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An Epidemiological Study on Infestation Rate of Ticks in Ruminants of Sargodha Division Pakistan

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ABSTRACT

This study investigated tick infestation rates and their distribution on various body parts of ruminants in Sargodha Division, comprising four districts. Samples were collected from 10 farms per district between February and June 2021. Of the 1,067 ruminants (cows, buffaloes, goats, and sheep) observed, 348 (32.10%) were infested. The highest infestation rate was recorded in Mianwali (54.44%), followed by Sargodha (28.92%), Bhakkar (25.69%), and Khushab (24.71%). Among species, cows were the most infested (41.45%), followed by buffaloes (33.73%), sheep (27.38%), and goats (16.41%). Female cows (45.10%) were more infested than males (31%), while male buffaloes (59.37%) showed higher infestation than females (33.58%). Male sheep (34.44%) and goats (29.41%) were also more infested than their female counterparts. In female cows, ticks were predominantly found on the tail (50.42%) and udder (36.75%), while in female buffaloes, the udder (79.77%) and tail (70.78%) were most infested. Male cows and buffaloes had the highest tick distribution on the testicles and dewlap. Ticks were predominantly found in the ears of all infested goats and sheep, regardless of sex. This study highlights that species, sex, and body part preferences significantly influence tick infestation rates. As the first report on tick infestation in Sargodha Division, it provides valuable insights for controlling ticks and related diseases in ruminants, paving the way for future research and management strategies.

INTRODUCTION

Ticks are considered second worldwide to mosquitoes as vectors of human diseases, as well as they are considered the main vectors of parasites in homegrown and wild animals (Wikel, S. K., 2018). Pakistan is a subtropical country where most of the inhabitants of rural areas depend upon livestock, which includes ruminants, for their livelihood (Ghafar A. et al., 2020). Ticks are known for their negative effect on domesticated animals and human wellbeing. Ticks and tick-borne illnesses cause an expected US $ 13.9 to 18.7 billion loss (de Castro JJ 1997; Karim.S. et al., 2017). Small ruminant populations, especially goats, contribute a significant offer to the domesticated animal population of the country (Sajid, M.S et al., 2020). Environmental change has influenced the connection between parasites and host animal species. Parasitism in domesticated animals has particularly expanded as far as ticks and tick-borne diseases (TTBDs). Ectoparasites and their related

sicknesses present a significant issue for dairy-based economies like Pakistan (Nasreen, N et al., 2020). Ticks and tick-borne diseases (TBDs) influence 80% of the world cow's populace and are broadly appropriated all through the world, especially in tropical and subtropical zones including India, Pakistan, and Bangladesh. Ticks and tick-communicated diseases have coevolved with different wild animal hosts (Ghosh S et al., 2007).

Ticks are classified into the phylum Arthropoda and order Acarina. There are a total of 899 tick species, categorized as the parasites of vertebrates, comprising 185 species of (Argasidae). 713 species of (Ixodidae) and one species of (Nutallilllididae) (Kaur, D et al., 2017). There are about Seventy-five tick species reported from Pakistan primarily based on morphological details (Nasreen, N et al., 2020). In domestic animals such as cattle, buffaloes, goats and sheep, there is an outbreak of diseases primarily caused by Tick-borne protozoal (babesiosis and theileriosis) and rickettsia (anaplasmosis and cowdriosis) diseases are the source of major health problems and production, and it is also affecting economy baldly, especially in subtropical and tropical regions (Ghafar, A et al., 2020). Blood reduction due to an adult female tick infestation on animals can lead to reduced weight gain and lower milk production in animals (Kaur, D et al., 2017). Ticks have been recorded from practically all districts of Pakistan, including Sindh, Khyber Pakhtunkhwa (KPK) Balochistan, and northern regions of Pakistan, including Gilgit-Baltistan (Soomro et al., 2014; Sajid, M.S et al., 2020). The climatic determinants of the investigation zones are very significant in the commonness of ticks in domestic ruminants (Sajid, M.S et al., 2007). The ticks are found efficiently during summer and spring in contrast with other seasons (Bianca, N., 2016; Kiran, A. et al., 2019).

Ticks have a few morphologic characteristics and physiologic structures that aid in the selection of a host, ingestion of vertebrate blood, mating, endurance, and multiplication. In spite of the fact that the regular history of ticks shifts extensively among species, these arthropods are very much adjusted to get by in tropical, mild, and even subarctic natural surroundings. Key elements, including the inversion of farming topographies to timberlands and a nearby relationship between individuals and ticks, have significantly expanded the danger of tick infestation and human infection (Anderson, J. F., & Magnarelli, L. A., 2008). This study is designed to evaluate the i) infestation rate of ticks in ruminants in Sargodha Division and ii) associated epidemiological factors.

MATERIALS AND METHODS

Study Area

Location and climate of the study area

This cross-sectional study was conducted in the Sargodha Division of Punjab, Pakistan. Sargodha Division is comprised of four Districts (Mianwali, Bhakkar, Khushab, and Sargodha). The total area of the Sargodha division is 26,360 km2 and 6513697.9 acres, with the GPS coordinates of 32° 4' 56.8776" N and 72° 40' 8.8608 "" E.

