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Ixodid Ticks (Arachnida: Acari) Prevalence Associated with Risk Factors in the Bovine Host in District Quetta, Balochistan

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Authors' Contribution
NR and AK conceived and designed the study. AG, WMA, SS, MAM and MS collected data. NR, AK and WMA analyzed the data. AK wrote the article.

Key words
Ixodid ticks, Prevalence, Cattle, *Bos permiginus*.

ABSTRACT

The present study aimed at determining the hard tick species and their abundance with respect to host-related risk factors in *Bos permiginu s* cattle was conducted in farm houses at three main regions (Western by-pass, Spiny village, and Sariab region) of District Quetta from March, 2013 to March, 2014. Around 1649 ticks were captured from six main body parts of 404 cattle. Of these 346 (65.96%) were observed to be plagued by one or more tick infestation. Compositions of tick species captured from the host were *Hyalomma anatolicum anatolicum* (33.39%), followed by *Dermacenter andersoni* (31.76%), *Hyalomma aegyptium* (26.16%), and *Boophilus microplus* (8.67%). The risk factor like sex and age of cattle did not demonstrate enormous relationship with the infestation ratio but rather there was relationship with both breeds and body conditions. The commonness of tick infestation in medium body condition (92.9%), poor body condition (57.44%), and good body condition (87.39%) was observed to be significant at P-value ($P < 0.01$) among the three body. Analysis of sex wise tick counting with age of animals revealed positive and significant correlation ($P = 0.1145$, $P < 0.05$). The ratio of tick infestation was observed to be insignificant ($P < 0.01$) among the breeds, with most elevated prepotency in local (88.97%) and cross breeds (13.33%), respectively.

INTRODUCTION

Ixodid ticks (Acari: Ixodidae) are of global veterinary and public health concern (Jongejan and Uilenberg, 1994) that directly cause poor health and loss of production to their vertebrate hosts (Jonsson, 2006). They transmit a wider variety of pathogen than any other arthropods (Iqbal *et al*., 2016). Some tick species have retained a predilection for cold-blooded vertebrates. *Amblyomma rotundatum* (Koch, 1844) is an ixodid tick that infests ectothermic animals reported to infest reptiles and amphibians (Rodrigues *et al*., 2010). Ticks are generally of 3 types identified as hard ticks, soft ticks and Nuttalliella (the combination of hard and soft ticks) (Guglielmon *et al*., 2010). Ticks have worldwide distribution and have a preference humid and temperate atmosphere and typically attach to the legs, under arms and abdomen of their host body (Nuttal, 1905). They suck host blood during their lengthy attachment period (7-14 days), which may be extended depending on the tick species and unique host association (El Hakim *et al*., 2007; Perveen *et al*., 2010). Tick infestation decrease quality of skin (hide) up to 20-30% (Gharbi *et al*., 2006) and causes severe anemia, weakness and immunosuppression in the infected animals (Gwakisa *et al*., 2001).

All the dairy animal species are apt to tick infestation. Because of voracious habit of parasite's blood sucking; loss of blood for their rapid development impoverishes the hosts. In heavy infestation cattle must have more feed merely to meet the demands of the parasites; hence the growth of young animals is retarded, and they may remain thin, weak and stunted. In dairy cows, milk production is greatly reduced. Although, economic losses due to ticks are mainly due to the diseases which they transmit (Garcia,

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2003; Atif *et al*., 2012b). Numerous species of hard ticks including those from the genera *Boophilus, Haemaphysalis, Hyalomma, Amblyomma* and *Rhipicephalus* are reported infesting cows, buffalo and other cattle in India and other parts of the world (Shahardar *et al*., 1998). Globally tick infestation is causing loss of Rs. 560 billion in the animals with the deterioration of host health, including weight loss and breeding success (Imamura *et al*., 2008).

