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Full Length Article

Diversity and Species Composition of Ixodid Ticks in District Khyber, Khyber Pakhtunkhwa, Pakistan

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Abstract

Ticks are one of the neglected arthropod groups to be studied in Pakistan. The present study aims to determine the diversity and species composition of Ixodid ticks in District Khyber, Khyber Pakhtunkhwa, Pakistan. A total of 1,075 ticks were collected from 172 host animals (101 cows, 28 bulls, 14 calves, 19 goats, 5 sheep, 4 dogs and a human) at seven major localities from March 2020 to February 2021. After collection, the identification of ticks up to the species level was done using a specific key. Ten species of ticks belonging to two families, Argasidae and Ixodidae, were identified phenotypically. Argasidae was represented by only a single species, *Argas persicus*. Ixodidae was represented by two genera: *Rhipicephalus* and *Hyalomma*. The genus *Rhipicephalus* was represented by *R. microplus*, *R. sanguineus*, and *R. haemaphysaloides*, while genus *Hyalomma* was represented by *H. aegyptium*, *H. asiaticum*, *H. anatolicum excavatum*, *H. anatolicum anatolicum*, *H. marginatum* and *H. kumari*. *Rhipicephalus* ticks were more prevalent than *Hyalomma* ticks, and *R. microplus* was found throughout the year. The rate of tick infestation was highest among cows followed by bulls, goats, calves, dogs, sheep and human. The infestation was highest in March and July, and the anal region was the most severely infested body part. Hard ticks were more prevalent than soft ticks in the study area and were largely found in the livestock population. The distribution of Ixodid ticks was found to be widespread in all agro-climatic zones of District Khyber, Khyber-Pakhtunkhwa. The research provides a foundation for policymakers, livestock owners, and veterinary professionals to develop and implement preventive measures and education programs. By increasing awareness about tick diversity, proper livestock management practices and the importance of tick control, the well-being of livestock and the livelihoods of communities reliant on them can be significantly improved.

Keywords: Ticks; Ixodidae (Hard Ticks); Khyber; Diversity; Infestation; Genus; Family

Introduction

Ticks are obligate hematophagous arthropods that parasitize nearly all vertebrates except fishes (Fuente and Villar 2021). Taxonomically, ticks are categorized within the Phylum Arthropoda, Class Arachnida, Subclass Acari, Order Parasitiformes and Suborder Ixodida (Sonenshine 2018). Ixodida consists of three families, the Ixodidae or hard ticks (694 species), the Argasidae or soft ticks (177 species) and a single species represents the family Nuttalliellidae (Farooqi *et al.* 2017). On the basis of morphology, lifecycle four subfamilies were recognized including Amblyomminae (having two genera *Aponoma* and *Amblyomma*), Rhipicephalinae (*Anomalohmalaya*, *Dermacentor*, *Cosmmioma*, *Boophilus*, *Margaropus*, *Rhipicentor*, *Rhipicephalus* and *Nosomma*) Hyalomminae (genus *Hyalomma*) and Haemaphysalinae (genus *Haemaphysalis* (Sonenshine 2018). Ticks are recognized as significant vectors for pathogenic bacteria, protozoa, rickettsia, spirochaetes and viruses. They transmit a wide range of disease causing pathogens than any other arthropods to livestock, humans, and companion animals, making them the most crucial vectors in terms of disease transmission (Rehman *et al.* 2017; Mans *et al.* 2019). In sub-tropical and tropical parts of the world ticks are responsible for significant loss of livestock (Wanzala 2017). Moreover, tick directly affects animals through heavy infestation and cause severe dermatitis (Rodriguez-Vivas *et al.* 2018) leading to anemia and an increased parasitic burden (Polanco-Echeverry and RíosOsorio 2016). Tick infestation causes unending stress,

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which negatively impacts the welfare and behavior of the animals and impairs their immune function (Roy *et al.* 2018). It also leads to decreased milk production and can even result in the death of young host animals (Ali *et al.* 2019; Mans *et al.* 2019). The variation in tick prevalence in different areas can be attributed to a variety of factors, such as geo-climatic conditions, the association and lifestyle of different animal species, awareness and education of farmers and farm management practices (Farooqi *et al.* 2017; Fuente and Villar 2021). In Khyber Pakhtunkhwa, common species of ticks belonging to genus *Rhipicephalus* were reported including *R. microplus, R. haemaphysaloides, R. turanicus* and *Rhipicephalus* (Farooqi *et al.* 2017; Khan *et al.* 2022). Data on Ticks distribution and diversity are still insufficient in Khyber-Pakhtunkhwa. The present study was aimed to determine the diversity and specie composition of Ixodid ticks in District Khyber, Khyber Pakhtunkhwa, Pakistan.

