Original Article

Tick Ectoparasites of Animals in Borderline of Iran-Iraq and Their Role on Disease Transmission

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Abstract

Background: Since ticks are potent vectors of various diseases, identification of these species are clinically important to protect the public health and control veterinary problems in the communities. We aimed to figure out the frequency of ticks on cows, goats, sheep, lambs, turtles and also obscure hosts in Kurdistan Province, bordered with Iraq June 2012 to May 2013.

Methods: The hosts were selected randomly and examined individually for tick infestation. In case of infestation, ticks were collected using forceps and then preserved in 70% ethyl alcohol. All collected specimens were preserved in tubes and relative information was recorded and then identified based on morphological characteristics.

Results: Totally, 1209 ticks were collected. The prevalence of ticks on cows, sheep, goats, lambs, turtles, poultry and obscure hosts was 11.33%, 55.41%, 6.53%, 5.95%, 0.9%, 8.02% and 11.82% respectively. The mean number of ticks on each animal was 1.6. Number of 5 genera, including *Rhipicephalus*, *Argas*, *Ornithodoros*, *Hyalomma* and *Haemaphysalis* and 9 species; including *R. sanguineus* (60.05%), *R. bursa* (0.08), *Hy. anatolicum* (12.33), *Hy. asiaticum* (1.49), *Hy. aegyptium* (0.91), *Hy. marginatum* (0.08), *Haemaphysalis parva* (4.22), *Hyalomma* sp. (0.99), *Ornithodoros lahorensis* (11.83), and *Argas persicus* (8.02) were identified.

Conclusion: The most abundant species in this study area was *Rh. sanguineus* (60.05%). Due to high prevalence of tick specimens and a variety of collected species from sheep (55.41%), the vaccination of sheep and control of tick vectors are recommended.

Keywords: Tick, Ruminants, Turtle, Iran

Introduction

Ticks (Acari: Ixodidae) are considered as the important vectors of pathogens (1). They play an important role in the survival of the pathogens that cause disease in humans and animals (2). Ticks are able to transmit a variety of pathogens that are responsible to develop some diseases such as tick-borne encephalitis, Crimean Congo Hemorrhagic Fever (CCHF), anaplasmosis, babesiosis, rickettsiosis, borreliosis and ehrlichiosis (3, 4). Such diseases are considered as public health or veterinary problems in the countries (5, 6). To the best of our knowledge, 10% of the currently known tick species act as vectors of pathogens of animals and humans (2). In addition to the transmission of pathogens, they are also responsible for damages directly due to their feeding behavior (7). As only 10% of tick species transmit a number of pathogens, identification of tick species is important. Tick spe-

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cies distribution in Iran is briefly investigated on the basis of published records. data were presented for 642 ixodid ticks taken from small-sized mammals, mainly rodents in different zoogeographical zones of Iran (8). The prevalence of ixodid ticks was studied on cattle in Mazandaran Province, north of Iran (9) and east of the country (10) in another study the prevalence of ticks was investigated in Khuzestan Province and showed Shosh was the most infected city in Khuzestan, Ticks infection rate on sheep, goat, and cow was 84.12%, 12.69% and 3.17%, respectively (11).

In a similar investigation, the distribution and ecological preferences of ticks of domestic animals were studied from 2002 to 2005 in north part of the country (12). The prevalence of ticks was surveyed in north-west of the country in Ardebil (13) and West Azerbaijan (14). Additionally, hard ticks of domestic ruminants were surveyed in central part of Iran (15). Recently, some other investigations have been carried out in some other geographical locations of Iran (16-19), and in Kurdistan region of Iran and Iraq (20-22). In 2002, the presence of *Hy. aegyptium* from *Testudo graeca* turtle was reported in Iran (23). *Hy. aegyptium* and *T. graeca* were found in northwest of Iran (24). Recently the situation of tick born disease showed in Iran. The CCHFV RNA was detected in 5.2% of 492 ticks collected from livestock in different regions of Golpayegan (6). In total, 49 ticks including five species: *R. sanguineus*, *Hyalomma anatolicum*, *Hy. asiaticum*, *Hy. dromedarii* and *Hy. marginatum* with a prevalence of 46.9%, 32.7%, 4.1%, 4.1% and 2.1% respectively were identified; and CCHFV was detected in three ticks among 49 collected ticks. The ticks infected with CCHFV belonged to the genus *Hyalomma* and *Rhipicephalus*. Phylogenetic analysis demonstrated that two sequences clustered in clade IV (Asia-1) and one sequence was located within clade IV (Asia-2) (25). All positive ticks were from *Hyalomma* genus and *Hy. marginatum* species. They were not able to find virus in *Hy. anatolicum*, *Hy. schulzei*, *Hy. dromedarii*, *R. sanguineus* and *Argas persicus*. *Hyalomma marginatum* is the main vector in that study (26)

