
Parasitic infections among Southeast Asian labourers in Taiwan: a long-term study

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SUMMARY

Parasitic infections have been reported to be relatively common among the Southeast Asian labourers in Taiwan. This study, conducted in 1992–6, was designed to determine the temporal changes of the prevalence. Faecal specimens were examined by the formalin–ethyl acetate sedimentation technique and blood samples screened using the quantitative buffy coat technique and confirmed by Giemsa stained blood smear. The overall prevalence of intestinal parasitic infections was 10·3%. The annual prevalence decreased from 33·3% in 1992–3 to 4·6% in 1995–6. The Thai (12·0%) and Indonesian (11·1%) had a higher prevalence than the Malaysian (6·7%) and Filipinos (5·9%). *Opisthorchis viverrini* was the most important parasite in the Thai and *Trichuris trichiura* in the remaining groups. Moreover, no blood parasites were found in the labourers. The dramatic temporal decline in the intestinal parasitic infections suggests that limiting the entry of infected persons, periodic follow-ups, and immediate treatment of sporadic cases are necessary in preventing transmission of non-indigenous parasites through large population change.

INTRODUCTION

The introduction of labourers from Southeast Asian countries relieves the shortage of labourers in Taiwan. However, this large population change also causes an enormous impact on the health of the local population, since parasitic infections and other infectious diseases are very common in these tropical countries. According to a survey in 1991–2, 18% of Thai labourers in Taiwan were infected with one or more species of intestinal parasites [1].

In addition to the Thai, many labourers came from the Philippines, Indonesia, and Malaysia. In Thailand, hookworms and *Opisthorchis viverrini* are highly prevalent in the rural areas [2, 3]. Soil-transmitted nematode infections are highly prevalent in the rural populations of the Philippines, Indonesia and Malaysia [4–7]. Moreover, schistosomiasis is endemic

in some areas of Central and the Southern Philippines and more than 2000 cases of capillariasis have been reported in Northern Luzon [4]. High prevalences of intestinal parasitic infections have also been reported among Indonesians (71%) and Filipinos (74%) working in Japan [8] and Thai workers (74%) in Israel [9]. Asian female housekeepers in Saudi Arabia had a prevalence of 46·5% [10]. Malaria remains an endemic disease in these countries, although the infection concentrates in certain areas [11].

In Taiwan, soil-transmitted nematode infections are limited to the mountainous and remote areas [12]. Food-borne parasitic zoonoses are confined to some ethnic groups [13, 14]. Moreover, malaria had been eradicated for more than 30 years [15]. However, the subtropical climate and suitable environmental conditions maintain a considerable number of potential vectors and intermediate hosts of various parasites throughout the island [16, 17]. It is not

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impossible that the mosquito-borne and snail-transmitted parasitic infections spread in Taiwan through the Southeast Asian labourers.

Every alien labourer staying in Taiwan is required to pass health examinations before entry, within 3 days after entry, after every 6 months of employment, and before applying for contract extension. The items of examination include general physical check-up, chest roentgenography, serological tests for human immunodeficiency virus antibody, syphilis, and hepatitis B surface antigen, blood and faecal examinations for parasites, pregnancy test, and urine analysis for morphine and amphetamine. Moreover, labourers who fail in passing all the examination items after entry will be deported immediately. However, the prevalence of intestinal parasitic infections among the Southeast Asian labourers in Taiwan has been reported to be around 17% before 1994 [1, 18, 19]. In order to understand the temporal changes in the parasitic infections among the Southeast Asian labourers, we have conducted a continuous study since 1992.

MATERIALS AND METHODS

Study population

This study was carried out between July 1992 and June 1996. The study population was the Southeast Asian labourers participating in the health examination at Chang-Gung Memorial Hospital (a medical centre) and Ming-Sheng Hospital (a district hospital) in Tao-Yuan County, North Taiwan. They either immediately arrived at Taiwan (entry examination) or had been staying here for more than 6 months (follow-up examination).

