Research Article

Prevalence and Association of Hard Ticks (Ixodidae) with Various Breeds of Sheep and Goats

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Abstract | Pakistan has agricultural land and livestock play a significant part particularly to raise the living standard of poor farmer's communities. Ectoparasites are one of the greatest dangers to livestock and among ectoparasites, ticks are the most common one. The current study was completed in district Quetta, Balochistan, Pakistan to determine the tick infestation in different breeds of goat and sheep. A total of 840 animals were investigated during the winter and summer seasons to determine ticks prevalence. The overall prevalence of tick infestation in the sheep and goat population of the Quetta district was 12.26%. Five species of ticks i.e. *Ixodes* (3.98%), *Haemaphysalis* (1.90%), *Hyalomma* (7.38%), *Rhipicephalus* (7.14%), and *Boophilus* (2.62%) were prevalent in the study area. A non-significant association ($P > 0.05$) of tick infestation with sheep and goat breeds was found in the present study. The highest prevalence of ticks was found in animals of 1-2 years of age (15.79%), followed in order by less than one year (11.44%), and 2-3 years (9.06%) of age. Females (15.56%) were found more prone to tick infestation than males (9.20%). The tick infestation was significantly ($P < 0.05$) higher in summer (18.81%) as compared to winter (5.71%). Among breeds of sheep, the highest prevalence of tick infestation was found in Bibrik sheep (13.60%), followed in order by Afghani sheep (12.50%), Balochi sheep (12.50%) and Harnai sheep (10.00%). The Khurasani goat (15.15%) showed higher infestation as compared to Lehri goat (11.85%) and Sindhi goats (10.00%). It is concluded that the different breeds of sheep and goats were equally susceptible to tick infestation and there were no association of tick infestation with sheep and goat breeds however, the prevalence of ticks was significantly higher in summer than winter.

Keywords | Epidemiology, Ticks, Seasons, Small ruminants, Quetta

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INTRODUCTION

Ectoparasites (Insecta and Arachnida) are a common risk to the livestock economy by infecting about 20-80% population around the world. Ectoparasites depend on the host for shelter, food and other fundamentals for their survival and are mainly present on the skin and outgrowth of the skin (Rechav and Nutall, 2000). Ectopara-

sites directly affect the livestock production and living of animals (Sajid et al., 2020). Ticks are the blood-sucking ectoparasites infecting chordates counting in mammals, reptiles, amphibians and birds. The transmission of diseases in humans and animals is carried out by approximately of 10% species of hard and soft ticks (Jongejan and Uilenberg, 2004). Food and Agriculture Organization (FAO) reported that tick infestation is responsible for 7 billion US $ losses globally (Harrow et al., 1991).

Tick affects the animals by causing damage to hide (moderating 20-30% of its features), toxin production, weight loss, reduced milk production and stunted growth (Gharbi et al., 2006). Ticks are also responsible for the transmission of viruses, bacteria, protozoan and viral diseases like anaplasmosis, babesiosis, theileriosis, ehrlichiosis and Crimean Congo hemorrhagic fever in dairy and meat animals (Rajput et al., 2006). Tropical and subtropical areas are mostly affected by these diseases where the climate is suitable for the development and growth of ticks. The condition is worse in these countries due to the unavailability of control practices (Sajid et al., 2017; 2020).

Many species of ticks were recorded to be prevalent in sheep and goats in Baluchistan. *Hyalomma (Euhyalomma) schulzei* was reported and re-described for the first time in Balochistan (Kakarsulemankhel, 2011). *Hyalomma (H.) aegyptium*, *H. anatolicum* and *Haemaphysalis flava* are tick species that areresponsible for the transmission of the Congo virus in animals (Rizwan et al., 2019). Two hard tick species viz *H. anatolicum* and *H. aegyptium* were reported from different localities including, Loralai, Sibi, Noshki, Qallat, and Harnai (Rafiq et al., 2015). Many breeds of sheep including Baluchi, Harnai, Rakhshani and Bibrik in Balochistan were infested with *Haemaphysalis flava* (Khan, 2000). Keeping in view the importance of ticks like the risk of tick-borne diseases, and production losses, the present study was planned to explore the prevalence of ticks in sheep and goat populations and the distribution of ticks in different breeds of sheep and goats in the district Quetta, Balochistan, Pakistan.