Despite the aforementioned investigations, there still seems to be a gap in our knowledge about distribution of tick species in Iran. This study was aimed to figure out the frequency of ticks on cows, goats, sheep, lambs, turtles and also obscure hosts in Kurdistan Province, bordered with Iraq.

Materials and Methods

This survey was carried out in Kurdistan Province, located in west part of Iran, in Region 3 and bound by Iraq on the west, the province of West Azerbaijan to its north, Zanjan to the northeast, Hamedan to the east and Kermanshah to the south (27). This province is one of the 31 provinces of Iran. It is 28817km² in area (Coordinates: 35.3113°N 46.9960°E). The capital of Kurdistan Province is the city of Sanandaj, located in Sanandaj County. Other counties with their major cities are Marivan, Baneh, Saqqez, Qorveh, Bijar, Kamyaran, Dehgolan, Diwandarreh and Sarvabad (Fig. 1).

Samples collection

From June 2012 to May 2013, ticks from goats, cows, sheep, lambs, turtles and obscure hosts from various regions of the province were collected. Ticks were mostly found on sheep of the livestock. In total, 724 animals from 104 herds including 62 cows, 506 sheep, 73 goats and 23 lambs were selected randomly and examined individually for tick infestation. Additionally, we selected 2 turtles and 37 obscure hosts randomly for detection of tick infestation on them. Thirty minutes were spent for each flock to collect ticks. All inspections and tick collections were carried out between 08:00 a.m. and 11:00 a.m. In case of infestation, ticks were collected using forceps and then preserved in 70% ethyl alcohol.

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Collected samples were preserved in tubes and relative information was recorded such as collector name, date, host information and date of collection, then, samples were transferred to the Entomology Laboratory, School of Public Health, Tehran University of Medical Sciences, Tehran, Iran. All collected samples were identified based on morphological characteristics and the keys given by Janbakhsh (28) and Walker et al. (29) based on shape of capitulum, scutum, eyes, festooned and hypostome, spiracle, genital groove, spure of coxa, adanal shield and other appropriate characters.

Results

Totally 1209 ticks were collected and the occurrence of ticks on cows, sheep, goats, lambs, turtles, poultry and obscure hosts was 11.33%, 55.41%, 6.53%, 5.95%, 0.9%, 8.02% and 11.82% respectively. The mean number of ticks on each animal was 1.6 ticks per animal. Totally 5 Genus: *Rhipicephalus*, *Argas*, *Ornithodoros*, *Hyalomma* and *Haemaphysalis* were identified in study areas (Table 1). *Rhipicephalus sanguineus* was the most abundant species in the studied area (60.05%), also, we found *R. bursa* (0.08%), *Argas persicus* (8.02 %), *Ornithodoros lahorensis* (11.83%), *Hy. marginatum* (0.08%), *Hy. asiaticum* (1.49%), *Hy. anatolicum* (12.33%), *Hy. aegyptium* (0.91 %), *Ha. parva* (4.22%) and *Hyalomma* sp. (0.99%). Spatial distribution of tick species in different elevations is presented in Fig. 2.

The coordinates of collection sites have presented in Table 2.

