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Prevalence of some ectoparasites infesting different breeds of dogs in Qalyubia Governorate, Egypt

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ABSTRACT

The present study aimed to identify ectoparasites species infesting dogs in Qalyubia governorate, Egypt during the period extended from June 2021 to May 202. For this purpose, 271 dogs belonged to nine species were examined to detect ectoparasites. The results showed that prevalence of ticks species was 98.2% and 1.8% for Rhipicephalus sanguineus and Hyalomma dormedari, respectively. The incidence of fleas species was 48.24% and 51.76% for Ctenocephalides felis and Ctenocephalides canis, respectively. Lice species distribution was 84.46% and 14.5% for Heterodoxus spriniger and Haematopinus species, respectively. The infestation by ticks, fleas, and lice was the highest (40.34, 33.89, and 31.08 %, respectively) in summer season, while the winter season showed the lowest infestation of 7.31, 17.37 and 19.52% for ticks, fleas and lice respectively. Stray dogs had the highest infestation rate (62.5%), and male dogs were slightly higher than females without significance (27.9, and 25.4, respectively). All ages are infested, and the highest age of infestation was 7 month to 1 year (15.86%) while young dogs less than 6 months showed less infestation. Dogs weighed (≥ 25kg) showed higher infestation (24.35%) than other weights. Ectoparasites infestation was (57.57%) in pregnant bitches and (31.25%) in lactating bitches. Also, single and mixed infestation between male and female dogs, fur color, and place where ectoparasites distributed on dogs were calculated. It could be conclud that stray dogs were more susceptible to ectoparasites infestation than dog breeds. Fleas are more common followed by ticks, so control measures must be carried against them in dogs.

1. INTRODUCTION

Dogs are common household pets, helping the physical, social, and emotional development of children as well as the well-being of their owners in both developed and developing countries (Abdulkareem et al., 2019).

Dogs are preferred hosts for a variety of ectoparasites, including ticks, fleas, and lice, which serve as vectors and reservoirs for a variety of zoonotic infections (Dobler and Pfeffer, 2011).

Ectoparasites are a significant global barrier to the health and productivity of animals. Dogs frequently have ectoparasites, which are a significant factor in both pruritic and non-pruritic skin conditions. They cause hypersensitivity and spread several diseases (Mosallanejad et al., 2012). Many of these ectoparasites as lice are host-specific, but others e.g., ticks, parasitize a broader range of hosts (Okely et al., 2021). Ticks are one of the most serious ectoparasites affecting the welfare and health of dogs and cats all over the world. Ticks' blood-feeding behavior is linked to clinical symptoms (Marchiondo et al., 2007; Kumsa et al., 2019). Also, many diseases are transmitted by ticks to dogs e.g., Babesia canis, Hepatozoon canis, Ehrlichia canis, Borrelia burgdorferi, and Spotted fever (Shaw et al., 2001).

Fleas (order Siphonaptera) are obligate blood-feeding insects, that have been implicated in pathogen transmission, including Haemoplasma and Rickettsia (Jongejan and Uilenberg, 2004). Ctenocephalides infesting dogs is a known vector for the bacteria Bartonella henselae, Bartonella clarridgeiae, and Rickettsia and Flea-borne bacterial zoonoses (flea-borne spotted fever, murine typhus, and plague) are endemic in East African countries (Eisen and Gage, 2012; Aboelela et al., 2022). Moreover, pet fleas are intermediate hosts for helminths, such as the dog tapeworm Dipylidium caninum, which can parasitize humans (Dobler and Pfeffer, 2011; Kumsa et al., 2019).

Lice are host-specific and also among the most common ectoparasites of household animals such as dogs. Lice infestations in dogs can result in thriftiness, dermatological lesions, anemia, alopecia from scratching, biting, rubbing, and secondary skin diseases (Wall and Shearer, 1997; Kumsa et al., 2019; Aboelela et al., 2022). They are significantly more resulting in severe dermatitis. High lice infestations can also induce adverse immunological reactions (hypersensitivity and anaphylaxis), skin necrosis, localized hemorrhages, decreased weight gain or loss, anemia, hypoproteinemia, secondary infection, as well as secondary bacterial or fungal infections (Brown, 2000; Green et al., 2001; Turner, 2003).

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Due to the importance of ectoparasites infesting dogs in the transmission of many diseases. Few studies were carried out on ectoparasites infesting dogs in Egypt (Abuzeid, 2015; Aboelela et al., 2022). So, the present study was carried out to identify species of ectoparasites infesting dog, their seasonal prevalence, the effect of dog breed, sex, age, weight, lactation and pregnancy on their prevalence and determination the distribution of ectoparasites on dog body.

