



Contents lists available at ScienceDirect

Journal of Acute Disease

journal homepage: [www.jadweb.org](http://www.jadweb.org)



Document heading doi: 10.1016/S2221-6189(14)60050-0

## The epidemiology of tick-borne relapsing fever in Bijar County, North-Western Iran

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### ARTICLE INFO

#### Article history:

Received 29 June 2014

Received in revised form 15 July 2014

Accepted 15 August 2014

Available online 20 December 2014

#### Keywords:

Epidemiology

*Borrelia persica*

Tick-borne relapsing fever

Iran

### ABSTRACT

To explain the demographic and epidemiological aspects of found cases of illness in the Bijar County, north-western Iran, in the year of 2007–2008.

**Methods:** In this descriptive study population included all febrile cases referring to health services centers of Bijar County. A confirmed case was defined as an individual who had both febrile disease and detection of *Borrelia* in a peripheral blood smear by Wright–Giemsa using dark-field microscope. Each patient was asked to fulfill a questionnaire including clinical and epidemiological features and demographic information of TBRF.

**Results:** During the year of 2007–2008, 11 cases have been reported from Bijar County. There were 5 cases (45.4%) of the patients younger than 10 years, 6 cases (54.5%) were 10–19 years old. Of the patients, 63.6% occurred in summer and 27.3% in spring. All cases developed during the months of May to October. Fever and chills, the most common symptoms, occurred in all patients. Most (54.5%) of the cases were students and the remaining were children. Approximately 72.7% of the patients were keeping cattle and sheep near or inside their homes.

**Conclusions:** As showed, TBRF is a remarkable public health challenge, particularly for children and students living in Bijar County.

## 1. Introduction

Tick-borne relapsing fever (TBRF) is an acute zoonotic disease implicating plenty species of small mammals and rodents all over the globe<sup>[1,2]</sup>. This infection observed in North America, Africa, Europe and the Middle East<sup>[2,3]</sup>. *Ornithodoros tholozani* (*O. tholozani*) is spread in the Middle East and is recognized as the major transmitter and along with rodents are reservoir hosts for *Borrelia persica* (*B. persica*), that is frequently responsible for old world TBR<sup>[4–7]</sup>.

Most prevalent signs of the TBRF are chills, headache and fever. Laboratory verification of the disease is made by observation of *Borrelia* in smears of peripheral blood during

a febrile episode, provided with Giemsa or Wright's stain utilization dark field microscopy<sup>[8–11]</sup>.

In Iran three species of Argasidae including, *O. tholozani* (Figure 1), *O. erraticus* and *O. tartokovyskyi* are able to transmit the TBRF to humans. Moreover, *B. persica*, *B. microti*, *B. latyschevi*, and *B. baltazardi* are the major causative agents of TBRF in Iran<sup>[12]</sup>. In Iran, principal foci of TBRF are mountainous provinces of north-west and west, and also it is reported from various parts situated in south and center of the country<sup>[1,2,13]</sup>.

People in endemic regions should forbear tick – infected areas and rodents and use repellents and protective costume to impede tick bites<sup>[8]</sup>. This study was carried out during 2007–2008 to investigate the tick-borne relapsing fever in Bijar County, northwestern Iran.

## 2. Materials and methods

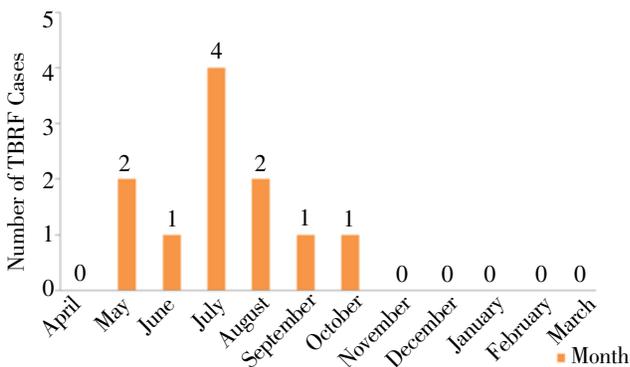
Bijar is a county in Kurdistan Province in Iran. At the

