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Prevalence of tick species in goats in the District of Sibi, Pakistan

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Abstract: Globally, tick infestation and tick-transmitted diseases affect the health of domestic species and cause huge economic losses. The current study investigated the prevalence of tick species in the goat population in the District of Sibi, Province of Balochistan, Pakistan. A total of six villages were selected, three from Tehsil Sibi: i) Khajjak, ii) Kurak, iii) Marghazani, and three from Tehsil Lehri; i) Taro Laal Shah, ii) Trihaar, and iii) Tehri Behramani. A total of 300 animals (50/village) were randomly selected. The prevalence of ticks associated with age, gender, and various housing systems was recorded. Tick samples were collected, processed for morphological examination under stereomicroscope, and mounted for gross identification. The data was analyzed using the Chi-square test, Fisher's exact test using SPSS software, and MS Excel frequency distribution. A total of 198 animals were found infested with ticks, resulting in an overall prevalence of 66%. Specifically, 150 animals were examined from each Tehsil, with 96 and 102 animals infested with ticks in the Sibi and Lehri tehsils, respectively, resulting in 64.0 and 68.0% prevalence rates. The prevalence of ticks in Khajjak, Kurak, and Marghazani villages was recorded as 33.0, 29.0, and 34.0%, respectively. The prevalence of tick infestation in Taro Lal Shah, Trihaar, and Tehri villages was 35.0, 30.0, and 37.0%, respectively. The gender, age, and type of housing system showed an overall tick prevalence of 66.0%. In the present study, *Amblyomma variegatum* (50%), *Rhipicephalus sanguineus* (35%), and *Hyalomma truncatum* (15%) were observed. The prevalence of ticks was associated with risk factors such as sex (females) and age (old age) of goats, as well as housing (mud-type) systems. The study focused on tick prevalence, emphasizing the importance of tick control, production, and the prevention of tick-borne diseases. This is the first report on the prevalence of ticks in goats in the Sibi District of Balochistan, Pakistan.
Keywords: Multi-tick infection, *Amblyomma variegatum, Rhipicephalus sanguineus, Hyalomma truncatum.*

1. Introduction

Globally, tick infestation and tick-transmitted diseases affect the health of domestic species. The severity of tick-transmitted diseases depends on various factors such as area, animal population, animal species, socio-economy, and techniques used for controlling tick infestation (Ghosh and Gaurav., 2014). It has been reported that various types of ticks transmit the diseases to different species of animals in Pakistan (Jabbar et al., 2015). More occurrence of tick infestation was reported during the summer and spring seasons compared to other seasons (Ramzan et al., 2020). Tick infestation can lead to direct losses, including anemia, skin and udder damage, and transfer of tick toxins, as well as indirect losses, including mortality and tick-transmitted diseases. The worldwide annual loss of USD 3.24 billion from ticks is estimated in 2022 (de la Fuente et al., 2023).

In Pakistan, the burden of ticks affects the decline of milk production and causes skin damage and hides, ultimately impacting the economic aspects of the dairy sector and the leather industry (Ullah et al., 2022). Worldwide, the tick burden is an important problem that affects the economy. It is well-established that tick infestation occurs in diverse species of animals, including sheep, goats, cattle, and buffalo (Monfared et al., 2015).

It has been proven that tick infestation occurs in various species of ruminants in Pakistan, including goats (Khan et al., 2019). Detailed epidemiological studies are needed in various agricultural climatic regions of the country to enhance our understanding of tick infestation. Previously, no study had been conducted regarding the prevalence of tick infestation in goats in Sibi District, Pakistan. In this study, we reported the tick prevalence in goats in two Tehsil or sub-districts of district Sibi, Pakistan. This preliminary survey provides information on tick infestation, which will help implement control and prevention measures and judicious usage of drugs against ticks.