Materials and Methods

Study area

The study area for the research was District Khyber, located in the Northern region of Pakistan and sharing borders with Afghanistan, the City of Peshawar, Orakzai and Kurram districts. The total area of the district is 2,576 kilometers square, with only 8.22% of forest cover. the geographical coordinates of district Khyber are 33.9405°N and 71.0498°E. The district has a rugged and barren mountainous landscape with narrow strips of valleys and the weather is hottest from May to August and coldest from November to January. The survey was conducted at seven major localities which are as follows: Landikotal, Bara, Ali Masjid, Chura, Ghundi, Shahkas, Khajuri and Besay. Collection was random and domesticated animals were examined for collection purposes. The present study was performed from March 2020 to February 2021. Many animals including cows, bulls, calves, dogs, cats, sheep and goats were examined randomly (Fig. 1).

Collection of ticks

The fieldwork duration ranged from March 2020 to February 2021. A total of 1308 individual hosts mammals were observed while 172 host mammals were selected for collection of ticks which include 101 cows, 28 bulls, 14 calves, 19 goats, 5 sheep, 4 dogs and a human. A total of 1075 specimens of ticks were collected from the infested body part of the host animal, disturbed with a camel hairbrush and captured either by hands covered with gloves or by forceps. After collection, the ticks were shifted to Eppendorf tubes containing 70% ethanol for preservation. Tubes containing ticks were properly labeled with information supporting the study *i.e*., species of animals (Cow, Goat, Sheep, Dog, Bull, calf *etc*.), gender of animal, infested part of animal from where ticks were collected, number of ticks from each infested part, ornamentations on the Scutum (present or absent), name of zone and month of collection (Ali *et al.* 2013). Collected and labeled data were shifted to Laboratory of Vector Biology and Entomology, Department of Zoology, University of Peshawar.

Tick mounting

The preserved ticks were transferred to petri dish and were washed to remove excess alcohol. On the ventral side of tick two or three holes were made with the help of find needles, this helps in cleaning of tick quickly. Ticks were then shifted to 15% Potassium hydroxide solution containing glass tubes and then boiled over a spirit lamp for 15 to 20 min depending upon the transparency of the specimen. After boiling, when the color of specimen changed from dark brown to pale yellow, they were shifted to petri dish and washed with water to remove excess alkali. To dehydrate, ticks were passed through different grades of aqueous ethyl alcohol solution (70, 80, 90 and 95%). In each grade of ethanol, ticks were kept for 30-45 min before shifting to higher grades. After getting passed through the last series of aqueous solution of alcohol *i.e*., 95%, ethanol ticks were washed with tap water to remove the remaining alcohol and then shifted to aniline oil and were allowed for 24–48 h to get clear. Clearing completed when the specimen sank to bottom and became perfectly transparent. After 24–48 h, ticks were removed from clearing agent and were washed twice with xylol. Ticks were dried by keeping it on glass slide. Enough Canada balsam was put over tick on glass slide and cover was applied to make a permanent mount. The slides were kept in an oven or on hot plates in order to dry them. Systematic Identification of ticks up to the species level was done under stereomicroscope by using standard keys and description (Keirans and Litwak 1989; Taylor *et al.* 2007).

Fig. 1: Map of Khyber district, Khyber Pakhtunkhwa (https://cmdo.org.pk/khyber-agency/)

Statistical analysis

Statistical analysis was conducted using SPSS 20 (20 IBM, USA) software, including minimum, maximum, averages, and correlation analysis, using the Chi-Square test ($\chi 2$) (Aqib *et al.* 2017), with a p value less than 5% ($P < 0.05$) considered statistically significant.

