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Epidemiological features of intestinal infection with *Entamoeba histolytica* in Taiwan, 2002–2010

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Summary Amebiasis remains an important public health problem worldwide, and immigration and an increase in international travel have affected the incident cases of the disease. The purpose of this study was to assess the prevalence of *Entamoeba histolytica* in Taiwan between 2002 and 2010. We analyzed data from surveillance programs run by the Centers for Disease Control, Taiwan (Taiwan CDC), and only laboratory-confirmed cases were analyzed. In total, 1796 cases with *E. histolytica* infections were included in our analysis. Among them, 788 (44%) of the cases were imported, and 1008 (56%) were locally acquired. The average annual incidence rate of *E. histolytica* infections was 0.49 and 9.26 per 100,000 for local patients and immigrants/foreign workers from endemic countries, respectively. The annual incidence of *E. histolytica* infections among immigrants/foreign workers was significantly higher than among Taiwanese who had not traveled abroad ($P < 0.0001$). Travelers to *E. histolytica*-endemic areas (e.g., Southeast countries) had a higher risk acquiring an *E. histolytica* infection. This study emphasized that *E. histolytica* infection is an important intestinal infectious disease in Taiwan. The risk of infection with *E. histolytica* for travelers was higher for those

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with destinations in South and Southeast Asia. To control *E. histolytica* infections in Taiwan, a sensitive surveillance system needs to be established, and the amebiasis-screening program for immigrants/foreign workers from endemic countries should be enforced.

Introduction

Amebiasis is an acute disease that is caused by the protozoan *Entamoeba histolytica*. Each year, this disease affects an estimated 50 million people and causes 100,000 deaths globally [1]. There are several amebic species of protozoans, and *E. histolytica* is a pathogenic ameba that can cause invasive intestinal and extra-intestinal diseases [2]. The majority of *E. histolytica* infections are asymptomatic or cause only mild disease; however, some patients develop invasive disease that includes extra-intestinal infections, which may result in severe and potentially fatal illness [2,3]. The most frequent manifestations of invasive amebiasis are colitis and liver abscesses [4,5].

E. histolytica can be present in sewage and contaminated water, and cysts may remain viable in suitable aquatic environments for several months at low temperatures. Ingestion of contaminated water and food is the primary route of transmission for amebiasis [6]. The disease is common in tropical and subtropical areas with poor sanitary conditions and health education and in countries with a high population density [2]. In developed countries, *E. histolytica* infections are commonly observed in travelers, recent immigrants, homosexual men, and inmate populations [7,8]. Some of these infections are zoonotic, including wildlife and domestic animals as reservoirs [9].

Taiwan is located at 23°4′ N and 121°0′ E and has a subtropical climate; the average monthly temperatures range from 16 °C to 29 °C, and the average monthly relative humidity ranges from 75% to 90%. Taiwan has become a developed country, with a Gross Domestic Product (GDP) of US $20,503 per capita. Despite the availability of effective therapy, the morbidity and mortality associated with amebic infection have persisted in Taiwan [10], suggesting that interventions designed to limit or eliminate the disease are ineffective. Nonetheless, little information is available on the burden of amebiasis-related morbidity and mortality in Taiwan. The purpose of this study was to assess the occurrence of *E. histolytica* infections and examine demographic and regional associations.

Materials and methods

Data sources

Taiwan has a population of approximately 23 million on a land area of 36,188 km^2, for a population density of 627/km^2. The majority (95%) of the population resides in the western part of Taiwan, which we divided into northern, central, and southern regions. Only 5% live in eastern Taiwan, where the medical care and socioeconomic status are classified as underprivileged. Since 1990, the National Notifiable Diseases Surveillance System (NNDSS) has reported cases to the Centers for Disease Control of Taiwan (Taiwan CDC), as previously described in the literature [11]. As *E. histolytica* infection is a reportable disease in Taiwan, physicians are required to report all cases of *E. histolytica* infections by entering the data into local databases and electronically forwarding the data to the Taiwan CDC within 24 h of case ascertainment using Taiwan CDC-developed software [12—14]. According to a survey in Taiwan [15], more than 84% of physicians indicated they would report a notifiable disease to the CDC if they had diagnosed the disease. After reports are received by the CDC, an epidemiologic team (field epidemiologist, entomologist, and public health nurse) is assigned by the CDC to perform a patient follow-up, verify the diagnosis, and collect patient information. Follow-up consists of in-person interviews, telephone calls, and correspondence with health care providers as well as an interview with the *E. histolytica*-infected patient.

We collected all *E. histolytica* infection-related data reported to the NNDSS at the Taiwan CDC from January 2002 to December 2010. The reported information included the patient's age, gender, area of residence, geographic location of exposure, contact with ill people, and travel history [10].

This study was approved by the Institutional Review Board of National Cheng Kung University Hospital.

Case definition

In this study, a case was defined as a patient with acute diarrhea accompanied by a laboratory-confirmed intestinal infection due to *E. histolytica*. For all cases, at least two unambiguous test results of four tests (stool microscopy, serological tests, copro-antigen enzyme-linked immunosorbent assay (ELISA), and real-time polymerase chain reaction (PCR) for fecal samples) were available, and at least two test results were unambiguously positive for *E. histolytica* [16].

In this article, 'traveler' is used as an umbrella term for the aforementioned groups of individuals who crossed international borders. Imported *E. histolytica* was defined as an infection acquired in an amebiasis-endemic country outside of Taiwan that was diagnosed in Taiwan after the development of clinical symptoms and confirmation by laboratory testing. Indigenous *E. histolytica* was defined as an infection acquired in Taiwan after the development of clinical symptoms and confirmation by laboratory testing.

Laboratory examination

Specimens consisted of stool and blood samples from inpatient or outpatients who were suspected of *E. histolytica*