Fig. 1. The study area, Kurdistan Province is located in west part of Iran

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Table 1. Tick species and their hosts and places in Kurdistan Province, 2012–2013 (N: Nymphs, F: Females, M: Males)

Species of ticks	Host and Place (%)							Collected samples			Total (%)
	Cow	Sheep	Goat	Lamb	Turtle	Poultry	Fold	N	F	M	
R. sanguineus	17	572	65	72	0	0	0	53	200	473	726 (60.05)
R. bursa	0	1	0	0	0	0	0	0	0	1	1 (0.08)
Hy. anatolicum	114	35	0	0	0	0	0	0	88	61	149 (12.33)
Hy. asiaticum	0	5	13	0	0	0	0	0	6	12	18 (1.49)
Hy. aegyptium	0	0	0	0	11	0	0	0	9	2	11 (0.91)
Hy. marginatum	0	0	1	0	0	0	0	0	0	1	1 (0.08)
H. parva	0	51	0	0	0	0	0	0	20	31	51 (4.22)
***Hy.* sp**	6	6	0	0	0	0	0	1	11	0	12 (0.99)
O. lahorensis	0	0	0	0	0	0	143	122	8	13	143 (11.83)
A. persicus	0	0	0	0	0	97	0	63	21	13	97 (8.02)
Total	137 (11.33)	670 (55.41)	79 (6.53)	72 (5.95)	11 (0.90)	97 (8.02)	143 (11.82)	239 (19.77)	363 (30.02)	607 (50.21)	1209 (100)

