An epidemiological survey on diversity and seasonal distribution of hard ticks in sheep and goats in Multan, Pakistan

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Abstract
Tick infestation is the major obstacle in livestock spreading in the tropical and subtropical region of the world. The purpose of the present study was to determine the tick infestation in small ruminants in district Multan, Pakistan. During sampling the adult ixodid ticks were collected from sampled animals and identified on the basis of shape of scutum, leg color, body, coxae one and ventral plates. The results showed the prevalence of tick infestation was 48.0% in small ruminants. Sheep was more infested with ticks (50.0%) compared to goats (43.6%). Hylomma anatolicum was the dominant tick species 52.2% followed by Rhipicephalus sanguineus 17.4%. The mixed infection was found 30.4% in small ruminants. The sex wise prevalence was higher in females (48.5%) than in males (45.2%). The tick prevalence based on age recorded higher in age >3 years was 52.3%, in age 1-2 years was 45.2% and lower in age <1 year (44%) respectively. Among sheep the highest prevalence was in Lohi breed (51.0%) than Kajli breed (50.0%) while in goats highest tick infestation was reported in Beetal breed (52.6%), followed Nachi breed (42.7%), and Teddy breed (39.2%). The result indicated that significantly higher tick prevalence was in June (81.0%) and lower in November (350%). The higher tick infection was recorded in summer season (77.7%) followed by autumn season (52.3%), spring season (50%) and lowest in winter season (11.1%). Breed wise prevalence revealed Lohi breed in sheep (51%) and Beetal breed in (52.6%) was more infested. The present study shown It was found that in sheep internal ear (94%) and external ear (80%) and in goats internal ear (95%) were the most infested sites.

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Introduction

Small ruminants play key role in economical setting and ecological niche in Asian countries. Livestock owners in rural communities earned their daily income through trade of surplus animals and their byproducts (Irshad et al., 2010). Pakistan, next to China and India is the dominant goat generating country throughout the world. Livestock, the pivotal part of agricultural economy of Pakistan, is adversely affected by ectoparasitic infestation such as ticks (Sajid et al., 2008). Ticks being vectors of bacterial, protozonal, spirocheatal and viral diseases transmit pathogens to humans and livestock animals (Kaker, 2008). Major obstruction in livestock expansion is tick-borne diseases such as theileriosis, bebesiosis, anaplasmosis and heartwater (Ahmad et al., 2007).

The impact of ticks and tick-borne diseases (TTBDs) had been ranked very high on the livelihood of resource poor farming communities. Ticks not only damage hides and skins of infested animals but also impedes with meat and milk production which causes great economic losses all over the world (Desalegn et al., 2015). Ticks restricted growth of young animals due to blood meal which resulted in thin, stunted and weak production of livestock ruminants (Jonsson et al., 1998). Livestock sector miserably damaged due to tick-borne diseases by reducing 14% lactation in the infested animals. Ticks resulted in annual loss of US$ 500000 from hides and skin downgrading in eastern Ethiopia (Desalegn et al., 2015). The global cost estimated for treatment of tick borne diseases is between US$ 13.9 to 18.7 billion annually (De Castro, 1997).

Pakistan being part of tropical region has greater tick fauna (Rasul and Akhtar, 1975) and surveillance studies conducted in domestic and wild animals revealed higher tick prevalence (Manan et al., 2007). Tick and tick-borne diseases (TTBDs) affect 80% livestock population in tropical and subtropical part of world including India, Pakistan and Bangladesh. The climatic conditions for tick growth and development are favorable in these countries (Ghosh et al., 2007).

The information regarding tick infestation, tick taxonomy and efficacy of different acaricidal used for tick control is diminutive in Pakistan (Khan et al., 1998). Most studies conducted are institutional based and not more than a decade old, furthermore ignored those areas which have heavy livestock population such as lower Punjab, Pakistan (Iqbal et al., 2013; Khan et al., 1993). The objective of the present study was to determine distribution of tick species infesting sheep and goats in district Multan, Southern Punjab, Pakistan.

Materials and methods

Study Area

The present study was conducted in the district Multan, Punjab, Pakistan. The data was collected from six administrative towns of district Multan including Bund Bosan, Shahruknealam, Shershah, Mumtazabad, Shujaabad and Jalalpur.

The district Multan is situated between 29'-22' north latitude and 71'-4' east longitude with mean annual temperature 25 °C with an average rainfall of 127 mm. Topographically rivers, canals and narrow water channels divide the vast plain grounds of district Multan. Multan is located in a bend created by five confluent rivers. Small holder mixed farming system is the main mode of production of the farmers in the studied area.