The district Sargodha covers an area of 5.854 K km² with GPS coordinates of 32.0740° N, 72.6861° E. The climate of Sargodha is extremely hot in summer and temperate cold in winter. The maximum range of temperature in summer is 50 C^{o,} and in winter is 8 Co, while annual precipitation is 532.5 mm (per year). The district Khushab covers an area of 6,511 km² with GPS coordinates of 32.2955° N, 72.3489° E. The climate of Khushab is extremely hot in summer, with a maximum temperature of 50 Co and a minimum temperature of -1 C^{o} in winter. The average rainfall in winter is 100mm, and in summer is 424 mm.

The district Bhakkar covers an area of 8,153 km² with GPS coordinates of 31.8621° N, 71.3824° E. The climate of Bhakkar is desert-like, with almost no rainfall. The district Mianwali covers an area of 5,840 km² with GPS coordinates of 32.6645° N, 71.4774° E. The climate of Mianwali is extremely hot in summer, with a maximum temperature of 50 C$^{o\ and}$ with average rainfall of 352mm.

Data Collection

Ethical considerations

The ticks were collected from domestic animals (ruminants) with the verbal consent of their owners. The verbal informed consent was obtained from the owners of the livestock farms for tick collection.

Sample Collection and Preservation

The ticks were collected from different body parts of four ruminant species (cow, buffaloes, goat and sheep) from February to May 2021. The specimens were collected using fine-tipped tweezers and preserved in separate vials containing 70% ethanol. In addition, all information regarding the Date of collection, District, and Farm number was also coded on the vials.

Statistical Analysis

The infestation rate of studied animals is calculated by using the given formula:

Infestation rate= $\frac{\text{No.of infested animals}}{\text{No.of observed animals}} \times 100$ and expressed in simple percentages. Tick distribution on body parts of studied ruminants was also expressed in percentage by using a formula. $\frac{\text{No.of body parts infested}}{\text{No.of infested animals}} \times 100$

RESULTS

Epidemiologic Studies of Ticks Infestation

(a) District-wise infestation rate of ticks

In each District, Ten farms were selected for sampling. (Table-1, Fig-1) In District Mianwali, The tick infestation percentage recorded was (54.44%), which is

the highest infestation percentage, followed by Sargodha, where the infestation rate was (28.92%), and Bhakkar (25.69%) and the lowest tick infestation was observed in ruminants of District Khushab (24.71%) as compared to other districts of Sargodha Division. In Sargodha Division, including four Districts, the overall tick infestation rate was (32.61%).

Figure 1

Vials Containing Specimens

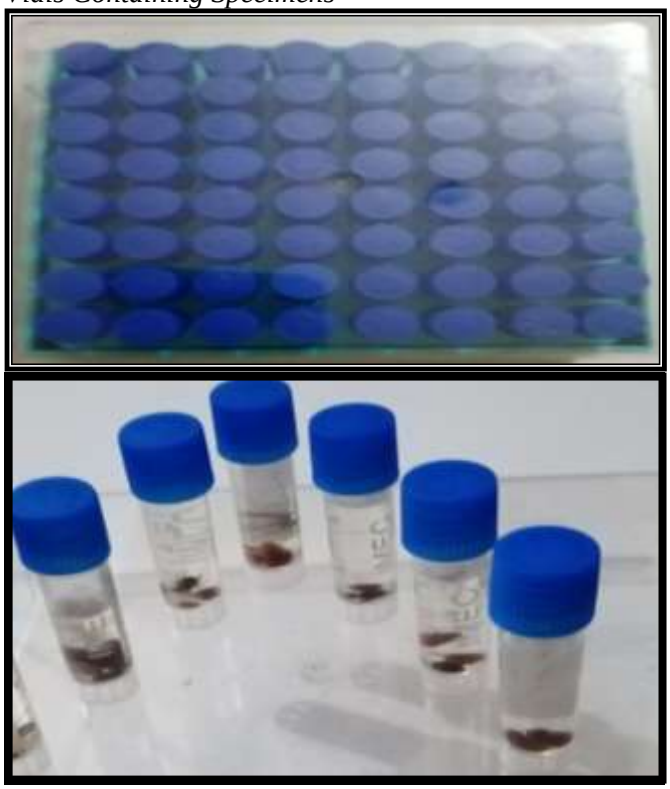


Table 1

District-wise Tick infestation percentage in the Sargodha Division

District	Number of animals observed	Number of animals infested	infested Percentage
Mianwali	270	147	54.44%
Bhakkar	288	74	25.69%
Khushab	267	66	24.71%
Sargodha	242	70	28.92%
Total	1067	348	32.61%

(b) Ruminants specie wise ticks infestation rate in studied districts

In Mianwali, the most infested ruminant was cows (65.97%), followed by buffaloes (64.55%), goats (35.41%) and sheep (32.60%). In Bhakkar, the most infested species was also cow (36.78%), followed by sheep (22.85%), (22.5%) and Goats (16.27%). In Khushab, the most infested species was buffalo. (32.69%) followed by cows (29.31%), Sheep (16.98%) and Goats (13.04%). In Sargodha, the Highest tick infestation was observed in sheep (56.52%), followed by cows (36.04%), buffaloes (33.73%), and the less infested ruminant was goats (10.9%).

