

INTESTINAL PARASITIC INFECTION AMONG FIVE INTERIOR COMMUNITIES AT UPPER REJANG RIVER, SARAWAK, MALAYSIA

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Abstract. Intestinal parasitic infection among five interior communities at Bakun Valley, upper Rejang River, Sarawak, Malaysia, was investigated as part of a public health impact assessment of the proposed US\$ 3 billion Bakun Hydroelectric Project. Coproparasitological examination of 355 stool samples from 7 of 16 villages representing 5 of 7 tribes in the area revealed infection rate of 41%. A higher infection rate was found among the settled Kayans (56%) than the semi-nomadic Penans (29%). Infection rate was high (68%) among children less than 14 years old. *Trichuris trichiura* accounted for more than 90% of all infections; less common were *Ascaris lumbricoides*, hookworms and *Strongyloides stercoralis*. Polyparasitism was found in 8% of the individuals surveyed with dual infection due to *T. trichiura* and *A. lumbricoides* being more common than dual infection with *T. trichiura* and hookworm. Women had higher infection rates (57%) than men (33%).

INTRODUCTION

Intestinal parasitic infection is common with an estimated 3 billion people infected worldwide (Bundy, 1997; WHO, 2000). It is a major public health problem in Southeast Asia particularly among poor children living in urban squats and rural communities (Bundy *et al*, 1992; Chan, 1997). In Malaysia, intestinal parasitic infection is endemic among these groups (Sinniah, 1984; Rajeswari *et al*, 1994). High infection rates are associated with high human population density, low socio-economic status, inadequate supplies of clean water, insanitary disposal of feces and larger families (Rajeswari *et al*, 1994). Infection distribution in a community follows a negative binomial pattern: although everybody is susceptible, most individuals are uninfected or have low infection intensity, whilst only a small proportion carry a heavy parasite load (Bundy *et al*, 1992).

In Sarawak, earlier studies found infection rates ranging from 65-97% among the rural Ibans, nomadic Penans and coastal Malays (Anderson, 1978; Neo *et al*, 1987). This study attempted to determine the prevalence and distribution of intestinal parasitic infection among the interior communities at Bakun Valley, upper Rejang River, as part of a public health impact assessment of the proposed US\$3 billion Bakun Hydroelectric Project.

MATERIALS AND METHODS

The Bakun hydroelectric Project at Bakun Valley, upper Rejang River, Sarawak, Malaysia, will result in the flooding of approximately 70,000 hectares. The seven interior tribes (Kayan, Kenyah, Punan, Kajang, Badang, Ukit and Penan) from 16 villages (Murun, Linau, Sah A, Liko, Dupah, Belanoi, Sah B, Batu Kalo, Batu Keling, Bulan, Jawe, Pangai, Belangan, Ayak, Geng and Lesong Laku) inhabiting the area will need to be resettled

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(Sagin *et al*, 2000). Seven of the longhouses were selected for this study as they are near representation of 5 of the 7 interior tribes in the area (Sagin *et al*, 2001). The villages were visited and the villagers briefed on the purpose of the study: those consenting to take part in the study were told how to collect a stool sample. Samples were processed and fixed with 10% formalin; coproparasitological examination was conducted at the Central Medical Laboratory, Kuching, Sarawak, using a standard formalin-ether concentration technique.

RESULTS

Coproparasitological examination of 355 stool samples taken from a cross-section of the interior communities detected the presence of one or more intestinal parasites in 41% of the individuals surveyed (Table 1). The commonest intestinal parasite found was *T. trichiura* (>90%). Less common were *Ascaris lumbricoides*, hookworms, *Giardia lamblia* and *Hymenolepis nana*. Polyparasitism was found in 8% of infected individuals: dual infection due to *T. trichiura* and *A. lumbricoides* was more common than dual infection with *T. trichiura* and hookworm. High infection rates

were found among the villagers of Long Linau (56%), Long Murun (41%) and Long Pangai (33%). Analysis of the infection data showed that the Kayan communities had the highest infection rate (56%), compared with the Kajangs (33%) and the Penans (29%).

