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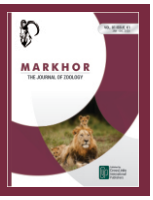

Original Article

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Prevalence and Taxonomic Identification of Tick Species Infesting Goats and the Influence of Abiotic Factors on Host Parasite Interactions in District Sanghar, Pakistan

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ABSTRACT

Goats are an important livestock component of the agricultural sector globally. Ticks are the most significant ectoparasites of domesticated animals in tropical and subtropical regions that affect public health and animal health. **Objectives:** To determine the prevalence of tick infestation, taxonomic identification, and to observe the impact of abiotic factors on the host-parasite relationship. **Methods:** The cross-sectional epidemiological study was conducted in the Sanghar district located in the Sindh province of Pakistan. This was conducted from December 2020 to March 2021. **Results:** The highest prevalence was recorded in the Bar Khan Jatoi (66.67%), and the lowest was in Jhool (33.33%). The infestation rate was higher in females as compared to males, with 50.98% and 32.11%, respectively. The prevalence percentage in < 6 Months, 6 to 24 Months, and C >24 Months was 42.22, 46.57, and 43.13%, respectively. Goats reared in cottage-type housing showed higher infestation (55.71%) than those in open housing (30.00%). The lowest prevalence was in December with 29.33%, and the highest was in March, 60.67%. The humidity in January was 50%, and 52% tick infestation and in the month of March, by 20%, and the tick infestation by 32%. The prevalence percentage of *Hyalomma* tick infestation was higher, while *Rhipicephalus* and *Amblyomma* were recorded as 43.00%, 29.50%, and 27.50%, respectively. **Conclusion:** The highest prevalence was recorded in the Bag Khan Jatoi, while *Hyalomma, Amblyomma*, and *Rhipicephalus* were prevalent. Young animals reared in cottage-type housing in March, as compared to December, were most susceptible to the burden of tick infestation.

INTRODUCTION

Goats are considered an important livestock community and contribute to the development of the agricultural sector globally. During 2017-2018, the livestock sector contributed 11.1% to Pakistan's GDP; its share in the value of all agricultural commodities was 58.9% [1, 2]. Furthermore, the livestock sector is facing various issues, including a lack of veterinary service, health, and finical issue in various tropical and sub-tropical regions of the world [3, 4]. Ticks are the most significant ectoparasites of domesticated animals in tropical and subtropical regions, affecting public health, animal health, and livestock production, and decreasing live weight gain, milk

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production, and livestock economy [5, 6]. Ticks are divided into two major families, *Ixodidae* (Hard Ticks) and *Argasidae* (Soft Ticks). Ticks belong to the family Ixodidae, are blood-feeding arthropods, and play a major role in transmitting various pathogens, including bacteria, viruses, helminths, and protozoa, that affect both animals and humans [7]. Hard ticks are a serious threat to goats by causing direct harm and a high risk of disease transmission among vertebrate animal hosts. The epidemiological profile of hard ticks across different agro-ecological zones is typically associated with distinct environmental dynamics that shape their distribution, transmission, and subsequent habitat adaptation [8]. Tick prevalence is influenced by a variety of factors, including host availability, host-to-host interactions, vegetation type, habitat features, and environmental elements that support tick growth and survival [9, 10]. The small ruminant farming of goats and sheep has higher annual growth and contributes to the country's economy [11, 12]. While in District Sanghar in Sindh Province, many livestock owners have small scale animals' holdings and are landless.

Additionally, the outbreak of tick-borne diseases (TBDs) in Sanghar district is due to a lack of surveillance and proper management, a lack of extensive knowledge of tick control, a lack of veterinary service, and limited awareness among the goat owners. in different areas of Sanghar. The present state of knowledge is on the effects of climate change on tick distribution and life cycles, as well as the dynamics of tick-borne illnesses. This study aims to generate data on tick infestation in goats and to study the host-parasite relationship due to abiotic factors on tick infestation.