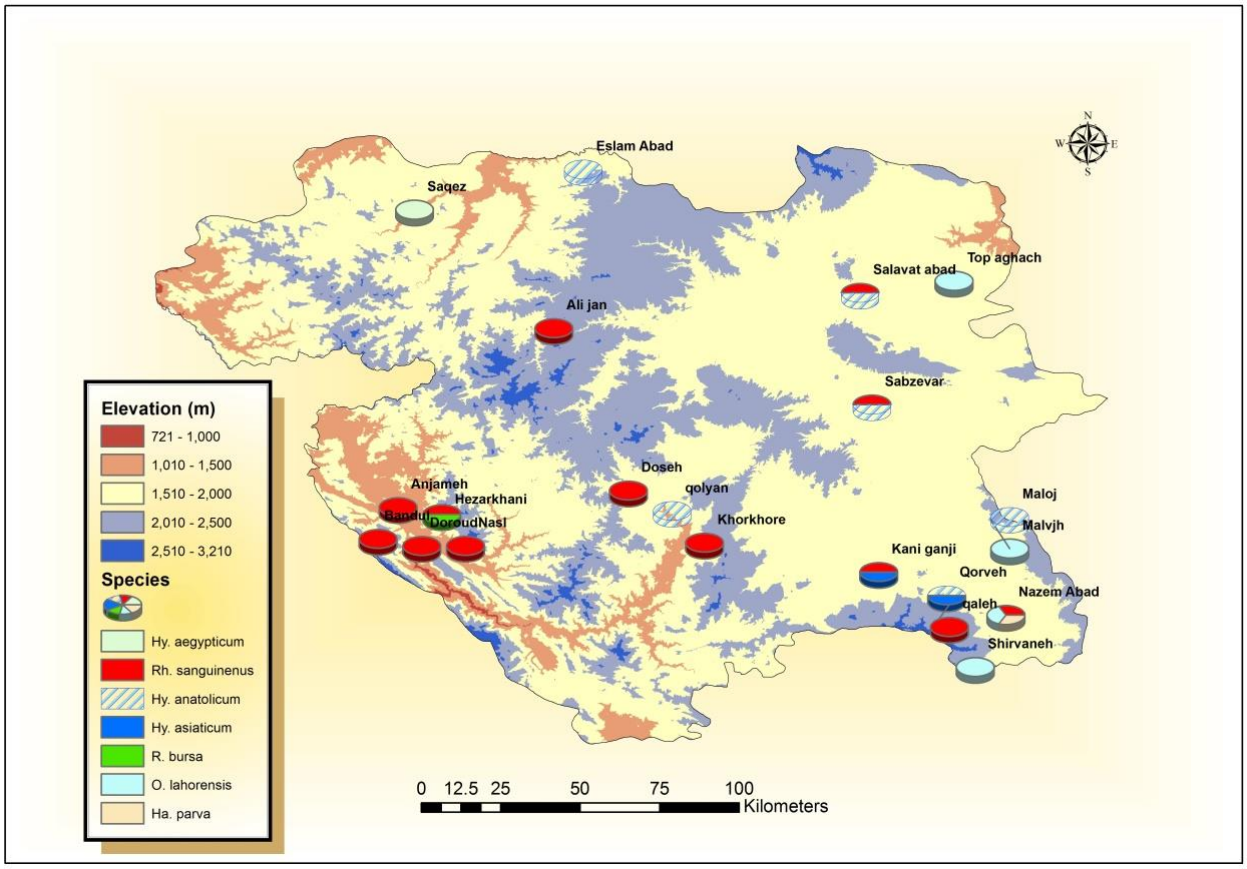

Fig. 2. Spatial distribution of livestock ticks in different altitudinal categories of Kurdistan Province of Iran, 2012-2013

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Table 2. Spatial distribution of ticks collected from the study area, Kurdistan Province of Iran, 2012–2013 (+: Collected,-: Not collected)

County	Village	X	Y	Host	*Hy. aegyptium*	*Rh. sanguineus*	*Hy. anatolicum*	*Hy.asiaticum*	*R.bursa*	*O. lahorensis*	*Ha.parva*
Bijar	Khorkhore	47.1094	35.3086	Sheep	-	+	-	-	-	-	-
Bijar	Sabzevar	47.5833	35.7	Sheep	-	+	+	-	-	-	-
Bijar	Bijar-salavatabad	47.55	36.0166	Sheep	-	+	-	-	-	-	-
Bijar	Salavatabad	47.55	36.0166	Cow	-	-	+	-	-	-	-
Bijar	Salavatabad	47.55	36.0166	Cow	-	-	+	-	-	-	-
Bijar	Salavatabad	47.55	36.0166	Goat	-	+	-	-	-	-	-
Bijar	Top aghach	47.8161	36.0508	Sheep	-	-	-	-	-	+	-
Bijar	Top aghach	47.8161	36.0508	Sheep	-	-	-	-	-	+	-
Qorveh	qaleh	47.4810	35.0803	sheep	-	+	-	-	-	-	-
Qorveh	Maloj	47.9733	35.2922	sheep	-	-	+	-	-	-	-
Qorveh	Kaniganji	47.3611	35.1332	Sheep	-	-	-	+	-	-	-
Qorveh	Kaniganji	47.3611	35.1332	Sheep	-	+	-	-	-	-	-
Qorveh	Qorveh	47.7951	35.1594	Goat	-	-	+	+	-	-	-
Qorveh	Qorveh	47.7951	35.1594	Sheep	-	-	-	-	-	-	-
Qorveh	Malvjh	47.9733	35.2922	Goat	-	-	-	-	-	+	-
Qorveh	Nazem Abad	47.9625	35.1038	Sheep -Goat	-	-	-	-	-	-	+
Qorveh	Nazem Abad	47.9625	35.1038	Sheep -Goat	-	-	-	-	-	+	-
Qorveh	Nazem Abad	47.9625	35.1038	Sheep -Goat	-	+	-	-	-	-	-
Qorveh	Shirvaneh	47.8755	34.9566	Goat	-	-	-	-	-	+	-
Sanandaj	Ali jan	46.6833	35.9166	Sheep	-	+	-	-	-	-	-
Sanandaj	Doseh	46.8955	35.4566	sheep	-	+	-	-	-	-	-
Sanandaj	qolyan	47.0106	35.2355	sheep	-	-	+	-	-	-	-
Saqez	Saqez	46.2892	36.2523	Turtle	+	-	-	-	-	-	-
Saqez	Eslam Abad	46.7666	36.3666	Sheep	-	-	+	-	-	-	-
Sarvabad	Anjameh	46.35	35.3666	Goat	-	+	-	-	-	-	-
Sarvabad	Anjameh	46.35	35.3666	Cow	-	+	-	-	-	-	-
Sarvabad	Bandul	46.1535	35.1911	Sheep	-	+	-	-	-	-	-