Figure 2

District wise Percentage Analysis of Tick infestation in Sargodha Division Pakistan

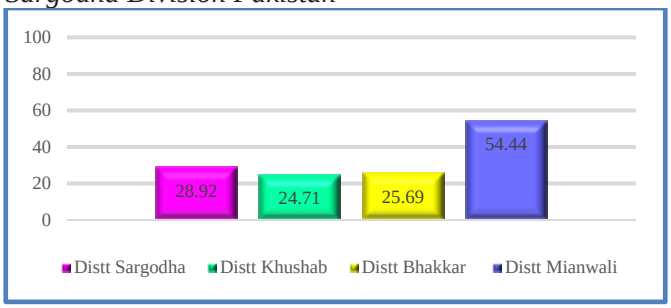


Table 2

Ruminant-wise Tick infestation percentage in four Districts in the Sargodha Division

District	Species			
	Cow	Buffalo	Goat	Sheep
Mianwali	64/97= 65.97%	51/79= 64.55%	17/48= 35.41%	15/46= 32.60%
Bhakkar	32/87= 36.78%	27/120= 22.5%	7/46= 16.27%	8/35= 22.85%
Khushab	34/116= 29.31%	17/52= 32.69%	6/46= 13.04%	9/53= 16.98%
Sargodha	31/86= 36.04%	20/78= 25.64%	6/55= 10.9%	13/23= 56.52 %

Table 3 revealed the results for the whole division, including four districts. Cows were found more infested with ticks (39.40%), and buffalo was the second most highly infested species (33.73%). Small ruminants were found less infested with sheep (27.38%). In addition, the least infested ruminant species was goat (17.61%).

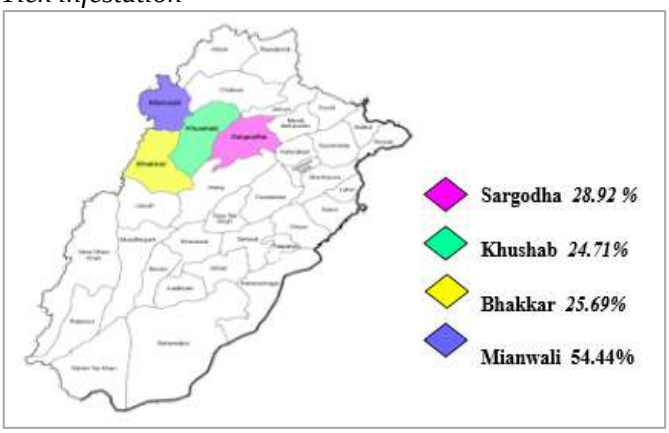
Table 3

Overall Tick infestation percentage of ruminants in the Sargodha Division

S. No	Ruminant Species	Number of observed animals	Number of animals infested	Infestation rate
1	Cow	386	160	41.45%
2	Buffalo	329	111	33.73%
3	Sheep	157	43	27.38%
4	Goat	195	34	16.41%

Figure 3

Map of Province Punjab (District) to show the study regions of Division Sargodha & District percentage of Tick infestation



(c) Sex-wise tick infestation rate in ruminants:

In district Mianwali, female cows (69.33%) were found more infested than male cows (50%), while male buffaloes (73.33%) were found more infested than female buffaloes. Male sheep (35.48%) were more infested than female sheep (20%). Male goats (44.44%) were more infested than female goats (26.66%).

Table 4

Ruminants (Sex) wise Tick infestation percentage in Districts Mianwali

S. No	Ruminant Species (Female)	Number of observed animals	Number of animals infested	Infestation rate
1	Cow	75	52	69.33%
2	Buffalo	64	40	62.5%
3	Sheep	15	3	20%
4	Goat	30	8	26.66%
S. No	**Ruminant Species (Male)**	**Number of observed animals**	**Number of animals infested**	**Infestation rate**
1	Cow	22	11	50%
2	Buffalo	15	11	73.33%
3	Sheep	31	11	35.48%
4	Goat	18	8	44.44%

In District Bhakkar, The female cows (41.42%) were more infested than male cows (29.41%). Buffaloes male (30%) were found more infested than buffaloes female (20%). Sheep males (46.15%) were found more infested than sheep females (9.09%). Goat males (20%) were found more infested than females (11.53%).

Table 5

Ruminants (Sex wise) Tick infestation percentage in Districts Bhakkar

S. No	Ruminant Species (Female)	Number of observed animals	Number of animals infested	Infestation rate
1	Cow	70	29	41.42%
2	Buffalo	90	18	20%
3	Sheep	22	2	9.09%
4	Goat	26	3	11.53%
S. No	**Ruminant Species (Male)**	**Number of observed animals**	**Number of animals infested**	**Infestation rate**
1	Cow	17	5	29.41%
2	Buffalo	30	9	30%
3	Sheep	13	6	46.15%
4	Goat	20	4	20%

In District Khushab, female cows (34.11 %) were found to be more infested than male cows (16.12%). Buffaloes males (33.33%) were found more infested than females (32.60%). Sheep males (21.87%) were found more infested than sheep females (9.52%). Goat males (23.52%) were found more infested than females (6.89%).

