.*, 1977
After socioeconomic development activities commenced (i.e. 1978)						
1988	1,574	66.7	46.6	5.3	66.7*	Bundy *et al.*, 1988
1991	ns	59.0	43.0	26.0	59.0*	Che Ghani & Oothuman, 1991
1994	ns	ns	ns	ns	79.5	Rajeswari *et al.*, 1994
1995	25	24.0	20.0	16.0	61.5*	Karim *et al.*, 1995
1996	93	36.6	58.0	ns	79.6	Mohd Sham, 1996
1997	ns	92.0	63.0	28.8	92.0*	Norhayati *et al.*, 1997
1997	84	41.7	59.5	6.0	79.8	Rahmah *et al.*, 1997
1998	ns	29.0	17.0	24.0	29.0*	Noor Hayati *et al.*, 1998
1999	268	29.7	43.9	6.3	47.4	Zulkifli *et al.*, 1999
2002	159	55.3	33.3	44.7	55.3*	Ghani *et al.*, 2002
2004	281	26.0	19.0	3.0	26.0*	Nor Aini *et al.*, 2004
2005	368	98.2	61.9	37.0	98.2*	Al-Mekhlafi *et al.*, 2005
2007	292	95.5	67.8	13.4	100	Al-Mekhlafi *et al.*, 2007a
2007	74	31.1	25.7	8.1	59.5	Hakim *et al.*, 2007

* Since overall prevalence was not indicated. Figure written denotes the highest prevalence rate of a particular infection detected in the studied population (either *Ascaris*, *Trichuris* or hookworm infection).
ns not stated

fauna in the Orang Asli were less diverse with a marked decrease in the diversity of protozoan infections.

There are a variety of reasons to account for the decreased diversity of parasitic fauna over time. While the diversity of a parasite usually declines in natural habitats modified by humans, its prevalence and intensity increases (Dunn, 1972). Orang Asli living in habitats that has not undergone significant modification, are infected with a greater diversity of parasites than those living in simplified surroundings, i.e. on a natural habitat modified by humans and prepared for settlement and cultivation. When the tropical forest ecosystem is simplified, some intestinal parasite species are eliminated (Dunn, 1972), due to their inability to adapt to the new environment which leads to the disruption of their natural cycles of transmission, thus leaving the more adaptable parasites to thrive. For instance, Orang Asli children in resettlement villages (simplified habitat) and peripheral areas often have higher prevalence and intensities of helminth infections compared to those living in traditional Orang Asli villages (Zulkifli *et al.*, 1999; Al-Mekhalafi *et al.*, 2006). In addition, resettled villages cover less surface area than traditional villages and can become more crowded. The adoption of similar defecation habits in both village types tend to contaminate soil with parasite transmissive stages at higher abundances in resettled villages than in traditional villages. Furthermore, experimental design also

influenced reporting of parasite prevalence data. Most studies performed after 1978 focused on parasites such as *Ascaris*, *Trichuris* and hookworm deemed to be of greater medical importance, whereas studies performed before 1978 were more investigative and reporting a broader range of intestinal parasites.

Analysis of the 20 research findings reported after 1978 indicates that the overall mean intestinal parasitic infection rates in Orang Asli communities has reduced from 91.1% to 64.1%. These figures still remained higher than the overall mean intestinal parasitic infection rates (55.4%) of the general Malaysian population encompassing rural and urban communities (Table 2). Although this reduction is encouraging, these findings should be interpreted with caution because detailed analysis of helminth infection rates suggested that almost 80% of studies performed after 1978 still reported prevalence of more than 50%. Between 2005 and 2007, at least two studies have reported prevalence of more than 90% (Al-Mekhlafi *et al.*, 2005; 2007a). These data identified that socioeconomic developments have little impact in reducing the prevalence of intestinal parasitic infections amongst Orang Asli.

The most common intestinal parasitic infections in Orang Asli remain unchanged. STH infections are more prevalent and with higher intensities than protozoan infections. Prior to 1978, the predominant STH infection was hookworm, but in subsequent decades, trichuriasis has become the leading STH infection. The high prevalence of hookworm infections in Orang Asli communities before 1978 are attributed primarily to their dislike for wearing shoes and the defecation habits of children, usually performed in close proximity to their dwellings. These habits have changed to some extended with social development. Currently, trichuriasis is the leading STH infection, followed by ascariasis and hookworm. Because of their similar transmission routes, *Ascaris* and *Trichuris* co-infections are commonly seen in Orang Asli communities (Al-Mekhlafi *et al.*, 2007a). The higher rates of trichuriasis may be due to the reported ineffective dosage and choice of anthelminths (i.e. pyrantel pamoate) used (Adams *et al.*, 2004). Currently, the recommended treatment regime for the removal of STH infections are benzimidazole drugs such as mebendazole and albendazole. Although both albendazole and mebendazole are effective against *Ascaris* in a single dose, in hookworm, a single dose of mebendazole has a low cure rate and albendazole is more effective (Bennett & Guyatt, 2000; Albonico *et al.*, 2002). Conversely, a single dose of albendazole is not effective in many cases of trichuriasis (Adams *et al.*, 2004). For both trichuriasis and hookworm infections, several doses of benzimidazole anthelmintic drugs are commonly needed.