Faecal examination

A faecal specimen was collected from each labourer in a 25-ml plastic container. These specimens were examined for eggs, larvae, or cysts of intestinal parasites by formalin-ethyl acetate sedimentation [20]. In order to ensure the quality of examination, each specimen was examined by two experienced research assistants for more than 5 min. In addition, the age, sex, and nationality of labourers were recorded.

Blood examination

At Chang-Gung Memorial Hospital, blood specimens were also obtained from the labourers by

venepuncture into EDTA tubes. These specimens were screened for blood parasites by the quantitative buffy coat (QBC) technique [21]. The results were confirmed by microscopic examination of two thin and two thick Giemsa stained smears prepared with $60.0 \pm 5.0 \mu\text{l}$ of blood [20].

Statistical analysis

Rates were compared by the Chi-square test. $P < 0.05$ was considered to be statistically significant.

RESULTS

Of 11 403 Southeast Asian labourers examined, 1169 (10.3%) were found to be infected with 1–3 species of intestinal parasites: single infection 9.1%, double infection 1.0%, and triple infection 0.2%. However, there was a significant reduction in the prevalence from 33.3% in 1992–3 to 4.6% in 1995–6 ($P < 0.001$). Results of the entry and follow-up examinations had similar decreasing trends. In 1993–4, the entry prevalence was significantly higher than the follow-up prevalence ($P < 0.001$). However, no significant differences were found in the subsequent years ($P > 0.05$) (Table 1).

Among the labourers examined, 7670 (67.3%) were Thai, 2669 (23.4%) Filipinos, 570 (5.0%) Indonesian, and 494 (4.3%) Malaysian. The prevalence of intestinal parasitic infections was significantly higher in the Thai (12.0%) and Indonesian (11.1%) than the Malaysian (6.7%) and Filipinos (5.6%) ($P < 0.001$). The annual changes in the prevalence among these four groups are shown in Figure 1. The prevalence decreased significantly from 41.6% in 1992–3 to 4.2% in 1995–6 in the Thai, from 18.5 to 4.9% in the Filipinos, and 11.7 to 2.4% in the Malaysian ($P < 0.001$). However, there was no significant change in the prevalence among the Indonesian, although it increased from 10.7% in 1993–4 to 14.6% in 1994–5 and then decreased to 9.4% in 1995–6 ($P > 0.05$).

Table 2 shows the annual changes of the prevalence in the two sexes. Although the overall prevalence in males (11.2%) was significantly higher than that in females (7.1%) ($P < 0.001$), no significant sexual differences were found in the last 2 years. Moreover, there was a decreasing trend in the prevalence by age ($P < 0.001$) (Table 3).

Fifteen species of intestinal parasites were found in the labourers. Thai labourers had 13 species and *O. viverrini* had the highest prevalence. The Filipino also had 13 species, the Indonesian had 8 species, and the

Table 1. Annual changes in the prevalence of intestinal parasitic infections among Southeast Asian labourers at arrival (entry examination) and after staying in Taiwan for more than 6 months (follow-up examination)

Year*	Entry examination		Follow-up examination		Total	
	No. exam.	No. (%) pos.	No. exam.	No. (%) pos.	No. exam.	No. (%) pos.
1992-3	793	33.3			793	33.3
1993-4	1413	15.8	1642	11.0	3055	13.2
1994-5	909	9.6	2304	9.4	3213	9.4
1995-6	830	3.5	3512	4.9	4342	4.6
Overall	3945	15.1	7458	7.7	11403	10.3

* From July to June.

