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Chronic *Strongyloides stercoralis* infection in Laotian immigrants and refugees 7–20 years after resettlement in Australia

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SUMMARY

During the period 1974–91 large numbers of Southeast Asian immigrants and refugees were resettled in Western countries, including Australia. Health screening during this period demonstrated that intestinal parasite infections were common. A cross-sectional survey of 95 Laotian settlers who arrived in Australia on average 12 years prior to the study was conducted to determine if chronic intestinal parasite infections were prevalent in this group. Twenty-three participants had positive *Strongyloides stercoralis* test results (22 with positive serology, including 1 with *S. stercoralis* larvae detected in faeces and another with larvae and equivocal serology). Of these 23 participants, 18 (78%) had an elevated eosinophil count. Two patients had eggs of *Opisthorchis* spp. identified by faecal microscopy. The detection of chronic strongyloidiasis in Laotian settlers is a concern because of the potential serious morbidity associated with this pathogen.

INTRODUCTION

The number of immigrants and refugees entering Australia from Vietnam, Cambodia and Laos in the late 1970s and 1980s increased due to conflict in Indo-China and changes in Australian immigration policy [1]. Between 1974 and 1991 approximately 150000 settlers from Southeast Asia arrived in Australia, predominantly in the states of NSW and Victoria (Fig. 1), and screening clinics were established to assess and manage their health problems [2, 3]. Approximately 50000 settlers to Victoria were screened for health problems during this period. With the exception of tuberculosis clinics, formal screening procedures were discontinued in most states by 1991 [4].

The prevalence of intestinal parasite infections in Southeast Asian settlers in Australia during this period was 33–50% [5, 6] and was also high in settlers in the United States (52–77%) [7, 8], and Canada (54%) [9]. *S. stercoralis* infection was common in people from Laos and Cambodia [5, 6, 8, 10, 11], a concern as these parasites may survive for years in the human host and eventually cause disseminated infection and death [12]. Individuals identified with *S. stercoralis* infection in Australian clinics were treated with thiabendazole [4]. The reported efficacy of thiabendazole treatment for *S. stercoralis* infection is 89–100%, but may be lower as cures are usually defined as negative faecal microscopy, which is known to be insensitive [12, 13]. Thiabendazole also causes

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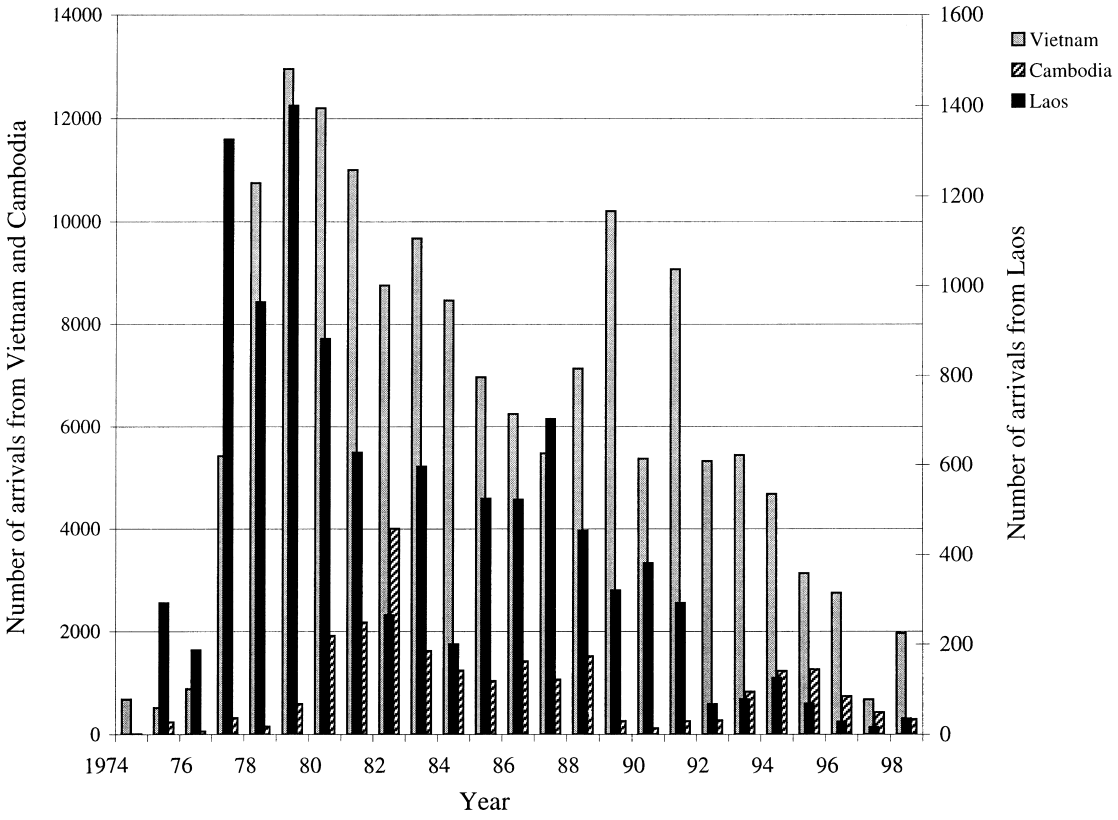