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Table 2. Continued …

Sarvabad	Doroud	46.3533	35.2994	Sheep /♀	-	+	-	-	-	-	-
Sarvabad	Doroud	46.3533	35.2994	lamb/ ♀	-	+	-	-	-	-	-
Sarvabad	Hezarkhani	46.3666	35.35	Sheep /♀	-	+	-	-	+	-	-
Sarvabad	Hezarkhani	46.3666	35.35	Sheep /♀	-	+	-	-	-	-	-
Sarvabad	Hezarkhani	46.3666	35.35	Goat /♀	-	+	-	-	-	-	-
Sarvabad	Hezarkhani	46.3666	35.35	lamb/ ♀	-	+	-	-	-	-	-
Sarvabad	Nasl	46.4333	35.3	Sheep /♀	-	+	-	-	-	-	-
Sarvabad	Nasl	46.4333	35.3	Sheep /♀	-	+	-	-	-	-	-
Sarvabad	Nasl	46.4333	35.3	sheep /♂	-	+	-	-	-	-	-
Sarvabad	Nasl	46.4333	35.3	Cow/ ♀	-	+	-	-	-	-	-
Sarvabad	Nasl	46.4333	35.3	Sheep	-	+	-	-	-	-	-
Sarvabad	Nasl	46.4333	35.3	Sheep /♀	-	+	-	-	-	-	-

Discussion

Ticks are considered as ectoparasites, living by hematophagy on the blood of mammals, birds, and sometimes reptiles and amphibians. About 10% of Ixodidae (hard ticks) and Argasidae (soft ticks) are vectors of a number of diseases that affect both humans and other animals. As ticks are important vectors of diseases; they are subject of many studies in Iran. Due to former investigations, there is limited information about distribution of tick infestation in Kurdistan Province.

In most regions of Iran, the dominant tick genera responsible for infestation belong to *Hyalomma, Rhipicephalus*, *Haemaphysalis*, and *Ixodes* (30). In this investigation, we could collect three of the aforementioned genera except for *Ixodes* but also we collected some species of genera *Argas* and *Ornithodoros* too.

We collected 1209 ticks. Most of the collected ticks were male (50.21%) (Table 1). Our survey revealed that the most occurrences of ticks were observed on sheep (55.41%). The identification of collected ticks also revealed that the occurrence of ticks on cows, goats, lambs, turtles and obscure hosts were 11.33%, 6.53%, 5.95%, 0.9% and 11.82% respectively. As haemoparasitic diseases are considered as a major problem to efficient sheep production in Iran due to theileriosis and babesiosis, it has important role (30). The major tick genera found on sheep and goats are mostly *Hyalomma*, *Rhipicephalus*, *Haemaphysalis* and *Ixodes* (30). Our investigation revealed the presence of all species of ticks except *Hy. marginatum* and *Hy. aegyptium* on sheep. Due to high prevalence of tick specimens and variety of collected species of sheep, the vaccination of sheep and control of tick vectors are recommended.

An investigation in Kurdistan region in Iraq was carried out (22). Three genera species were collected and identified on cattle. The highest prevalence was observed in *Boophilus* sp. followed by *Hyalomma* sp. and *Rhipicephalus* sp. (22). We could not detect any *Boophilus* species, but we found *R. sanguineus* and *Hy. anatolicum* on cows. These findings are in concordance with the mentioned investigation (22).

Our investigation shows the presence of 9 species: *R. sanguineus* (60.05%), *R. bursa* (0.08), *Argas persicus* (8.02), *Ornithodoros lahorensis* (11.83), *Hy. marginatum* (0.08), *Hy. asiaticum* (1.49), *Hy. anatolicum* (12.33), *Hy. aegyptium* (0.91), *Ha. parva* (4.22) and *Hyalomma* sp. (0.99) in the province. *R. sanguineus* was the most collected tick sample (726/1209), also, these species were found on all hosts except turtles (Table 1). *Rh. sanguineus* (brown dog tick) is considered as the most widespread ixodid tick, colonizing both human and animals (31). *R. Sanguineus* species are very resistant to heat and moisture deficits (32). This species is able to transmit pathogens like *Ehrlichia canis* to dog (33). They can participate in the epidemiology of canine visceral leishmaniasis (34) and spotted fever group rickettsia (35). Some other Ehrlichia associated species in *R. sanguineus* are *E. ewingii*, and *E. chaffeensis* (36).