Table 6

Ruminants (Sex wise) Tick infestation percentage in Districts Khushab

S. No	Ruminant Species (Female)	Number of observed animals	Number of animals infested	Infestation rate
1	Cow	85	29	34.11%
2	Buffalo	46	15	32.60%
3	Sheep	21	2	9.52%
4	Goat	29	2	6.89%
S. No	**Ruminant Species (Male)**	**Number of observed animals**	**Number of animals infested**	**Infestation rate**
1	Cow	31	5	16.12%
2	Buffalo	6	2	33.33%
3	Sheep	32	7	21.87%
4	Goat	17	4	23.52%

In District Sargodha, Cow females (33.92%) were found more infested than males (33.33%). Buffaloes male (30.76%) were found more infested than buffaloes females (24.61%). Sheep females (66.66%) were found more infested than males (50%). Goat males (30.76%) were found more infested than females (4.76%).

Table 7

Ruminants (Sex wise) Tick infestation percentage in Districts Sargodha

S. No	Ruminant Species (Female)	Number of observed animals	Number of animals infested	Infestation rate
1	Cow	56	19	33.92%
2	Buffalo	65	16	24.61%
3	Sheep	9	6	66.66
4	Goat	42	2	4.76
S. No	**Ruminant Species (Male)**	**Number of observed animals**	**Number of animals infested**	**Infestation rate**
1	Cow	30	10	33.33%
2	Buffalo	13	4	30.76%
3	Sheep	14	7	50%
4	Goat	13	4	30.76%

Table 8 shows the results of gender-wise infestation of ruminants in the whole division. Female cows (45.10%) were found more infested than male cows (31%). Male buffaloes (59.37%) were found more infested than female buffaloes (33.58%). Male sheep (34.44%) were found more infested than female sheep (19.40%), and male goats (29.41%) were found more infested than female goats(11.8%).

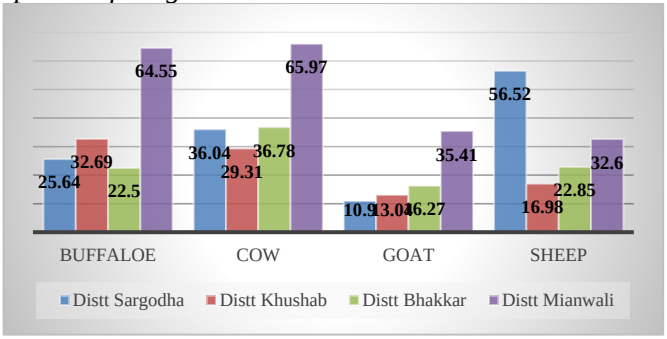
Table 8

Ruminants (Sex wise) Tick infestation percentage in Sargodha Division

S. No	Ruminant Species (Female)	Number of observed animals	Number of animals infested	Infestation rate
1	Cow	286	129	45.10%
2	Buffalo	265	89	33.58%
3	Sheep	67	13	19.40%
4	Goat	127	15	11.8%
S. No	**Ruminant Species (Male)**	**Number of observed animals**	**Number of animals infested**	**Infestation rate**
1	Cow	100	31	31%
2	Buffalo	64	38	59.37%
3	Sheep	90	31	34.44%
4	Goat	68	20	29.41%

Figure 4

Percentage of Tick infestation in studied ruminant species of Sargodha Division



(d) District-wise results of the distribution of ticks on different body parts

The result of the study revealed that in District Mianwali, in female cows, ticks were highly distributed on the tail (75%), followed by inner thighs (44%), External Genitalia (25%), udder (21%), full body (21%) and no ticks were found distributed on ears while in male cows ticks were highly distributed on testicles (91.66%) followed by Inner thighs (75%), Dewlap (58.33%) and least infested part was tail (8.33%). In Female buffalo, the highest tick distribution was found in the tail and udder (92.5% and 90%), followed by inner thighs (62.5%) and very low distribution was observed evenly on the full body while in male buffaloes, the most infested body part was dewlap (81.81%) followed by testicles (72.72%), Inner thighs (54.54%) and external genitalia (36.66%). In infested goats and sheep (both males and females), the ticks were only found distributed in their ears.

Figure 5

Overall Tick infestation percentage of ruminants in Sargodha Division

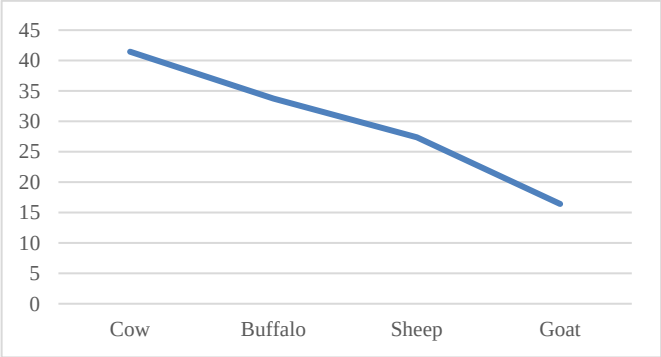


Table 9

Percentage of tick infestation on different body parts of ruminants of District Mianwali