With the exception of the study conducted by Dunn, most studies failed to focus on the ethnicity, culture and environment of the Orang Asli (Dunn, 1972). This is regrettable because the various groups of Orang Asli live in diverse ecosystems, have diverse cultural practices and different approaches to managing illnesses. Dunn investigated 1,273 individuals from seven ethnic groups and subgroups, [Negrito, Temiar, Semai Jahut and Semelai (Senoi), Jakun and Temuan (Aboriginal Malay)] and found 91.3% of them were infected with intestinal parasites (Table 3). This was the largest study conducted prior to 1978. The Negritos harboured more intestinal parasite species than any other ethnic group studied, most likely due to their complex habitat in the Malaysian rain forest. Negritos who survive on hunting, fishing and gathering, do not significantly modify or simplify their habitat, and therefore were subjected to a greater diversity of parasites compared to the other groups of Orang Asli living in surroundings that have been drastically simplified for settlement and cultivation. Although sanitary behaviour appears to be similar for all the seven Orang Asli communities, certain environmental and cultural practices and taboos may have interacted with their customary behaviour to produce different sanitary conditions (Che Ghani & Oothuman, 1991). This study also revealed that the groups of Orang Asli (Temiar, some Semai and Jahut) that live at higher, cooler elevations, have fewer STH

Table 2. Chronological reports of helminth infections in other (non-Orang Asli) communities in Malaysia

Year	No. examined	Percentage of infection (%)			Overall STH infection (%)	Reference
		Trichuris	*Ascaris*	Hookworm		
1934	ns	ns	ns	70.7	70.7*	Russel & Paul, 1934
1964	2,732	ns	ns	ns	43.0	Lie, 1964
1967	65	57.0	89.0	30.8	93.8	Heyneman *et al.*, 1967
1970	96	22.0	14.5	22.0	40.0	Bisseru & Abdul Aziz, 1970
1970	110	59.0	34.5	53.5	87.3	Bisseru & Abdul Aziz, 1970
1970	138	87.5	85.5	14.5	95.0	Bisseru & Abdul Aziz, 1970
1970	183	82.0	50.0	34.0	90.0	Bisseru & Abdul Aziz, 1970
1970	151	23.8	15.2	1.3	23.8*	Bisseru & Abdul Aziz, 1970
1971	202	46.0	47.0	31.7	51.0	Lie *et al.*, 1971
1978	433	55.4	67.2	12.2	76.2	Khairul Anuar *et al.*, 1978
1978	84	90.6	81.1	60.4	90.6*	Nawalinski & Roundy, 1978
1978	150	56.0	52.0	28.0	82.7	Sinniah *et al.*, 1978
1979	834	84.5	86.7	43.2	95.0	Lo *et al.*, 1979
1980	562	18.5	15.0	27.8	36.3	Zahedi *et al.*, 1980
1982	7,682	44.5	21.9	4.6	50.0	George & Ow Yang, 1982
1982	305	14.8	17.4	3.0	39.0	Hamimah *et al.*, 1982
1982	25,246	33	18.8	7.1	39.6	Kan, 1982
1984	1,157	81.3	56.4	14.3	89.0	Kan, 1984
1984	1,888	40.3	31.6	10.7	52.7	Sinniah, 1984
1987	11,874	33.3	19.3	3.3	41.1	Kan & Poon, 1987
1988	1,574	66.7	49.6	5.3	66.7*	Bundy *et al.*, 1988
1989	819	36.4	33.9	15.6	51.0	Kan, 1989
1990	1,203	83.2	71.7	14.2	83.2*	Li, 1990
1991	9,863	49.0	33.0	6.0	58.0	Hanjeet *et al.*, 1991
1992	ns	61.0	47.0	4.0	61.0*	Chan *et al.*, 1992
1994	456	47.1	7.9	2.9	62.9	Rajeswari *et al.*, 1994
1995	ns	13.0	4.0	2.0	13.0*	Norhayati *et al.*, 1995
1995	ns	37.9	27.7	0.5	60.3	Oothuman *et al.*, 1995
1997	249	41.4	29.3	7.2	43.3	Mahendra *et al.*, 1997
1998	nd	nd	nd	34.1	34.1*	Rahman, 1998
1999	237	24.0	22.0	2.0	42.0	Menon *et al.*, 1999

* Since overall prevalence was not indicated. Figure written denotes the highest prevalence rate of a particular infection detected in the studied population (either *Ascaris*, *Trichuris* or hookworm infection).