Study design and sampling strategy

A cross sectional study was conducted on small ruminants (sheep and goats) of both sexes, different age groups and breed to collect ticks in Multan district from January 2013 to December 2013. Farm and herd selection was established based on the criteria of distance from one farm to other was not less than 10 km and 10% animals were sampled from each herd. A questionnaire was made to collect the information and associated risk factors involved in the severity of infestation in small ruminants during field survey.
During sampling the adult ixodid ticks were removed from surveyed animals and collected carefully in bottles containing 70% ethyl alcohol as preservative.

The bottles were properly labeled with species of animals, gender and date of collection. The tick samples were brought to the laboratory of Institute of Pure and Applied Biology, Bahuddin Zakryya University, Multan and were identified. The sampled ticks were spread on filter paper to absorb excessive preservative.

Permanent mounts of the tick specimens were prepared. Ticks were identified on the basis of shape of scutum, leg color, body, coxae one and ventral plates. Tick classification was done by using stereoscope based on identification key Walker et al. (2003).

Various determinants including month, season, area under study, gender, age, and breed were studied to determine their impact on tick prevalence. The data of temperature, rainfall and relative humidity was collected from Meteorological Department of Multan, Pakistan. Body parts of surveyed animals were examined for tick predilection sites.

**Data management and analysis**

The filed data of collected ticks were analyzed by using Minitab 16 software package. The tick infestation was determined by dividing the number of positive animals by the total number of animals surveyed expressed as percentages. Three age groups of studied animals were made: 1 year, 1-2 year and 3 year. Breed-wise tick infestation studied both in sheep (Lohi and Kajli) and goats (Beetal, Nachi, Teddy). Chi-square test (X²) was used to assess the significant level of tick prevalence in studied ruminants. A p values less than 0.05 were considered as significant for data analysis.

**Results and discussion**

Of the total 1200 surveyed small ruminants (sheep and goats), 574 (48.0%) were infested by one or more tick species. The tick infestation rate in sheep and goats was 50.0%, 43.6% respectively (Table 1).

The single tick presence on the surveyed animal considered them as positive for tick infestation. Similar trends of higher tick infestation in sheep were reported from different parts of country which is in agreement to the present study: 31% in sheep and 29% in goats from Sindh by Hussain (1980); 12.8% in
sheep and 12.0% in goats from Peshawar by Manan et al. (2007) and 43.37% in sheep and 41.53% in goats from Lahore by Irshad et al. (2010). The higher infestation of ticks in sheep may attributed to sheep wool which provide suitable environment for ticks (Yagoub et al., 2014) while distinct grooming behavior in goats reduced tick attachment to body (Tasfaye et al., 2012), but contradicts to Sertse and Wessone (2007) and Mulugeta et al., (2010) who reported higher prevalence of ticks in goats compared to goats.

The higher tick prevalence in goats compared to present study may endorsed due to difference of climatic geographical factors, goats breed and genetic resistance to ticks in the studied animals. The tick species identified during present study depicted in figure 1. *Hylomma anatolicum* was the dominant tick species 300 (52.17%) followed by and *Rhipicephalus sanguineus* 100 (17.39%) in the surveyed animals.

The mixed infection of both tick species was found 175 (30.43%) in small ruminants as summarized in table 1.

### Table 1. Relative abundance of tick species species infesting in small ruminants (sheep and goats) of district Multan, Punjab, Pakistan.

<table>
<thead>
<tr>
<th>Tick species</th>
<th>Total count</th>
<th>Percentage %</th>
</tr>
</thead>
<tbody>
<tr>
<td><em>Rhipicephalus sanguineus</em></td>
<td>100</td>
<td>17.39</td>
</tr>
<tr>
<td><em>Hylomma anatolicum</em></td>
<td>300</td>
<td>52.17</td>
</tr>
<tr>
<td>Mixed infection</td>
<td>175</td>
<td>30.43</td>
</tr>
<tr>
<td>Total</td>
<td>575</td>
<td>-</td>
</tr>
</tbody>
</table>

### Table 2. Results of statistical analysis of different epidemiological factors in sheep and goats of district Multan, Southern Punjab, Pakistan.

