

Research Article

Identification, prevalence, distribution of ectoparasites and associated host-related risk factors on domestic animals in district Dera Ismail Khan, KPK, Pakistan

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Abstract

To determine the type of ectoparasitic fauna, their prevalence, distribution and associated host-related risk factors on domesticated animals in district Dera Ismail Khan, Pakistan, study was carried out from April 2021-April 2022. Two mite species (*Psoroptes ovis*, *Sarcoptes scabiei*), five lice species (*Bovicola bovis*, *Haematopinus quadripertusis*, *H. eurysternus*, *H. tuberculatus*, *Linognathus vituli*), and seven tick species (*Amblyomma variegatum*, *Boophilus decoloratus*, *Hyalomma dromedarii*, *H. anatolicum*, *H. excavatum*, *Haemaphysalis punctata*, and *Rhipicephalus singuanieus*) were identified. *H. eurysternus*, *Sarcoptes scabiei*, and *H. anatolicum* were the most prevalent species with 3.12 and 3.79 and 21.69% prevalence, respectively. The prevalence of *H. anatolicum*, *Rhi. singuanieus*, *Hae. punctata*, *Hy. dromedarii*, *Hy. excavatum*, *B. decoloratus*, *A. variegatum*, *Psoroptes ovis*, *Sarcoptes scabiei*, *Bovicola bovis*, *Haematopinus quadripertusis*, *H. eurysternus*, *H. tuberculatus*, and *Linognathus vituli* were 21.69, 15.71, 13.26, 10.92, 10.82, 5.82, 4.11, 2.86, 3.79, 2.65, 2.08, 3.12, 1.71, and 1.40%, respectively. For all ectoparasites there was no statistical deference ($p > 0.05$) between the prevalence of any of the ectoparasite infestation with sex, age and body condition score. It concluded a high prevalence and diverse ectoparasitic fauna that ultimately caused significant economic losses in the country, so proper control measures should be adopted to manage these ectoparasites in the study area.

Keywords: Epidemiology; *Hematophagous ectoparasites*; Pakistan; Prevalence; Risk factors

Introduction

Agriculture, as an important and fundamental sector of the economy, is a way of life for

more than half of Pakistan's population. Animal husbandry is a vital agriculture sub-sector that plays a crucial role in developing

a country's economic growth, especially in Pakistan [1, 2]. It plays a vital role in the country's economy and is a primary source of income or livelihood for the poor community and foreign currency [3, 4]. More than 30-35 million people in Pakistan are engaged in this livestock industry. Livestock is the main source of dairy products (meat, milk, ice cream, butter, and cheeses). Approximately 22.4 million cattle, 23.3 million buffaloes, 24.2 million sheep, and 49.1 million goats are found in Pakistan [5-7]. The livestock industry is badly affected due to several ectoparasites and endoparasites. Ectoparasites are the main threat to the livestock industry worldwide, especially in Pakistan, which significantly impacts animal husbandry and productivity [4, 8]. Among ectoparasites, ticks, mites, and lice are the major ones which directly or indirectly affect the livestock (cows, buffaloes, sheep, and goats). Mange is a parasitic mite-caused skin infestation in animals characterized by alopecia, pruritus, crusted lesions, and erythema. The severe irritation causes the animal to scratch its body against herd walls and tree trunks, causing skin damage and exposing the animal's skin to secondary viral and bacterial infections [9]. Parasites reduce weight and production, damage skin, and hide indirectly while causing direct damage by blood feeding and transmitting various diseases/pathogens (bacterial, viral, and protozoal) during feeding [10, 11]. These vector-borne diseases like nanophthalmos, babesiosis, and theileriosis caused by ectoparasites have negative impacts or toxic residues in the host's dairy products (meat, milk) [12, 13]. Parasitic infected animals keep poor physical condition and develop an anemic appearance, discolored, greasy hair, and unthrifty. Animal industries in many regions of the world are badly affected primarily due to numerous zoonotic disease pathogens transmitted by ectoparasites which can lead to mortality, low

productivity, and other economic losses [14, 15]. There is a lack of information regarding ectoparasites on domesticated animals in Pakistan. The present study was conducted to identify their species, prevalence, infestation, distribution, and associated risk factors.