Results

Taxonomic diversity and distribution of tick species

In this study, ten species belonging to two families, *i.e*., Ixodidae (hard ticks) and Argasidae (soft ticks), were reported. Ixodidae was represented by two genera: *Rhipicephalus* and *Hyalomma*. Argasidae was represented by a single species. Nine species of hard ticks belonging to two genera *i.e*., *Rhipicephalus* and *Hyalomma* were recorded. The genus *Rhipicephalus* was represented by *R. microplus, R. sanguineus* and *R. haemaphysaloides*. The genus *Hyalomma* was represented by *H. aegyptium, H. asiaticum, H. anatolicum excavatum, H. anatolicum anatolicum, H. marginatum* and *H. kumari*. While a single species of soft ticks, *Argas persicus* was reported (Table 1; Fig. 2a–c).

Frequency of different tick species

Rhipicephalus was the most prevalent genus followed by *Hyalomma*. *R. microplus* was the most abundant species (55.72%) followed by *H. aegyptium* (12.27%). The least common species was found to be *H. kumari* and only a single specimen was collected from a goat (Table 2).

Proportional analysis of male and female tick species

Within *R. microplus*, the proportion of females was higher (81.96%) than that of males (18.03%). The same trend was observed for *H. aegyptium*, *H. an. excavatum*, and *H. an. anatolicum*, whereas in *H. asiaticum*, *H. marginatum*, and *R. haemaphysaloides*, the proportion of males was higher than females. An equal number of male and female specimens were reported for *R. sanguineus*. The *P*-value <0.05 indicates significant difference between the proportions of male and female ticks, with female composition being on average higher than that of males (Table 3).

Location-wise distribution of tick species

The maximum number of ticks were collected from Landikotal, followed by Alimasjid. The least number of ticks were collected from Ghundi. The *P*-value being less than 0.05 indicates a significant association between the species and their location of availability (Table 4).

Host animal related distribution of tick species

Infestation was found to be more severe in cows (56%) followed by bulls (19.25%) and goats (13.76%). Infestation was lesser in calves (6.97%), dogs (2.69%) and sheep (1.20%). The infestation was the least in human. Only a single specimen of *R. sanguineus* was collected from a human. Since *P*-value is less than 0.05, which indicates that there is significant association between species and their availability in different animals (Table 5).

Comparative analysis of ticks infestations among various body regions

Among different body parts, anal region (24.18%) was

Table 1: Taxonomic Diversity and Distribution of Hard and Soft Tick Species in the Study Area

Phylum	Family	Genus	Species
Arthropoda (Class Arachnida)	Ixodidae	*Rhipicephalus*	*R. microplus*
		Hyalomma	*H. aegyptium*
		Hyalomma	*H. asiaticum*
		Hyalomma	*H. an. excavatum*
		Hyalomma	*H. an. anatolicum*
		Rhipicephalus	*R. sanguineus*
		Hyalomma	*H. kumari*
		Hyalomma	*H. marginatum*
		Rhipicephalus	*R. haemophysaliodes*
		Rhipicephalus	*R. microplus* (nymphs)
	Argasidae	*Argas*	*A. persicus*

Table 2: Frequency of different species of ticks Isolated from Animal Hosts

Genus	Species	Number of specimens	Percentage
Rhipicephalus	*R. microplus*	599	55.72093%
Hyalomma	*H. aegyptium*	132	12.27907%
Hyalomma	*H. asiaticum*	119	11.06977%
Hyalomma	*H. an. excavatum*	72	6.697674%
Hyalomma	*H. an. anatolicum*	43	4%
Rhipicephalus	*R. sanguineus*	36	3.348837%
Argas	*A. persicus*	14	1.302326%
Hyalomma	*H. marginatum*	13	1.209302%
Rhipicephalus	*R. haemaphysaloides*	4	0.372093%
Hyalomma	*H. kumari*	1	0.093023%
Rhipicephalus	*R. microplus* (nymph)	42	3.906977%
Total	10	1075	

Table 3: Proportional Analysis of Male and Female Tick Species collected from study area

Species	Total	Male (No.)	Male (%)	Female (No.)	Female (%)
R. microplus	599	108	18.03	491	81.96
H. aegyptium	132	45	34.09	87	65.90
H. asiaticum	119	73	61.34	46	38.65
H. an. excavatum	72	35	48.61	37	51.38
H. an. anatolicum	43	20	46.51	23	53.48
R. sanguineus	36	18	50.00	18	50.00
H. marginatum	13	10	76.92	3	23.07
R. haemaphysaloides	4	3	75.00	1	25.00
H. kumari	1	0	0	1	100
Total	1033	318		715	
Mean	3.15		3.77		
ST Deviation	1.564		1.126		
T calculated	1.935				
P Value	0.0013				