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infections, partly because the lower soil temperatures reduce the embryonation rate of ova. In contrast, groups that live in warmer lowland areas acquired STH more rapidly as the soil conditions are more favourable to the embryonation of *Ascaris*, *Trichuris* and hookworm. The association of intestinal parasitism with cultural practices and ecological conditions associated with the various subgroups of Orang Asli has not been investigated further in studies conducted in peninsular Malaysia. It is therefore vital for future parasitological studies to consider the cultural, social and geographical aspects in the different subgroups of Orang Asli so that accurate and meaningful results could assist in effective planning and implementation of specific prevention and control strategies for each group.

Table 3: Parasite prevalence rates for nine subgroups of Orang Asli

Subgroup	No. examined	Negative (%)	Proportion infected (%)							
			E. histolytica	*E. hartmanni*	*E. coli*	*E. nana*	*G. Lamblia*	*Hookworm*	*Ascaris*	*Trichuris*
Negrito	86	3.5	1.2	1.2	30.2	5.8	9.3	93.0	11.6	55.8
Temiar	236	15.7	0.8	0.4	17.8	2.1	3.0	77.6	2.1	23.3
Semai & Jahut	65	16.9	1.5	–	27.7	6.2	7.7	52.3	20.0	29.2
Semai	83	14.5	6.0	4.8	38.6	3.6	9.6	73.5	13.3	12.1
	50	4.0	16.0	2.0	38.0	16.0	20.0	66.0	58.0	60.0
	85	1.2	4.7	14.1	38.8	4.7	49.5	57.6	56.5	83.5
Jakun	78	7.7	–	1.3	30.8	2.6	2.6	64.1	65.4	61.6
Semelai	159	3.8	0.6	3.1	17.0	5.0	5.7	69.9	71.0	72.3
Temuan	194	1.5	5.7	7.7	36.6	11.9	12.4	78.9	59.3	91.3
Total no. examined & average proportions infected	1036	7.8	3.2	4.0	28.2	6.0	11.1	72.8	38.1	55.4

Source: Dunn, 1972

Risk factors

The risk factors for Orang Asli to acquire intestinal parasitic infections include poor sanitary hygiene and overcrowding (Rajeswari *et al.*, 1994; Rahmah *et al.*, 1997; Zulkifli *et al.*, 1999), low socioeconomic background, environmental (water supply, sanitary disposal of faeces) and cultural-behavioural factors relating to diet and food preparation, and poor dietary intake/food availability (Al-Mekhlafi *et al.*, 2008a). It is clear that the transmission of intestinal parasitic infections within Orang Asli communities is predominantly linked to their habits, particularly eating, defecation, personal hygiene, cleanliness and level of education, which are also tell-tale signs of poverty, low educational attainment, poor health awareness and the lack of basic amenities. However, environmental factors such as water supply for domestic and personal hygiene, sanitation and housing condition and other factors such as socioeconomic, demographic and health related behaviour are also known to influence the acquisition of infection (Rajeswari *et al.*, 1994). Overall, the risk factors for intestinal parasitic infections among the Orang Asli have not changed much. Certainly this highlights the need to reassess the existing programmes and policies associated with these risk factors in order for future control strategies to be more successful in reducing the problem of intestinal parasitic infections.

Clinical and public health significance

The clinical significance of intestinal parasitic infections is difficult to assess because most of these infections are asymptomatic with very low morbidity and mortality. Public health significance is measured by the prevalence, intensity of the infection and the association of infection with human nutrition, growth and development in children and work productivity in adults. The impact of intestinal parasitic infections on nutrition, growth and development of Orang Asli has only been studied intensively since the late 1980s. Several studies have demonstrated that severe ascariasis, trichuriasis and hookworm infections are strong indictors of malnutrition, iron deficiency anaemia and low serum retinol, indicative of vitamin A deficiency (Khor, 1988; Osman & Zaleha, 1995; Rahmah *et al.*, 1997; Zulkifli *et al.*, 1999, Nor Aini *et al.*, 2004; Al-Mekhlafi *et al.*, 2005;

2007b). In addition, the public health significance of STH is further enhanced by their immunomodulatory influences on vaccination outcomes and co-infections with other important infectious diseases including malaria, AIDS and tuberculosis. These interactions must be recognised, acknowledged and understood especially by the JHEOA so that appropriate measures of intervention and empowerment can be provided to the Orang Asli.

