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## Collection, prevalence and identifying hard tick species among small ruminants in Southern Khyber Pakhtunkhwa, Pakistan

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Ticks are blood-feeding ectoparasites that transmit diseases to humans, domestic and wild animals. These carry several zoonotic diseases, including Crimean-Congo Haemorrhagic Fever (CCHF) and Lyme diseases. Livestock are an essential source of income and food for poor farmers and play key role in boosting rural economy of Pakistan. The purpose of the current research was to find out the prevalence and identify the tick species on small ruminants found in four well known districts of Pakistan including Dera Ismail Khan, Bannu, Lakki Marwat and Tank. To fill this aim, research study was performed from March 2020 to July 2021. A total of 4800 domestic animals (goats and sheep) were examined randomly to collect ticks and total of 3115 tick specimens were collected and identified morphologically to species level. Eleven tick species belong to four genera were identified, the identified tick species were *Dermacentor marginatus*, *D. silvarum*, *Hyalomma anatolicum*, *Hy. marginatum*, *Hy. excavatum*, *Hy. hussaini*, *Hy. rufipes*, *Haemaphysalus punctata*, *Ha. pinulosa*, *Rhipicephalus sanguineus* and *R. appendiculatus*. *Hyalomma anatolicum* was dominant species in these areas. Highest tick infestation was recorded in D.I.Khan (80.75%) followed by Bannu (63.08%), Lakki Marwat (36.00%) and Tank (23.00%). Maximum tick infestation was recorded in sheep (81.34%) and minimum in goats (50%) while tail was found more infested site for tick. The old and female animals were high loaded with tick species than male and young. Further studies related to tick species and proper control measures are required to control ticks distribution and burden in these study area.

**Keywords:** Ticks; Hyalomma; Livestock; Sothorn's areas; KP, Pakistan

### INTRODUCTION

Economy of Pakistan is dependent on agricultural products and livestock play key role in the development of economy in the form of wool, milk, meat, hides, skin and various other products (Ramzan et al. 2021; Rahman et al. 2022). Poor people rely primarily on livestock for their income in the country (Ramzan et al. 2018). The small ruminants (goats and sheep) are reared by small and large farmers to earn the revenue and mostly reared to scarify at Eid-UI-Izha in the country (Lawal-Adebowale,

2012). According to the economic survey of Pakistan in 2017–2018, total livestock population of the country consisted of goats (72.2 million) and sheep (30.1 million). Livestock population of the country is almost lower than other developing countries such as India and China due to various biotic and abiotic factors. Abiotic factors include climate change and biotic factors include ectoparasites and endoparasites (Farooqi et al. 2017; Karim et al. 2017).

Ticks as the main ectoparasites are becoming the main threat for livestock industry especially goats and

sheep production in Pakistan due to wide host range and climate change (Farzana et al. 2010). The mortality, low productivity and huge losses occurred by tick pathogens which transmit zoonotic diseases such as Lyme and CCHF to human and animals (wild and domestic). Ticks act as vector of many other contagious diseases such as theileriosis, babesiosis and rickettsial diseases throughout the world (Ramzan et al. 2021). Ticks and tick borne diseases are the major health problems limiting or restricting goats and sheep productivity in the country (Pakistan). Ticks are blood-feeding ectoparasites of tropical and subtropical vertebrates especially human, domestic animals, wild animals, birds, and reptiles world wide including Pakistan (Jabbar et al. 2015). Tick species have reported throughout the world but these tend to thrive more in countries with humid and warm climates which prove suitable sites for tick multiplication, growth and development. Among reported species, widely distributed species in the world are belonging to three genera such as *Rhipicephalus*, *Amblyomma* and *Hyalomma* (Rajput et al. 2006; Ramzan et al. 2020).

It has been reported that relationship between ticks fauna and host animals significantly affected due to various factors especially climate changes such as temperatures and humidity (Ramzan et al. 2018; Nasreen et al. 2020). Now a days, ticks have invaded those areas which were tick free before one year. The wide spread of ticks is due to the movements of humans and other animal including domestic and wild (Dantas-Torres, 2015).

Although tick species have documented from various areas of Pakistan (Rehman et al. 2017; Sajid et al. 2018; Khalil et al. 2018; Ghafara et al. 2020; Ramzan et al. 2019,2020; Rahman et al. 2022), but information's regarding tick species, prevalence and molecular phylogeny on small ruminants are still missing from the current study area of this country (Pakistan). Not a single study on the tick diversity, tick species and prevalence on small ruminants from Southern areas of country has been recorded. Keeping in mind the scarcity of data, the present study was conducted to look into the diversity, species and prevalence of ticks infesting goats and sheep in an important area in Southern areas of Pakistan where the economy is strongly reliant on livestock.