In Pakistan, there are more than 62.9 million of cattle and buffaloes, 85.7 millions of sheep and goats and 1.0 millions of camels (Anonymous, 2010). Prevalence of *Hyalomma* species in Pakistan is significantly higher ($p>0.05$) than *Haemaphysalis, Amblyomma* and *Boophilus* species of hard ticks (Ali *et al*., 2009) and reported to be the most prevalent member of *Ixodidae* (hard ticks) infests buffalo, cattle and other wild animals in countries of Africa, Europe, Middle East and South Asia (Dumanli *et al*., 2005; Ahmad and Ahmad, 2007; Asmaa, 2012; Hassan and Al-Zubaidi, 2014; Farooqi *et al*., 2017).

Fig. 1. Map of Balochistan province showing district Quetta.

Ticks as parasitic feeders on blood of cattle and as vector of pathogenic microorganisms reported to destabilize the health and fecundity of domestic animals in Balochistan province (Pakistan) (Iqbal and Nawaz, 2007; Iqbal *et al*., 2009). Given that the farm animals have become an integral part of the province (Balochistan) economy. Therefore, to meet the demand of animal (cattle) protein, it is timely to identify gaps in the knowledge of tick infestation and diseases in the region. Although, there have been some published data on prevalence of ticks infestation in sheep and goats of Balochistan (Iqbal *et al*., 2009), but not a single report is available on prevalence, distribution and rick factors (sex and age) of bovine tick species in district Quetta. This article describes preponderance of hard ticks (Ixodidae) on domestic cow breed, *Bos permiginus* and categorize the major tick's species in relation to both breed and body condition of cattle in the proposed areas of study in district Quetta.

MATERIALS AND METHODS

Study site

The study was carried out in three administrative domains (Sariab region, Western bypass and Spinny village) from March 2013 to March 2014 in district Quetta (Balochistan), Pakistan (Figs. 1, 2). The area is typical basin of highlands (30°-03' and 30°-27' N, 66°-44' and 67°-18' E.) in province with an average annual rainfall of around 269 mm and 1700 meter elevation and one of the main milk producing regions in the district (Fig. 3).

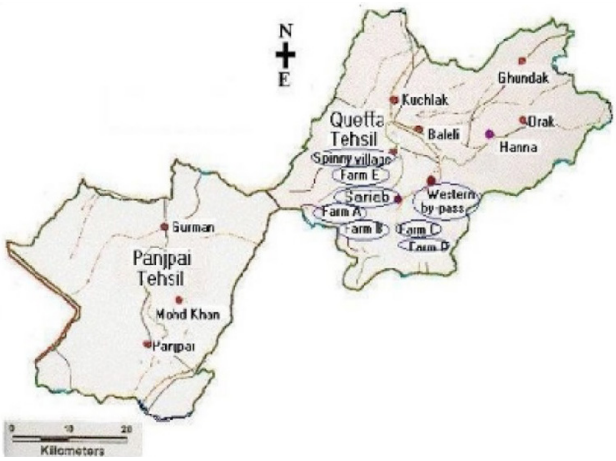

Fig. 2. Map of district Quetta. Blue circles showing study area.

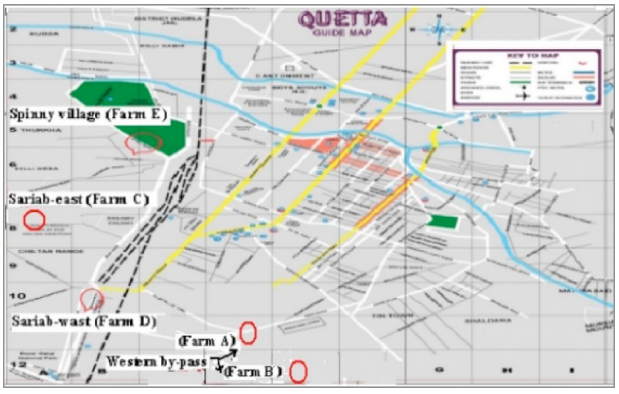

Fig. 3. District Quetta guide map. Red circles showing area of study.