STH are known to play an important contributory role in the aetiology of childhood malnutrition. Heavy and chronic infections with *Ascaris*, *Trichuris* and hookworms can aggravate or precipitate malnutrition, especially among already undernourished children from these socio-economically disadvantaged communities (Rahmah *et al.*, 1997; Al-Mekhlafi *et al.*, 2008a). Malnutrition reflects the disadvantaged conditions, chronic or repeated infections, and inadequate food intake (Zulkifli *et al.*, 1999). The change from a culture of hunting and gathering to a more sedentary lifestyle has taken a considerable toll on the health and nutritional status of Orang Asli communities (Chee, 1995; Zulkifli *et al.*, 1999). Treatment of undernourished Orang Asli schoolchildren for intestinal helminth infections improves growth, appetite and physical fitness (Rahmah *et al.*, 1997). However, reinfection is a major problem and in highly endemic areas, reinfection occurs as early as 2 months post-treatment. After 4 months, almost half of the treated population has been reinfected (Norhayati *et al.*, 1997) and by 6 months the intensity of infection has returned to pretreatment levels (Norhayati *et al.*, 2003; Al-Mekhlafi *et al.*, 2008b). High reinfection rates for helminth infections are one of the crucial elements to consider in formulating an effective control programme. Relevant authorities need to recognize that providing treatment alone will not eliminate the problem. Reinfection rates will continue to remain high unless the source of contamination as well as the high level of environmental contamination are tackled and eradicated simultaneously.

RECOMMENDATIONS

National parasitic infection databases and the World Health Organisation-Healthy Village Initiative (WHO-HVI)

The Malaysian Government, particularly through the Ministry of Rural and Regional Development and JHEOA, is proactive in ensuring that Orang Asli communities are involved in the mainstream of national economic development processes through land development programmes, economic and social development, resettlement, provision of infrastructure and public amenities, training and human development. Whilst these interventions will assist in alleviating the Orang Asli from the poverty trap, challenges including low self-esteem, over-dependence on government assistance, high rate of school absenteeism, poor accessibility to schooling and no land ownership remain setbacks that must be addressed before these interventions maximise Orang Asli potential.

Given the influence of STH on, and the heterogeneity of, Orang Asli communities, a national parasitic infections baseline data on morbidity and mortality in each of their 18 subgroups, which will assist in identifying where and what interventions are required, is deemed imperative. Many studies have failed to appreciate the heterogeneity of the Orang Asli group (i.e. 18 subgroups). The diversity of the 18 subgroups and the effect of this diversity on the pattern and prevalence of intestinal parasitic infections need to be recognised. There seemed to be a lack of knowledge and appreciation in this aspect, hence it is important for future studies to associate parasitic infections with cultural, behavioural and environmental differences in order to assist successful planning and implementation of government policies and programmes for the alleviation of parasitic diseases for each subgroups.

In view of the falling admission rates in Gombak Hospital and low priority in the Orang Asli medical service to have first-line Orang Asli health workers who can support and clarify technical matters for their hospitalised 'relatives', implementation

of the WHO-HVI among Orang Asli communities, whereby empowerment in environmental and public health issues at individual, village, community and district levels will complement current programme (e.g. JHEOA programme to train village-level Orang Asli Health Volunteers), and ensure that the mechanism of delivery and empowerment by government agencies, in particular Ministry of Rural and Regional Development through JHEOA, is made more effective and productive. The WHO-HVI has introduced programmes that foster a holistic approach to health management through promotion of personal, domestic and community hygiene, provision of health care and housing quality and management of the environment (Howard *et al.*, 2002). Some of these initiatives are already in place, but the adoption of the WHO-HVI mechanism will empower Orang Asli to take responsibility for their own health and wellbeing and overcome their low self esteem.

Through this initiative, Orang Asli communities will be empowered to take responsibility for all their community health and hygiene, maternal health, child health and family planning issues through the instigation of small committees for each of these critical areas. Each committee will be offered information, education and training, an increased rationale for communicating and discussing local health issues, and shown the benefits of collecting, cataloguing, collating and disseminating data, and practical maintenance for local resources (Howard et al., 2002). This can be targeted at both community volunteers and government health surveillance assistants. Underpinning this set of initiatives for Orang Asli communities is their inherent cohesiveness, their empowerment, the obvious benefits that can be delivered from 'local solutions' for 'local problems', and the increased ability of communities to interact with the MOH and the JHEOA.