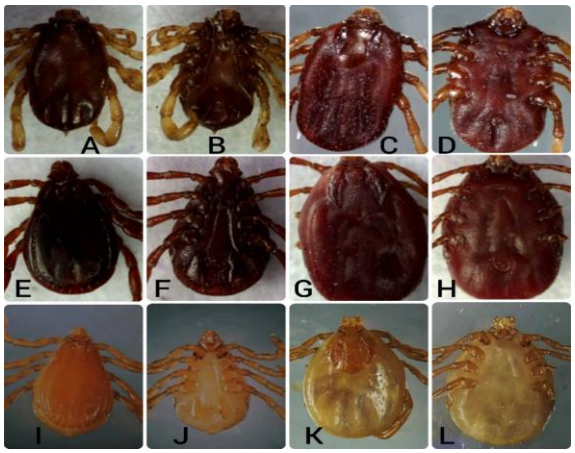

Fig. 2a: Tick Species Collected from Animal Hosts
Fig. 2.1: Genus *Rhipicephalus*
A. dorsal view of male *R. microplus,* **B**. ventral view of male *R. microplus,* **C**. dorsal view of female *R. microplus,* **D**. ventral view of female *R. microplus,* **E**. dorsal view of male *R. sanguineus,* **F**. ventral view of male *R. sanguineus,* **G**. dorsal view of female *R. sanguineus,* **H**. ventral view of female *R. sanguineus,* **I**. dorsal view male *of R. haemaphysaloides,* **J**. ventral view of male *R. haemaphysaloides,* **K**. dorsal view of female *R. haemaphysaloides* **L**. ventral view of female *R. haemaphysaloides*

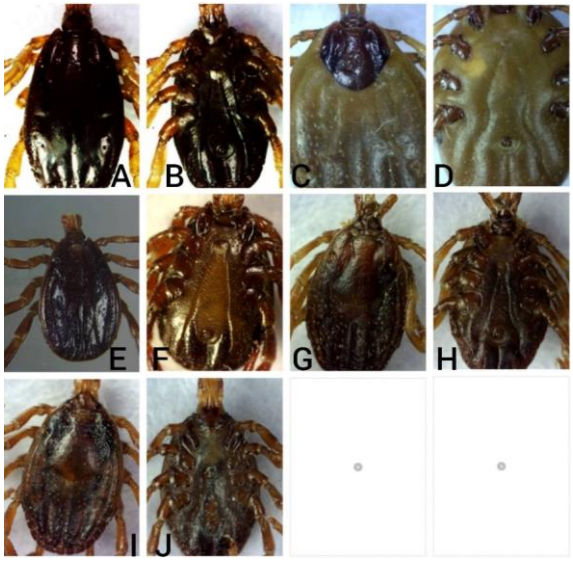

Fig. 2b: Genus *Hyalomma*
A. dorsal view of male *H. an. anatolicum,* **B**. ventral view of male *H. an. Anatolicum,* **C**. dorsal view of female *H. an. Anatolicum,* **D**. ventral view of female *H. an. Anatolicum,* **E.** dorsal view of male *H. marginatum isaaci,* **F**. ventral view of male *H. marginatum isaaci,* **G**. Dorsal view of female *H. marginatum isaaci,* **H**. ventral view of female *H. marginatum isaaci,* **I**. Dorsal view of male *H. kumari* **J**. ventral view of male *H. kumari*

severely infested followed by udder (19.25%) and groin region (13.95%). Ears (3.25%) and armpits (2.97%) were least infested (Table 6).

Seasonal diversity of tick species

The diversity of tick species peaked during March and a total of eight species were collected from different zones of Khyber. The maximum number of ticks were collected in

