

Epidemiology of *Blastocystis hominis* and other intestinal parasites among the immigrant population in northeastern Taiwan by routine physical examination for residence approval

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Background and purpose: *Blastocystis hominis* has not been reported as an endemic disease in Taiwan, but high prevalence rates have been found among immigrants. Due to the increasing number of immigrants in Taiwan, *B. hominis* may become a public health problem in Taiwan. This study was performed to determine the prevalence of *B. hominis* among immigrant populations.

Methods: Stool examination data from the Immigrant Physical Examination for Residence Approval in 2006 were examined.

Results: Among the 932 immigrants from 4 countries, 188 individuals (20.2%) were infected with *B. hominis*. The prevalence was higher among immigrants from Southeast Asian countries (Indonesia, 26.4%; Vietnam, 20.6%; The Philippines, 19.3%) than among those from China (7.6%). Coinfection with intestinal parasites of fecal-oral transmission (*Endolimax nana* and *Entamoeba hartmannii*) was a risk factor for *B. hominis* infection (odds ratio, 16.9; 95% confidence interval, 6.84-43.55). No significant differences in prevalence for sex and age were observed.

Conclusion: To prevent local transmission and endemic spread of *B. hominis*, obligatory routine health screening for immigrant populations and early eradication of the infection are important policies for this high-risk group.

Key words: *Blastocystis hominis*; Emigrants and immigrants; Endemic diseases; Parasites

Introduction

Blastocystis hominis, a unicellular protozoan, is one of the most common parasites found in the human intestinal tract [1]. Infection with *B. hominis* is common throughout the world, especially in tropical and subtropical countries. Studies have shown that developing countries have a higher prevalence of *B. hominis* infection (30% to 50%) than developed countries (1.5% to 10%) [2,3]. *B. hominis* is water-borne [4,5] and transmitted as a cyst via fecal-oral routes, especially

in areas with poor hygiene and sanitation [2,6,7]. As the organism is found in the intestines of both symptomatic and asymptomatic individuals, *B. hominis* has been considered to be part of the normal intestinal flora in the past [8-11]. However, the protozoan has recently been reported to cause diarrhea, nausea, abdominal pain, ulcerative colitis, eosinophilia, and anemia [7,12-18]. The pathogenic potential of *B. hominis* warrants further clarification.

The increasing number of immigrants as laborers, language teachers, or spouses has brought about considerable changes in Taiwan's social and economic structure. While *B. hominis* is not an endemic disease in Taiwan, recent studies have found a high prevalence among immigrant populations [19,20]. The potential

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risk for endemic spread of *B. hominis* may therefore be a public health concern. The purpose of this study was to determine the epidemiology of *B. hominis*, as well as other intestinal parasites, among immigrant populations by analyzing stool examination data from the Immigrant Physical Examination for Residency Approval (IPERA) in 2006.

Methods

Participants

All individuals who received routine IPERA examination from January 1 to December 31, 2006 at Lo-Tung Poh-Ai Hospital, I-Lan, Taiwan, were included. Data were collected by reviewing the IPERA records. Nationality, age, sex, and infection with *B. hominis* and other parasites were analyzed. Only immigrants from China, Vietnam, Indonesia, and The Philippines were included in this study. Immigrants from other countries were excluded due to the relatively small sample sizes (Australia, 2; Burma, 3; Cambodia, 5; France, 2; Japan, 2; Macao, 1; Malaysia, 2; Thailand, 9). 932 immigrants were included in the study.

Intestinal parasite examination

Stool examination for intestinal parasites was performed by using the classical merthiolate-iodine-formaldehyde concentration method [21]. Each stool specimen was also examined by direct wet-mount observation at low- ($\times 100$) and high- ($\times 400$) magnification.

To analyze the coinfection rate for *B. hominis* and other intestinal parasites, the other parasites were classified into 3 groups by transmission routes: soil-mediated (hookworms, *Trichuris trichuria*, and *Strongyloides stercoralis*), food-borne (*Metagonimus yokogawai* and *Clonorchiasis sinensis*), and fecal-oral (*Endolimax nana*, *Entamoeba hartmannii*, *Entamoeba coli*, and *Entamoeba histolytic/dispar*).

Statistical analysis

Data were analyzed by using the Epi Info™ software (Centers for Disease Control and Prevention, Atlanta, GA, USA). Statistical significance was determined by computing chi-squared test and odds ratios.

Results

Of the 932 immigrants included in this study, 188 (20.2%) were infected with *B. hominis*. There were no significant differences in prevalence for sex and age (Table 1). Immigrants from Southeast Asian countries (Indonesia, Vietnam, The Philippines) had a higher prevalence of *B. hominis* infection than those from China (22.8% vs 7.6%; $p < 0.001$).