Fig. 1. Number of settlers arriving in Australia from Laos, Cambodia and Vietnam by year.

marked nausea, which may lead to poor compliance [4].

Little is known about the health status of these immigrants and refugees in the years after settlement, although a Canadian study showed that 6 years after screening and treatment, the overall prevalence of intestinal parasites in Cambodian refugees had reduced from 63·7% to 21·9% [14]. The prevalence of *S. stercoralis* had only decreased from 15% to 11% during this period, in spite of treatment with thiabendazole.

The known poor sensitivity of faecal microscopy for the diagnosis of *S. stercoralis* [12, 13] as well as possible non-compliance with treatment, led us to suspect that chronic intestinal parasite infection may be a current, although undetected, health problem in some immigrant and refugee communities in Australia. We therefore examined the prevalence of intestinal helminth infections in Laotian settlers who had arrived in Australia 7–22 years previously.

MATERIALS AND METHODS

A cross-sectional survey was conducted through a general practice in the Western suburbs of Melbourne run by a Laotian-speaking medical practitioner over a 2-week period in June 1998. English and Laotian language letters and plain language statements were sent by mail to 216 Laotian settlers aged 18 years or older recorded on the patient register of the general practice. The study was also advertised on local and community radio and in a Melbourne Laotian magazine. Ninety-five people volunteered to participate and answered a face-to-face questionnaire in the presence of an interpreter, after written informed consent was obtained. Participants were asked about social networks, knowledge of intestinal parasites, symptoms, and their preferred source of medical care. Ethics approval for the study was obtained prior to commencement from the Research and Ethics Committee of the North Western Health Care Network.

The questionnaire was initially tested on and refined by a small group of Laotian women. Univariate analyses of categorical variables derived from questionnaire and laboratory results were performed by χ^2 tests. Differences in medians of non-parametric variables were compared by the Kruskal–Wallis test. Ninety-five per cent confidence intervals for odds ratios were calculated by the method of Cornfield, using Epi Info (version 6.0) [15].

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Each participant was asked to collect a faecal sample into SAF (sodium acetate-acetic acid-formalin) fixative using a standard kit (Para-Pak, Meridian Diagnostics, Ohio). Faecal concentrates were made in commercially supplied tubes (Johns Parafilter, Selby Scientific, Clayton, Vic, Australia) using a modified formalin-ethyl-acetate procedure [16]. Slides, prepared by resuspending a small volume of faeces in normal saline and iodine, were examined and ova and parasites identified on the basis of morphology and size. Blood samples were collected into plain and EDTA tubes for serology, haemoglobin and eosinophil count estimations. Serum specimens that had been stored at −20 °C were tested for *S. stercoralis* antibodies using an enzyme-linked immunosorbent assay (ELISA) with soluble antigens from third stage *S. ratti* larvae. The sensitivity and specificity of this test are estimated to be 93% and 95% respectively [17]. An ELISA optical density (OD) value of $> 0{\cdot}5$ was considered positive, 0·3–0·5 equivocal and $< 0{\cdot}3$ negative.

Every participant was followed up, and treatment with albendazole, 400 mg twice daily for 3 days, was prescribed for those with strongyloidiasis [18].