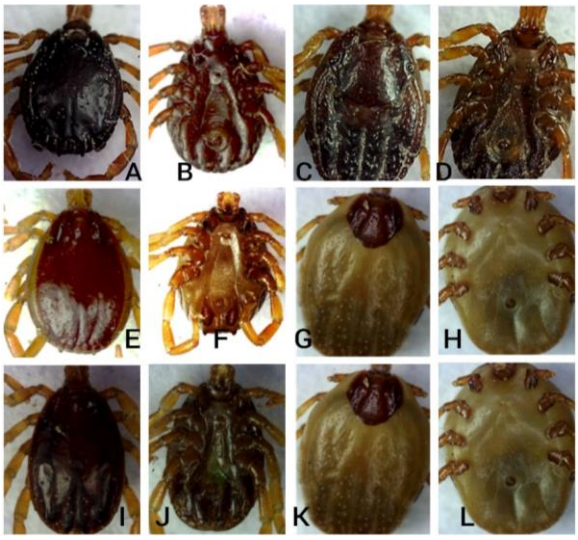

Fig. 2c: Genus *Hyalomma*
A. dorsal view of male *H. aegyptium,* **B**. ventral view of male *H. aegyptium,* **C**. dorsal view of female *H. aegyptium,* **D**. ventral view of female *H. aegyptium,* **E**. dorsal view of male *H. asiaticum,* **F**. ventral view of male *H. asiaticum,* **G**. dorsal view of female *H. asiaticum,* **H**. ventral view of female *H. asiaticum,* **I**. dorsal view male *of H. an. Excavatum,* **J**. ventral view of male *H. an. Excavatum,* **K**. dorsal view of female *H. an. Excavatum,* **L**. ventral view of female *H. an. excavatum*

Table 4: Distribution of tick species in different localities of district Khyber, Khyber-Pakhtunkhwa, Pakistan

Species	Locations						
	Ghundi	Bara	Shakas	Ali masjid	Landi-kotal	Besay	Jaba
R. microplus	76	67	105	122	102	100	63
H. aegyptium	9	17	2	22	56	9	16
H. asiaticum	24	15	24	16	21	20	3
H. an. excavatum	10	11	0	11	0	4	36
H. an. anatolicum	0	12	0	0	8	8	15
R. sanguineus	6	0	13	4	3	0	13
A. persicus	0	0	0	0	0	0	14
H. marginatum	0	5	0	0	0	8	0
R. haemophysaliodes	0	0	0	0	0	0	4
H. kumari	0	0	0	0	0	0	1
Total	125	127	144	175	190	149	165
Chi-square	12.52						
P Value	0.03994						

Table 5: Host animals infested with tick species in different localities of district Khyber, Khyber-Pakhtunkhwa, Pakistan

Species	Bull	Calf	Cow	Dog	Human	Goat	Sheep
R. microplus	149	56	387	0	0	49	0
H. aegyptium	29	0	56	0	0	47	0
H. asiaticum	12	13	89	0	0	5	0
H. an. excavatum	6	6	29	0	0	28	3
H. an. anatolicum	11	0	32	0	0	0	0
R. sanguineus	0	0	0	29	1	0	6
A. persicus	0	0	0	0	0	14	0
H. marginatum	0	0	9	0	0	4	0
R. haemaphysaloides	0	0	0	0	0	0	4
H. kumari	0	0	0	0	0	1	0
Total	207 (19.25%)	75 (6.97%)	602 (56%)	29 (2.69%)	1 (0.09%)	148 (13.76%)	13 (1.20%)
Chi-square	12.52						
P Value	0.0001						

the month of March (134) followed by July (125). *R. microplus* was prevalent throughout the year. Its infestation was highest during March and lowest during August. *H. marginatum* was prevalent in summer with a few of its specimens recorded in winter as well (Table 7).

Table 6: Comparative Analysis of ticks Infestations Among Various Body Regions of selected host species

Species	Abdomen	Anal	Armpit	Back	Ear	Groin	Legs	Neck	Tail	Udder
R. microplus	45	133	18	48	19	118	24	39	37	118
H. aegyptium	43	27	---	---	---	4	18	31	---	9
H. asiaticum	6	43	11	4	---	14	5	5	6	25
H. an. excavatum	---	21	3	---	8	4	---	3	1	32
H. an. anatolicum	---	10	---	5	4	10	2	2	3	7
R. sanguineus	7	---	---	8	---	---	4	---	---	---
A. persicus	2	---	---	8	---	---	4	---	---	---
H. marginatum	---	5	---	1	---	---	---	---	1	6
R. haemaphysaloides	---	---	---	---	4	---	---	---	---	---
H. kumari	---	---	---	1	---	---	---	---	---	---
R. microplus (nymphs)	8	21	---	9	---	---	7	4	---	---
Total	111	260	32	84	35	150	64	84	48	207
	10.32%	24.18%	2.97%	7.81%	3.25%	13.95%	5.95%	7.81%	4.46%	19.25%