<table>
<thead>
<tr>
<th>Variables</th>
<th>Category</th>
<th>Number examined</th>
<th>Number (%) found to be infested</th>
<th>Significance</th>
</tr>
</thead>
<tbody>
<tr>
<td>Species</td>
<td>Sheep</td>
<td>737</td>
<td>374 (50.7)</td>
<td>X² = 6.128</td>
</tr>
<tr>
<td></td>
<td>Goats</td>
<td>463</td>
<td>201 (43.4)</td>
<td>P = 0.013</td>
</tr>
<tr>
<td>Sex</td>
<td>Male</td>
<td>217</td>
<td>98 (45.16)</td>
<td>X² = 0.806</td>
</tr>
<tr>
<td></td>
<td>Female</td>
<td>983</td>
<td>477 (48.52)</td>
<td>P = 0.369</td>
</tr>
<tr>
<td>Age</td>
<td>≤1 year</td>
<td>310</td>
<td>138 (44.00)</td>
<td></td>
</tr>
<tr>
<td></td>
<td>1-2 year</td>
<td>420</td>
<td>190 (45.23)</td>
<td>X² = 6.321</td>
</tr>
<tr>
<td></td>
<td>≥3 year</td>
<td>470</td>
<td>246 (52.34)</td>
<td>P = 0.04</td>
</tr>
<tr>
<td>Locality</td>
<td>Bund Bosan</td>
<td>200</td>
<td>34 (17.00)</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Shahruknealam</td>
<td>200</td>
<td>160 (80.00)</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Shershah</td>
<td>200</td>
<td>40 (20.00)</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Musapak shaheed</td>
<td>200</td>
<td>110 (55.0)</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Shujaabad</td>
<td>200</td>
<td>100 (50.0)</td>
<td>X² = 246.84</td>
</tr>
<tr>
<td></td>
<td>Jalalpur</td>
<td>200</td>
<td>130 (65.0)</td>
<td>P = 0.00</td>
</tr>
<tr>
<td>Breed</td>
<td>Kajli</td>
<td>58</td>
<td>29 (50.00)</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Lohi</td>
<td>679</td>
<td>345 (51.00)</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Teddy</td>
<td>127</td>
<td>50 (39.37)</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Nacchi</td>
<td>260</td>
<td>111 (42.69)</td>
<td>X² = 9.616</td>
</tr>
<tr>
<td></td>
<td>Beetal</td>
<td>76</td>
<td>40 (52.63)</td>
<td>P = 0.04</td>
</tr>
<tr>
<td>Season</td>
<td>Winter</td>
<td>300</td>
<td>35 (11.66)</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Spring</td>
<td>300</td>
<td>150 (50.00)</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Summer</td>
<td>300</td>
<td>233 (77.66)</td>
<td>X² = 264.29</td>
</tr>
<tr>
<td></td>
<td>Autumn</td>
<td>300</td>
<td>157 (52.33)</td>
<td>P = 0.00</td>
</tr>
</tbody>
</table>
Among sheep *Hyalomma anatolicum* accounts for 195 (26.45%) followed by *Rhipicephalus sanguineus* 65 (8.81%) where as mixed infestation of both tick species was observed 113 (15.33%) while in goats *Hyalomma anatolicum* were reported 104 (22.46%) followed by *Rhipicephalus sanguineus* 35 (7.55%) where as mixed infestation was observed 62 (13.39%) as indicated in Figure 2.

The prevalence of tick infestation was found statistically significant (P<0.05) in different age groups and breed of animal but gender wise tick prevalence found non significant as stated in table 2.Significantly (P<0.05) higher tick infestation (52.3%) was found in older animals of age >3 years followed by (45.23%) in animals of age 1-2 years and lower 44.0% in animals of age <1 year.

**Fig. 1.** Tick species identified during current study
Fig. 2. Specie wise tick prevalence in sheep and goats.

The results of present study were in line with those of Sertse (2007) and Desalegn et al. (2015) who reported higher tick infestation in age groups greater than 3 years compared to lower age animals in domestic ruminants. The higher tick infestation in older animals may be attributed to long distant animal’s movement to pursuit food and water, so the chance of tick infestation higher during this period (Teseema and Gashaw, 2010). Our results contradicts to the findings of Sajid et al. (2011) who reported greater exposure of young animal to tick infestation might be endorsed due to reduced behavioral activities. Moreover, acquired immunity produced with age and thicker skin of old age animals can also support to resistance against tick burden in older age animals (Obi et al., 2014).

Fig. 3. Correlation between prevalence of Tick prevalence and weather parameters in sheep and goats of district Multan, southern Punjab, Pakistan.

The prevalence of H. anatolicum was recorded higher in all age groups of small ruminants <1 year, 1-2 year and >3 year i.e. 50.34%, 55.31% and 51.04% respectively. The R. sanguineus infestation was found higher in age group 1-2 year (30.82%) followed by age group ≤1 year (21.08%) and lower in age group ≥3 year (13.57%). The mixed infection of both species was recorded higher in age group >3 year (31.38%),

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followed by age group 1-2 year (30.82%) and age group <1 year (28.57%) as depicted in figure 7.

The breed-wise prevalence of ticks was found significant (P<0.05) between different breeds of small ruminants. Among sheep the highest prevalence was in Lohi breed (51.0%) than Kajli breed (50.0%) while in goats highest tick infestation was reported in Beetal breed (52.6%), followed Nachi breed (42.7%), and Teddy breed (39.2%) as stated in table 2. Similar to our results Sajid et al., (2011) found higher tick prevalence in Teddy breed (78.9%) followed by Beetal breed (67.0%), cross-bred breed (60.8%), Nachi breed (56.9%) and lower in Dira Din Pannah (DDP) breed (38.5%) in goats. The difference of tick infestation among different breeds of goats could be due to difference of genetic resistance in different breeds and climatic conditions of the studied area (Jongejan and Uilenberg, 2004). However, the factors involved to become more susceptible to ticks bites need to be identified in Pakistan.