Body parts	Species (Females)			
	Cow	Buffalo	Goat	Sheep
Tail	75%	92.5%	-	-
Inner Thighs	44%	62.5%	-	-
Udder	21%	90%	-	-
Ext. Genitalia	25%	-	-	-
Ear	-	-	100%	100%
Full body	21%	2.5%	-	-
Body parts	**Species (Males)**			
	Cow	**Cow**	**Cow**	**Cow**
Tail	8.33%		-	-
Inner thighs	75%	54.54%	-	-
Dewlap	58.33%	81.81%	-	-
Ext. Genitalia	-	36.66%	-	-
Ear	-	-	100%	100%
Testicles	91.66%	72.72%		
Full body	-	-	-	-

Figure 6

Percentage of Tick Infestation on Different Body Parts of Ruminants of District Mianwali (Female)

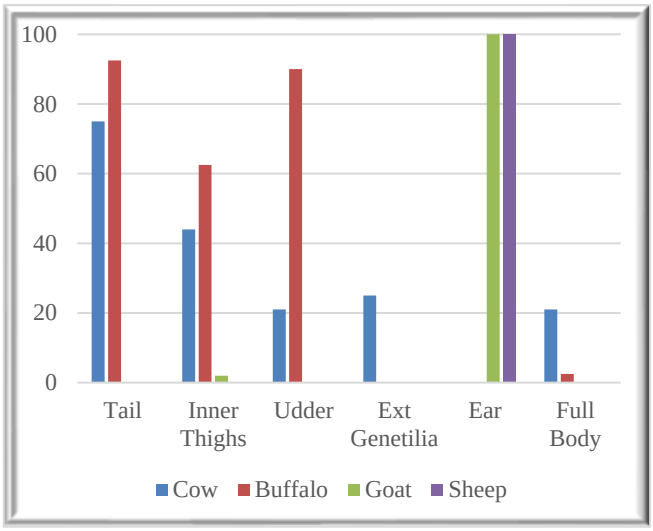
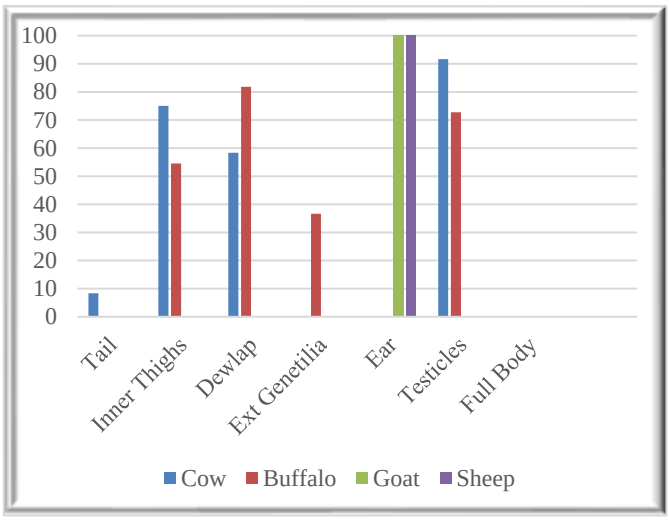


Figure 7

Percentage of Tick Infestation on Different Body Parts of Ruminants of District Mianwali (Male)



In District Bhakkar, Female cow's ticks were found distributed all over the body (78.94%), followed by the tail and udder (21.05%), while in male cows, the most infested body part was dewlap and testicles (60%), followed by the full body(40%). In Female buffalo, the ticks were highly distributed in the tail (83.33%), followed by the udder (38.88%), and (a 22.2%) rate was

observed on the full body, while in males, ticks were highly distributed on dewlap (77.77%) followed by testicles (66.66%) and in tail and full body least infestation was observed which was (11.11%). In addition, goats and sheep, both sexes, were least infested, and ticks were found only in ears.

Figure 8

Percentage of Tick Infestation on Different Body Parts of Ruminants of District Bhakkar (Female)

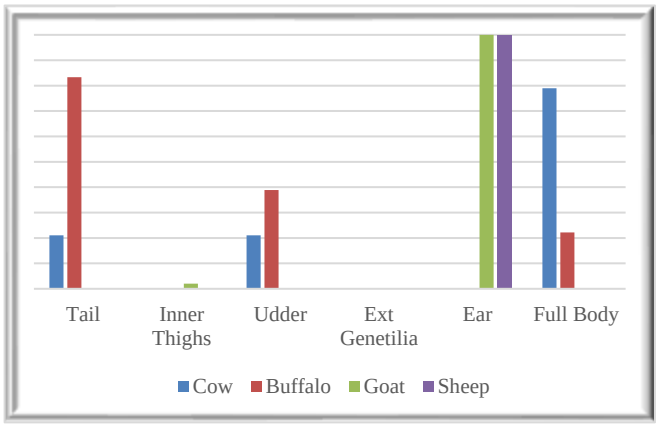


Figure 9

Percentage of Tick Infestation on Different Body Parts of Ruminants of District Bhakkar (Male)