For example, deworming interventions, including worm burden assessments, deworming benefits and failures, influence of local transmission routes, descriptive local epidemiology etc., are multi-disciplinary, and can be organised communitywide, given the increased educational uptake among Orang Asli and the obvious benefits of utilising first-line Orang Asli health workers who can support and clarify technical matters. This is particularly so under the WHO-HVI, where 'model' villages can be identified and their successes can be rolled out to neighbouring villages and communities.

In this way, the Orang Asli community becomes empowered to take charge of its own issues, and not to remain dependent on local government efforts alone. WHO-HVI is an obvious way ahead for the heterogeneous communities of the Orang Asli because of its unique attribute of action by the community for its community, which takes into account serious consideration of each community's diverse cultures and practices. WHO-HVI does not contradict the efforts that the Malaysian government has put in place: instead, WHO-HVI complements government deliverables and ensures that the mechanism of delivery is made more effective, efficient and productive.

CONCLUSION

Orang Asli communities remain behind other Malaysian ethnic communities despite the numerous socioeconomic development programmes implemented by the Malaysian government to alleviate Orang Asli communities from the web of poverty, which is inextricably linked with poverty associated infections/diseases such as intestinal parasitic infections and other neglected tropical diseases. Collectively, the overall published findings highlight the fact that the implemented socioeconomic development programmes did have some positive impact on the health of the Orang Asli in terms of parasitic infection; however this does not apply to all (i.e. 18) different Orang Asli subgroups. Intestinal parasitic infections remain prevalent in Orang Asli communities. There is an urgent need to reassess some of the control strategies and policies so that effective measures taken will benefit all the different groups of Orang Asli.

Recommendations highlighted in this paper include:

1. Establishment of a **national parasitic infections databases for the 18 Orang Asli subgroups**. Such an approach has the potential to greatly aid the prevention and control not only of parasitic infections but could also provide a 'model' for the deployment of similar strategies for other diseases.
2. Implementation of the **WHO-HVI programme** where Orang Asli community will be empowered to take responsibility for all their community health and hygiene, maternal health, child health and family planning issues through the instigation of small committees for each of these critical areas. Orang Asli active participation is essential for identifying local solutions to local problems (e.g. parasitic diseases).

The vision for healthier, interactive Orang Asli communities, particularly for combating parasitic diseases, through the instigation of WHO-HVI at village, community and district levels and increased interaction with government deliverables, will be a reality, which will enable the Orang Asli to assert the recognition of their rights as a people, and with it, the delivery of a more sensitive and effective healthcare system.

REFERENCES

Adams, V.J., Lombard, C.J., Dhansay, M.A., Markus, M.B. & Fincham, J.E. (2004). Efficacy of albendazole against the whipworm *Trichuris trichiura*: a randomised, controlled trial. *South African Medical Journal* **94:** 972–976.

Albonico, M., Ramsan, M., Wright, V., Jape, K., Haji, H.J., Taylor, M., Savioli, L. & Bickle, Q. (2002). Soil-transmitted nematode infections and mebendazole treatment in Mafi a Island schoolchildren. *Annals of Tropical Medicine and Parasitology* **96**: 717–726.

Al-Mekhlafi, H.M.S., Azlin, M., Nor Aini, U., Shaik, A., Sa'iah, A., Fatmah, M.S., Ismail, M.G., Firdaus Ahmad, Aisah, M.Y., Rozlida, A.R. & Norhayati, M. (2005). Protein-energy malnutrition and soil-transmitted helminthiases among Orang Asli children in Selangor, Malaysia. *Asia Pacific Journal of Clinical Nutrition* **14**: 188-194.

Al-Mekhlafi, M.S., Azlin, M., Nor Aini, U., Shaikh, A., Sa'iah, A., Fatmah, M.S., Ismail, M.G., Firdaus, M.S., Aisah, M.Y., Rozlida, A.R. & Norhayati, M. (2006). Prevalence and distribution of soil-transmitted helminthiases among Orang Asli children living in peripheral Selangor, Malaysia. *Southeast Asian Journal of Tropical Medicine and Public Health* **37**(1): 40-47.

Al-Mekhlafi, H.M.S., Atiya, A.S., Lim, Y.A.L., Mohammed Mahdy, A.K., Wan Ariffin, W.A. & Johari Surin. (2007a). An unceasing problem: soil-transmitted helminthiases in rural Malaysian communities. *Southeast Asian Journal of Tropical Medicine and Public Health* **38:** 998-1008.

