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The epidemiology of tick-borne relapsing fever in Iran during 1997–2006

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Summary *Background:* Tick-borne relapsing fever is an acute febrile and endemic disease in Iran. For many reasons, the incidence of disease is on decrease, however tick-borne relapsing fever is still a health issue in the rural areas for travelers. This study was carried out during 1997–2006 to investigate the tick-borne relapsing fever in Iran.
Methods: Based on a cross-sectional, retrospective and descriptive study in all the provinces, the residents in the endemic areas who were febrile and suspicious to tick-borne relapsing fever were enrolled in the study. Tick-borne relapsing fever is a notifiable disease in Iran and the national communicable disease surveillance data were used through questionnaires. The infectivity of *Ornithodoros* species to *Borrelia* also was studied in two highly endemic areas including Hamadan and Qazvin provinces.
Results: During 1997–2006, a total of 1415 cases have been reported from the entire country. The highest prevalence was observed in year 2002 with the incidence rate of 0.41/100,000 population. Ardabil province is the first ranked infected area (625 out of 1415), followed by Hamadan, Zanjan, Kurdestan and Qazvin provinces sequentially. The disease is recorded during the whole year but its peak occurs during summer and autumn. There have been 87.6% of the cases recorded from June to November. Forty five percent of the infected cases were male and one third of the patients were under 5 years of age. Fifty four percent of the patients comprise the children under 10 years. Ninety two percent of the cases were living in rural areas where their dwellings were close to animal shelters. They were involved mainly with farming and animal husbandry activities. All the febrile patients with confirmed spirochetes in their blood samples were treated according to a national guideline for tick-borne relapsing fever treatment. Only 7% of the patients were hospitalized and 0.8% of them exhibited the

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Jarisch—Herxheimer reaction. The study of infectivity of *Ornithodoros* species to *Borrelia* revealed that *Ornithodoros tholozani* was infected with *Borrelia persica* and *Ornithodoros erraticus* with *Borrelia microti*.
Conclusion: Travelers to the rural areas with high prevalence of the disease should be made aware of the risk of tick-borne relapsing fever and use of appropriate control measures. Communicable disease surveillance including tick-borne relapsing fever should be pursued as well.

Introduction

Tick-borne relapsing fever is a zoonotic disease transmitted worldwide by soft ticks of the genus *Ornithodoros*. It transmits at least 15 distinct *Borrelia* species throughout the world.[1] The disease is reported from North and South America, Africa, Asia and Europe. The epidemiology of the disease in each region depends on the relationships between the tick and *Borrelia* species as well as environmental condition in its distribution area. Reservoir hosts are usually wild rodents.[2]

Tick-borne relapsing fever is one of the endemic diseases in Iran and is notifiable in national communicable surveillance system. The prevalence of the disease was considerable in the past, but the incidence rate of it decreased to 0.06/100,000 in 2006. Retrospectively, *Ornithodoros tholozani* and *Borrelia persica* were first identified and reported from Iran.

To make proper decision on the better management and revision of previous control measures, a cross-sectional, clinic-based study was performed to investigate the latest situation of tick-borne relapsing fever in Iran during 1997—2006. Since the understanding of vector infectivity with agent is an important factor in any tick-borne relapsing fever epidemiological study, the infectivity of ticks to the *Borrelia* was studied in the endemic region.

Materials and methods

This study was carried out as a cross-sectional, descriptive and retrospective design during the decade from 1997 up to the year 2006 in all the provinces within Iran. All the residents in the endemic areas who were febrile and suspicious to tick-borne relapsing fever were enrolled in this study. As a part of national communicable disease surveillance a questionnaire was designed in the Center for Disease Control, Ministry of Health and Medical Education of Iran. The questionnaire contained information on demography, living conditions such as building materials that may be favorable for ticks breeding places, occupation, age and other relevant information obtained in interviews. Axillary temperature of each patient with fever was measured. Blood was collected from the arm by vein puncture or from a finger by lancet stick and applied to glass microscope slides. Thick and thin blood smears were stained with Wright—Giemsa and analyzed by microscopy at a magnification of 400× for spirochetes. Information from disease report forms and records of tick-borne relapsing fever were requested from all provincial health centers in Iran. According to the National guideline of relapsing fever surveillance, the case is defined as a person who has both fever and the spirochetes in the blood smear stained with Wright—Giemsa and seen by dark-field microscopy. All the reported cases were confirmed by laboratory procedures.

To find out the fauna and natural infection of soft ticks with *Borrelia* in more prevalent provinces two provinces including Qazvin and Hamadan were selected. To do so, a field study was carried out in the region of Qazvin. A total of 54 villages were selected randomly and ticks were collected from their habitats according to the standard methods. A total of 3197 Argasidae ticks were collected from human dwelling, poultry and animal shelters. In Hamadan province, 53 villages were randomly selected and a total of 4805 ticks were collected from cracks, crevices, ceilings, floors in human dwellings, animal and poultry shelters in 30 min as well as from rodents burrows. All the specimens were identified according to the national systematic key. *O. tholozani* and *Ornithodoros erraticus* were fed on Guinea pigs and new-borne mice, respectively for 30—45 min. After 2 weeks blood samples were obtained from the subject animals and examined microscopically for the presence of *Borrelia*. *O. tholozani* was smashed and then injected subcutaneously into the sensitive animals. The animals' blood samples were examined for the presence of *Borrelia* after one week using dark-field microscopy stained with Wright and Giemsa dye. The EPI6 software were used to analyze the data.

Results

Analyzed data revealed that the disease is limited to only 18 provinces of the 30 provinces in Iran during the decade (1997—2006). A total of 1415 cases have been reported from the entire country. Five provinces including Ardebil ($n = 625$), Hamadan ($n = 218$), Zanjan ($n = 182$), Kordestan ($n = 139$) and Qazvin ($n = 66$) comprise 87% of all cases (Table 1, Fig. 1). The highest incidence rate (i.e., 0.41/100,000) population was observed in the year 2002 ($n = 284$) (Graph). There were 470 cases (33%) of the patients younger than 5 years, 254 cases (18%) were 6—10 years old and 382 cases (27%) were 11—20 years old. A total of 309 cases (22%) were over 20 years old. Study showed that the age group younger than 10 years was susceptible to tick-borne relapsing fever (54% of the total cases). The cases include 777 females (55%) and 638 males (45%) which occurred during all the months of the year with the peak reported from June to November (Table 1). The peak of the disease occurs in summer and autumn. Ninety two percent of the reported cases were living in rural areas where their