METHODS

The cross-sectional epidemiological study was conducted in the Sanghar district located in the Sindh province of Pakistan. This was conducted for a period of four months from December 2020 to March 2021. It consists of six tehsils: Jam Nawaz Ali, Khipro, Sinjhoro, Shahdadpur, and Tandoadam. Sanghar is 15Km above sea level and located at 26.03° N 68.95° E. It is 9874 square kilometers in area. The present study was conducted on goat tick-infestation and host-parasite relationship with respect to abiotic impact. The prevalence of tick infestation in goats was recorded, and the tick samples were collected from the study area. The collected samples were transported to the post-graduate laboratory of the Department of Veterinary Parasitology, Sindh Agriculture University, and Tandojam for further analysis and identification of the samples. The epidemiological data were recorded from ten villages that were selected randomly in the district of Sanghar. The abiotic factors, such as temperature and humidity, were recorded during the collection of samples. The temperature of the collected sample area was recorded with the help of a thermometer, and the humidity was recorded with the help of a hygrometer. Other factors (rearing system, gender, age) were randomly selected for interview using a questionnaire form. The obtained data were analyzed using frequency distribution and ordered in tabulated form. Ticks were collected and preserved in a sterilized test tube containing alcohol (70% ethyl alcohol) as a preservative and brought to the lab, and taxonomic identification of goat ticks was carried out. The collected specimens were rinsed in distilled water to remove the preservative and then heated in a 10% potassium hydroxide (KOH) solution for 30 minutes. The specimens were treated with 10% glacial acetic acid for 5 minutes to clear the residues of KOH and washed with distilled water, then stained with 10% acid fuchsine for 2 minutes. After that, the ticks are washed out with distilled water to clear the remaining stains. Dehydration of stained specimens was accomplished using various percentages of ethyl alcohol, including 30, 50, 70, 80, 90, and pure alcohol. The specimen was cleaned with clove oil and placed on a glass slide using Canada balsam. Ticks were morphologically studied and identified as specified using a stereomicroscope [12].

Data were entered into the designed Performa, followed by the MS Excel Program. The prevalence data were analyzed using the Chi-square (χ^2) test to determine associations between variables. A p-value of less than 0.05 ($p<0.050$) was considered statistically significant. Data were statistically analyzed in GraphPad.

RESULTS

The prevalence of tick infestation in goats in Sanghar district is presented. A total of 600 animals were examined from Sanghar city and adjoining villages in the district of Sanghar. The highest prevalence was recorded in the Bag Khan jatoi (66.67%) followed, by Kandi Water (65.00%), Landhi (59.09%), Sultan Kot (53.13), Dil Shakh (48.89%), Gujri (47.62%), Workshop Stop (46.59%), Sanghar City (46.59%), Bakhoro (43.75%), Chaak (42.42%), Satar Nizamani Village (40.00%), Mangli (40.00%), Rawotiani (39.39%), Achi Masjid (39.29%), Kot Nawab (37.50%), Muhammad Ali Waah (37.50%), Wadha Village (36.00%), Khadro (35.71%), Miyanr (35.71%) and Jhool (33.33%) (Table 1).

Table 1: Prevalence of Tick Infestation in Goats in Sanghar District

Sr. No.	Collection Areas	No. Examined Goats	No. infested (%)
1	Bag Khan Jatooi	21	14 (66.67%)
2	Kandi Water	20	13 (65.00%)
3	Landhi	22	13 (59.09%)
4	Sultan Kot	32	17 (53.13%)
5	Dil Shakh	45	22 (48.89%)
6	Gujri	21	10 (47.62%)
7	Workshop Stop	47	22 (46.81%)
8	Sanghar City	88	41 (46.59%)

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9	Bakhoro	16	7 (43.75%)
10	9-10 Chaak	33	14 (42.42%)
11	Satar Nizamani Villege	30	12 (40.00%)
12	Mangli	35	14 (40.00%)
13	Rawotiani	33	13 (39.39%)
14	Achi Masjid	28	11 (39.29%)
15	Kot Nawab	26	10 (38.46%)
16	Muhammad Ali Waah	24	9 (37.50%)
17	Wadha Villege	25	9 (36.00%)
18	Khadro	28	10 (35.71%)
19	Miyanr	14	5 (35.71%)
20	Jhool	12	4 (33.33%)
Total		600	270 (45.00%)

Results show the showed that the infection rate was higher in females as compared to males, with 50.98% and 32.11%, respectively. The proportion of female goats was considerably higher than that of male goat at district of Sanghar. Proportions of gender-wise tick infestation in goats in the district Sanghar were significant. The highest tick infestation was recorded in young animals as compared to kids and old animals. The age-wise prevalence percentage in group A (<=6 months), group B (6-24 months), and group C (>24 months) was 42.22%, 46.57%, and 43.13%, respectively. Statistically non-significant (p = 0.7900) difference among ages. The prevalence percentage of tick infestation according to the animal housing types was higher in those animals that were reared in cottage-type housing as compared to open-type housing. The prevalence percentage was 55.71% in the cottage and 30.00% in open-type housing. However, the results of tick infestation according to the type of house were highly significant (Table 2).