![Fig. 4. Townwise tick prevalence in sheep and goats in district Multan, Punjab, Pakistan.](image)

The prevalence of tick infestation found higher in females (48.5%) than males (45.2%) but the association between gender and tick prevalence in overall small ruminants was found non significant (P>0.05). In sheep the tick infestation recorded higher in females (51%) followed by males (50%) while in goats males were found highly infested (46.5%) as compared to females (42.5%). The results of present study are in agreement to Yakhchali and Hosseine (2006) who reported higher tick infestation (78.1%) in females than in males 21.9% in small ruminants in Iran. Higher secretion of prolactin and progesterone in females made them more susceptible to tick bites than males reported by Lloyd (1983) and Rony et al. (2010). The difference of tick prevalence in female can be hypothesized due to confinement of females either during lactation or gestation, which make them less active, low immunity and hormonal impacts may be related to higher susceptibility of tick bites in females as stated by Urquhart et al. (2001).

The month and season wise prevalence was determined in present study. The ticks started to appear by the start of February and highly active from end of April to August (Figure 3).

The higher tick prevalence was recorded in June (81.00%) while lower in November (35.00%). The statistical analysis has showed significant differences (P<0.05) in the prevalence of tick infestation in different months.

These results were in line with Atif et al. (2012); Manan et al., 2007 and Mustafa et al. (2014) who reported the higher tick prevalence from June to
August and lowest in November and February might be validated due temperature difference and humidity throughout the year. Higher tick prevalence was found in summer season (77.7%) followed by autumn season (52.3%), spring season (50%) and lowest in winter season (11.1%). The results were in line with the findings of Rony et al. (2010), Abadi et al. (2010) and Kabir et al. (2011) who recorded higher tick infestation in summer season followed by winter and rainy season due to higher temperature in summer season favorable for tick bites.

Although the different towns of district Multan lies in the same agroecological zone, the higher tick infestation was recorded in Shahruknealam Town (80%), followed by Jalal pur Town (65%), Mumtazabad Town (55%), Shujaabad Town (50%), Sher shah Town (20%) and Bundbosan Town (17.50%).

The statistical analysis has showed significant differences (P<0.05) in the prevalence of tick infestation in different towns of district Multan, Punjab Province, Pakistan as depicted in figure 4. Various body sites of small ruminants (sheep and goats) were determined in order to rank the predilection sites of ticks. It was found that in sheep internal ear (94%) and external ear (80%) were the most infested sites followed by back (10%), inner thighs (9%), external genitalis (8%), eyes (7%) flanks (4%), legs and tail (3% each).

In goats internal ear (95%) were the most infested sites of tick infestation followed by external ear (20%), external genitalis (10%), eyes (5%), inner thighs (4%), flanks, legs and tail (2% each) as shown in figure 5. Similar results of predilection sites of ticks were found Sajid et al. (2011) in sheep and goats.

The ears of the animals compared to other body parts are preferable for ticks to reside and feed blood meal from host animal (Sajid et al., 2007). Soft and pliable skin of young small ruminants enables tick bites and helpful to extend duration of attachment to the host.

The higher tick infestation around ears in small ruminants might be endorsed that ticks frequently choose thinner and dumpy hair skin for infestation which benefits for easy penetration of tick’s mouthparts into the feeding areas of the animals body which are richly supplied with blood vessels reported by Rehman et al. (2010).
Our results was in agreement to the findings of Jongejan and Uilenberg, (2004) and Kabir et al., (2011) who observed that ears, neck and dorsal floor frequently infested by ticks due to richly supplied blood capillaries to these areas.

**Conclusions**

In the present study two tick species *Hylomma anatolicum* and *Rhipicephalus sanguineus* were identified. The abundant tick species was *Hylomma anatolicum* in the study area.

The tick prevalence was statistically significant within month, season of year, age and breed of animals. Generally ticks are highly prevalent in this study area due to poor veterinary services, auspicious geoclimatic circumstances and poor cognizance of owners to damages due to tick infestation in the study area. Therefore, attention should be given to the control and prevention of tick infestation.

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**Author’s contribution**

Survey, tick sample collection, the experimental work in the laboratory i.e. tick processing, permanent mounts of ticks in canada balsam were performed by Muhammad Riaz and the compilation of results were performed by Muhammad Riaz and Muhammad Zakaullah while the manuscript was critically analyzed and reviewed by Prof. Dr. Zahida Tasawar.

**Conflict of interest**

It is declared that there is no conflict of interest between the authors.

**References**