The brown dog tick is also able to transmit *Rickettsia ricksettsii*, causing Rocky Mountain Spotted Fever (37), *Rickettsia conorii*, which is the bacteria responsible for causing Mediterranean spotted fever as well as *Rickettsia massiliae* (38) and *R. massiliae* (39). *Rhipicephalus sanguineus* is also reported to transmit *Hepatozoon canis* (40) as well as *Babesiacanis* (41).

Conclusion

Ticks contamination has been detected in a variety of livestock in the Kurdistan region, also the variety of ticks is abundant. The *Ornithodoros* and *Hyalomma* are more important than carriers of known diseases in the Kurdi-

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stan, including Crimean Congo hemorrhagic fever (CCHF) and tick-borne relapsing fever (TBRF).

Regarding the high contamination of livestock, the presence of disease and borderline province, the importance of the vector control in Kurdistan is more evident, as well as the necessity of further research, especially on the movement of livestock and ticks, as well as the resistance of ticks to the pesticide.

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References

1. Burt FJ, Goedhals D (2015) Crimean-Congo haemorrhagic fever virus, an emerging and re-emerging pathogen. In zoonoses-infections affecting humans and animals. Springer Netherlands. pp. 977–996.
2. de la Fuente J, Estrada-Pena A, Venzal JM, Kocan KM, Sonenshine DE (2008) Overview: Ticks as vectors of pathogens that cause disease in humans and animals. Front Biosci. 13: 6938–6946.
3. Balashov Y S (1967) Blood-sucking ticks (Ixodoidea)-vectors of diseases of man and animals. Krovososushchie kleshchi (Ixodoidea)-perenoschiki boleznei cheloveka i zhivotnkh. p. 147.
4. Telmadarraiy Z, Chinikar S, Vatandoost H, Faghihi F, Hosseini-Chegeni A (2015) Vectors of Crimean Congo hemorrhagic fever virus in Iran. J Arthropod Borne Dis. 9(2): 137–143.
5. Jafarbekloo A, Vatandoost H, Davari A, Faghihi F, Bakhshi H, Ramzgouyan MR, Nasrabadi M, Telmadarraiy Z (2014) Distribution of tick species infesting domestic ruminants in borderline of Iran-Afghanistan. J Biomed Sci Eng. 7(12): 982–986.
6. Biglari P, Chinikar S, Belqeiszadeh H, Telmadarraiy Z, Mostafavi E, Ghaffari M, Shahhosseini N (2016) Phylogeny of tick-derived Crimean-Congo hemorrhagic fever virus strains in Iran. Ticks Tick Borne Dis. 7(6): 1216–1221.
7. Ghashghaei O, Nourollahi-fard SR, Khalili M, Sharifi H (2016) A survey of ixodid ticks feeding on cattle and molecular detection of *Coxiella burnetii* from ticks in Southeast Iran. Turkish J Vet Animal Sci. 41(1) : 46–50.
8. Filippova N, Neronov V, Farhang-Azad A (1976) Data on Ixodid tick fauna (Acarina, Ixodidae) of small mammals in Iran. Ent Obozr. 55(2): 467–479.
9. Razmi G, Glinsharifodini M, Sarvi S (2007) Prevalence of Ixodid ticks on cattle in Mazandaran Province, Iran. Korean J Parasitol. 45(4): 307–310.
10. Razmi G, Naghibi A, Aslani M, Dastjerdi K, Hossieni H (2003) An epidemiological study on Babesia infection in small ruminants in Mashhad suburb, Khorasan Province, Iran. Small Ruminant Res. 50(1): 39–44.
11. Daftari M, Nourmohamadi Z, Chinikar S, Telmadarraiy Z (2015) Seasonal distribution of CCHF vectors in Khouzistan Province, Iran during 2013–2014. Archives Med Lab Sci. 1(2): 13–18.
12. Nabian S, Rahbari S, Shayan P, Haddadzadeh H (2007) Current status of tick fauna in north of Iran. Iran J Parasitol. 2(1): 12–17.
13. Telmadarraiy Z, Ghiasi SM, Moradi M, Vatandoost H, Eshraghian MR, Faghihi F, Zarei Z, Haeri A, Chinikar S (2010) A survey of Crimean-Congo haemorrhagic fever in livestock and ticks in Ardabil Province, Iran during 2004–2005. Scandinavian J Infectious Dis. 42(2): 137–141.