2. Materials e Methods

2.1. Study Area and Sample Collection

Based on climate, physiography, soil type, and land use, Pakistan is divided into 10 agro-ecological zones: (i) Indus Delta, (ii) Southern irrigated plain, (iii) Sandy desert, (iv) Northern irrigated plain, (v) Arid, (vi) Wet mountains, (vii) Northern mountains, (viii) Western dry mountains, (ix) Drywestern plateau and (x) Sulaiman piedmont (Khan, 2004). This study was conducted in the District of Sibi, Province of Balochistan, Pakistan, situated between the longitude of 29.33°-29.55°N and the latitude of 67.53°-67.88°E, at the confluence of the Indus Plains and Sulaiman Ranges. The district is divided into the Sibi and the Lehri sub-districts or tehsils. In the present study, the sample size of the farms was calculated from a large population of goats with a desired precision of 10% and a confidence interval (CI) of 95%. In the first phase of the study, six villages were selected: three from tehsil Sibi (Khajjak, Kurak, and Marghazani) and three from tehsil Lehri (Taro Laal Shah, Trihar, and Tehri Behramani). In each village, 50 goat farmers were randomly selected and interviewed using a questionnaire (Table 2). In the second phase of the study, taxonomic

identification of goat ticks was carried out. A total of 300 animals (50/village) were randomly selected, and a physical examination was conducted to record the tick infestation. Information such as the number of goats, age, gender, breeds, and intensity of ticks on each goat was recorded.

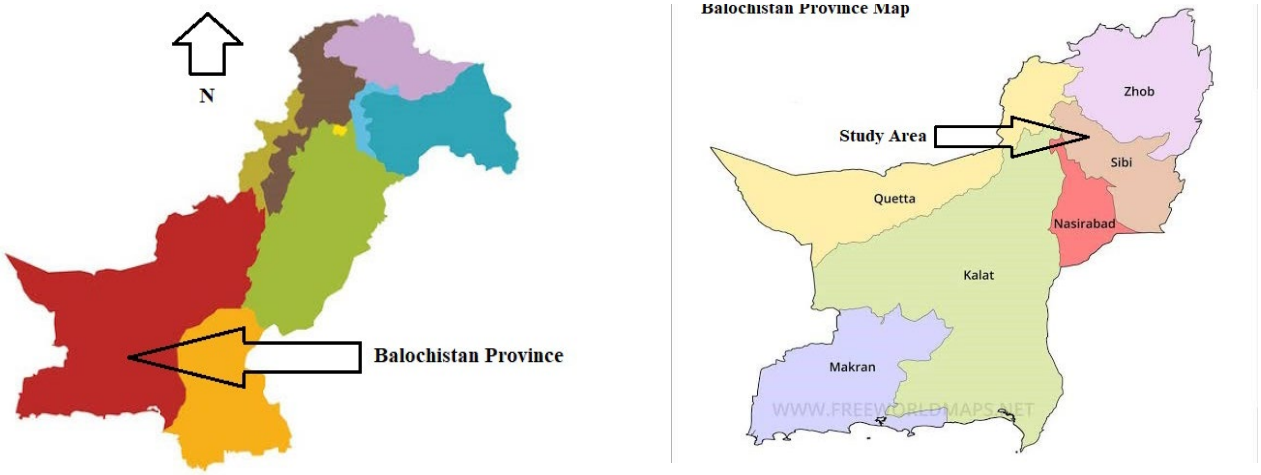

Figure 1. (A) Pakistan showing Balochistan Province. **(B)** Map of the region of Balochistan, Pakistan, arrow indicates the Sibi and the other regions in the Balochistan, Pakistan.

2.2. Ticks Sample Preservation

Tick samples were collected in glass bottles containing 70% ethyl alcohol and were brought to the Veterinary Parasitology Laboratory at the Sindh Agriculture University, Tandojam, Pakistan. Briefly, ticks were washed with distilled water, boiled in a 10% potassium hydroxide solution for 30 minutes, cleared with a 10% glacial acetic acid for 5 minutes, washed again, and stained with a 10% acid fuchsine for 2 minutes. The ticks were washed, dehydrated with a series of ethyl alcohol dilutions and pure ethyl alcohol, cleared in clove oil, and mounted with Canada balsam. The morphological characteristics of ticks were examined under a stereomicroscope (Irshad et al., 2010) and identified according to morphological properties (Estrada-Pena et al., 2004). The ticks were processed and morphologically examined under a stereomicroscope and identified (Irshadet al., 2010; Estrada-Pena et al., 2004).

2.3. Permanent Mounting of the ticks

Permanent mounts of ticks were prepared on glass slides using Canada balsam as a sticking agent. A cover slip was applied over the specimens to make them permanently mounted in the Parasitology laboratory at SAU, Tandojam. Then, the slides were kept in an incubator at 37^{o}C.