RESULTS

Study participants

Fifty-two females and 43 males between the ages of 18 and 82 volunteered for the study. Most participants (71%, 67/95) arrived in Australia between 1980 and 1989, with 65% (62/95) aged between 20 and 39 years on arrival. The median time since resettlement in Australia was 12 years (range 7–21 years).

Eighty-three percent of participants (80/95) had heard of intestinal parasites or 'gut worms'. Of these, 75% (60/80) said they had previously had worms, while 18% (14/80) had not and 8% (6/80) were unsure. Of those who had heard of worms, 58% (46/80) did not know of any symptoms caused by worms, while 64% (51/80) did not know of any serious problems associated with worm infection. Over 50% ($n = 52$) of the study group lived in a household with five or more people.

Faecal microscopy

Eighty-seven participants provided a faecal specimen, in six of which at least one pathogen was identified by light microscopy (Table 1). None of these six participants complained of diarrhoea, abdominal pain or rash during the preceding 12 months. Two participants (one with hookworm alone and another with *Opisthorchis* infection alone) had visited Laos since settlement in Australia.

Serology results

The ELISA test for *Strongyloides* antibodies was positive in 22, equivocal in 17 and negative in 54 participants. Serology was not performed in two patients. The median age for those with positive results was 44 years (range 28–82 years) and the median time since resettlement 12 years (range 7–20 years). There was no correlation between time since resettlement and the serology result ($P = 0{\cdot}4$). One of the 22 participants with positive serology and 1 of the 17 participants with equivocal serology had *S. stercoralis* larvae detected by faecal microscopy. Although nearly half (10/22) of those with positive serology reported symptoms which may have been associated with chronic strongyloidiasis (diarrhoea, abdominal pain or rash), there was no significant difference between this group and those who had negative serology and similar symptoms. Seventeen of the 39 patients with positive or equivocal serology had travelled to Laos on at least one occasion since settlement in Australia.

Eosinophilia

Twenty-five participants (26%) had an elevated eosinophil count ($> 0{\cdot}40 \times 10^9$/l), which was not associated with age or time since resettlement. Of the 25, 17 had positive and 3 had equivocal *Strongyloides* serology. All six participants who had intestinal parasite infections detected on faecal microscopy had eosinophilia.

Overall, 23 participants had positive *Strongyloides* test results (22 with positive serology, including 1 with *S. stercoralis* larvae detected in faeces, and another with larvae and equivocal serology). Of the 23, 18 (78%) had an elevated eosinophil count. If eosinophilia is used as a screening test for a positive *Strongyloides* test (either serology or faecal microscopy) in these study participants, the sensitivity and specificity are 78% and 90% respectively, with positive and negative predictive values of 72% and 93% respectively (Table 2).

Nine participants with eosinophilia had a history of hay fever and two had a history of asthma. However, six of these participants also had positive

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Table 1. *Laboratory test results for patients with positive faecal microscopy*

Age*, gender	Year of arrival in Australia	Pathogen(s) detected on faecal microscopy	Strongyloides serology	Eosinophil count (normal range 0·04–0·40 × 10^9/l)
54, M	1986	*S. stercoralis* rhabditiform larvae	Equivocal	1·01
35, F	1984	Hookworm eggs	Negative	0·43
35, M	1989	*Opisthorchis* spp. eggs	Negative	0·74
34, F	1989	*Opisthorchis* spp. eggs Hookworm eggs	Positive	0·92
37, M	1989	*S. stercoralis* rhabditiform larvae	Positive	0·85
28, F	1989	*Opisthorchis* spp. eggs	Positive	0·44

* The median age of the six participants was 35 years (range 28–54 years).

Table 2. *Test characteristics of eosinophilia as an indicator of* S. stercoralis *infection in Laotian immigrants and refugees tested a median of 12 years since arrival in Australia*

		Strongyloides infection*		
		Pos	Neg	Total
Eosinophilia†	Pos	18	7	25§
	Neg	5	63	68§
	Total	23‡	70‡	93

* Defined as positive by either serology and/or faecal microscopy.
† Defined as an eosinophil count of $> 0{\cdot}40 \times 109$/l.
‡ Sensitivity $= 18/(18+5) \times 100\,\% = 78\,\%$; specificity $= 63/(63+7) \times 100\,\% = 90\,\%$.
§ Positive predictive value $= 18/(18+7) \times 100\,\% = 72\,\%$; Negative predictive value $= 63/(63+5) \times 100\,\% = 93\,\%$.