Material and Methods

Study area and population

The present study was conducted in the district Dera Ismail Khan, Khyber Pakhtunkhwa (KPK) (34.95260 N, 72.33110 E), Pakistan, from April 2021 to April 2022 to determine the diversity of ectoparasites species, prevalence, infestation, and distribution on domesticated animals. Domesticated animals such as goats, sheep, buffalo, and cows are the primary agricultural enterprises for farmers and poor communities in the study area. Different farms and local houses of DIKhan raising domesticated animals were visited to detect ectoparasites.

Ectoparasites collection

A total of 1922 ectoparasites consisting of 1583 ticks, 211 lice, and 128 mites were collected from different body parts, ages, sex, and body conditions of 2230 examined animals. The age of animals was grouped as adults (≥ 3 years) and young (between 1 and 3 years) according to the classification method of Bitew *et al.* [16] and the method of Nicholson and Butterworth [17] followed for body conditions [16-18].

Preservation and identification

Both parasitological and physical examinations were performed. Ectoparasites were collected in vials containing 70% ethanol, labeled, and transported to the Department of Parasitology for further processing and taxonomic identification using standard protocols [19, 20]. The dehydrated specimens were cleared in xylene and mounted in Canada balsam. Identification of the collected ectoparasites was carried out under stereo- and compound

microscopes using identification keys [19-21].

Statistical analysis

Data were statistically analyzed using Statistical Package for the Social Sciences (SPSS) version 20. The prevalence percentage was determined by using the given formula by Thrusfield [22] while the relationship between age, sex, and body conditions of animals was done by using the chi-square (X^2) test. To indicate significance, 95% confidence intervals and $P < 0.05$ were used in all analyses.

Results and discussion

Out of 2230 animals, 478 sheep, 511 goats, 589 cows, and 652 buffaloes were examined for rural and urban areas of KPK. A total of 1922 ectoparasites were collected during the study period and identified to species level. Two mite species belonged to two genera, five lice species belonged to three genera, and seven tick species belonged to five genera were identified in the current study. Identified lice and mite species were *Bovicola bovis*, *Haematopinus quadrpertusis*, *H. eurysternus*, *H. tuberculatus*, *Linognathus vituli*, and *Psoroptes ovis*, *Sarcoptes scabiei*. Tick species identified during the current study were *Amblyomma variegatum*, *Boophilus decoloratus*, *Hyalomma dromedarii*, *Hy. anatolicum*, *Hy. excavatum*, *Haemaphysalis punctata*, and *Rhipicephalus singuanieus* (Table 1). Among lice and mite species, *H. eurysternus* and *Sarcoptes scabiei* were dominant species, respectively, with 3.12 and 3.79% prevalence. *Hy. anatolicum* was recorded most dominant tick species with 21.69% prevalence, followed by *Rhi. singuanieus* (15.71%), *Hae. punctata* (13.26%), *H. dromedarii* (10.92%), *H. Excavatum* (10.82%), *B. decoloratus* (5.82%), and *A. variegatum* (4.11%). *H. anatolicum* is a widely distributed tick species in study areas of the country (Pakistan) and the globe. This species