14. Telmadarraiy Z, Bahrami A, Vatandoost H (2004) A survey on fauna of ticks in West Azerbaijan Province, Iran. Iran J Public Health. 33(4): 65–69.
15. Abadi YS, Telmadarraiy Z, Vatandoost H, Chinikar S, Oshaghi M, Moradi M, Ardakan EM, Hekmat S, Nasiri A (2010) Hard ticks on domestic ruminants and their seasonal population dynamics in Yazd Province, Iran. Iran J Arthropod Borne Dis. 4(1): 66–72.
16. Loui Monfared A, Mahmoodi M, Fattahi R (2015) Prevalence of ixodid ticks on cattle, sheep and goats in Ilam County, Ilam Province, Iran. J Parasit Dis. 39 (1): 37–40.
17. Ghashghaei O, Fard SRN, Khalili M, Sharifi H (2016) Abundance and associated risk factors of ixodid ticks (Acari: Ixodidae) collected from one-humped camels (*Camelus dromedarius*) in Sistan and Balouchestan region, southeast of Iran. Persian J Acarol. 5(3): 219–227.
18. Rashtibaf M, Najarnejad V, Razmi G (2016) Determination the frequency of Ixodid ticks on the sheep in Khorasan Razavi Province, Iran. Arch Razi Inst. 66(2): 129–132.
19. Tajedin L, Bakhshi H, Faghihi F, Telmadarraiy Z (2016) High infection of Anaplasma and *Ehrlichia* spp. among tick species collected from different geographical locations of Iran. Asian Pacific J Trop Dis. 6(10): 787–792.
20. Banafshi O, Rafinezhad J, Esmaeilnasab N (2004) Faunistic investigation on soft ticks and infection of *Ornithodoros tholozani* to *Borrelia persica* in Bijar, Kurdistan Province, Iran 2003. Sci J Kurdistan Univ Med Sci. 7(331): 50–58.
21. Fakoorziba MR, Golmohammadi P, Moradzadeh R, Moemenbellah-Fard MD, Azizi K, Davari B, Alipour H, Ahmadnia S, Chinikar S (2012) Reverse transcription PCR-based detection of Crimean-Congo hemorrhagic fever virus isolated from ticks of domestic ruminants in Kurdistan Province of Iran. Vector Borne Zoonotic Dis.. 12(9): 794–799.
22. Mustafa BH, Faraj H (2013) Resistance of hard tick (Ixodidae) with some acaricide in cattle (naturally infestation) in sulaimani governorate fields-Kurdistan regional/Iraq. J Agr Sci Tech. 3(11): 927–934.
23. Nabian S, Mirsalimi S (2002) First report of presence of *Hyalomma aegyptium* tick from *Testudo graeca* turtle in Iran. J Faculty Vet Med. 59(1): 61–63.
24. Tavassoli E, Rahimi-Asiabi N, Tavassoli M (2007) *Hyalomma aegyptium* on spur-thighed tortoise (Testudo graeca) in Urmia Region West Azerbaijan, Iran. Iran J Parasitol. 2(2): 40–47.
25. Shahhosseini N, Jafarbekloo A, Telmadarraiy Z, Chinikar S, Haeri A, Nowotny N, Faghihi F (2017) Co-circulation of Crimean-Congo Hemorrhagic Fever virus strains Asia 1 and 2 between the border of Iran and Pakistan. Heliyon. 3(11): e00439.
26. Telmadarraiy Z, Saghafipour A, Farzinnia B, Chinikar S (2012) Molecular detection of Crimean-Congo Hemorrhagic fever virus in ticks in Qom Province, Iran, 2011–2012. Iran J Virol. 6(3): 13–18.
27. Mojtahed-Zadeh P (2007) Boundary politics and international boundaries of Iran. a study of the origin, evolution, and implications of the boundaries of modern iran with its 15 neighbors in the middle east, the persian gulf, the caucasus, the caspian sea, central asia, and west asia by a number of renowned experts in the field, Universal-Publishers. p. 359.
28. Janbakhsh B (1957) A research review about ticks responsible for relapsing fever in Iran. J Faculty Hlth Institute Public Hlth Res. 484: 223–230.
29. Walker AR, Bouattour A, Camicas JL, Estrada-Peña A, Horak IG, Latif AA,