## MATERIALS AND METHODS

The current research was conducted in Southern areas of Pakistan including Dera Ismail Khan (DI Khan), Bannu, Lakki Marwat and Tank. Ticks collected randomly from different farms of these mentioned areas from March 2020 to July 2021. In the whole study period, 3115 specimens were collected from 4800 animals (2400 goat and 2400 sheep). Animals' dewlap, ear, hooves, brisket, tail, head, belly, back, neck, testes, thorax, and udder were all examined. Ticks were maintained in 70% Ethyl Alcohol at PARC Arid Zone Research Centre, DI Khan and sent to Veterinary Research & Disease Investigation Center Dera Ismail Khan for morphological identification

using several morphological keys under a stereomicroscope (Walker et al. 2014). These literatures guide the tick collecting and preservation process (Ica et al. 2007; Ramzan et al. 2020a, Jamil et al. 2021, 2022; Ullah et al. 2022).

## RESULTS AND DISCUSSION

The tick is an ectoparasite that feeds on the blood of vertebrates throughout the world, including birds, humans, reptiles and animals (Rajput et al. 2006; Ramzan et al. 2019; Jamil et al. 2021, 2022; Ullah et al. 2022). Kilpatrick et al. (2007) state that although they are cosmopolitan in distribution, they tend to occur in tropical and subtropical regions with humid and warm climates, which allow them to undergo metamorphosis. In addition to being a tropical country, Pakistani environment is favorable for tick growth (Ramzan et al. 2018) and distribution. Pakistan's rural population relies heavily on livestock, primarily goats and sheep, for food and livelihood. Majority of animals were found infested with tick burden in study areas of Pakistan.

Total 4800 animals including 2400 goats and 2400 sheep were scanned and 3115 tick specimens were randomly collected from different body parts of hosts. Overall, tick prevalence infestation was 50.70% for goat and sheep in different districts of the study area. Another report from Kemal et al. (2016) reported 93.8% infestation of ticks. Out of 1200 examined animals, 80.75%, 63.08%, 36.00% and 23.00% animals were infested in D.I.Khan, Bannu, Lakkimarwat and Tank, respectively (Table 1). Total eleven species belonging to four genera were collected and identified in the study area. The species which identified during the current study were *Dermacentor marginatus*, *D. silvarum*, *Hyalomma anatolicum*, *Hy. marginatum*, *Hy. excavatum*, *Hy. hussaini*, *Hy. rufipes*, *Haemaphysalus punctata*, *Ha. pinulosa*, *Rhipicephalus sanguineus* and *R. appendiculatus* (Table 2).

Kemal et al. (2016) had reported four hard tick species belonging to genera *Rhipicephalus* and *Amblyomma*. *Amblyomma cohaerens* was recorded dominant tick species while *Hy. anatolicum* reported most dominant tick species in the current study area. Our findings are similar to the previous researcher's findings. Ramzan et al. (2019; 2020) had reported seven tick species belonging to four genera such as *Hy. excavatum*, *Hy. anatolicum*, *Hy. dromedarii*, *R. microplus*, *R. sanguineus*, *D. marginatus* and *Hae. punctata*. *Hy. anatolicum* a dominant tick species on domesticated animals (small as well as large ruminants). The highest population of *Hy. anatolicum* was recorded while *D. silvarum* lowest. Among all identified species, *Hy. anatolicum* was dominant species in all study areas. Many other researchers had reported various tick species from different areas of the world (Adil et al. 2019; Soundararajan et al. 2018; Ali et al. 2015).