belongs to hard ticks. From many areas of the country, several researchers have reported the *H. anatolicum* as a dominant species [23-25]. Out of the total animals examined, 1235 were infested with ectoparasites, as shown in (Fig. 1). Out of 478 sheep and 511 goats examined, 57.11 and 35.22%, respectively, were infested with more than one ectoparasite species. 62.42 and 63.66% of buffaloes and cows were infested with ectoparasites. The current findings are in line with the results of Kamal *et al.* [26] and Islam *et al.* [27], who reported almost 65.5% prevalence of ectoparasites in cows. Some previous scientists had reported a 75.1% prevalence on animals which is different from our study findings [28]. This difference may be due to climatic conditions and the age or sex of animals where samples are taken. Iqbal *et al.* [29] have identified two species of ticks (*Hy. anatolicum*, *Rhi. microplus*); three species (*Damalinia bovis*, *H. eurysternus*, *L. vituli*) of lice and two species (*S. scabiei*, *P. bovis*) of mites while in the current study *Rhi. microplus* and *D. bovis* was not identified. Another researcher had identified two lice species (*Bovicola caprae* and *L. africanus*) on goats in Mexico, while *B. caprae* was not found in the study areas [30]. The absence of this species might be due to geographical variations, sample size, etc.

Among ectoparasites, the maximum tick population was recorded on animals, followed by lice and mites. Area-wise data showed that Dera Ismail Khan was highly infested in the study area, while Pahariapur was the least infested in the study area (Table 2). Another study was conducted by Jamil *et al.* [24] in Dera Ismail Khan to check the infestation percentage of ticks on animals. They reported the highest tick infestation in Dera Ismail Khan compared to other study areas. It was recorded that the prevalence of ectoparasites was significantly ($p < 0.05$) higher in adult animals and lowest in young

animals [24]. Islam *et al.* [27] also reported similar findings that the prevalence of ectoparasitic infestation was found maximum in old animals (61.5%) than in calves (56%) and adults (38.5%), while according to the findings of Vatsya *et al.* [31], young animals or calves carried a more significant number

of ectoparasites than grownups and adults [27, 31]. Manan *et al.* [32] had reported resistance in the livestock but in the current study no such resistance was observed. Young animals have strong innate immunity which become less vulnerable to ectoparasites [32, 33].

Table 1. Details of caught ectoparasites with prevalence percentage

Species of Ectoparasites	Number of ectoparasites	Prevalence (%)
<i>Bovicola bovis</i>	51	2.65
<i>Haematopinus quadripertusis</i>	40	2.08
<i>Haematopinus eurysternus</i>	60	3.12
<i>Haematopinus tuberculatus</i>	33	1.71
<i>Linognathus vituli</i>	27	1.40
<i>Psoroptes ovis</i>	55	2.86
<i>Sarcoptes scabiei</i>	73	3.79
<i>Amblyomma variegatum</i>	79	4.11
<i>Boophilus decoloratus</i>	112	5.82
<i>Hyalomma dromedarii</i>	210	10.92
<i>Hyalomma anatolicum</i>	417	21.69
<i>Hyalomma excavatum</i>	208	10.82
<i>Haemaphysalis punctata</i>	255	13.26
<i>Rhipicephalus sanguineus</i>	302	15.71
Total number of ectoparasites	1922	100