Pegram RG, Preston PM (2003) Ticks of domestic animals in Africa: a guide to identification of species. Bioscience Reports, Edinburgh. p. 227.
30. Hashemi-Fesharki R (1997) Tick-borne diseases of sheep and goats and their related vectors in Iran. Parassitologia. 39 (2): 115–117.
31. Gray J, F. Dantas-Torres A, Estrada-Peña, Levin M (2013) Systematics and ecology of the brown dog tick, *Rhipicephalus sanguineus*. Ticks Tick Borne Dis. 4(3): 171–180.
32. Yoder JA, Hedges BZ, Tank JL, Benoit JB (2009) Dermal gland secretion improves the heat tolerance of the brown dog tick, *Rhipicephalus sanguineus*, allowing for their prolonged exposure to host body temperature. J Therm Biol. 34(5): 256–265.
33. Groves M, Dennis G, Amyx, Huxsoll D (1975) Transmission of *Ehrlichia canis* to dogs by ticks (*Rhipicephalus sanguineus*). Am J Vet Res. 36(7): 937–940.
34. Coutinho M, Bueno L, Sterzik A, Fujiwara RT, Botelho JR, De Maria M, Genaro O, Linardi PM (2005) Participation of *Rhipicephalus sanguineus* (Acari: Ixodidae) in the epidemiology of canine visceral leishmaniasis. Vet Parasitol. 128(1): 149–155.
35. Burgdorfer W, Sexton D, Gerloff R, Anacker R, Philip R, Thomas L (1975) *Rhipicephalus sanguineus*: vector of a new spotted fever group rickettsia in the United States. Infect Immun. 12(1): 205–210.
36. Murphy GL, Ewing, LS, Whitworth C, Fox JC, Kocan AA (1998) A molecular and serologic survey of *Ehrlichia canis*, *E. chaffeensis*, and *E. ewingii* in dogs and ticks from Oklahoma. Vet Parasitol. 79(4): 325–339.
37. Dantas-Torres F (2007) Rocky mountain spotted fever. Lancet Infect Dis. 7(11): 724–732.
38. Parola P, C D, Paddock Raoult D (2005) Tick-borne rickettsioses around the world: emerging diseases challenging old concepts. Clin Microbiol Rev. 18(4): 719–756.
39. Eremeeva ME, Bosserman EA, Demma LJ, Zambrano ML, Blau DM, Dasch GA (2006) Isolation and identification of *Rickettsia massiliae* from Rhipicephalus sanguineus ticks collected in Arizona. Appl Environ Microbiol. 72(8): 5569–5577.
40. Baneth G, Samish M, Alekseev E, Aroch I, Shkap V (2001) Transmission of Hepatozoon canis to dogs by naturally-fed or percutaneously-injected *Rhipicephalus sanguineus* ticks. J Parasitol. 87(3): 606–611.
41. Dantas-Torres F (2008) The brown dog tick, *Rhipicephalus sanguineus* (Latreille, 1806) (Acari: Ixodidae): from taxonomy to control. Vet Parasitol. 152(3): 173–185.

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