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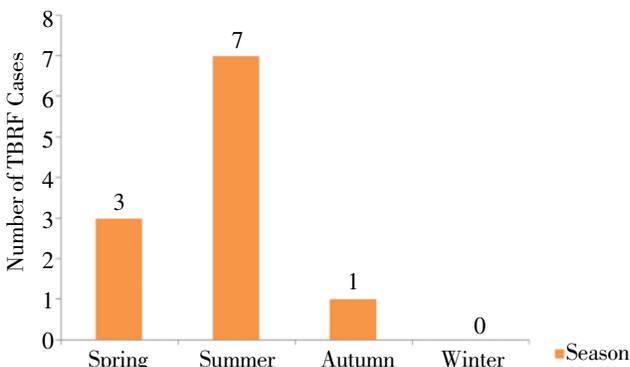
2006, the county's population was 95 461, in 23 614 families. This study was carried out as a cross-sectional, descriptive design during 2007–2008 in Bijar County. A blood sample from each suspected patient of TBRF was examined for *B. persica* under Wright–Giemsa staining by dark-field microscopy. Data were collected on the demographics and clinical manifestations of each confirmed case. Data was analyzed using SPSS.

### 3. Results

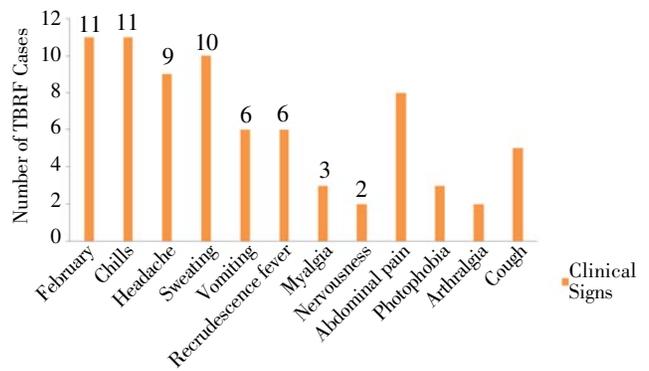
In this epidemiological research, a total number of 11 patients have been found over 2007–2008. Incidence rate was calculated 0.1/1000 population. Patients occurred from May through October; most cases reported in July (4 cases, 36.4%) (Figure 1). The maximum of cases were diagnosed during the summer (7 cases, 63.6%) (Figure 2). Although the clinical data available for each patient varied considerably, a composite of recorded symptoms accurately reflects a characteristic clinical presentation. The most prevalent clinical signs were fever (100%), chills (100%), sweating (90.9%), head ache (81.8%) and abdominal pain (72.7%). Other findings included vomiting, cough, myalgia, photophobia, nervousness, arthralgia and nose bleeding. Recurrent fever occurred in 54.5% cases (Figure 3). The temperature was higher than 39.5 °C in all cases. All of the cases were cured according the national guideline for TBRF treatment. No patients this study died of TBRF.



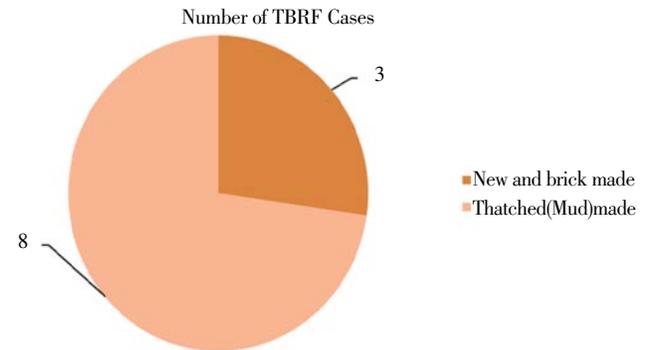
**Figure 1.** Frequency of TBRF cases by months in Bijar County, Western Iran (2007–2008).



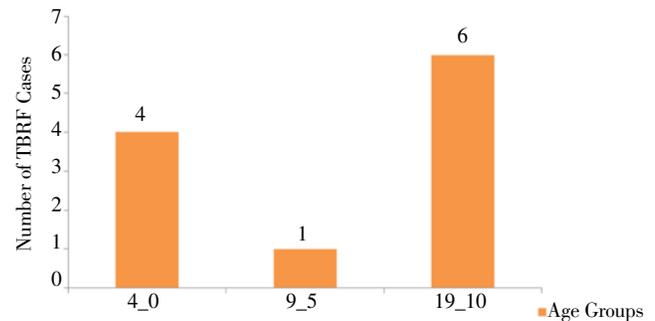
**Figure 2.** Frequency of TBRF cases by seasons in Bijar County, Western Iran (2007–2008).