All immigrants from China were spouses, whereas immigrants from the other Asian countries were mostly workers, with only 11 of 276 Indonesians and 93 of 398 Vietnamese immigrating for marriage. No difference in the prevalence of *B. hominis* was found between spouses (20.4%) and workers (20.7%) among

Table 1. Characteristics of patients with *Blastocystis hominis* infection.

Variable	No. infected	No. examined	Infection rate (%)	<i>p</i>
Total	188	932	20.2	
Sex				
Female	163	808	20.2	0.997
Male	25	124	20.2	
Age (years)				
21-30	111	514	21.5	0.270
31-40	61	341	17.9	
41-50	16	64	25.9	
>50 ^a	0	13	0	

^aThe age group >50 years was not included in the statistical analysis as the sample size was not sufficiently large.

Table 2. The prevalence of *Blastocystis hominis* infection among immigrants from different countries.

Nationality	No. infected	No. examined	Infection rate (%)	<i>p</i>
China	11	144	7.6	<0.001
Indonesia	73	276	26.4	
The Philippines	22	114	19.3	
Vietnam	82	398	20.6	

Table 3. Prevalence of *Blastocystis hominis* infection in immigrants by immigration purposes.

Nationality	Spouses			Workers		
	No. infected (%)	No. examined	<i>p</i>	No. infected (%)	No. examined	<i>p</i>
China	11 (7.6)	144	0.01 ^a	0	0	0.08
Indonesia	0 (0)	11		73 (27.5)	265	
The Philippines	0 (0)	0		22 (19.3)	114	
Vietnam	19 (20.4)	93		63 (20.7)	205	
Total	30 (12)	249		158 (23.1)	683	0.001

^aThe *p* value was analyzed between China and Vietnam.

Table 4. Age of immigrants with *Blastocystis hominis* infection by country.

Age (years)	Nationality				Total	<i>p</i>
	China	Indonesia	Vietnam	The Philippines		
21-30	8/64 (12.5)	52/199 (26.1)	42/201 (20.8)	9/50 (18.0)	111/514 (21.5)	0.11
31-40	2/49 (4.1)	21/75 (28.0)	28/160 (17.5)	10/57 (17.5)	61/341 (17.9)	0.009
41-50	1/19 (5.3)	0/2 (0)	12/36 (33.3)	3/7 (42.8)	16/64 (25.9)	0.06
>50 ^a	0/12 (0)	0 (0)	0/1 (0)	0 (0)	0/13 (0)	
<i>p</i>	0.24	0.82	0.19	0.26		

^aThe age group >50 years was not included in the statistical analysis as the sample size was not sufficiently large.

Table 5. Prevalence of parasites other than *Blastocystis hominis* by country.

Parasite	Nationality			
	China (n = 144)	Indonesia (n = 276)	The Philippines (n = 114)	Vietnam (n = 398)
Hookworms	1 (0.7)	6 (2.2)	4 (3.5)	20 (5.0)
<i>Trichuris trichuria</i>	0 (0)	3 (1.1)	3 (2.6)	12 (3.0)
<i>Strongyloides stercoralis</i>	0 (0)	1 (0.4)	0 (0)	2 (0.5)
<i>Metagonimus yokogawai</i>	2 (1.4)	6 (2.2)	5 (4.4)	6 (1.5)
<i>Clonorchiasis sinensis</i>	3 (2.0)	0 (0)	0 (0)	0 (0)
<i>Endolimax nana</i>	1 (0.7)	4 (1.4)	1 (0.9)	5 (1.3)
<i>Entamoeba hartmannii</i>	0 (0)	3 (1.1)	1 (0.9)	5 (1.3)
<i>Entamoeba histolytic/dispar</i>	0 (0)	2 (0.7)	2 (1.8)	3 (0.8)
<i>Iodamoeba bütschlii</i>	1 (0.7)	1 (0.4)	0 (0)	0 (0)

Vietnamese immigrants, but the 11 Indonesian spouses had no *B. hominis* infection compared with the Indonesian workers (73 of 265 immigrants; 27.5%) [Table 3].

There was no difference in prevalence between age groups within each country of immigration (Table 4). Crossing sex by age within each country showed no difference in sex within each age category and country (data not shown).