Tick collection

All visible adult ticks were detached carefully with the help of blunt steel forceps from different body parts (head, ear, neck, body trunk, ventrum, and extremities *etc*.) from at least 404 domestic cow breed (mean number = 346) varying in age, sex and breed. Collected ticks were brought to the laboratory, counted and preserved in bottles containing 70% ethanol. Each bottle was then labeled denoting the host body region of attachment, collection date and locality.

Ticks identification

Adult ticks were morphologically identified to the species level using dissecting (40X) and compound microscopes (Olympus CH4-DS, Japan) The tick genera naming was made according to the keys and descriptions given by Kaiser and Hoogstraal (1963), Horak *et al*. (2002) and Lloyed (2004). Permanent slides were prepared followed methods mentioned by Walker *et al*. (2003).

Prevalence of ticks was calculated as:

$$\text{Prevalence (P)} = \frac{\text{No of hosts observed}}{\text{No of hosts infested}} \times 100$$

Statistical analysis

The data was analyzed using Statistical Package Minitab Version 11.5 for Windows 2000. Chi-square test was used to determine relationship between sex and age/ breed of host and ticks.

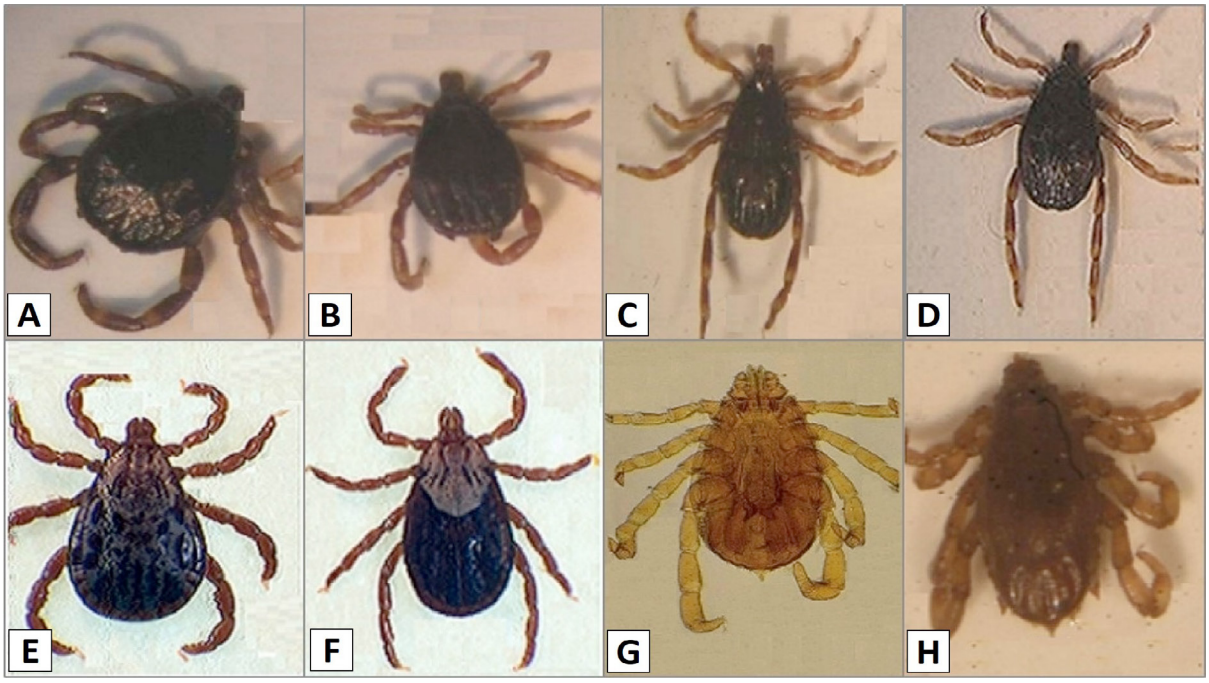

Fig. 4. Three genera of ticks collected from the cattle species from selected farms in Quetta, Balochistan. Dorsal view of *Hyalomma* male (A), *Hyalomma* female (B), *Hyalomma aegyptium* male (C), *Hyalomma aegyptium* female (D), *Dermacenter andersoni* male (E), *Dermacenter andersoni* female (F), *Boophilus microplus* male (G) and *Boophilus microplus* female (H). Photographs indicate 30 mm.