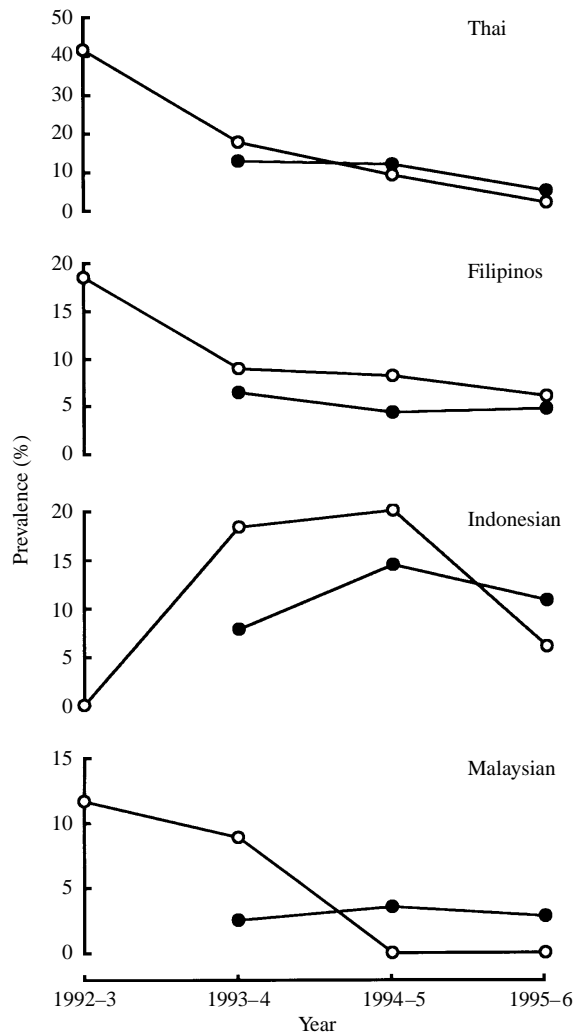


Fig. 1. Annual variation in the prevalence of intestinal parasitic infections among the four groups of Southeast Asian labourers in Taiwan at entry (○) and follow-up (●) examinations.

Table 2. Sexual difference in the prevalence of intestinal parasitic infections among Southeast Asian labourers in Taiwan

Year	Male		Female	
	No. exam.	% pos.	No. exam.	% pos.
1992-3	695	36.8	9.8	8.2
1993-4	2467	13.9	588	10.2
1994-5	2282	9.7	931	8.5
1995-6	3200	4.7	1142	4.4

* From July to June.

Table 3. Age-specific prevalence of intestinal parasitic infections among Southeast Asian labourers in Taiwan

Age group (years)	No. exam.	% pos.
20-30	7901	11.3
31-40	3112	8.0
> 40	390	7.7

Malaysian had 7 species. *Trichuris trichiura* was the most important species in the latter three groups (Table 4).

Figure 2 shows the changes in the prevalence of six important intestinal parasitic infections among the labourers. *O. viverrini/Clonorchis sinensis* infection decreased from 21.1% in 1992-3 to 1.0% in 1995-6, *Strongyloides stercoralis* from 8.6 to 0.8%, hookworm from 6.3 to 0.4%, *T. trichiura* from 2.3 to 0.5%, *Giardia lamblia* from 3.0 to 0.7%. However, *Entamoeba coli* infection increased from 0.5 to 1%.

Blood specimens from 2075 labourers were also examined. No parasites were found in these specimens.

DISCUSSION

Although Southeast Asian labourers working in Taiwan are required to pass a series of health examinations, 33.3% of them were found to harbour one or more intestinal parasites at the beginning of this study. This finding indicates that intestinal parasitic infections were generally neglected. However, this high prevalence aroused the attention of our government. Since then, labourers with any pathogenic parasite at the entry examination are deported immediately. Those with positive results at the follow-up examination receive treatment in the cost of their labour insurance. This change in policy leads to the