MATERIALS AND METHODS

Study Area and Animal Sampling

Balochistan is the biggest province of Pakistan covers a 350,000 sq. km area. Its capital is Quetta and is in 29° 48" 40' to 30° 28" 4' north latitude and 66° 14" 37' to 67° 17" 3' east longitude. During winter and summer seasons, various breeds of sheep (Bibrik, Harnai, Balochi, Shinwar-Afghani) and goats (Lehri, Patari and Khurasani), with different age groups that are less than one year, one to two years and two to three years of either sex were examined for the absence and presence of ticks. The study was approved by the ethical committee of Sardar Bahadur Khan Women's University, Quetta, Balochistan. The standard guidelines for animal care were followed in this study.

Collection and Identification of Ticks

From infected goats and sheep, ticks were collected for physical examination and then placed in clean dried plastic bottles and labeled properly. For further processing, the tick samples were sent to the laboratory of SBK Women's University, Department of Zoology. Ticks were preserved in 70% ethyl alcohol. Under stereo microscope identification of ticks was done by observing their morphology with taxonomic keys (Walker et al., 2003). For proper identification and conformation some samples were sent to the Islamabad NARC (National Agricultural Research Centre) laboratory.

Statistical Analyses

For data analysis Statistics version 8.1 was used after entering proper data into the Microsoft spreadsheet along with appropriate coding. Descriptive analyses were performed to determine the prevalence of ticks in goats and sheep. The Chi-square test was used for determining the risk factors (sex, breed, age) and the existence of tick distribution. The confidence interval was found to be 95% for significance and prevalence ($P < 0.05$) was settled for all the cases.

RESULTS

The overall prevalence of tick infestation in the sheep and goat population of the Quetta district was 12.26%. A non-significant association ($P > 0.05$) of tick infestation with sheep and goat breeds was found in the present study. The highest prevalence of ticks was found in animals of 1-2 years of age (15.79%), followed in order by less than one year (11.44%) and 2-3 years (9.06%) of age. Females (15.56%) were found more prone to tick infestation than males (9.20%). Among breeds of sheep, the highest prevalence of tick infestation was found in Bibrik sheep (13.60%), followed in order by Afghani sheep (12.50%), Balochi sheep (12.50%) and Harnai sheep (10.00%). Khurasani goat (15.15%) showed higher infestation as compared to Lehri goat (11.85%) and Sindhi goats (10.00%). The tick infestation was significantly ($P < 0.05$) higher in summer (18.81%) compared to winter (5.71%). Five species of ticks i.e. *Ixodes* (3.98%), *Haemaphysalis* (1.90%), *Hyalomma* (7.38%), *Rhipicephalus* (7.14%) and *Boophilus* (2.62%), were prevalent in the study area.

During winter tick infestation was higher in sheep (6.49%) than goats (4.76%). Among breeds Afghani sheep (9.62%) showed a higher prevalence while Sindhi goat (1.79%) showed the lowest prevalence. *Rhipicephalus* (3.81%) was

Table 1: Frequency distribution of ticks in sheep and goats during winter

Levels		Total animals		Ticks prevalence (%)					Chi-square	P-Value
		Examined	Infected No. (%)	Hyalomma	Boophilus	Rhipicephalus	Haemaphysalis	*Ixodes*		
Breeds	Balochi sheep	48	3 (6.25)	4.17	0.00	6.25	0.00	2.08	3.347	0.647
	Bibrik sheep	61	3 (4.92)	1.64	1.64	3.28	1.64	1.64		
	Harnai sheep	70	4 (5.71)	2.86	1.43	4.29	1.43	2.86		
	Afghani sheep	52	5 (9.62)	3.85	0.00	3.85	1.92	1.92		
	Khurasani goat	69	5 (7.25)	4.35	1.45	5.80	0.00	1.45		
	Lehri goat	64	3 (4.69)	3.13	0.00	1.56	1.56	1.56		
	Sindhi goats	56	1 (1.79)	1.79	0.00	1.79	0.00	0.00		
	Total	420	24 (5.71)	3.10	0.71	3.81	0.95	**1.67**		
Age (Year)	1	143	8 (5.59)	2.80	0.70	3.50	0.70	1.40	2.812	0.245
	1-2	152	12 (7.89)	4.61	1.32	5.26	1.97	2.63		
	2-3	125	4 (3.20)	1.60	0.00	2.40	0.00	0.80		
	Total	420	24 (5.71)	3.10	0.71	3.81	0.95	**1.67**		
Sex	Male	195	8 (4.10)	2.56	0.51	2.56	0.51	1.03	1.755	0.185
	Female	225	16 (7.11)	3.56	0.89	4.89	1.33	2.22		
	Total	420	24 (5.71)	3.10	0.71	3.81	0.95	**1.67**		