2.4. Data Analysis

The animal-level prevalence of ticks was calculated as the number of animals infested with ≥1 tick divided by the total number of animals examined. The overall tick prevalence (animal and herd levels) was compared between or among different zones and different age groups using the Chi-square test. Fisher's exact test was employed to compare the prevalence of ticks among the goat population. A P-value of ≤0.05 was considered as statistically significant. Data were analyzed using MS Excel for frequency distribution and SPSS software version 2.0 (Daniel, 2010).

3. Results

A total of 300 animals were examined from two Tehsils of the Sibi district, out of which 198 animals were infested with ticks, resulting in an overall prevalence of 66% in the Sibi District. Specifically, 150 animals were examined from each Tehsil, with 96 and 102 animals infested with ticks in the Sibi and Lehri tehsils, respectively, resulting in prevalence rates of 64.0 and 68%. The prevalence of ticks in Khajjak, Kurak, and Marghazani villages was recorded as 33.0, 29.0, and 34%, respectively. The prevalence of tick infestation in Taro Lal Shah, Trihaar, and Tehri villages was 35.0, 30, and 37%, respectively. The proportion of tehsil-wise tick infestation in goats in the district of Sibi was non-significant (P=0.6698). The highest number of animals found infested was 34 in Marghazani, followed by 33 and 29 animals in Khajjak and Kurak, respectively. The proportion of village-wise tick infestation in goats in Sibi was non-significant (P=0.803).

The data related to age and gender prevalence indicates that, overall, 198 animals with a prevalence percentage of 66% were found infested with ticks in the study area. Maximum tick infestation, 108% prevalence, was recorded in female goats compared to male goats at 90%. It shows that the proportion of female goats was considerably higher than that of male goats in the study area in district Sibi. The proportion of gender-wise tick infestation in goats in district Sibi was non-significant (P=0.2008).

The majority (82%) of animals found infested with ticks belonged to the age group above 24 months, compared to 68and 48% of animals under the age groups of 13-24 months and 0-12 months, respectively. This indicates that maximum tick infestation was found in goats aged above 24 months, and the minimum tick infestation was observed in goats aged 0-12 months. The proportion of age-wise tick infestation in goats in district Sibi was significant (P=0.0128). The data indicated that, overall, 198 goats, with a prevalence percentage of 66%, were found infested with ticks in the study area, indicating those kept under open cottages and mud-type houses. Maximum tick infestation, 80%, was recorded in goats reared under mud-type housing, followed by goats reared under open and cottage-type houses, with tick prevalence of 65.0 and 53%, respectively. The proportion of housing-wise tick infestation in goats in the district of Sibi was significant (P=0.0625). The majority, 29.6%, of owners used handpicking of ticks, while 22.2% used ivermectin injection for tick control in goats. Additionally, 16.7% used cloth soap mixed with water, 12.9% used black mobile oil (used engine oil), 11.1% used spray, and only 7.4% of the farmers used ash for tick control in goats in the study area.

The severity of infestation was categorized as low (1-20 ticks on the body), medium (21-50 ticks on the body) and high (above 50 ticks on the body). The 15.2, 34.3, and 50.5% of the cases were categorized as low, medium and high severity, respectively. In the present study, three tick species/genera, *A. variegatum* (Figure 2), *R. sanguineus* (Figure 3), and *H. truncatum* (Figure 4) were observed. The proportion of *A. variegatum*, *R. sanguineus*, and *H. truncatum* was recorded as 50, 35, and 15% format, respectively. This is the first time we reported the prevalence of ticks in the Sibi District of Balochistan. Pakistan. All the results are shown in Tables 1, 2, and 3.

Figure 2 – Female of *Amblyomma variegatum* under stereomicroscope (10x).

Figure 3 – Male of *Rhipicephalus sanguineus* under stereomicroscope (10x).

Figure 4 – Female of *Hyalomma truncatum* under stereomicroscope (10x).

No	Name of Tehsil	No of Animals examined	No of infested	Prevalence (%)
1	Sibi	150	96	64.00
2	Lehri	150	102	68.00
Total		300	198	66.00
Prevalence of tick infestation in goat atdistrict Sibi				
1		Khajjak	50	33
2		Kurak	50	29
3		Marghazani	50	34
Total		150	96	64.00
Prevalence of tick infestation in goat at tehsil lehri district Sibi				
1		Taro Lal Shah	50	35
2		Trihaar	50	30
3		Tehri	50	37
Total		150	102	68.00
Gender wise prevalence of tick infestation in goat at district Sibi				
1		Male	150	90
2		Female	150	108
Total		300	198	66.00
Age wise prevalence of tick infestation in goat at district Sibi				
1		0-12	100	48
2		13-24	100	68
3		Above 24	100	82
Total		300	198	66.00
Effect of animal housing on prevalence of tick infestation in goat at district Sibi				
1		Open	100	65
2		Cottage	100	53
3		Mud type house	100	80
Total		300	198	66.00

Table 1 – Prevalence of tick infestation in a goat population at various Districts/Tehsils of Balochistan, Pakistan.