Table I.- Sex wise tick count and age of animals analyzed during the study period from March, 2013 to March, 2014.

Tick species	Tick count		Total No.	Percentage (%)	Mean± SD	Age of animal (Year)
	Male	Female				
Hyalolmma a. *anatolicum*	284	260	544	33.39	544 ± 5.53	4
Hyalolmma aegyptium	270	172	442	26.16	442 ± 2.45	2
Dermacenter andersoni	263	256	529	31.76	529 ± 2.93	3
Boophilus microplus	59	85	144	8.67	144 ± 1.26	1
Total	876	773	1649			

The chi-square statistics is 11.032. The P-value is 0.1154. The result is significant at ($P < 0.05$).

RESULTS

In this study a total of 1649 ixodid ticks (876 males and 773 females) (Table I) were sampled from six different body parts of 404 cattle of local (n=254) and cross (n=150) breeds. Of the total cattle, 346 (85.64%) were found to be positive for tick infestation (Tables II, III). However, the tick parasite may also infest the udder, dewlap, anal area and tail of host body (Nibret *et al*., 2012). The statistical analysis was done for the prevalence of tick infestation with hypothesized risk factors (age, sex, breed and body condition). Three tick genera *Hyalomma*, *Dermacentor* and *Rhipicephalus*, and four species include *H. anatolicum anatolicum* (Koch, 1844), *H. aegyptium* (Linnaeus, 1758), *D. andersoni* (Stiles, 1908) and *Rhipicepalus* (*Boophilus*) *microplus* (Canestrini, 1988) were identified from the infested cow breeds, *Bos permiginus* (Fig. 4). Compositions of parasite species captured were 33.39% (*H. anatolicum anatolicum*), 26.16% (*H. aegyptium*), 31.76% (*D. andersoni*) and 8.67% (*B. microplus*), respectively. Mean tick infestation recorded were relatively high (373±3.85) in the neck of the host followed by ear pinnae (344+3.20), body trunk (267±2.30), head (180±2.20), ventrum (137±2.20) and extremities (45±1.21) as shown in Table II. In this regard highly significant (P = 0.0001) difference was found between neck and extremities region of domestic cow breed. There was statistical significant difference between all tick species (P < 0.05) (Table I) and attachment site of ticks to host (Table II). Male specimens of tick outnumbered females for most species except for the *Boophilus* sp. (Table I). Area wise tick infestation observed was 20.8% and 20.98% and 1% , respectively in farm A, B and C of western by-pass; it was 19.28% in Sariab region, while the noted average in cattle farm-E of Spinny village was 17.22%. Regarding the general incidence of tick species significant relationship (P< 0.05) was found in the present study (Table IV).

Table II.- Total count of adult tick species on different body parts of domestic cow breeds, *Bovis Permiginus* the study period from March, 2013 to March, 2014.

Body parts	Ticks		
	No. of ticks	Percentage (%)	Mean ± SD
Head	180	13.37	180 ± 2.20
Ear pinnae	344	25.55	344 ± 3.32
Neck	373	27.71	373 ± 3.85
Body trunk	267	19.83	267 ± 2.30
Ventrum	137	10.17	137± 2.20
Extremities	45	3.34	45 ± 1.21
P			0.0000

P < 0.0001.

Table III.- Prevalence of ticks in relation to body condition and breed of animals.