A. lumbricoides was common among Penan while *T. trichiura* was the predominant intestinal parasite among the Kayans; hookworm infection was higher among the Kajangs than among the other tribes. High infection rates were found in children (Table 2). Polyparasitism was significantly more common in pre-school children than in any other age group. Among children 6-14 years old, *A. lumbricoides* was more common than in pre-schoolers. The infection rate among women (female >14 yrs old) was greater than that among men (male >14 yrs old): 57% compared with 33%.

DISCUSSION

In a previous survey, it was reported that 68% of the interior tribes surveyed, were infected with various intestinal parasites (Lai, 1992). The present study showed that the infection rate has decreased to 41%. The ob-

Table 1
Intestinal parasitic infection in five Orang Ulus villages in Bakun Valley, upper Rejang River, Sarawak, Malaysia.

Longhouse (Tribe)	No. of stool samples (%) positive for intestinal parasites ^a						
	T	A	H	Others	T+A	T+H	Total
Murun (Kayan) (n=152)	60 (39)	9 (6)	1 (1)	5 (3)	8 (13)	0 (0)	62 (41)
Sah "A" (Kayan) (n= 62)	8 (13)	0 (0)	5 (8)	0 (0)	1 (1)	2 (3)	11 (18)
Linau (Kayan) (n=90)	48 (53)	9 (10)	3 (3)	2 (2)	8 (9)	2 (2)	50 (56)
Ayak (Ukit) (n=7)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)
Laku (Penan) (n=24)	4 (17)	5 (21)	0 (0)	0 (0)	2 (8)	0 (0)	7 (29)
Sah "B" (Kenyah) (n=7)	2 (29)	1 (14)	2 (29)	1 (15)	0 (0)	2 (29)	3 (43)
Pangai (Kajang) (n=42)	8 (19)	0 (0)	5 (12)	1 (2)	0 (0)	3 (7)	14 (33)
Total (N=355)	130 (37)	24 (7)	17 (5)	9 (3)	20 (6)	9 (3)	144 (41)

^aThe common intestinal parasites are *Ascaris lumbricoides* (A), *Trichuris trichiura* (T) and hookworm (H). Polyparasitism due to *T. trichiura* and *A. lumbricoides* (T+A) was more common than infection with *T. trichiura* and hookworm (T+H).

Table 2
Intestinal parasitic infection in Bakun Valley, upper Rejang River, Sarawak, Malaysia
by age group and sex.

Group	No. of individuals (%) infected by :							Total
	T	A	H	G ^b	Hn ^c	T+A	T+H	
Children <6 yrs (n=35)	20 (57)	1 (3)	1 (3)	2 (6)	1 (3)	7 (20)	0 (0)	24 (68)
Children 6-14 yrs (n=62)	29 (47)	10 (16)	1 (2)	0 (0)	0 (0)	1 (2)	0 (0)	40 (65)
Male >14 yrs (n=119)	25 (21)	6 (5)	6 (5)	2 (2)	0 (0)	1 (1)	2 (2)	39 (33)
Female >14 yrs (n=114)	50 (44)	9 (8)	5 (4)	1 (1)	0 (0)	1 (1)	4 (4)	65 (57)
Total (N=330) ^a	124 (38)	26 (8)	13 (4)	5 (2)	1 (0.3)	10 (6)	6 (3)	168 (51)

Polyparasitism was detected in 8% of the individuals surveyed. Only two individuals (30 yrs, M; 11 yrs, M) were co-infected by three intestinal parasites. Fifteen individual were excluded as their age or sex was not stated (^a).

^b*Giardia lamblia*; ^c*Hymenolepis nana*.

served decrease in the infection rate is suspected to be associated with the general improvement in the health status of the people. Better and more accessible health care facilities are now available compared with a decade ago. Health care services to remote villages are provided by the regular flying doctor service. Additional improvements in basic health facilities included gravity-fed piped water (80%) and pour-flush latrines (78%). The socio-economic status of the local people has been improved by various commercial forestry activities, which have provided employment opportunities, and decreased the population density of the crowded villages, by housing workers in living quarters at the logging camps.