No.	Control method applied	No. of responses	Frequency (%)
1	Hand picking of ticks	80	29.62
2	Permethrin Spray (Tyfon)	30	11.11
3	Ivermectin	60	22.22
4	Ash (mixture of charcoal)	20	7.40
5	Black mobile oil (Used Engine Oil)	35	12.96
6	Cloth soap mixed water	45	16.67
Total		270	100.00

Table 2 – Treatments applied by owners against tick infestation in the district of Sibi, Pakistan.

Nº	Severity	Animal infested	Frequency (%)
1	Low	30	15.16
2	Medium	68	34.34
3	High	100	50.50
Total		198	100.00

Identified ticks in goats at district Sibi.

Nº	Type of Ticks	No. Ticks	Frequency (%)
1	*Amblyomma variegatum*	60	50.00
2	*Rhipicephalus sanguineus*	42	35.00
3	*Hyalomma truncatum*	18	15.00
Total		120	100.00

Table 3 – Severity of tick infestation in a goat population of Balochistan, Pakistan.

4. Discussion

In this study, the overall prevalence of ticks in goats was 66% in the Sibi district, Pakistan. The prevalence of ticks in Sibi and Lehri tehsils was recorded as 64.0 and 68.0%, respectively. The variation in tick prevalence in different areas can be attributed to various factors like geo-climatic conditions, the association and lifestyle of other species of animals, awareness, farmer's education, and farm management practices (Soundararajan et al., 2018). The high prevalence rate may be attributed to the hot and humid season prevalent during these months, as tick infestation is influenced by temperature, rainfall, and relative humidity (Gosh et al., 2014). According to Gopalakrishnan et al. (2017), the total prevalence of ticks in goats was 72.11% in India, and tick prevalence was associated with the summer season and bad preventive practices. Prakasan and Ramani (2007) in Kerala, India, reported a prevalence of 74.73% of various ticks; Vathsala et al. (2008) in Tamil Nadu with 97.66%, and Soundararajan et al. (2018) in Tamil Nadu (78.21%).

Maximum tick infestation was found in goats aged above 24 months (82%), and the minimum tick infestation was observed in goats aged 0-12 months (48%). The higher tick infestation in older animals may be attributed to long-distance animal movement to pursue food and water, increasing the chances of tick infestation. The findings of Sajid et al. (2011) reported a greater exposure of young animals to tick infestation, possibly due to reduced behavioral activities. Moreover, acquired immunity produced with age and thicker skin of old age animals can also contribute to resistance against tick burden in older animals (Obi et al., 2014). A study by Sertse (2007) reported higher tick infestation in age groups greater than 3 years compared to lower-age sheep and goat populations. Mohammad and Ali (2006) documented that young animals were severely infected (83.87%), followed by adults (71.43%). Gopalakrishnan et al. (2017) suggested that all adult and young, or male and female goats are equally susceptible to the identified tick infestation. This finding of tick prevalence associated with age and gender is close to the previous report of Onu and Shiferaw (2013), who documented that there is no statistically significant difference ($p>0.05$) in the prevalence of ticks, including *A. cajennense* and *A. maculatum* between sex, age, and body condition score categories in cattle in Ethiopia during the summer season.

The maximum tick infestation (72%) was recorded in female goats, compared to male goats (60%) in the study area of Sibi district. Mohammad and Ali (2006) reported a higher tick infestation, including *R. appendiculatus* and *R. capensis,* in female goats (78.10%) than in male goats (21.90%) in Iran. According to Muhammad et al. (2017), the prevalence of tick infestation was found to be higher in females (48.5%) than in males (45.2%), but the association between gender and overall tick prevalence in small ruminants was non-significant ($P\geq0.05$). In a study by Muhammad and Ali (2006), they reported a higher tick infestation (78.1%) in females than in males (21.9%) in small ruminants in Iran.