Al-Mekhlafi, M.H., Azlin, M., Nor Aini, U., Shaik, A., Sa'iah, A. & Norhayati, M. (2007b). Prevalence and predictors of low serum retinal and hypo-albuminaemia among children in rural Peninsular Malaysia. *Transaction of the Royal Society of Tropical Medicine and Hygiene* **101:** 1233-1240.

Al-Mekhlafi, M.S., Surin, J., Atiya, A.S., Ariffin, W.A., Mahdy, A.K. & Abdullah, H.C. (2008a). Current prevalence and predictors of protein-energy mal-nutrition among schoolchildren in rural Peninsular Malaysia. *Southeast Asian Journal of Tropical Medicine and Public Health* **39**(5): 922-931.

Al-Mekhlafi, M.H., Surin, J., Atiya, A.S., Ariffin, W.A., Mohammed Mahdy, A.K. & Che Abdullah, H. (2008b). Pattern and predictors of soil-transmitted helminth reinfection among aboriginal schoolchildren in rural Peninsular Malaysia. *Acta Tropica* **107:** 200–204.

Baer, A. (1999). *Health, Disease and Survival: A biomedical and genetic analysis of the Orang Asli of Peninsular Malaysia*. Center for Orang Asli Concerns, Subang Jaya, Malaysia.

Bennett, A. & Guyatt, H. (2000). Reducing intestinal nematode infection: efficacy of albendazole and mebendazole. *Parasitology Today* **16**: 71–74.

Bisseru, B. & Abdul Aziz, A. (1970). Intestinal parasites, eosinophilia, haemoglobin and gamma globulin of Malay, Chinese and Indian schoolchildren. *Medical Journal of Malaya* **25:** 29-33.

Bolton, J.M. (1973a). Family centered hospital treatment in the aboriginal people of West Malaysia. *Community Health* **5:** 70-74.

Bolton, J.M. (1973b). A training-oriented medical programme in West Malaysian aboriginals. *Medical Journal of Australia* **2:** 1122-1125.

Bundy, D.A.P., Kan, S.P. & Rose, R. (1988). Age-related prevalence, intensity and frequency distribution of gastrointestinal helminth infection in urban slum children from Kuala Lumpur, Malaysia. *Transaction of the Royal Society of Tropical Medicine and Hygiene* **82:** 289-294.

Chan, L., Kan, S.P. & Bundy, D.A. (1992). The effect of repeated chemotheraphy on the prevalence and intensity infection of *Ascaris lumbricoides* and *Trichuris trichiura*. *Parasitology* **104:** 371-377.

Chee, H.L. (1995). Health and nutrition of the Orang Asli. The need for primary health care amidst economic transformation. In: *Indigenous minorities of Peninsular Malaysia; Selected issues and Enthnographies* (Editor, R. Rashid) INAS Kuala Lumpur.

Che Ghani, B.M. & Oothuman, P. (1991). Patterns of soil-transmitted helminth infection in relation to types of water supply, housing facilities and availability of latrines in rural area of Peninsular Malaysia. In: *Collected papers on the control of soil-transmitted helminthiasis Vol V* (Editors, M. Yokogawa, *et al.*) 64-71. APCO, Tokyo.

Dissanaike, A.S., Kan, S.P., Vijayamma, T. & Ong, H.T. (1977). Studies on parasitic infections in Orang Asli (Aborigines) in Peninsular Malaysia. *Medical Journal of Malaysia* **32:** 48-55.

Dunn, F.L. (1972). Intestinal parasites in Malayan aborigines (Orang Asli). *WHO Bulletine* **46:** 99-113.

George, J. & Ow Yang, C.K. (1982). Prevalence of soil transmitted helminths in school children in the Federal Territory of Malaysia. *Medical Journal of Malaysia* **37:** 11.

Ghani, M.K.A., Kasim, S., & Lai, K. (2002). Protozoan infection amongst the Orang Asli (aborigines) community in Pangsoon, Malaysia. *International Medical Journal* **8:** 15-18.

Hakim, S.L., Gan, C.C., Malkit, K., Azian, M.N., Chong, C.K., Shaari, N., Zainuddin, W., Chin, C.N., Sara, Y. & Lye, M.S. (2007). Parasitic infections among Orang Asli (aborigine) in the Cameron Highlands, Malaysia. *Southeast Asian Journal of Tropical Medicine and Public Health* **38:** 415-419.