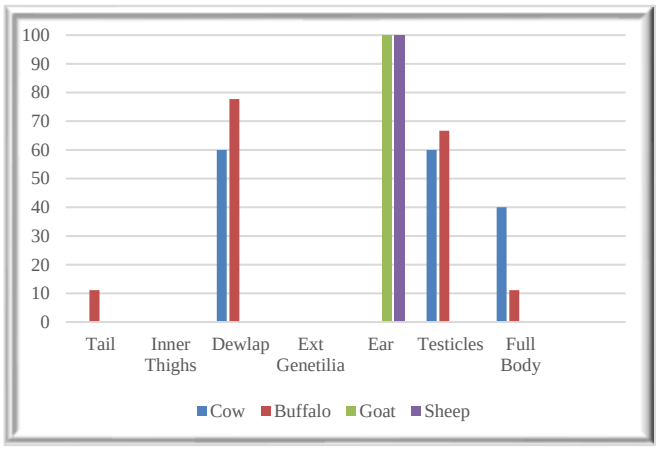


Table 10

Percentage of tick infestation on different body parts of ruminants of District Bhakkar

Body parts	Species (Females)			
	Cow	Buffalo	Goat	Sheep
Tail	21.05%	83.33%	-	-
Inner thighs	-	-	-	-
Udder	21.05%	38.88%	-	-
Ext. genitalia	-	-	-	-
Ear	-	-	100%	100%
Full body	78.94%	22.22%	-	-
Body parts	**Species (Males)**			
	Cow	**Cow**	**Cow**	**Cow**
Tail	-	11.11%	-	-
Inner thighs	-	-	-	-
Dewlap	60%	77.77%	-	-
Ext. genitalia	-	-	-	-
Ear	-	-	100%	100%
Testicles	60%	66.66%	-	-
Full body	40%	11.11%	-	-

In District Khushab, the highly infested body part of the female cow was the tail (44.28%), followed by the udder (41.37%), the external genitalia (13.79%) and the least infestation was observed on the whole body (3.44%) while in males ticks were highly distributed on dewlap(40%) followed by testicles (20%). In Buffalo, ticks were highly distributed on the tail (73.33%) followed by the udder (66.66%), ticks distribution on the full body was (26.66%), and the least infested part was external genitalia (6.66%) while in the opposite sex in observed buffalo, all the ticks were found on testicles (100%). In small ruminants (goats and sheep) of both sexes, ticks were only found distributed in ears.

Figure 10

Percentage of Tick Infestation on Different Body Parts of Ruminants of District Khushab (Female)

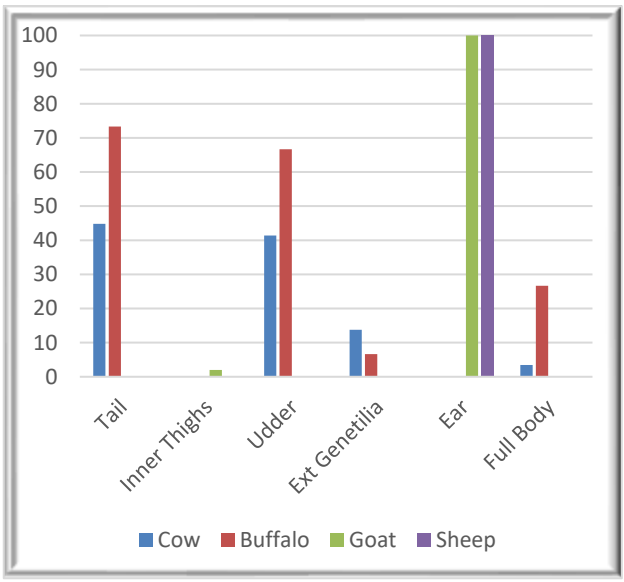


Figure 11

Percentage of Tick Infestation on Different Body Parts of Ruminants of District Khushab (Male)

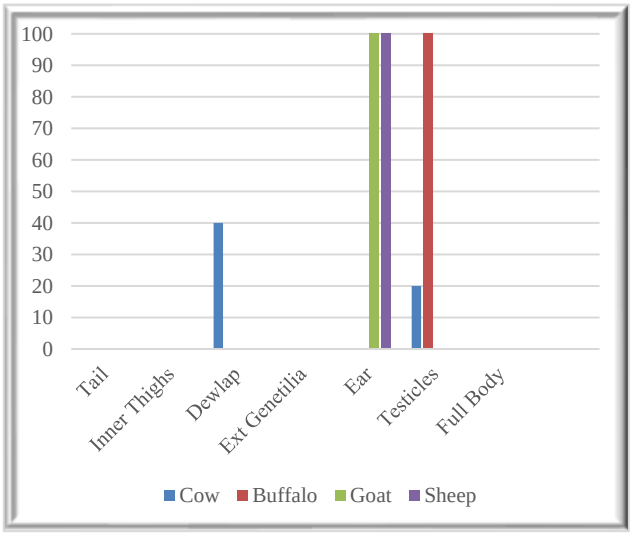


Table 11

Percentage of tick infestation on different body parts of ruminants of District Khushab