Among the 932 immigrants, 236 (25.3%) were infected with at least 1 species of intestinal parasite: 186 immigrants (78.9%) were infected with a single species of parasite, 42 (17.8%) with 2 species, 7 (3.0%) with 3 species, and 1 with 4 species (*B. hominis*, *S. stercoralis*, *E. nana*, *T. trichuria*). *B. hominis* was the most common pathogen (n = 188; 20.2%), followed by hookworms

(n = 31; 3.3%), *M. yokogawai* (n = 19; 2.0%), *T. trichuria* (n = 18; 1.9%), *E. nana* (n = 11; 1.2%), *E. hartmannii* (n = 9; 1.0%), *E. histolytic/dispar* (n = 7; 0.7%), *S. stercoralis* (n = 3; 0.3%)/*C. sinensis* (n = 3; 0.3%), and *Iodamoeba bütschlii* (n = 2; 0.2%). The prevalence of parasites other than *B. hominis* among the different countries is shown in Table 5. The hookworm infection rate was highest among Vietnamese immigrants (5%) compared with immigrants from other countries.

The *B. hominis* coinfection rate was higher in individuals infected with parasites via the fecal-oral route of transmission (78.8%; odds ratio [OR], 16.9; 95% confidence interval [CI], 6.84-43.55) than for food-borne (27.3%; OR, 1.5; 95%CI, 0.52-4.15) or

Table 6. Prevalence of *Blastocystis hominis* infection among immigrants with other intestinal parasite infections by route of infection.

Route of infection	<i>Blastocystis hominis</i>	Simultaneous infection with other parasites	<i>Blastocystis hominis</i> infection rate	Odds ratio (95% confidence interval)
Soil-mediated	18	47	38.3%	2.61 (1.36-5.00) ^a
Food-borne	6	22	27.3%	1.50 (0.52-4.15) ^a
Fecal-oral	26	33	78.8%	16.9 (6.84-43.55) ^{a,b}

^aCompared with immigrants without coinfection of other parasites.

^b $p < 0.001$.

soil-mediated (38.3%; OR, 2.61; 95%CI, 1.36-5.00) parasites (Table 6).

Discussion

In this study, *B. hominis* was the most common intestinal parasite (20.2%) among immigrants from China and Southeast Asian countries, but the prevalence rates were not significantly different for sex, age, or immigration purpose (marriage vs work). Immigrants from Southeast Asian countries had approximately 3-fold higher rates of *B. hominis* infection than those from China, but they had comparable prevalences of *B. hominis* infection to each other (Indonesians, 26.4%; Filipinos, 19.3%; Vietnamese, 20.6%; $p = 0.14$). The prevalence rate of *B. hominis* infection among immigrants from Southeast Asian countries found in this study was in concordance with previous studies conducted among Thais [9,20,22,23] and immigrants to Taiwan [20].

Immigrants from China were all spouses, but those from Southeast Asian countries were mostly workers (85.6%). Whether the purpose of immigration, hence the socioeconomic status of these immigrants, may account for the different prevalence in *B. hominis* infection needs further study.

Coinfection with other intestinal parasites was not rare (21.1%), and has also been reported previously [20,24,25]. *B. hominis* is thought to be a water-borne or fecal-oral-transmitted parasite [5,26], and low hygiene standards have been proposed to increase the transmission rate [27,28]. In this study, the fact that immigrants infected with other fecal-oral-transmitted intestinal parasites had a high *B. hominis* infection rate (78.8%) may support this hypothesis.

Direct stool wet-mount observation for *B. hominis* was used for this study. The results were similar to most previous studies of the prevalence of *B. hominis* infection [9,20,22,23]. However, 2 other studies conducted among

immigrants to Taiwan showed lower prevalence rates of 14.1% and 3.4% [12,19]. This may be due to the inevitable observational bias when wet-mount smear is used as the screening method. Parasite culture and molecular tools may enhance the accuracy of diagnosis.

Immigrant workers, especially women, are usually employed as housekeepers, servants, or nurses in health care facilities; immigrants coming for marriage, which has become more common in Taiwan, are often key people in kitchens. These immigrants may have close contact with children and elderly people among the families or in hospitals, who may be predisposed to infection. In Taiwan, the prevalence of *B. hominis* is relatively low (1.13%) [29], so the high prevalence of *B. hominis* infection among immigrants may pose a threat to local parasite-free families and health care institutions. A family outbreak of *B. hominis* infection with gastroenteritis has been reported [30]. Thus, the possibility of a *B. hominis* outbreak is of concern. For the prevention of local transmission or endemic spread in Taiwan, routine health screening of the immigrant population and early eradication are important policies for high-risk groups.

In conclusion, although the pathogenicity of *B. hominis* requires further study, a high prevalence of *B. hominis* infection among immigrants, especially those from Southeast Asia has been observed. Active screening and treatment for the infection are warranted.

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