The infection rates in Bakun were compared with those found in the more developed rural areas of Sarawak. A study of schoolchildren in three primary and two secondary schools in Serian district, found an infection rate of 33.6% (Lee *et al*, 1999); in contrast, a retrospective study in Kuching, involving five defined groups: in-patients (n = 7,285), out-patients (n = 932), soldiers (n = 253), tuberculosis patients (n = 65) and student nurses and medical assistants (n = 163), found an infection rate of 16% (Sagin, unpublished data). That the infection rate among the indigenous remote interior tribes in Bakun Valley is high is not surprising as high infection rates have been

reported amongst indigenous tribes living in remote rural communities in Brazil and Puerto Rico (Hillyer *et al*, 1990; Ferrari *et al*, 1992; Scolari *et al*, 2000).

The observation that *T. trichiura* is the commonest intestinal parasite in rural Bakun Valley is consistent with previous studies in Kuala Lumpur, Malaysia, which showed that trichuriasis is more common among rural subjects, while ascariasis and trichuriasis were common among squatters (Sinniah, 1984; Rajeswari *et al*, 1994). These data suggest that trichuriasis and ascariasis are associated with rural and urban infection respectively.

The higher infection rate among the Kayans of Long Linau (56%) and Long Murun (41%), compared with the semi-nomadic Penans of Lesong Laku (29%) is surprising as a previous study had found a 69% infection rate among the nomadic Penans of Mulu area, Sarawak (Anderson, 1978). The availability of a health clinic at the Penan village and at Long Linau, suggests that the differences in infection rates may be associated with the higher population density, and the poorer environmental sanitation at Long Murun and Long Linau. Variation in infection rate among the villages indicates that although everybody is susceptible to infection, villagers in each village have varying degrees of re-exposure and re-infection risk.

The present data should not be interpreted as an indication of a direct association between ethnicity and intestinal parasitic infection. High infection rates may instead be associated with population density, environmental sanitation and general lifestyle in the villages (Rajeswari *et al.* 1994): this possibility is supported by the differences in infection rates among the Kayans of Long Murun (41%), Long Linau (56%) and Long Sah A (18%) - Long Sah A has a much lower population density.

The high infection rate among children (65%) found in this study is consistent with various studies in other countries such as Brazil, Puerto Rico, Chile and Mali (Ferrari *et al.*, 1992; 1994; Oberg *et al.*, 1993; Hillyer *et al.*, 1999; Behnke *et al.*, 2000). The infection rate in Bakun is however much lower compared with the marginalized children of Indonesian immigrants (90%) and Orang Asli (79%) living in urban squats and rural areas in West Malaysia (Rajeswari *et al.*, 1994). An important factor that could result in a high infection rate among children is poor environmental sanitation leading to higher re-exposure and re-infection (Ferreira *et al.*, 1994).

Heavy intestinal parasitic infection in childhood can result in growth retardation and may compromise cognitive development (Hlaing, 1993; WHO, 2000). As *T. trichuria* caused >90% of all infection and was a co-infection in > 80% of cases and, as the high-risk groups are children < 14 years old, helminth control measures should be directed towards these children. In rural areas, effective control measures must involve active community participation particularly at the primary school level rather than at village level as there are always more schools than health centers and more teachers than health workers. It is recommended that at least 75% of all school-age children at risk of morbidity be regularly treated (WHO, 2000).

The observation that among adults, women have a higher infection rate (57%) than men (33%) suggests a correlation between sex and intestinal parasitic infection. This difference may be due to higher exposure, increased

susceptibility, behavioral or occupational factors or the superimposition of several random dispersal factors or some unknown genetic, cultural or other spatial reason (Oberg *et al.*, 1993). Considering cultural factors, women are responsible for child-rearing and are in contact with children's feces: given that infection is high in children, transmission could have occurred from children to their mothers rather than *vice versa*. Children probably acquired the infection from other children.

The observation that the prevalence and distribution of infection is high in villages with high population density suggests that human population density is a significant factor in intestinal parasitic infection. High population density has the potential to increase the risk of environmental seeding and re-exposure, particularly in the riverside setting of the villages where environmental sanitation standards are poor.

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