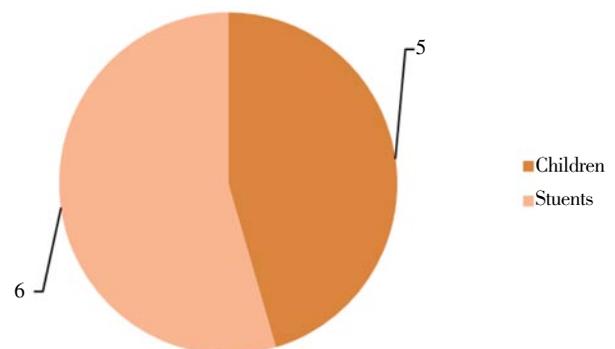
**Figure 3.** Frequency of TBRF cases by clinical manifestations in Bijar County, Western Iran (2007–2008).



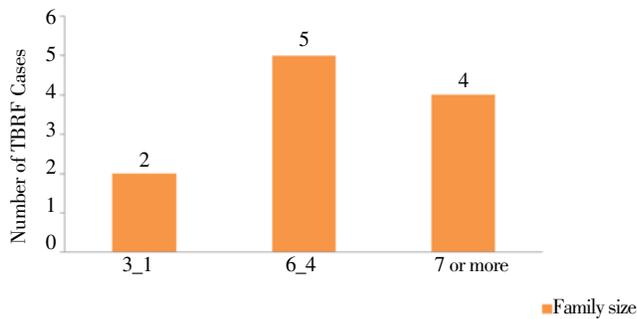
**Figure 4.** Frequency of TBRF cases by building type in Bijar County, Western Iran (2007–2008).



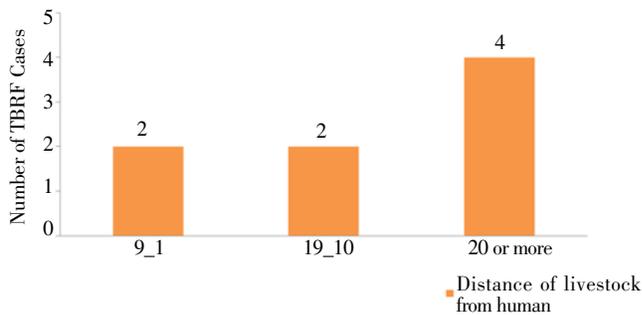
**Figure 5.** Frequency of TBRF cases by age groups in Bijar County, Western Iran (2007–2008).



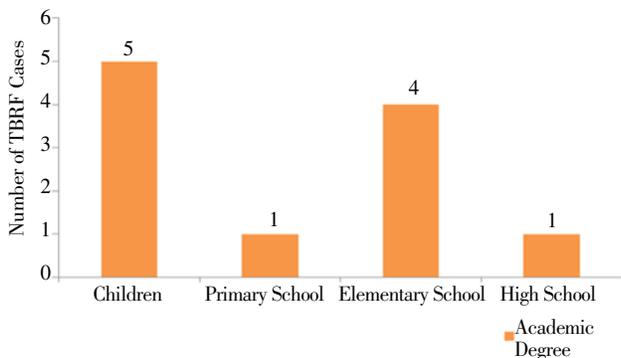
**Figure 6.** Frequency of TBRF cases by occupation groups in Bijar County, Western Iran (2007–2008).



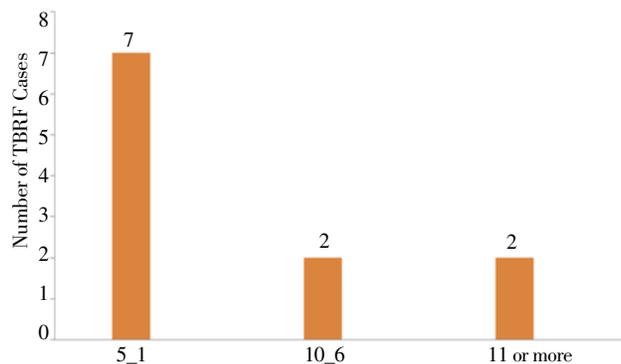
**Figure 7.** Frequency of TBRF cases by family size in Bijar County, Western Iran (2007–2008).



**Figure 8.** Frequency of TBRF cases by distance of livestock from human dwelling place in Bijar County, Western Iran (2007–2008).



**Figure 9.** Frequency of TBRF cases by educational levels in Bijar County, Western Iran (2007–2008).



**Figure 10.** Frequency of TBRF cases by time interval between slide preparations to check it out (Hours) in Bijar County, Western Iran (2007–2008).