Hamimah, I., Zahedi, M. & Ainiyah, J. (1982). The prevalence of intestinal parasites among children at the General Hospital, Kuala Lumpur, Malaysia. *Medical Journal of Malaysia* **37:** 373-377.

Hanjeet, K., Lai, K.P.F., Mathias, R.G. & Ow Yang, C.K. (1991). Soil transmitted helminthiases in squatter populations around Kuala Lumpur by ethic distribution. *Tropical Biomedicine* **8:** 33-37.

Harrison, M. (2001). Healthcare Decisions Among Semelai Women of Malaysia, Honours thesis, Hanover, NH: Dartmouth College.

Heyneman, D., Ramachandran, C.P., Balasingam, E. & Umathevy, T. (1967). A combined parasitology survey III. Preliminary observation on intestinal parasitism in the island population. *Medical Journal of Malaya* **2:** 265-268.

Howard, G., Bogh, C., Goldstein, G., Morgan, J., Prüss, A., Shaw, R. & Teuton, J. (2002). Healthy Villages. A guide for communities and community health workers. World Health Organization. Geneva.

Jabatan Hal Ehwal Orang Asli (2004). Data Maklumat Asas.

Jabatan Hal Ehwal Orang Asli (2005). Pelan Tindakan Kesihatan Masyarakat Orang Asli. Kuala Lumpur: Jabatan Hal Ehwal Orang Asli.

Kan, S.P. (1982). Soil transmitted helminthiases in Selangor Malaysia. *Medical Journal of Malaysia* **37:** 180-190.

Kan, S.P. (1984). Soil transmitted helminthiases among Indian primary school children in Selangor, Malaysia. *Medical Journal of Malaysia* **39:** 143-147.

Kan, S.P. (1989). Soil transmitted helminthiases among inhabitants of an oil palm plantation in West Malaysia. *Journal of Tropical Medicine and Hygiene* **92:** 263-269.

Kan, S.P. & Poon, G.K. (1987). Prevalence, distribution and intensity of soil transmitted helminthiases among Malaysian children. *Public Health* **101:** 243-251.

Karim, R., Rahman, N., Khairul Anuar, A., Mehdi, R. & Abdullah, B. (1995). Parasitic infections in the aboriginal community at Temenggor, Hulu Perak, Malaysia. *Malayan Nature Journal* **48:** 425-432.

Khairul Anuar, Ramachandran, C.P. & Paran, T.P. (1978). Parasitic disease among fishermen living on Penang Island. *Medical Journal of Malaysia* **32:** 321-327.

Khor, G.L. (1988). Malnutrition among Semaian Children. *Medical Journal of Malaysia* **43:** 318-326.

Li, C.F. (1990). Hookworm infection and protein energy malnutrition: transverse evidence from two Malaysian ecological groups. *Tropical and Geographical Medicine* **42:** 8-12.

Lie, K.J. (1964). Prevalence of intestinal helminths among patients of the General Hospital in Kuala Lumpur. *Tropical and Geographical Medicine* **16:** 229-237.

Lie, K.J., Kwo, E.H. & Ow Yang, C.K. (1971). Soil transmitted helminths in rural infants and children near Kuala Lumpur. *Southeast Asian Journal of Tropical Medicine and Public Health* **2:** 196-200.

Lo, E.K., Varughese, J., Ghouse, A. & Noor, M. (1979). Helminthiases in Penisular Malaysia – Prevalence and density of infestation of hookworm, *Ascaris* and *Trichuris* in rural school children. *Medical Journal of Malaysia* **34:** 95-99.

Mahendra, R.S., Sein, K.T., Khairul Anuar, A. & Mustaffa, B.E. (1997). Effect of intestinal helminthiases on school attendance by early primary school children. *Transaction of the Royal Society of Tropical Medicine and Hygiene* **91:** 131-132.

Menon, B.S., Abdullah, M.S., Mahamud, F. & Singh, B. (1999). Intestinal parasites in Malaysian children with cancer. *Journal of Tropical Pediatrics* **45:** 241-242.

Ministry of Rural and Regional Development Malaysia (2005). The development of the Orang Asli community in Peninsular Malaysia: The way forward. Paper presented in the International Conference on the Indigenous People 2005; 4-5 July; Legend Hotel, Kuala Lumpur.

Mohd Sham, K. (1996). Nutritional status of Orang Asli (aborigines) children in the resetttled village in Pangsoon, Hulu Langat, Selangor, Malaysia. *Journal Children's Health* **8:** 31-37.

Mohd Tap, S. (1990). An examination of development planning among the rural Orang Asli of west Malaysia. PhD thesis, University of Bath.