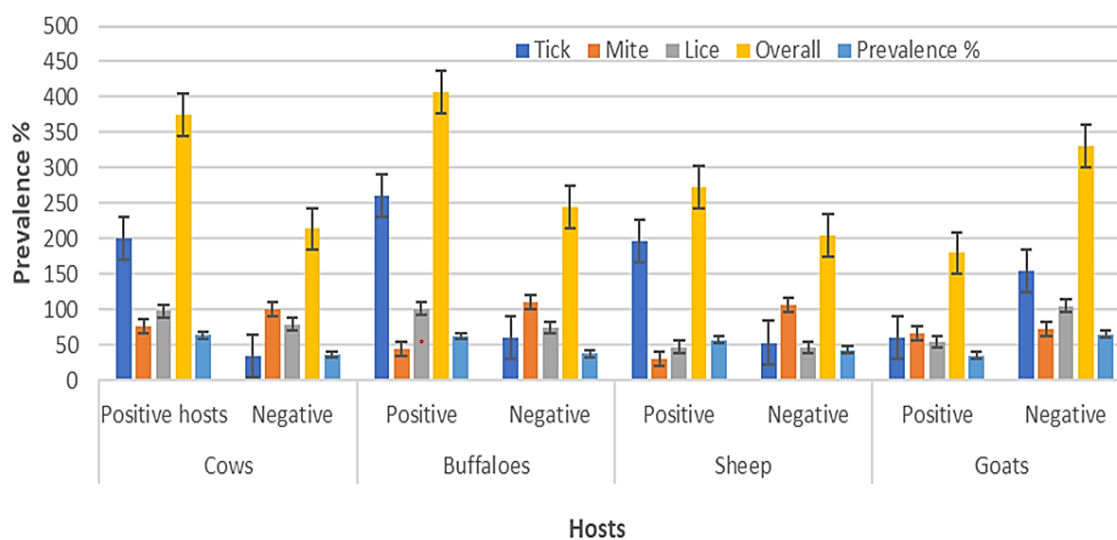


Figure 1. Infested and non-infested number of hosts

Table 2. Area wise ectoparasite prevalence

Area	Ectoparasite			Prevalence
	Ticks	Mites	Lice	
Dera Ismail Khan	697	58	91	44.01%
Daraban	453	37	69	29.08%
Paharpur	433	33	51	26.89%
Total	1583	128	211	100

Sex and age-wise ectoparasite prevalence showed that females were more highly infested hosts than males, and old animals carried a more significant number of one or more species of ectoparasites. The overall prevalence of ectoparasites species was 43.44 and 56.55% in males and females. The difference in the prevalence in both sexes was not statistically significant ($p>0.05$). In both sexes, *S. scabiei* and *H. eurysternus* were dominant lice and mite species, while *Hy.*

anatolicum was recorded most dominant tick species in both sexes (Table 3). Onu and Shiferaw [34] gave the similar findings.

The overall prevalence of ectoparasites in animals with good, medium, and poor body conditions was 21.33%, 34.49%, and 44.17%, respectively. The difference in the prevalence of the three body conditions of animals is given in (Table 4). Our current study findings are in line with the previous researchers [35, 36].

Table 3. Sex and age wise ectoparasites prevalence

Ectoparasites	Sex		X ² (p-values)	Age		X ² (p-values)
	Male n (%)	Female n (%)		Adult n (%)	Young n (%)	
Lice						
<i>B. bovis</i>	24 (11.37)	27 (12.79)	0.572 (0.615)	29 (13.74)	22 (10.42)	11.912 (0.000)
<i>H. quadrpertusis</i>	18 (8.53)	22 (10.42)	0.324 (0.876)	22 (10.42)	18 (8.53)	1.342 (0.123)
<i>H. eurysternus</i>	29 (13.74)	31 (14.69)	0.293 (0.563)	37 (17.53)	23 (10.90)	0.683 (0.233)
<i>H. tuberculatus</i>	15 (7.10)	18 (8.53)	0.067 (1.122)	19 (9.00)	14 (6.63)	1.435 (0.301)
<i>L. vituli</i>	11 (5.21)	16 (7.58)	0.213(1.137)	16 (7.58)	11 (5.21)	0.321 (0.231)
Mites						
<i>P. ovis</i>	27 (21.09)	28 (21.87)	2.263 (0.718)	30 (23.43)	25 (19.53)	1.452 (0.001)
<i>S. scabiei</i>	30 (23.43)	43 (33.59)	0.273 (0.973)	38 (29.68)	35 (27.34)	2.583 (0.236)
Ticks						
<i>A. variegatum</i>	35 (2.21)	44 (2.77)	0.174 (0.867)	41 (2.59)	38 (2.40)	11.361 (0.526)
<i>B. decoloratus</i>	45 (2.84)	67 (4.23)	0.064 (0.847)	79 (4.99)	33 (2.08)	9.542 (0.003)
<i>Hy. dromedarii</i>	99 (6.25)	111 (7.01)	2.749 (0.758)	121 (7.64)	89 (5.62)	3.674 (0.461)
<i>Hy. anatolicum</i>	186 (11.74)	231 (14.59)	3.023 (0.534)	219 (13.83)	198 (12.50)	3.352 (0.921)
<i>Hy. excavatum</i>	91 (5.74)	117 (7.39)	2.649 (0.452)	122 (7.70)	86 (5.43)	2.648 (0.736)
<i>Hae. punctata</i>	106 (6.69)	149 (9.41)	3.456 (0.463)	143 (9.03)	112 (7.70)	0.586 (0.738)
<i>Rhi. singuanieus</i>	119 (7.51)	183 (11.56)	2.376 (0.814)	154 (9.72)	148 (9.34)	0.523 (0.437)
Overall	835 (43.44)	1087 (56.55)		1070 (55.67)	852 (44.32)	