In about 72.7% of patients, the houses they inhabited in were mud-thatched and old; the remainder had new brick made houses (Figure 4). Meantime, all of the cases of TBRF were resident of the villages or were infected during their stay in a village. All of them were single. Six cases (54.5%) were 10–19 years old (Figure 5). Out of the 11 cases of

TBRF, the jobs in 6 (54.5%) patients were students (Figure 6). Approximately 81.8% of the patients lived in busy families (4 or more persons in family) (Figure 7). Cattles or sheep were kept in the homes of 72.7% of patients. Nearly 54.5% of those cases lived within 10 m (or more) of the place of livestock (Figure 8). About 36.4% of the patients were studying in elementary schools (Figure 9). Time interval (hours) between slide preparation to check it out is given in figure 10. Only 18% of patients were hospitalized and the others (82%) were treated as outpatients. Also, none of the homes or animal shelters of the patients had a history of spraying with insecticides.

#### 4. Discussion

Most people in this region are involved with animal husbandry and agriculture jobs. Continuing contacts to the infected ticks are the major reason of great spread of the TBRF. In this epidemiological study, a total number of 11 cases were investigated. The most common clinical manifestations of TBRF in the present study were fever (100%), chills (100%), sweating (90.9%) and headache (81.8%), which is similar to other researches performed in this field. In Arshi *et al* investigation in Ardabil; northwestern province of Iran; the most prevalent clinical symptoms were reported fever (93.3%), chills (86.2%) and headache (85.9%)<sup>[14]</sup>. In a study in Montana, all patients had fever and other clinical manifestations consistent with TBRF (such as, headache, rash, vomiting and myalgia)<sup>[11]</sup>. In Moemenbellah–Fard *et al*'s investigation in western Iran, cases of TBRF is characterized by recurring episodes of fever, chills and headache<sup>[15]</sup>.

The majority of cases in our study were students, which is similar to the finding of Rafinejad *et al* on TBRF in Kurdistan province, western Iran. In the mentioned study, the rate of infection in students was reported 40%<sup>[13]</sup>. The most of patients in Arshi *et al* study were children<sup>[14]</sup>. In this investigation, all diagnosed patients of TBRF found in rural regions. In study of TBRF in Iran during 1997–2006 approximately 92% of the patients were living in villages that is consistent with our report<sup>[2]</sup>. In Arshi *et al* investigation more than 84% of the cases were resident of the rural areas or had become infected during their stay in a village<sup>[14]</sup>. In Rafinejad *et al*'s survey, about 90.7% and 9.3% of cases were occurred in rural and urban areas, respectively<sup>[13]</sup>.

Similar to other countries, TBRF occurs frequently in warm months. However, the disease also occurs during the winter<sup>[16]</sup>. In our study, nearly 63.6% were occurred in the summer, and the frequencies were from May to October. In Masoumi–Asl *et al*'s investigation, the peak of the TBRF occurred in summer and the disease occurred during all months of the year with the maximum reported from June through November<sup>[2]</sup>. In study of the United States, patients found during all months of the year: 71% cases were occurred from June to September; the majority of cases diagnosed in

July (24%) and August (23%)<sup>[8]</sup>. In the present study, in 72.7% of patients, the buildings they lived in were old. In Arshi et al's survey, most (70%) of the subjects lived in households in the old mud-and-thatch houses<sup>[14]</sup>.

Most incidence of the disease was 54.5% among the age groups of 10–19 years old. In Rafinejad *et al* study, most frequencies of TBRF based on age groups showed 43.3%, 17.5% and 17.5% in 10–19 years old, 20–29 years old and 0–4 years old, respectively<sup>[13]</sup>. In Moemenbellah–Fard *et al* investigation, most (91%) of the patients were reported young people<sup>[15]</sup>. In Masoumi–Asl *et al's*, there were 33% of the cases younger than 5 years old, 18% were 6–10 years old and 27% were 11–20 years old<sup>[2]</sup>. Approximately 54.5% of the subjects lived within 10 meters (or more) of the site of livestock. In Rafinejad *et al* study, about 72% of the cases habited within the mentioned distance of livestock<sup>[13]</sup>. Results of this survey showed that families lived 1–2 meters from livestock dwellings had the minimum infection rate that is similar with Rafinejad *et al's* results<sup>[13]</sup>. Prevention of TBRF disease comprises avoiding tick and rodent infested habitations and infested natural places (i.e. caves animal shelters). Furthermore, 45.4%, 36.4%, and 18.2% of the *Borrelia* spirochetes infections were detected in family sizes of 4–6,  $\geq 7$  and 1–3 people in a family, respectively, that is in accordance with Rafinejad *et al* survey<sup>[13]</sup>.