Nawalinski, T. & Roundy, L. (1978). Intestinal parasitism in a kampun on Pulau Pangkor, West Malaysia. *Southeast Asian Journal of Tropical Medicine and Public Health* **3:** 440-451.

Nevin, H.M. (1938). Ipoh Branch Laboratory. Health Survey. Report Institute for Medical Research Federated Malay States for 1937. 145-148.

Noor Hayati, M.I., Sano, M.I., Mohammod, C.G., Norhayati, M., Rohani, A.K. & Halimah, A.S. (1998). Infeksi parasit usus pada masyarakat Orang Asli di Pos Piah, Sungai Siput (U), Perak. Proc. 2nd National Health Science Symposium, 72-78.

Nor Aini, U., Al-Mekhlafi, H.M.S., Azlin, M., Shaik, A., Sa'iah, A., Fatmah, M.S., Ismail, M.G., Firdaus Ahmad, Aisah, M.Y., Rozlida, A.R. & Norhayati, M. (2004). Iron deficiency anaemia as an adjunct to soil-transmitted helminthiasis among Orang Asli children in Selangor, Malaysia. *Asia Pacific Journal of Clinical Nutrition* **13 (Suppl):** S124.

Norhayati, M., Noor Hayati, M.I., Oothuman, P., Fatmah, M.S., Zainudin, B. & Fatimah, A. (1995). Nutrient intake and socio-economic status among children attending health exhibition in Malaysian rural villages. *Medical Journal of Malaysia* **50:** 382-389.

Norhayati, M., Zainudin, B., Mohammod, C.G., Oothuman, P., Azizi, O. & Fatmah, M.S. (1997). The prevalence of *Trichuris*, *Ascaris* and hookworm infection in Orang Asli children. *Southeast Asian Journal of Tropical Medicine and Public Health* **28:** 161-168.

Norhayati, M., Fatmah, M.S., Yusof, S. & Edariah, A.B. (2003). Intestinal parasitic infection in man: A Review. *Medical Journal of Malaysia* **58:** 296-305.

Oothuman, P., Noor Hayati, M.I., Mohammod, C.G., Norhayati, M. & Kannapan, P. (1995). Prevalence and reinfection of intestinal helminthiases among school children in an estate. *Tropical Biomedicine* **12:** 159-164.

Osman, A. & Zaleha, M.I. (1995). Malnutrition status of women and children in Malaysian rural populations. *Asia Pacific Journal of Clinical Nutrition* **4:** 319 – 324.

Polunin, I. (1953). The Medical Natural History of Malayan Aborigines. *Medical Journal of Malaya* **8:** 55-174.

Rahmah, N., Ariff, R.H., Abdullah, B., Shariman, M.S., Nazli, M.Z. & Rizal, M.Z. (1997). Parasitic infections among aborigine children at Post Brooke, Kelantan, Malaysia. *Medical Journal of Malaysia* **52:** 412-414.

Rahman, W.A. (1998). Helminthic infections of urban and rural schoolchildren in Penang Island, Malaysia: implication for control. *Southeast Asian Journal of Tropical Medicine and Public Health* **29:** 596-598.

Rajeswari, B., Sinniah, B. & Hussein, H. (1994). Socioeconomic factor associate with intestinal parasites among children living in Gombak, Malaysia. *Asia Pacific Journal of Health* **7:** 21-25.

Russel & Paul, F. (1934). Racial and age-group incidence of common intestinal helminths in the Straits Settlements. *Malayan Medical Journal* **9:** 196-200.

Sandosham, A.A. (1953). Worm infections of some Malaysian aborigines. Studies from the Institute For Medical Research Federated Malaya, No. 26, 210-211.

Sinniah, B. (1984). Intestinal protozoan and helminth infections and control of soil transmitted helminths in Malay school children. *Public Health* **98:** 152-156.

Sinniah, B., Manmohan, S. & Poon, G.K. (1978). Prevalence of parasitic infection in Malaysian oil plam estate workers. *Southeast Asian Journal of Tropical Medicine and Public Health* **9:** 272-276.

Zahedi, M., Oothuman, P., Sabapathy, N.N. & Bakar, N.A. (1980). Intestinal nematode infections and efficacy study on oxantel-pyrantel pamoate among plantation workers. *Medical Journal of Malaysia* **35:** 31-37.

Zulkifli, A., Khairul, A.A., Atiya, A.S. & Yano, A. (1999). Malnutrition and helminth infections among pre-school children in Orang Asli resettlement villages in Kelantan. *JUMMEC* **2:** 99-103.