Body parts	Species (Females)			
	Cow	Buffalo	Goat	Sheep
Tail	44.82%	73.33%	-	-
Inner thighs	-	-	-	-
Udder	41.37%	66.66%	-	-
Ext. genetilia	13.79%	6.66%	-	-
Ear	-	-	100%	100%
Full body	3.44%	26.66%	-	-
Body parts	**Species (Males)**			
	Cow	**Cow**	**Cow**	**Cow**
Tail	-	-	-	-
Inner thighs	-	-	-	-
Dewlap	40%	-	-	-
Ext. genitalia	-	-	-	-
Ear	-	-	100%	100%
Testicles	20%	100%		
Full body	-	-	-	-

In District Sargodha, in female cows, ticks were highly distributed on full body (76.47%) followed by udder (23.52%), tail (17.64%), while in males the most infested part was Dewlap (71.42%) followed by males(57.14%), testicles (28.57%) and least infestation was observed on all over the body (14.28%). In Buffalo females, the highly infested body part was the tail (62.5%), followed by the udder (50%) and external genitalia (18.75%) and the least infestation was observed on the full body (12.5%), while in males the most infested part was testicles (75%) followed by the tail(25%). In small ruminants (goats and sheep) of both sexes, ticks were found in the ears.

Table 12

Percentage of tick infestation on different body parts of ruminants of District Sargodha

Body parts	Species (Females)			
	Cow	Buffalo	Goat	Sheep
Tail	17.64%	62.5%	-	-
Inner thighs	-	-	-	-
Udder	23.52%	50%	-	-
Ext. genitalia	-	18.75%	-	-
Ear	-	-	100%	100%
Full body	76.47%	12.5%	-	-
Body parts	**Species (Males)**			
	Cow	**Cow**	**Cow**	**Cow**
Tail	57.14%	25%	57.14%	-
Inner thighs	-	-	-	-
Dewlap	71.42%	-	71.42%	-
Ext. genitalia	-	-	-	-
Ear	-	-	-	100%
Testicles	28.57%	75%	28.57%	
Full body	-	-	-	-

Figure 12

Percentage of Tick Infestation on Different Body Parts of Ruminants of District Sargodha (Female)

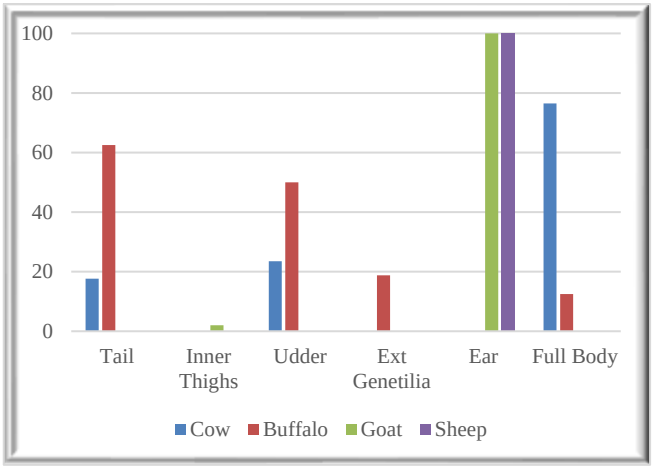


Figure 13

Percentage of Tick Infestation on Different Body Parts of Ruminants of District Sargodha(Male)

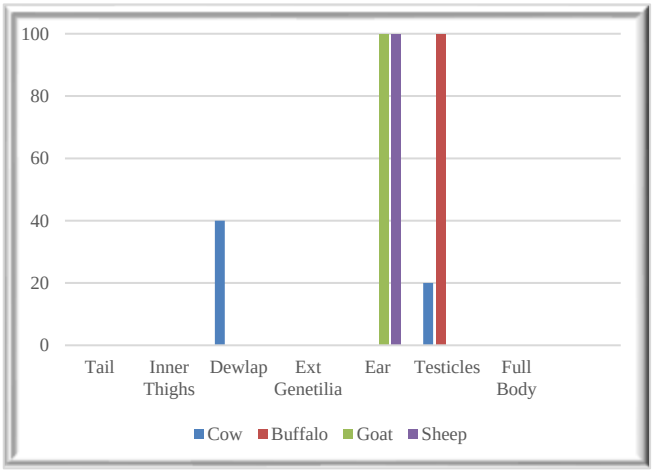


Table 13 shows the result of overall infested parts of all ruminants in the Sargodha Division. Results reveal that the most infested body part of cows (female) is the udder (36.75%), inner thighs (35.04%), all over the body (33.33%), and the least infested part following the tail (50.42%) was external genitalia (14.52%), and no ticks were found distributed in ears. While in buffaloes (females), ticks were highly distributed on the udder (79.77%) followed by the tail (70.78%), inner thighs (28.08%), all over the body (11.23%) and the least infested part was external genitalia (4.49%), and no ticks were found distributed in ears. In all infested goats and sheep (Females), ticks were found in the ears.