Table 2: Frequency distribution of ticks in sheep and goats during summer

Levels		Total animals		Ticks prevalence (%)					Chi-square	P-Value
		Examined	Infected No. (%)	Hyalomma	Boophilus	Rhipicephalus	Haemaphysalis	*Ixodes*		
Breeds	Balochi sheep	56	10 (17.86)	12.50	7.14	14.29	3.57	5.36	2.615	0.855
	Bibrik sheep	64	14 (21.88)	14.06	3.13	9.38	1.56	7.81		
	Harnai sheep	60	9 (15.00)	8.33	3.33	11.67	1.67	3.33		
	Afghani sheep	52	8 (15.38)	7.69	5.77	9.62	3.85	1.92		
	Khurasani goat	63	15 (23.81)	14.29	7.94	11.11	4.76	6.35		
	Lehri goat	71	13(18.31)	14.08	2.82	9.86	1.41	4.23		
	Sindhi goats	54	10 (18.52)	9.26	1.85	7.41	3.70	11.11		
	Total	420	79 (18.81)	11.67	4.52	10.48	2.86	**5.71**		
Age (Year)	1	128	23 (17.97)	11.72	4.69	10.94	2.34	5.47	4.563	0.102
	1-2	152	36 (23.68)	15.13	5.26	13.82	3.95	7.89		
	2-3	140	20 (14.29)	7.86	3.57	6.43	2.14	3.57		
	Total	420	79 (18.81)	11.67	4.52	10.48	2.86	**5.71**		
Sex	Male	240	32 (13.33)	8.33	2.92	7.50	1.67	3.75	0.448	0.503
	Female	180	47 (26.11)	16.11	6.67	14.44	4.44	8.33		
	Total	420	79 (18.81)	11.67	4.52	10.48	2.86	**5.71**		

the most prevalent species of tick in small ruminants of district Quetta. During summer, out of 232 sheep, 41 (17.67%) and out of 188 goats, 38 (20.21%) were found positive for tick infestation. Khurasani goat breed (23.81%) was a highly infested breed, while Harnai sheep (15.00%) showed the lowest prevalence. Among species of ticks, *Hyalomma* (11.67%) was the most prevalent in small ruminants. The frequency distribution of ticks in the sheep and goat population of district Quetta during winter and summer is given in Tables 1 and 2 respectively.

DISCUSSION

Ticks are prevalent in many developing countries of Asia. The study in Baluchistan revealed the most abundant tick species *Boophilus* sp. (61.67%), followed by *Haemaphysalis* sp. (30.0%) and *Hyalomma sp.* (8.33%) (Noor et al., 2016). The most prevalent tick species in India was reported to

be *Haemaphysalis bispinosa* (100%), along with *Hyalomma marginatum isaaci* (7.29%), *Rhipicephalus haemaphysaloides* (3.13%) and *H. anatolicum anatolicum* (2.08%). The abundance of ticks in these countries is higher than in Europe (Hostis and Seegers, 2002) and Australia (Mustafa et al., 2014). Extensive research on tick prevalence and the related risk factors was carried out in different districts of Pakistan (Sultana et al., 2015; Sajid et al., 2017; 2020). Ticks act as a vector for many protozoal, viral and bacterial diseases, so the study on tick prevalence and risk factors plays a crucial role in planning control strategies (Dantas-Torres, 2012). Many threatening factors associated with tick-borne infections observed and reported globally including changing environment, season, habitat, presence of a host, humidity, rainfall, temperature and altitude (Cadenas et al., 2007; Greenfield et al., 2011; Sajid et al., 2017) breed, age, sex and nutritional status of the animal, pregnancy, lactation stage, husbandry practices and body condition (Sajid et al., 2011) and methods of application of acaricides (Bianchi et al., 2003).

Similar and different prevalence of tick species was also observed in different areas of Pakistan. *Haemaphysalis* (27.40%) followed by *Rhipicephalus* (21.92%) *Boophilus* (11.89%) and *Ixodes* (7.35%) reported by Shah et al. (2015) in Peshawar. In the goat population of Sargodha, the prevalence of *Hyalomma anatolicum* (31.56%), *Rhipicephalus* spp. (25.95%), *Haemaphysalis* spp. (21.07%), *Ixodes* spp. (15.46%), and *Ambylomma* spp. (5.93%) was reported by Manan et al. (2007). In Goat population of Dera Ismail Khan and Lakki Marwat of Northern, only *Boophilus* were observed while in sheep *Hyalomma* (33.3%) was reported by Perveen (2011). In Muzaffargarh of the lower Punjab *Hyalomma* 42.7%, *Rhipicephalus* (37.6%) by Sajid et al. (2008) whereas, in Rawalpindi prevalence of *Hyalomma* (12%), *Boophilus* (8.1%), *Haemaphysalis* (5%) and *Rhipicephalus* (3.1%) determined by Durrani et al. (2008). *Hyalomma (Euhyalomma) schulzei* was observed and re-described first time in Balochistan by Kakarsulemankhel, (2011).