Table 7: Seasonal Diversity of Tick Species among Different Zones of Khyber district Khyber, Khyber-Pakhtunkhwa, Pakistan

Species	Jan	Feb	Mar	Apr	May	June	July	Aug	Sept	Oct	Nov	Dec
R. microplus	85	68	96	42	48	20	12	5	81	52	43	47
H. aegyptium	---	---	---	---	---	26	83	23	---	---	---	---
H. asiaticum	---	---	---	25	19	11	16	48	---	---	---	---
H. an. excavatum	---	---	30	7	4	13	14	4	---	---	---	---
H. an. anatolicum	---	---	---	7	4	7	---	20	5	---	---	---
R. sanguineus	---	---	8	10	---	18	---	---	---	---	---	---
A. persicus	---	---	---	---	6	8	---	---	---	---	---	---
H. marginatum	---	---	---	---	7	---	---	---	---	---	3	3
R. haemaphysaloides	---	---	---	---	4	---	---	---	---	---	---	---
H. kumari	---	---	---	---	1	---	---	---	---	---	---	---
Total	85	68	134	91	93	103	125	100	86	52	46	50

Discussion

The prevalence of tick infestation on different host animals is a serious problem all over the world including in Pakistan. The warm and humid environment provides suitable conditions for a wide range of hematophagous ectoparasites especially the ticks (Batool *et al.* 2019). In Pakistan, the agricultural sector plays a crucial role in the economy of the country. However, the production of ruminants is severely hampered by the damage brought about by ticks and tick-borne diseases (Khan *et al.* 2022). The current study is an effort to find out the diversity, species composition, seasonal dynamics and rate of infestation of ticks in the district of Khyber, KP, Pakistan. The present study reports a survey carried out on domesticated animals, from March 2020 to February 2021, in order to collect and identify the tick species prevalent in District Khyber. A total of two genera of Ixodid ticks and one species of Argasid ticks were reported. Among the Ixodid ticks, *Rhipicephalus* was more prevalent, represented by three species followed by *Hyalomma* which was represented by six species. Only one species of soft ticks was reported. In Pakistan, some former studies provided similar findings for instance, Farooqi *et al.* (2017) conducted research in temporal zone of KP and presented the most prevalent genus as *Rhipicephalus* preceded by *Haemaphysalis* and *Hyalomma*. Karim *et al.* (2017) collected and examined 3866 tick samples for morphology and reported *Rhipicephalus*, *Haemaphysalis* and *Hyalomma* along with two species of Argasid ticks. The current study is in correspondence with the above-mentioned studies conducted within Pakistan and also in the other parts of the world (Karim *et al.* 2017).

The current study reports that out of 1308 observed animals, 172 host individuals were found to be positive for tick infestation and the overall tick infestation rate was 13.14%. Nasiri *et al.* (2010) performed a survey for ticks and reported that the rate of tick infestation was 11.4%. Similarly, the rate of infestation of ticks in dogs in Great Britain reported that the rate of tick infestation was 14.9% (Abdullah *et al.* 2016). The difference in the results of the current and previous studies may be due to the practices of the farmers. The farmers of the study area claimed the manual removal of ticks from their animals and killing them by either smashing or burning them in case of low infestation. They also claimed the application of acaricides in case of severe infestation.

The current study shows that overall; the ratio of female ticks (69.22%) was higher than that of male ticks (30.78%). Ali *et al.* (2019) provided similar results after conducting a survey for the collection of ticks in KP province and reported that the ratio of the females (partially or fully engorged) was higher than that of the males. Samples of ticks collected from different animals in Tehran gave results similar to the current study *i.e.* the ratio of females (57.99%) was higher than males (42.01%) in collected ticks (Abbasi 2022). The ratio of females was highest than males in Multan (Ramzan *et al.* 2020). The results of the above-mentioned studies are in agreement

with the findings of the current study. However, the results of the current study are not in correspondence with the study performed by Tesgera *et al.* (2017) which reported that the ratio of males was higher than that of females in the collected samples of ticks.

In present study the tick infestation was highest in cows followed by bulls, goats, calves, dogs, and sheep while a single species of *R. sanguineus* was collected from a human, Asmaa *et al.* (2014) carried out a field survey and showed that of total infested animals; cattle were the most infested followed by goats, buffaloes, and sheep. These findings are in collaboration with the current study. A survey in Punjab, Pakistan and reported that the prevalence of ticks was highest in cattle followed by buffaloes (Batool *et al.* 2019). A field survey of livestock farms in arid and semi-arid zones of Pakistan and reported that the infestation was highest in cattle followed by goats and sheep which further supports the findings of the current study (Rehman *et al.* 2017).