Table 13

Overall infestation percentage of distribution of ticks on different body parts of all observed ruminants of Sargodha Division

Species (Females)				
	Cow	Buffalo	Goat	Sheep
Observed animals	129	89	13	15

Body parts				
Tail	50.42%	70.78%	-	-
Inner thighs	35.04%	28.08%	-	-
Udder	36.75%	79.77%	-	-
Ext. genetilia	14.52%	4.49%	-	-
Ear	-	-	100%	100%
Full body	33.33%	11.23%	-	-
Species (Males)				
	Cow	**Buffalo**	**Goat**	**Sheep**
Observed animals	31	38	31	20
Body parts				
Tail	14.70%	7.69%	-	-
Inner thighs	-	-	-	-
Dewlap	55.88%	61.53%	-	-
Ext. genetilia	2.94%	15.38%	-	-
Ear	-	-	100%	100%
Testicles	55.88%	73.07%	-	-
Full body	14.70%	-	-	-

In males, ticks were highly distributed on testicles and dewlap (55.88%), followed by the tail and all over the body (14.70%), and the least infested part was external genitalia (2.94%).In buffalo (males), the most infested part was testicles (73.07%), followed by dewlap (61.53%), external genitalia (15.38%), and the least infested part was tail (7.69%), and no ticks were found distributed in ears. In all infested goats and sheep (males), ticks were found in the ears.

Figure 14

Infested body parts of ruminants

(a) Udder

(b) Tail

(c) Ears

DISCUSSIONS

The results of the study showed the highest tick infestation rate in Mianwali (54.44%), followed by Sargodha (27.38%) and Bhakkar (24.40%), and the lowest infestation rate was observed in Khushab (22.47%). In Mianwali, this is the first study carried out to determine the tick infestation rate of ruminants. The results of this study correlate with the results of Batool M et al., 2019. They reported that the lowest tick infestation (33.47%) was seen in the Northern zone of Punjab (Khushab and Bhakkar). In the whole Sargodha Division, the tick infestation rate in ruminants was (32.10%). Hussain. S et al., 2021 in their epidemiological survey regarding ticks and tick-borne diseases reported that the least tick infestation was observed in District Khushab (12.5%) as compared to other studied districts of their survey. The reason for the lowest tick infestation in District Khushab is the knowledge of farmers about tick infestation and taking care as well as cure of tick infestation. There are professional farm keepers to look after having experienced acaricide management in Khushab district.

The results of the study of ruminant-wise tick infestation rate showed the highest infestation on cows (39.40%) followed by buffalo (33.73%), sheep (27.38%) and the least infested species was goat (17.61%). These results show a resemblance with the one study conducted by Bibi, A. et al., 2020 in Baluchistan that the most infested ruminant was a cow (65%), followed by buffaloes (55) than sheep (30%) and the least infested was a goat (27.5%). The factor that could be responsible for higher tick infestation in cows is their thin skin as compared to buffaloes having thick skin (Sajid, M.S et al., 2009).

The results of ruminant specie (sex wise) infestation rate showed the highest infestation rate in female cows (45.10%) as compared to male cows (31%). Kakar M.E. et al., 2017 also reported high tick infestation in female cows (36%) as compared to males (32%). The higher tick infestation rate in female cows is higher may be due to some factors like hormonal imbalance and poor body conditions in pregnancy or the lactation period, which

makes them more prone to tick infestation (Shekhar, S and Singh, J.P et al ., 2020). The highest infestation rate was observed in male buffaloes (59.37%) as compared to female buffaloes (33.58%), and these findings are related to the findings of Tasawar Z et al., 2014 they also reported the higher tick infestation in male buffaloes (85%) and female buffaloes (43.33%) were found less infested than males. The highest tick infestation rate in male buffaloes can be related to the to a factor that they have poor immune systems as compared to females due to the chemical composition of their male hormone steroid, which may be responsible for weakening the defense mechanism of the male host and making it more susceptible to parasitic attacks (Khalil, M.I et al., 2018). The male host of small ruminants (goats and sheep) was found to be more infested as compared to females. These findings are in line with the study that male goats (58.33%) were found to be more infested than (41.67%) female goats (Noor, J et al., 2016).

The overall results of the distribution of ticks on various body parts of ruminants showed that in cows and buffaloes (females), the predilection sites of tick infestation were the tail, followed by the udder, inner thighs and least infested parts of all external genitalia and distribution on all over the body was observed very low and no ticks were observed on ears. These results are in line with the findings of research by H.I. Musa et al., 2016 that the most infested part of the female cows was the udder (84.3%) and the tail (69.81%), and least infested parts were ears and all over the body. However, Mustafa. I et al., 2014 reported the same results that in buffalo (females), ticks were found highly distributed on the udder. The smooth tissues of the predicted sites for tick infestation prove to be very beneficial for ticks. They can easily feed on blood at the smooth tissues and can easily reach to blood capillaries. Female ticks get an advantage by feeding on such parts for reproduction, as the sites like the udder and undertail are not exposed, so the poultry or birds cannot prey upon ticks (Mustafa. I et al., 2014). In male cows and buffaloes, the most infested sites were testicles and dewlap, followed by tail and all over the body and the least infested part was external genitalia. In the current study, in all small ruminants (goats and sheep), ticks were found distributed only in ears. These studies are in line with the studies of Mustafa. I et al. 2014 in their studies, ticks were mostly found in the ears of goats. The highest prevalence of ticks in the ears of small ruminants as compared to other parts of the body (. Noor. J et al., 2016). This study showed that the predilection site of tick infestation in goats and sheep was the ears (Ramzan.M et al., 2019).

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