It was observed that females were highly infested with

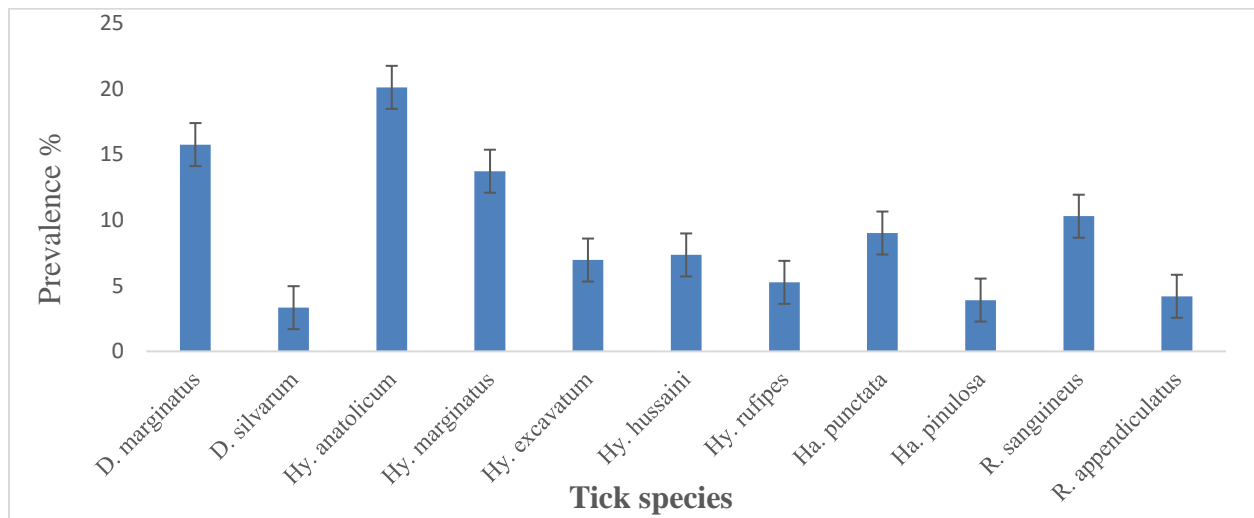
tick burden as compared to males and young animals weak health. were also recorded more resistant than old ones. The old animals were more susceptible to tick infection due to

**Table 1: Prevalence rates by area**

Location	Number of animals examined	Number of animals infested	Prevalence
D.I.Khan	1200	969	80.75%
Bannu	1200	757	63.08%
Lakki Marwat	1200	432	36.00%
Tank	1200	276	23.00%
<b>Total</b>	<b>4800</b>	<b>2434</b>	<b>50.70%</b>

**Table 2: Description of collected tick species from study area**

Tick species	Locations				Total
	D.I.K	Bannu	Lakkimarwat	Tank	
<i>D. marginatus</i>	Yes	No	Yes	Yes	491
<i>D. silvarum</i>	Yes	Yes	No	No	104
<i>Hy. anaticum</i>	Yes	Yes	Yes	Yes	627
<i>Hy. marginatus</i>	No	No	No	Yes	428
<i>Hy. excavatum</i>	Yes	Yes	Yes	No	217
<i>Hy. hussaini</i>	No	Yes	Yes	Yes	229
<i>Hy. rufipes</i>	Yes	No	No	Yes	164
<i>Ha. punctata</i>	yes	Yes	Yes	Yes	281
<i>Ha. pinulosa</i>	Yes	No	Yes	No	122
<i>R. sanguineus</i>	yes	Yes	Yes	Yes	321
<i>R. appendiculatus</i>	No	Yes	No	No	131
Total species	1078	943	596	398	3115



**Figure 1: Tick species prevalence in the study area**

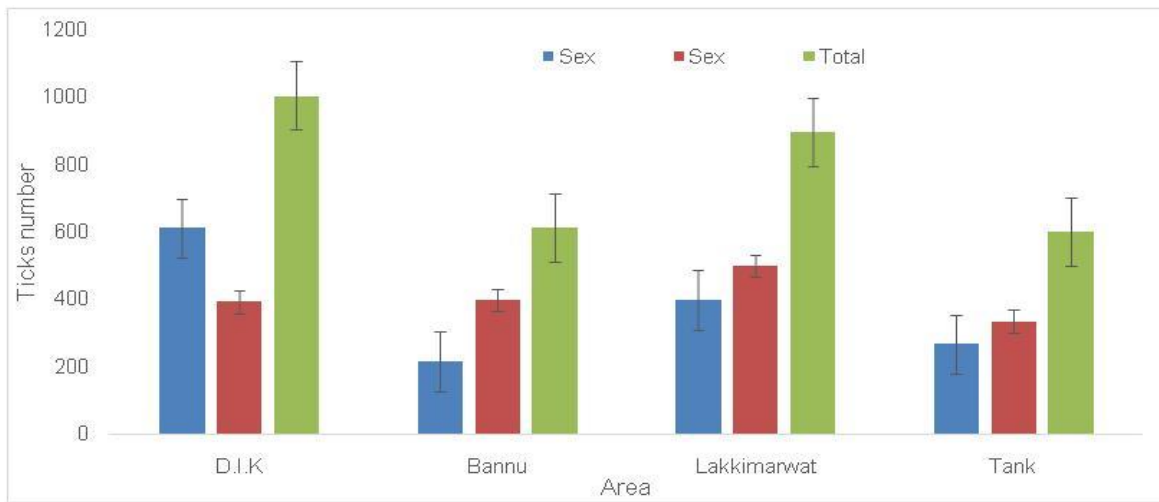


Figure 2: Sex wise prevalence of ticks found in study area

Table 3: Ticks collected, hosts, and sites of attachment on hosts observed in the study