Table 2: Gender-Wise, Age, Animal Housing, Prevalence of Tick Infestation in Goats at the District Sanghar

Variables	No. Examined Goats	No. infested (%)
Gender		
Male	190	61 (32.11%)
Female	410	209 (50.98%)
Total	600	270 (45.00%)
Age		
A (<=6 Months)	90	38 (42.22%)
B (6 -24 Months)	350	163 (46.57%)
C (>24 Months)	160	69 (43.13%)
Total	600	270 (45.00%)
Housing Type		
Open	250	75 (30.00%)
Cottage	350	195 (55.71%)
Total	600	270 (45.00%)

Gender: p-value=0.001, df = 1, Chi square = 10.274. Age: p-value= 0.7900, df = 2, Chi square = 0.471. Animal Housing: Gender: p-value=0.001, df = 1, Chi square = 21.492

The study shows the month-wise prevalence; the lowest prevalence was in December with 29.33%, followed by January, February, and March with 39.33%, 50.67%, and 60.67%, respectively. It was observed that the infection rate was lower in December and January due to low temperature and high humidity in December and January, and higher in the months of February and March. Statistically, the results are highly significant (Table 3).

Table 3: Month-Wise Prevalence of Tick Infestation in Goats in the District of Sanghar

Sr. No.	Months	No. Examined Goats	No. infested (%)
1	December 2020	150	44 (29.33%)
2	January 2021	150	59 (39.33%)
3	February 2021	150	76 (50.67%)
4	March 2021	150	91 (60.67%)
Total		600	270 (45.00%)

p-value: 0.001, df: 3, Chi square: 18.504

Three tick species, *Hyalomma*, *Rhipicephalus*, and *Amblyomma*, were observed in goats at the district Sanghar. The prevalence percentages of tick infestation were *Hyalomma*, *Rhipicephalus*, and *Amblyomma*, and were recorded as 43.00%, 29.50%, and 27.50%, respectively. This indicates that the more dominant species found in goats was *Hyalomma*. Followed by *Rhipicephalus*, the low number of tick species recorded in goats was *Amblyomma* (Table 4).

Table 4: Type of Tick Species Infestation in Goat at District of Sanghar

Sr. No.	Tick Species	Infected Goats	Identified (%)
1	*Hyalomma*	–	116 (43.00%)
2	*Rhipicephalus*	270	80 (29.50%)
3	*Amblyomma*	–	74(27.50%)
Total		–	270 (100%)

The findings show the effect of temperature on the prevalence of tick infestation in goats from December 2020 to March 2021. In January, a 19°C temperature was recorded, and the prevalence percentage is 35% when the temperature increased in the month of March (31°C), and the prevalence percentage was recorded 55%. The temperature gradually increased, which may affect the increase in the prevalence of tick infestation in goats in the study area (Figure 1).

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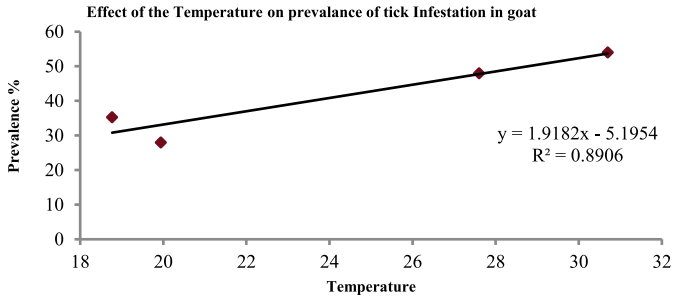

Figure 1: Effect of Temperature on Prevalence of Tick Infestation in Goats

The study shows the effect of humidity on the prevalence of tick infestation in goats from December 2020 to March 2021. In January, the humidity is 50% the burden of tick infestation in goats was recorded at 32%. Humidity decreased due to an increase in temperature in March by 20%, and the burden of tick infestation increased by 52%. Increased temperature may reduce the humidity percentage. This leads to reducing the tick infestation rate in the goats(Figure 2).