In our study, age, job, distance from livestock dwellings, building type and month likely represent important risk factors. Further epidemiological surveys among TBRF patients are needed to have a better understanding of the modalities of infection. Considering the epidemiology of the illness, new control measures should be established.

### Conflict of interest statement

We declare that we have no conflict of interest.

### Acknowledgements

Authors wish to express their sincere thanks to all staffs of the Health Centers of Bijar, Kurdistan University of Medical Sciences and who helped for doing this investigation. We also thank Mr. Mansour Karimi from Department of CDC, Kurdistan University of Medical Sciences Vice–Chancellor for Health for his support. This project has been partially financially supported by Chancellor for Research Affairs of Ahvaz Jundishapur University of Medical Sciences with project number 88 S.46.

### References

[1] Aghighi Z, Assmar M, Piazak N, Javadian E, Seyedi Rashti

- MA, Kia EB, et al. Distribution of soft ticks and their natural infection with *Borrelia* in a focus of relapsing fever in Iran. *Iranian J Arthropod–Borne Dis* 2007; **1**(2): 14–18.
- [2] Masoumi–Asl H, Goya MM, Vatandoost H, Zahraei SM, Mafi M, Asmar M, et al. The epidemiology of tick–borne relapsing fever in Iran during 1997–2006. *Travel Med Infect Dis* 2009; **7**: 160–164.
- [3] Rebaudet S, Parola P. Epidemiology of relapsing fever borreliosis in Europe. *FEMS Immunol Med Microbiol* 2006; **48**(1): 11–15.
- [4] Cunha BA. Tick–borne infectious disease. Diagnosis and management. New York: Marcel Dekker; 2002.
- [5] Dennis DT, Campbell GL. Relapsing fever. In: Braunwald E, Hauser SL, Fauci AS, Longo DL, Kasper DL, Jameson JL, eds. *Harrison's Principles of Internal Medicine*. New York: McGraw–Hill; 2001.
- [6] Goubau PF. Relapsing fevers. A review. *Ann Soc Belge Med Trop* 1984; **64**: 335–364.
- [7] Gray JS, Kahl O, Lane RS, Stanek G. Lyme borreliosis: Biology and control. Wallingford: CABI publishing Book; 2002, p. 368.
- [8] Dworkin MS, Shoemaker PC, Fritz CL, Dowell ME, Anderson DE. The Epidemiology of tick–borne relapsing fever in the United States. *Am J Trop Med Hyg* 2002; **66**(6): 753–758.
- [9] Dworkin MS, Schwan TG, Anderson DE Jr. Tick–borne relapsing fever in North America. *Med Clin North Am* 2002; **86**: 417–433.
- [10] Schwan TG, Burgdorfer W, Rosa PA. *Borrelia*. In: Murray PR, Baron EJ, Pfaller MA, Tenover FC, Tenover RH, editors. *Manual of clinical microbiology*. Washington: American Society for Microbiology; 1999, p. 746–758.
- [11] Schwan TG, Policastro PF, Miller Z, Robert Thompson RL, Damrow T, Keirans JE. Tick–borne relapsing fever caused by *Borrelia hermsii*, Montana. *Emerging Infect Dis* 2003; **9**(9): 1151–1154.
- [12] Vatandoost H, Ghaderi A, Javadian E, Zahir–Nia AH, Rassi Y, Piazak N, et al. Distribution of soft ticks and their infection with *Borrelia* in Hamadan Province, Iran. *Iranian J Publ Health* 2003; **32**(1): 22–24.
- [13] Rafinejad J, Shemshad K, Banafshi O. Epidemiological study on tick–borne (Acari: Argasidae) relapsing fever in Kurdistan Province, IRAN, 2000–2004. *Fla Entomol* 2012; **95**(3): 758–763.
- [14] Arshi S, Majidpoor A, Sadeghi H, Asmar M, Emdadi D, Derakhshan MH. Relapsing fever in Ardabil, a northwestern province of Iran. *Arch Iranian Med* 2002; **5**(3): 141–145.
- [15] Moemenbellah–Fard MD, Banafshi O, Rafinejad J, Ashraf H. Tick–borne relapsing fever in a new highland endemic focus of western Iran. *Ann Trop Med Parasitol* 2009; **103**(6): 529–537.
- [16] Cutler SJ, Bonilla EM, Singh RJ. Population structure of East African relapsing fever *Borrelia* spp. *Emerging Infect Dis* 2010; **16**(7): 1076–1080.