Breed of animals	Parameter			Number of animals with body condition		
	No. of animals examined	No. of animals infested	Prevalence (%)	Good	Medium	Poor
Local	254	226	88.97	230	127	47
Cross	150	120	13.33	201	118	27
Total No. of cattle	404	346	-	-	-	-
Over all prevalence (%)	85.6	53.0	-	87.39	92.9	57.44

Body condition, Chi-square statistics is 4.088. P-value is 0.1295. Result is not significant at P < 0 01; Breed, The chi-square statistics is 0.1593. P-value is 0.6897. Result is not significant at P < 0.01.

Table IV.- Distribution of ticks incidence in *Bovis permiginus* in different cattle farms during the study period from March, 2013 to March, 2014.

Farm	Location	Ticks species				Total No.	Percentage (%)
		Hylomma a. anatolicum	*Hylomma aegyptium*	*Dermacenter anderoni*	*Boophilus microplus*		
Farm A	Western by-pass	109	88	116	30	343	20.8
Farm B	Western by-pass	127	83	108	28	346	20.98
Farm C	Sariab east	105	103	113	37	358	21.71
Farm D	Sariab west	106	92	97	23	318	19.28
Farm E	Spinny village	97	68	93	26	284	17.22
Grand total						1649	

The *f* value is 258.47502 applying ANOVA. The result is significant at (P< 0.05).

Infestation by the tick species in local and cross breed was compared: cross breed cattle were found to be less infested (13.33%, n=120) than locally domesticated breeds of cow (88.97, n=226). No statistically significant (P=0.1295) difference was found comparing body condition with breeds (Table III). Cattle body condition was found to be varied as for as the tick infestation rate is concerned. As a result, tick prevalence was more (92.9%) on medium condition compared to cattle having good health (87.39%) and poor body (57.44%) conditions. These results are in line with those reported by Tadesse and Sultan (2014) who found that cattle with medium body condition have significantly (P<0.02) higher tick infestation. But reports of Walelign and Mekuriaw (2016) and Kemal *et al*. (2016) do not agree with our results where poor body showed significant burden (100%) than cattle with the other body condition scores (medium: 94.7%) and (good: 32.2%). On the other hand occurrence contrast between various age groups demonstrates the nearness of high prevalence of ticks in most cattle with age one to four years (Table I). Results revealed significant difference between tick counts and animals age (P < 0.05) using Chi-square test (Table I).

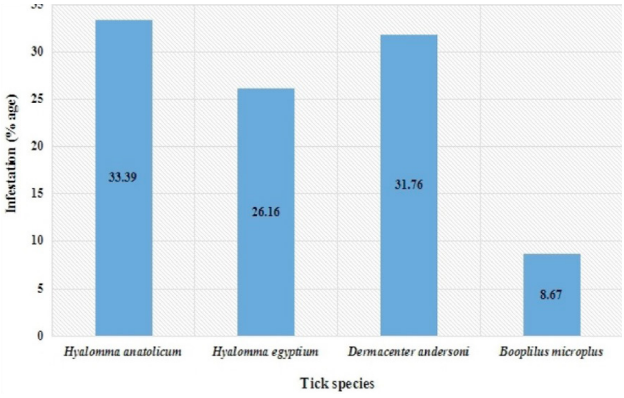

Fig. 5. Distribution ratio of three genera and four species of ixodid tick parasite collected from domestic cow breed, *Bovis permiginus* in district Quetta.