Table 4. Parasite-specific prevalence among Southeast Asian labourers in Taiwan

Parasite	Thai (n = 7670)		Filipinos (n = 2669)		Indonesian (n = 570)		Malaysian (n = 494)		Overall (n = 11403)	
	No. pos.	% pos.	No. pos.	% pos.	No. pos.	% pos.	No. pos.	% pos.	No. pos.	% pos.
<i>Opisthorchis viverrini/Clonorchis sinensis</i>	538	7.0	9	0.3	3	0.5	7	1.4	557	4.9
<i>Strongyloides stercoralis</i>	175	2.3	10	0.4	10	1.8	4	0.8	199	1.7
<i>Giardia lamblia</i>	97	1.3	19	0.7	14	2.5	10	2.0	140	1.2
Hookworms	120	1.6	23	0.9	5	0.9	4	0.8	152	1.3
<i>Entamoeba coli</i>	75	1.0	35	1.3	13	2.3	1	0.2	124	1.1
<i>Trichuris trichiura</i>	14	0.2	49	1.8	27	4.7	12	2.4	102	0.9
<i>Fasciolopsis buski</i>	6	0.1	3	0.1	0	0	0	0	9	0.1
Heterophid	8	0.1	0	0	0	0	0	0	8	0.1
<i>Endolimax nana</i>	2	< 0.1	4	0.1	1	0.2	0	0	7	0.1
<i>Entamoeba histolytica/E. dispar</i>	1	< 0.1	4	0.1	0	0	0	0	5	< 0.1
<i>Ascaris lumbricoides</i>	0	0	1	0	1	0.2	1	0.2	3	< 0.1
<i>Taenia</i> sp.	3	< 0.1	2	0.1	0	0	0	0	5	< 0.1
<i>Echinostoma</i> sp.	3	< 0.1	1	< 0.1	0	0	0	0	4	< 0.1
<i>Hymenolepis nana</i>	1	< 0.1	0	0	0	0	0	0	1	< 0.1
<i>Schistosoma japonicum</i>	0	0	1	< 0.1	0	0	0	0	1	< 0.1

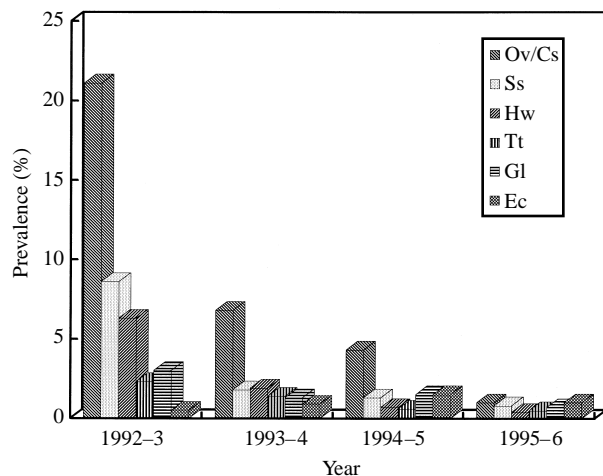


Fig. 2. Annual variation in the prevalence of *Opisthorchis viverrini/Clonorchis sinensis* (Ov/Cs), *Strongyloides stercoralis* (Ss), Hookworms (Hw), *Trichuris trichiura* (Tt), *Giardia lamblia* (Gl), and *Entamoeba coli* (Ec) infections among the Southeast Asian labourers in Taiwan.

reduction of intestinal parasitic infections in the subsequent years.

The majority of labourers were male and aged 20–40 years. However, the male:female ratio decreased from 7.1:1 to below 3:1. This change reflects the requirements of labourers in Taiwan. In early 1990s, male labourers were needed to participate in large constructions. Recently, female workers with technical skill and experience are employed to take

part in high technology manufacturing. In addition, many families employed Philippine maid servants. Most of the female labourers are urban dwellers and have higher educational level. This explains the sexual difference in the prevalence of intestinal parasitic infections. Moreover, labourers over 40 years were administrators. They might have better living conditions in their countries. Therefore, this group had a lower prevalence.