Strongyloides serology, two of whom had intestinal parasites detected on faecal microscopy.

Haematological markers

Microcytic red blood cells (MCV < 76 fl) with hypochromia (MCH < 27 pg) were found in 27 participants. Of these, five were anaemic with haemoglobin levels below the standard range for gender. Two other participants had low haemoglobin levels with normal mean corpuscular volumes. There was no correlation between intestinal parasite infection and abnormal red blood cell morphology or anaemia.

DISCUSSION

This study supports and extends the findings of Gyrokos et al. (1992) [14], who reported high rates of undetected parasitic disease in Cambodian refugees in Canada 6 years after parasite screening and treatment. The detection of chronic strongyloidiasis in Laotian settlers in this study is of particular concern because of the potential serious morbidity associated with this pathogen [12, 19].

Laotian immigrants and refugees were chosen as subjects for this study because of the very high rate of *S. stercoralis* (in excess of 30% in adults) and *Opisthorchis* spp. (41%) detected during post-settlement screening conducted 15–20 years ago [5]. Of the 10350 Laotian settlers who have arrived in Australia since 1974 [2, 3], 1996 census data suggest that approximately 2000 settled in Victoria [20]. Our sample may have represented 5% and may have been biased by the participation of people from the same family or those with chronic disease. We consider the latter unlikely as there was no correlation between positive tests for intestinal parasite infection and symptoms. Unfortunately it is not possible to retrieve the original medical records for these patients because of the time period involved, compounded by the closure of Fairfield Infectious Diseases Hospital in 1996, where most Indochinese refugees were screened in the 1970s and 1980s. It is also unlikely that individuals making subsequent visits to Laos received any assessment or treatment on return to Australia as the screening programme at that time was only for new arrivals. We therefore do not know whether these patients represent previous treatment failures or not, but can say that this sort of screening and treatment programme was relatively ineffective in eliminating *S. stercoralis* in this population.

Detection of *S. stercoralis* and *Opisthorchis* spp. through faecal microscopy is often difficult because of low larval/egg densities in faeces in chronic infections. The chance of identifying *S. stercoralis* in a single

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faecal specimen from an infected person is estimated to be less than 30% [13]. The finding of positive faecal microscopy in six participants that had been in Australia for a median period of 9 years emphasizes the fact that *S. stercoralis* can survive in a patient for long periods by autoinfection. Two individuals who had returned to Laos after settlement in Australia may have been infected during these visits. However the other four are likely to have had persistent infection since resettlement, as transmission of hookworm, *S. stercoralis* and *Opisthorchis* spp. is unlikely to occur in the temperate Victorian climate [21].

To overcome the insensitivity of faecal microscopy, we used an ELISA test to detect *S. stercoralis* antibodies and eosinophilia as diagnostic tools for strongyloidiasis [21, 22]. Kobayashi [23] and Nutman [24] have confirmed that antibody levels fall over a period of several months following adequate treatment of infection. We believe that it is highly likely that individuals with a positive ELISA test in this study had ongoing chronic strongyloidiasis given that eosinophilia was present in nearly 80%, and treatment with thiabendazole would have been administered 7–22 years ago, if at all.

The significance of an equivocal *S. stercoralis* serology result is less clear. Equivocal titres alone (where eosinophilia was not measured) have been implicated as representing infections that have not been completely eliminated [23–25]. Three individuals with equivocal serology also had eosinophilia, of whom one had *S. stercoralis* larvae in the faeces.

Twenty-five (26%) participants had eosinophilia and although 11 had a history of atopy, the strong association with positive *S. stercoralis* serology and the conduct of the study during early winter when allergic rhinitis is uncommon, suggest that eosinophilia can be mainly attributed to co-existing intestinal parasite infections.

Given the high rates of chronic intestinal parasite infections detected in Laotians in this study and in Cambodian refugees in earlier studies [11, 14], we recommend that clinicians exclude these infections in people from this background regardless of symptoms or time since resettlement. The current treatment of choice is ivermectin 200 mcg/kg in a single dose.

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