DISCUSSION

The faunistic survey of bovine tick prevalence and related risk elements in the study zone has not yet been investigated. In this study it was observed that distribution and abundance of tick species infesting domestic cow breed, *Bos permiginus* (Linnaeus, 1758) were differ from one locality to another. This variation may be due to the change in environmental conditions that highly affect the ecology of ticks. Change in temperature and rainfall have been reported to affect the distribution of ticks vectors (Taylor *et al*., 2007). Aktas *et al*. (2004) reported 85% humidity and 26°C to 37°C temperature requirements for growth and reproduction of ticks. This is in contrast to previous studies and suggests that it is not favorable for the ticks to be present in higher humidity (Huba *et al*., 2003); as they become prone to over saturation thus limiting their activities (Gray, 2007). Of the total observed (346 out of 404) *Bos permiginus*, (85.64) were found tick infested with highest rate (65.96%). The most prevalent tick species affecting domestic cow breed was *H. a. anatolicum* (33. 39%) compared to *D. andersoni* (31.76), *H. aegyptium* (26.16%) and *B. microplus* (8.67%) (Figs. 4, 5). During summer months infestation in cattle were found highly significant (P < 0.01). The upshot of warmth and moisture on prevalence of *Hyalomma* abundance was observed, and it was found that on average, the warmest month was July (Year 2013-2014) in Quetta where maximum average hotness rise up to 36°C, and moisture 42% greatly increased the occurrence of tick species. Khan *et al*. (1993) attributed an increase tick infestation during summer months due to an increase temperature and humidity. Their study on different livestock species reported 28.2 and 14.7% infestation in cattle and buffaloes, respectively. *Hyalomma* were the most prevailing tick species in cattle and buffalo followed by those belonging to *Boophilus*. This is in agreement with the findings of present study and those presented by Mustafa *et al*. (2014) and Tassarwar *et al*. (2014) who reported the highest prevalence (37%) of *Hyalomma a. anatolicum* and considered it the most wide spread and commonest cattle tick in Punjab province (Pakistan).

Nearly similar results were found by Atif *et al*. (2012a) where they recorded 22.86%, *Hyalomma a. anotolicum* tick followed by *Rhipicephalus* (*Boophilus*) *microplus* (21.33%), *R.* (*B.*) *sanguineus* (7.52%), *R.* (*B.*) *annulatus* (1.43%) and *Haemaphysalis* spp. (1.62%) they noted maximum (mean) temperature to be involved in high prevalence of tick infestation. Other researchers like ? Biu *et al*. (2012) described *Hyalomma* ticks as the most prevalent species (18.27%) reported infesting small ruminants of Nigeria. Similar finding were reported by other scientists in Pakistan. Durrani *et al*. (2008) recorded 66.7% prevalence of cattle *Hyalomma* tick in district Lahore. Manan *et al*. (2007) surveyed tick fauna in outskirts of Peshawar resulted two tick's genera *Rhipicephalus* (*Boophilus*) and *Hyalomma* as the most prevalent ticks showed 46.1% and 31.25% infestation, respectively. Ali *et al*. (2013) analyzed an overall tick prevalence reported *Hyalomma* as dominant (61%) over other genera of hard ticks. Female *Hyalomma* was highest in sex-wise dispersion (85%) than *Amblyomma* (81%), *Boophilus* and *Haemaphysalis* species (77%). Cows were examined to be more infested (70%) than buffaloes (34%). This situation

may occurs due to brooding period, age, or sex (Alonso *et al*., 2007), host accessibility or dietary status of the animal (Yacob *et al*., 2008).

Previous studies notably those by above Alekaw (1998) stated less prevalence (5.7%) of *Hyalomma* in the cattle of Metekel Ranch, Ethiopia. The female ticks were noted to be abundant transmitted *Babesia bigemina* to cattle of this region. These results however, disagree with our findings and with those reported by Shahardar *et al*. (1998) in bovine farm animals found infested with 40%, 20.14%, 16.96%, prevalence ratio by *Boophilus*, *Hyalomma*, *Haemaphysalis* while *Amblyomma*, *Nosoma* and *Rhipicephalus* caused 10.22%, 4.56% and 1.96%, respectively at Maharashtra, India.

The present study is to some degree comparable to studies conducted earlier in other parts of the world. Reports of Tiki and Addis (2011) and Onu and Shiferaw (2013) demonstrated comparatively less prevalence ratio (25.64) and (14.5%) of *Hyalomma* and *Boophilus* ticks, respectively. This difference may occur because of lactation phase of the tick (Teel *et al*., 1996), variation in agro-climatic condition of the study region. Since high infestation ratio (65.96%) of tick species prevalence was determined in the present study during March, 2013 to March, 2014. On the other hand, Fantahun and Mohamed (2012) reported 70.3% infestation in cattle of Assona town, Ethiopia in contrast to 48.2% described by Tamiru and Abebaw (2010) in local and cross breeds of cattle in Asella Town, south west Ethiopia. These findings are not in line with findings of the present study and those reported by above mentioned authors. This distinction may because of change in the climatic factors (Greenfield, 2011), breed, body condition (Hassan and Osman, 2003), and farming practices (Bianchi *et al*., 2003).