O. viverrini, the most important parasite in the Thai labourers, is endemic in northern and northeastern Thailand where people have the custom of eating raw freshwater fish (koipla). In the early 1980s, the overall prevalence was 14.6% [22]. The whole population over 10 years of age at some villages acquired the infection [23]. Moreover, it remains prevalent in this country [2, 3]. We found over 40% of Thai labourers with this infection in our pilot study in 1992. Since eggs of *O. viverrini* and *C. sinensis* are not easy to distinguish, examination of the adult worms is required in speciation [24]. Actually, misdiagnosis of *O. viverrini* had been a common problem for the laboratory personnel in Taiwan. Since we could not collect stool samples from the infected labourers after treatment, it is not possible to determine the species only based on the morphology of opisthorchiid eggs.

Clonorchiasis is now under control in Taiwan. However, snail hosts of the parasite can be found in many parts of the island. Although negative results

had been obtained by infecting *O. viverrini* to *Bithynia manchourica* [18], it is premature to draw conclusions on the susceptibility of Taiwanese snails to this trematode. On the other hand, Thai labourers is the major group and working throughout the island. It is not impossible for this non-indigenous parasite to adapt in Taiwanese snails through the infected labourers.

Soil-transmitted nematodes remain highly prevalent in the Southeast Asian countries [2–7]. In this study, *S. stercoralis* and hookworms were commonly found in the Thai and *T. trichiura* was the most important species in the Filipino, Indonesian and Malaysian. However, we revealed only three cases of ascariasis in this 4-year study. This finding indicates that many labourers may have received incomplete anthelmintic treatment just before their arrival. The observation of distorted *O. viverrini* eggs in many of our faecal specimens gives a clear evidence. In general, the dosage required to eradicate *Ascaris lumbricoides* is less than those for *T. trichiura*, *S. stercoralis*, and hookworms [25]. Therefore, *A. lumbricoides* became a rare species.

In this study, we found five male *E. histolytica*/*E. dispar* cyst-passers. Except for one cyst-passer who was revealed at arrival and deported immediately, the remaining ones were found in the follow-up examination and received chemotherapy. The same infection has also been reported in 1.2% of 5518 female Asian housekeepers in Abha District of Saudi Arabia [10] and 34 female Philippine labourers in North Taiwan [18]. Although cyst-passers are usually infected with *E. dispar* and do not have significant clinical manifestations [26], speciation should be based on appropriate biochemical, immunological, or genetic techniques [27]. Since the aetiologic agent was not known, close contact between infected female workers and the families of their employees may lead to an outbreak of invasive amoebiasis, although the chance is not high.

Schistosoma japonicum infection is endemic in the Southeast Asian countries [28]. One infected Thai has been found in a previous study [1]. In this study, another infected Filipino was detected in the follow-up examination in 1993–4. Although the Taiwan strain of *S. japonicum* has been documented to be zoophilic [29], the local oncomelanian snails are susceptible to various geographical strains of this parasite [30]. Fortunately, the finding of this infection was only sporadic. However, misdiagnosis or negligence of this parasite may have severe consequences.

In addition to stool samples, we also examined blood specimens from our teaching hospital. We limited the sample size because of insufficiency in facility and consideration of the freshness of the specimens. No positives were found, although the labourers came from endemic areas for malaria [11].

In Malaysia, children of Indonesian immigrant workers had a higher prevalence of intestinal parasitic infections (90%) than the local ethnic groups (36.4–79.5%) [7]. Moreover, intestinal parasites persist in refugees from Southeast Asian countries to North America [31, 32]. However, there is a dramatic temporal decline in the prevalence of intestinal parasitic infections among the Southeast Asian labourers in Taiwan. Improvement in the public health situations of the Southeast Asian countries may be a contributing factor. However, the results of the present study suggest that limiting the entry of infected persons, periodic follow-ups, and immediate treatment of sporadic cases, are the necessary measures in preventing transmission of non-indigenous parasites through large population change.

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