Table 4. Prevalence of species of ectoparasites by body condition

Ectoparasites	Body condition			X ² (p-values)
	Good n (%)	Medium n (%)	Poor n (%)	
Lice				
<i>B. bovis</i>	13 (6.16)	14 (6.63)	24 (11.37)	1.654 (0.328)
<i>H. quadripertusis</i>	9 (4.26)	14 (6.63)	17 (8.05)	3.334 (0.201)
<i>H. eurysternus</i>	17 (8.05)	20 (9.47)	23 (10.90)	1.143 (0.842)
<i>H. tuberculatus</i>	10 (4.73)	10 (4.73)	13 (6.16)	0.456 (0.785)
<i>L. vituli</i>	7 (3.31)	9 (4.26)	11 (5.21)	2.323 (0.359)
Mites				
<i>P. ovis</i>	5 (3.90)	22 (17.18)	28 (21.87)	3.562 (0.357)
<i>S. scabiei</i>	11 (8.59)	29 (22.65)	33 (25.78)	0.974 (0.893)
Ticks				
<i>A. variegatum</i>	19 (1.20)	23 (1.45)	37 (2.33)	0.856 (0.435)
<i>B. decoloratus</i>	24 (1.51)	39 (2.46)	49 (3.09)	0.337 (0.937)
<i>Hy. dromedarii</i>	48 (3.03)	75 (4.73)	87 (5.49)	1.238 (0.515)
<i>Hy. anatolicum</i>	86 (5.43)	141 (8.90)	190 (12.00)	3.274 (0.636)
<i>Hy. excavatum</i>	43 (2.71)	76 (4.80)	89 (5.62)	2.582 (0.947)
<i>Hae. punctata</i>	51 (3.22)	89 (5.62)	115 (7.26)	3.654 (0.726)
<i>Rhi. singuanieus</i>	67 (4.23)	102 (6.44)	133 (8.40)	1.939 (0.792)
Overall	410 (21.33)	663 (34.49)	849 (44.17)	

n= number of specimens collected

Conclusion

It is concluded from the present research that among lice and mite species, *H. eurysternus* and *Sarcoptes scabiei* were dominant species, respectively, with 3.12 and 3.79% prevalence. *Hy. anatolicum* was recorded most dominant tick species with 21.69% prevalence, followed by *Rhi. Singuanieus* (15.71%), *Hae. Punctate* (13.26%), *H. dromedarii* (10.92%), *H. Excavatum* (10.82%), *B. decoloratus* (5.82%), and *A. variegatum* (4.11%). *H. anatolicum* is a widely distributed tick species in study areas of the country (Pakistan) and the globe.

Authors' contributions

Conceived and designed the experiments: R Sarfraz & M Ali, Performed the experiments: M Ullah & N Jabeen, Analyzed the data: A Khan & I Khan, Contributed materials/

analysis/ tools: F Ramzan, Shakirullah & MZ Khan, Wrote the paper: M Jamil.

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