The present study was conducted in summer and winter, where the prevalence was 18.81% and 5.71% in the respective season. The same results were reported earlier by Riaz et al. (2017) who reported 77.7% in summer and 11.1% in winter. Sultana et al. (2017) reported 42.67% in winter and 66.67 % in summer, while Manan et al. (2007) reported 25.80% in summer and 6.73% in winter. The moist and warm environment in summer help ticks in their survival and as a result tick prevalence increased in the summer season (Ghosh et al., 2007).

In the current study, sheep and goats were found almost equally susceptible to tick infestation. The same results were described by Manan et al. (2007) from Peshawar with 12.0% prevalence in goats and 12.8% prevalence in sheep, by Irshad et al. (2010) from Lahore with 41.53% in goats and 43.37% in sheep, by Riaz et al. (2017) from Multan with 43.6% in goats and 50.0% in sheep and by Sajid et al. (2017) from Khyber Pakhtunkhwa with 72.05% in goats and 81.47% in sheep. But these results differ from Rehman et al. (2017) because they reported more prevalence of ticks in goats (60.0%) as compared to sheep (11.1%). Perveen (2011) reported a higher prevalence in goats (10.8%) as compared to sheep (4.1%).

This is the first study carried out in Baluchistan that exhibitedmore prevalence in Bibrik sheep (13.60%) followed in order by Afghani sheep (12.50%), Balochi sheep (12.50%) and Harnai sheep (10.00%). Khurasani goat (15.15%) showed higher infestation as compared to Lehri goat (11.85%) and Sindhi goats (10.00%). Riaz et al. (2017) reported the highest prevalence in Beetal goats (52.63%) followed in order by Lohi (51%), Kajli sheep (50.0%), Teddy goats (39.37%) and Nacchi goats (42.69%). *Haemaphysalis flava* was found infesting many breeds of sheep including Harnai, Bibrik, Rakhshani and Baluchi in Balochistan (Khan, 2000).

The results elaborated that female animals were more susceptible to tick infestation than males. Higher prevalence was described in many previous studies. Sultana et al. (2015) reported a 45.45% prevalence in females and 72.55% in males. Riaz et al. (2017) also reported the highest prevalence of ticks in females (48.52%) than males (45.16%). These results match with Sajid et al. (2017), who reported 66.44% prevalence in males and 80.33% in females. Hormones like estrogen and androgen had an inhibitory and stimulatory effect on immune responses which result in higher susceptibility of females than males (Bilbo and Nelson, 2001).

In the current study, the prevalence in animals of 1-2 years of age was found higher than young and adult animals. The prevalence was higher in summer than winter because the skin of animals is soft and plain and enables the ticks to attach more easily and for a longer period. These findings of Manan et al. (2007) showed more prevalence in young animals (15.8%) than in adults (13.9%). Sultana et al. (2015) reported 79.07% prevalence in young animals and 44.83% prevalence in adults. Similarly, Sajid et al. (2017) reported 85.67% prevalence in young animals and 66.44% in adults. However, these results did not match with Shah et al. (2015) who reported higher tick prevalence in adults (60%) than in young animals (40%).

CONCLUSION

It is concluded that the different species of ticks were prevalent in the study area. The association of tick infestation

with different breeds of sheep and goats was non-significant. The prevalence of tick infestation in different age groups and sexes was also found non-significant. However, the prevalence of tick infestation was significantly higher in summer than winter. Ticks act as a vector for many protozoal, viral, and bacterial diseases, so the study on tick prevalence and risk factors plays a crucial role in planning control strategies against ticks to improve the health of sheep and goats.

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CONFLICT OF INTEREST

The authors declare that they have no conflict of interest.

AUTHORS CONTRIBUTION

SS and AR conceived and planned the experiments. SS, GM, AS, RHAN and HMR contributed to sample preparation and carried out the experiments. HMR, MN and QA contributed to the interpretation of the results. SS and GM took the lead in writing the manuscript. AS and HMR contributed to the final version of the manuscript.

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