The increased secretions of prolactin and progesterone in females make them more susceptible to tick bites than males, as reported by Rony et al. (2010). The difference in tick prevalence in females may be hypothesized due to their confinement during lactation or gestation, resulting in reduced activity, lower immunity, and hormonal impacts, as suggested by Khan et al. (2022). This variation in tick infestation among goats could be due to differences in genetic resistance and climatic conditions. The differences in tick prevalence may also be related to the management system, where animals graze together in communal fields in the mixed farming system of the study area.

The maximum tick infestation was recorded in goats reared in open houses, followed by those in the cottage and mud-type houses with tick prevalence. The ticks were recovered from goats in the semi-intensive system (63.33%), while those in the intensive system were nearly free from tick infestation (16.67%).In another study, Rabbi (2006) reported the highest ectoparasite infestation in a semi-intensive system (59.7%), followed by an extensive system (33.5%) and an intensive system (8.27%). Additionally, Rony et al. (2010) observed a higher prevalence of ticks in goats under a free-range system (83.57%) compared to a semi-intensive system (60.0%). These differences were due to the restricted feeding and housing management practices.

The majority (29.62%) of the owners used the hand-picking method for tick control routinely in goats, while 22.22% used ivermectin injection with intervals of 3 months. Additionally, 16.67% used a mixture of cloth, washing soap, and water, 12.96% employed black mobile oil (used engine oil), and 11.11% used permethrin spray. Only 7.40% of the farmers in the study area used ash. They used ash mixed with mustard oil and applied on the animal's body with the help of a common brush and hands and spread it on the animal's body using a brush. Another study by Selles et al. (2021) reported that engine oil can be used as alternative tick

control substances, likely due to their cost effectiveness and accessibility. In contrast, Sanhokwe et al. (2016) revealed that farmers often dipped their goats to control parasites, contradicting the findings of Kunene and Fossey (2010), who observed limited dipping in rural communities. Regarding parasite control, 69.23% of respondents used medicinal plants, 11.54% purchased commercial drugs, and 19.23% used both medicinal plants and commercial drugs in their herd. Moreki et al. (2010) attributed the widespread use of ethno-veterinary medicine in villages to a lack of knowledge about commercial drugs and their high prices in many areas. However, Hassan et al. (2014) argued that the use of ethno-veterinary medicine is often the only viable option for resource-limited farmers in many countries of the world due to the lack of veterinarians in rural areas.

The more dominant tick species found in goats was *A. variegatum*, followed by *R. sanguineus*, with a lesser number of *H. truncatum, i*n a study by Hussain et al. (2021), where a prevalence of *H. aegyptium* ticks (12%) was observed, followed by *B. microplus* (8.1%), *H. aborensis* (5%), and *R. appendiculatus* (3.5%). In another study, the prevalence was reported in the district of Kasur, Pakistan, with 15% for *Hyalomma* ticks, 12% for *R. appendiculatus, B. microplus*, and 5% for *H. aborensis*, and 3% for *R. bequaerti.* These genera were consistent in both studies, including *Boophilus, Haemaphysalis,* and *Rhipicephalus*. *However, Amblyomma* and *Ixodes* were not reported in the present study, likely due to the different areas in which the studies were conducted (Durrani and Kamal, 2008). Ali (2005), studying poultry in northern areas of Pakistan, recorded the genera *Hyalomma, Boophilus,* and *Hypoderma* in cattle. In the present survey, five genera of ticks were reported: *Ixodes, Boophilus, Rhipicephalus, Hemophysalis*, and *Amblyomma*. The genera *Boophilus* was consistent in both studies. The genera, including *Ixodes, Rhipicephalus, Hemophysalis,* and *Amblyomma* from, in the present study were not found in the study of Ali (2005) due to different study areas. Additionally, Khan et al. (2022) recorded the highest prevalence of *H. anatolicum* (15%), followed by *R. sanguineous* (4%) and *B. microplus* (3.3%) in sheep in Faisalabad, Pakistan.

5. Conclusions

It is concluded that a higher prevalence of ticks was found in females of old-aged goats in the Sibi district of Pakistan. The most dominant species observed in goats was *A. variegatum,* followed by *R. sanguineus,* with fewer *H. truncatum.* The prevalence of ticks in the Sibi district was associated with poor management practices and housing systems, traditional (unconventional) treatment methods, and a lack of farmer awareness and technical assistance.

Conflict of Interest

There is no conflict of interest.

Ethics Approval

The study was approved by the Ethical Review Committee of the concerned department with protocol number 120 on 23 May 2018.

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