Host	Tick species	Attachment sites
Goat	<i>Hy. anatolicum</i> , <i>Hy. marginatus</i> , <i>Hy. excavatum</i> , <i>Hy. rufipes</i> , <i>Ha. punctata</i> , <i>Ha. pinulosa</i> , <i>R. sanguineus</i>	neck, groin, perineum, dewlap, genitalia, udder, axilla, tail
Sheep	<i>D. marginatus</i> , <i>D. silvarum</i> , <i>Hy. anatolicum</i> , <i>R. sanguineus</i> , <i>R. appendiculatus</i>	axilla, groin, genitalia, legs, perineum, udder, tail

Table 4: Multiple tick species infesting the same host observed in the current study

Host	Multiple tick species
Goat	<i>Hyalomma anatolicum</i> , <i>Rhipicephalus sanguineus</i>
Sheep	<i>Hyalomma anatolicum</i> , <i>Rhipicephalus sanguineus</i>

Table 5: Infestation of different tick genera on various predilection sites of goat and sheep

Ruminants	Predilection sites	<i>Dermacentor</i> spp.	<i>Hyalomma</i> spp.	<i>Haemaphysalis</i> spp.	<i>Rhipicephalus</i> spp.	p-value
Goat	Ear	0.00	603.00	120.00	129.00	
	Udder	0.00	261.00	91.00	79.00	
	Tail	0.00	123.00	31.00	7.00	
	Neck	0.00	2.00	0.00	0.00	$P < 0.001^{***}$
	Genitalia	0.00	12.00	0.00	0.00	
	Dewlap	0.00	2.00	0.00	0.00	
	Thighs	0.00	1.00	0.00	0.00	
Sheep	Ear	417.00	421.00	104.00	124.00	
	Udder	31.00	129.00	45.00	100.00	
	Tail	121.00	111.00	12.00	13.00	
	Neck	9.00	0.00	0.00	0.00	$P < 0.001^{***}$
	Genitalia	17.00	0.00	0.00	0.00	
	Dewlap	0.00	0.00	0.00	0.00	
	Thighs	0.00	0.00	0.00	0.00	

\*\*\* = Highly significant. P value represents the outcome of Chi-square test.

The similar observations were seen by many authors in various countries including Pakistan (Kabir et al. 2011), while some scientists had reported young animals more susceptible to ticks (KhaliL et al. 2018). It was observed that tail of goats and sheep was highly infested with tick species as shown in table 3 while the previous studies recorded under the most preferable site (Tadesse et al. 2012).

*D. silvarum* and *Ha. pinulosa* were first time collected from domestic animals especially small ruminants in the areas of Pakistan. Before this study, only these were reported on domestic animals in Dera Ismail Khan (Ullah et al. 2022). *Hy. anatolicum* was recorded in highest prevalence while *D. silvarum* lowest recorded species as shown in figure 1. Our current study findings are in line with the previous researchers (Rehman et al. 2017; Sultana et al. 2015). It was recorded that *Hy. anatolicum*, *R. sanguineus* were usually distributed tick species on sheep and goats (Table 4). Nnabuiife et al. (2021) had reported that among seven tick species identified in the study *R. sanguineus* was dominant species with prevalence (54.5%). Predilection sites and tick species on goats and sheep had significant associations with prevalence of ectoparasites ( $p < 0.001$ ) as shown in table 5. Kassa et al. (2015) had investigated the similar results about age, body conditions and tick species as well as attachment sites. Abera et al. (2010) had observed no significant difference related to sex. Sex wise prevalence of tick species in different areas is shown in figure 2.

## CONCLUSION

Ticks are Ectoparasites of various mammals, human, birds, reptile and animals. They transmit a wide range of zoonotic diseases, including bacterial strains, zoonoses to humans, and animals (wild and domestic) and viral during blood feeding. The most contagious diseases that spread by ticks are Crimean-Congo Haemorrhagic Fever (CCHF) and Lyme diseases. They can be grouped into three categories Nuttalllellidae, Ixodidae and Argasidae. In Pakistan as well as other parts of the world, hard ticks are prevalent. The present study findings suggest the proper management strategies against such parasites.

## CONFLICT OF INTEREST

The authors declared that present study was performed in absence of any conflict of interest.

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## AUTHOR CONTRIBUTIONS

In this study, all authors contributed equally

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