Among different body parts, anal region (24.18%) was severely infested followed by udder (19.25%) and groin region (13.95%). Ears (3.25%) and armpits (2.97%) were least infested. Similar results were provided by Musa *et al.* (2014) who showed that in tick infested animals, the infestation was mostly in udder and external genital area followed by inner thigh and tail while infestation was least in eyes and ears. Similar findings have been provided by Kabir *et al.* (2011) which indicate that among infested animals, the infestation was severe in anal and groin regions and least on neck and face. Hussain *et al.* (2022) gave similar results showing the most infested body regions to be udder and external genitalia and least infested body parts were eyes, ears and legs. The reason for attachment of ticks to these regions might be softness of the tissues of these areas. Soft tissues are advantageous as ticks can attach easily to them and make the contact with the blood vascular system of the host to obtain the blood meal (Tahir *et al.* 2020).

In the present study, the diversity of ticks was highest in March and followed by July. A total of 8 species of ticks were recovered from the host species during March. The diversity of ticks was least during winters. Kakar *et al.* (2008) provided similar results which indicated that the diversity of ticks was highest during summer and least during winters. present results are in agreement with Iqbal *et al.* (2022) that favorable environmental conditions might facilitate the development and survival of different tick species. The diversity was maximum in spring and summer. Khan *et al.* (2022) in former FATA of KP and reported that within the months in which collection was performed, the rate of infestation was highest during March (Pourmand *et al.* 2021). Current study reported that *R. microplus* was prevalent throughout the year. Debbarma *et al.* (2018) provided similar results which showed that *R. microplus* was prevalent throughout the year. *R. sanguineus* (brown dog tick) is one of the most widespread ticks in the world and feeds primarily on dogs and occasionally on other hosts that may include humans. *R. sanguineus* shows endophilous behavior (inhabits artificial shelter and burrows) and is a nidicolous tick. It may live as an exophilic tick and cling to its hosts (dogs in that area) from vegetation (Wanzala 2017). *R. sanguineus* was recovered from dogs and a single specimen was also collected from a human in the present study. in many cases *R. sanguineus* infesting humans (Földvári *et al.* 2022) . In another study it was reported that 81.5% of the total ticks removed from humans from June to September were *R. sanguineus* (Farooqi *et al.* 2017). In the present study, tick infestation is identified as the primary factor causing economic losses for local communities. The majority of livestock losses in the study area are attributed to tick-borne diseases such as Babesiosis, Theileriosis and Anaplasmosis. Furthermore, the transportation of livestock by people from one region to another is also a significant contributing factor to the spread of ticks from one zone to another. To enhance the application and effectiveness of tick control measures in vector-borne disease prevention programs, it is crucial to conduct studies on the bioecology of ticks. These studies should encompass information regarding their population dynamics, interactions with hosts, and environmental factors.

Conclusion

The distribution of Ixodid ticks was found to be widespread in all agro-climatic zones of District Khyber, Khyber-Pakhtunkhwa. Infestation of ticks on livestock have a severe impact on the income of local people, especially those belonging to lower-middle or middle-class families who heavily rely on livestock for their needs The research provides a foundation for policymakers, livestock owners, and veterinary professionals to develop and implement preventive measures and education programs. By increasing awareness about tick diversity, proper livestock management practices, and the importance of tick control, the well-being of livestock and the livelihoods of communities reliant on them can be significantly improved.

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Author Contributions

Kiran khan afridi, Habibullah planned and perfomed data

collection; Farrah zaidi: supervised the study; Farooq Ahmad, Najeeb Ullah,Tariq ahmad and Hafeezullah khan provide helps in laboratory work and provide accessbility to the study area and reviewof the manuscript; Muhammad Tayyab Khan arrange and analyzed data statistically; Faiz Ur Rehman wrote the manuscript and also supervised the work

Conflict of Interest

The authors have declared that there is no conflict of interests regarding the publication of this article.

Data Availability

Data will be share on a fair request made to corresponding author

Ethics Approvals

This study was conducted in full accordance with ethical principles. All experimental protocols were carried out in accordance with the relevant guidelines and regulations

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