Regarding the associated risk factors, tick infestation was found statistically significant ($P < 0.05$). The local cow breed (*Bos periginus*) were found highly infested (88.97%) than cross breed (13.33%) cattle (Table III). These results go in accordance with those reported by Kabir *et al*. (2011) was significantly ($P< 0.01$) higher in local cattle (43.82%) than the crossbred (24.13%) cattle. Results in Table I denoted that older ages (4 years animals) were found more infested (32.9%) than animals at the age of 2 years (26.8%), 3 (31.4), and one year old showed 8.7% infestation .The percent distribution on different body parts of analyzed cattle (Table III) revealed the neck (27.71), and ear pinnae (25.55) as the most preference sites of tick infestation followed by body trunk (19.83), head (13.37), ventrum (10.17) and extremities (3.34 %). The reason for the results may be highly supplied with blood to neck and ear pinnae region of the body. Ticks usually prefer thinner and short hair skin for infestation, this helps in easy penetration of mouth parts into richly vascular area for feeding (Sajid *et al*., 2007). Moreover, Atif *et al*. (2012a) indicated that perineum, udder and external genitalia (98%) were the most infested tick sites than dewlap (92%), inner thighs (90%), neck and back (54%), tail (26%), ears (13%), around eyes (10%), flanks (4%) and legs (2%), respectively.

The present study associate the ticks prevalence and ratio of infestation with change in the breed and body condition of the animals. In this regard higher commonness was observed in cattle with medium (92.9%) and poor body (57.44%) status ($P = 0.01$). Wasihun and Doda (2013) have reported 79.8% tick infestationin in medium body than poor body (67.9%), and animals having good body conditions (58.0%). This may be due to that medium body cattle are given to any form of illness when eating on the field, and poor body animal were kept at home because of their impotence to walk in field, so they turn out to be less pervaded than animal's posses medium body status. All about good cattle were resistant especially to any form of illness when they graze in the field or are kept at home. The result demonstrated significant difference between prevalence of tick infestation and the breeds ($P = 0.01$). The breeds are pervaded peculiarly by the ticks with the commonness (92.9%). The vast variety of tick infestation of various cow breeds in the present study may be assigned to compare administration frameworks, absence of subsidiary bolstering that resulted in low resistance to local breeds.

CONCLUSIONS

In conclusion, *Hyalomma a. anatolicum* (33.39%) was the most prevalent among the tick species followed by *Dermacenter andersoni* (31.76%), *Hyalomma aegyptium* (26.16%) and *Boophilus microplus* the least prevalent (8.67%) recorded in the study. The effect of temperature and humidity on prevalence of *Hyalomma* ticks abundance was observed, and it was found that on average, the hottest month was July (Year 2013-2014) in Quetta where maximum average temperature rise up to 36°C, and humidity 42% greatly enhanced the prevalence of tick species. Hence, it is suggested that distribution of ticks are not fixed but can be determined by a complex interaction of factors such as, atmosphere, host thickness, host susceptibility, grazing and posture herd management. Overall, the present study revealed very high prevalence of tick infestation that could potentially hamper the productivity of cattle in the study area, hence a serious measure should be put in place to control and reduce the adverse effect of tick infestation. Thus, influential tick control system ought to be formulated taking into account

the dispersion pattern of ticks and aspects liable for their distribution. It would be beneficial to evaluate the levels of tick prevalence infestation and transmissible pathogens present within study locations relating not only to wild and domestic animal health, but also to public health.

Statement of conflict of interest

Authors have declared no conflict of interest.

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