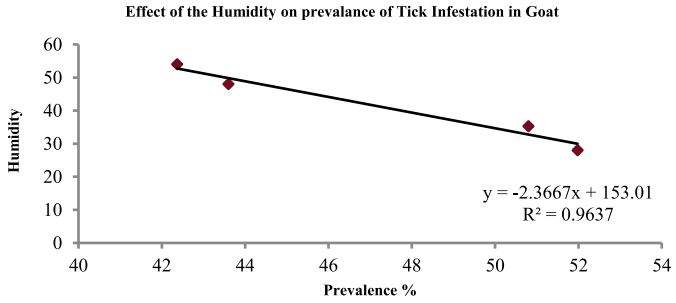

Figure 2: Effect of Humidity on Prevalence of Tick Infestation in Goats

DISCUSSION

Ticks transmit various pathogens, including viruses, bacteria, fungi, and protozoa, and can cause other infectious diseases in animals and humans [13]. The present study showed the prevalence, identification, and processing of ticks that were isolated from the district Sanghar and adjoining areas. Similar outcomes were observed by [14, 15] in Kerala (74.73%) and in Tamil Nadu (97.66%). The occurrence of tick infestation in various regions is different due to the geo-climatic conditions, temperature, humidity, and housing of animals. The present result shows that three tick species, *Hyalomma, Rhipicephalus*,s and *Amblyomma* were observed in goats at the district Sanghar. The prevalence percentages of tick infestation were *Hyalomma, Rhipicephalus*, and *Amblyomma* and were recorded as 43.00%, 29.50%, and 27.50%, respectively. This indicates that the most dominant species found in goats were *Hyalomma*, followed by Rhipicephalus, and the low number of tick species recorded in goats was *Amblyomma.* Similar results were reported by [16], who observed the prevalence (15%) of *Hyalomma* tick followed by *Boophilus* (12%), *Haemaphysalis* (5%), and *Rhipicephalus* (3%). The month-wise prevalence of tick infestation in goats was higher (60.67%), (29.33%) in March and lower in December, respectively. Furthermore, it was also indicated that the effect of humidity on the tick prevalence was lower in March due to an increase in temperature, while the tick infestation was recorded 52%, and in December, the percentage of humidity is high, and the burden of tick infestation was recorded 32%. Similar findings were observed in district Layyah by [17], which indicated that the percentages (56.9%) and (62.7%) were in July, and the lowest in November–March and December–March, respectively. Furthermore, similar findings were observed in Punjab, Pakistan, by [18]. According to gender-wise, the highest prevalence percentage of tick infestation in goats was higher in females (50.98%) as compared to males (32.11%). High secretion of prolactin and progesterone in females made them more prone to tick infestation than males [19]. The prevalence percentage was higher in animals that are in 6-24 months of age, followed by >24 months, and lowest in <6 months. A similar study was done in domestic ruminants, which reported increased tick infestation in age groups larger than 3 years compared to lower age animals [20]. The increased tick infestation in older animals due to long-distance animal movement in search of food and water increases the risk of tick infestation [21]. According to the type of housing, the highest prevalence was reported in cottage types of housing as compared to open types of housing.

This study was limited to a single district, which may restrict the generalization of the findings. Tick identification was based only on morphology without molecular confirmation, and seasonal and environmental factors were not fully explored. Additionally, the study did not assess the economic impact or pathogen transmission associated with tick infestation. Future research should include large-scale, multi-regional studies with molecular identification techniques and focus on effective control strategies, as well as the impact of tick infestation on livestock productivity and public health.

CONCLUSIONS

It was concluded from the present study that the highest prevalence was observed in Bag Khan Jatoi, district Sanghar. While *Hyalomma, Amblyomma,* and *Rhipicephalus* were prevalent, *Hyalomma* was the most prevalent in goats. Young animals were most susceptible to tick infestation, and the burden of tick infestation was higher in animals reared in cottage-type housing than in open-type housing. The prevalence percentage was higher in March than in December.

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Authors' Contribution

Conceptualization: RAK, AA
Methodology: RAK, ZL, HAA, MB, SS, SAMS
Formal analysis: SGK, AL
Writing and Drafting: SA
Review and Editing: RAK, ZL, HAA, SA, SGK, AL, MB, SS, SAMS, AA

All authors approved the final manuscript and take responsibility for the integrity of the work.

Conflicts of Interest

All the authors declare no conflict of interest.

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