2. MATERIAL AND METHODS

2.1. Animals

The experimental practice was agreed by the Ethics Committee for Animal Use in the Faculty of Veterinary Medicine, Benha University (BUFVTM 46-09-23).

A total number of 271 dogs were collected different sex and breeds (aged from ≤ 1 month – ≤ 2 years) including: stray, Husky, Pit Bull, German, Golden, Dalmatian, Chihuahua, Lolo and Rottweiler. Dogs were collected from different localities of Qalyubia governorate (Benha, Toukh, Shipen elkanater, Elmanzalah, Minyat elsipaa, Nokbas, Kafr attalah, Kafr elhamam and Batamdah). Dogs were investigated monthly during the period from June 2021 to May 2022 for ectoparasitic infestation (Table 1). The effect of season, dog breeds, sex, age, weight, fur color, lactation and pregnancy on the percentage of infestation, and the distributions of ectoparasites on dog body were also determined.

Table 1 Number of examined dogs in different seasons of the year .

Season	No. of dogs	%
Summer	66	24.35
Autumn	73	26.94
Winter	60	22.14
Spring	72	26.57
Total	271	100

2. 2. Ectoparasites collection

Ectoparasites were collected after calming the dog, then spraying external insecticide for easy collection beginning by head region, internal and external sides of the ear around nose, mouth, neck, back region followed by the belly, limbs till the toes, between toes, external genetalia and under tail. Lice and fleas were picked separately by hands, while ticks were removed anti clock wise and press it to inside and pull tick out then the collected ticks were picked by forceps, the collected ectoparasites were kept in plastic containers containing 70% ethanol and transferred to the parasitology laboratory for identification.

2.3. Ectoparasites identification

Ectoparasite was put in KOH (10%) overnight to clear its internal structure, then washed with distilled water for 10 minutes, passed through different alcoholic concentrations (30%, 50%, 70%, and 90%) for 5 minutes per each. Finally, the samples were transferred to xylene for 5 minutes. Each cleared sample was mounted on a microscopic slide with Canada balsam to be examined under a dissecting and light microscope (10X, 40X) (Thamer and Faraj, 2019). Each species of flea and lice were identified morphologically according to the keys (Pratt and Stojanovich, 1992 ; Wall and Shearer, 1997; Turner et al., 2004) while ticks were identified according to Longstaffe (1984) and Walker (2003).

2.4. Statistical analysis

The statistical analysis was carried out using Two-way ANOVA using SPSS, ver. 27 (IBM Corp. Released 2013). Data were treated as a complete randomization design according to Steel et al. (1997). Multiple comparisons were carried out applying Duncun test the significance level was set at ≤ 0.05.

3. RESULTS

In the present study six species of ectoparasites were identified including: ticks spp. which were Rhipicephalus sanguineus (98.2%) and Hyalomma dormedari (1.8%) from total ticks number, fleas spp. which were Ctenocephalides felis (48.24%) and Ctenocephalides canis (51.76%) from total fleas number, and lice spp. which were Heterodoxus spriniger (84.46%) and Haematopinus spp (14.5%) from the total lice number.

It was clear that R. sanguineus was more prevalent in summer and autumn (100% each), H. dromedari, C. canis and Haematopinus spp. had their peaks in winter (19.6%, 60.87%, 34.69%; respectively.), C. felis was more detected in autumn (59.18%) and H. spiringer was much seen in summer and spring (100 each) (Table 2, Plate 1**).**

It was the first time to identify male Hyalomma dormedari and male Haematopinus spp. infesting dogs in Egypt so it's not host specific for camel and cattle and can trans to other animals and their morphological characters were identified as follows:

-Hyalomma dromedari male: it has long mouth part and sub-anal plates which are aligned outside the adenal plates. The adanal l plates are also a characteristic shape with both long margins strongly curved in parallel and anal plates projection-like (Plate 1: d&e).

-Haematopinus spp male: its head was dorso-ventrally flattened. The lengths of the fore and hind heads were about equal, and it showed the typical v-shaped pseudopenis with the tip of the aedegus (penis) protruding (Plat 1: g)**.**

Table 2 Effect of season on the prevelance of ectoparasitic species infesting dogs .

Season	Ticks					Fleas					Lice				
	Total No. Of ticks	Rhipicephalus sanguineus		Hyalomma dormedari		Total No. Of fleas	Ctenocephalides felis		Ctenocephalides canis		Total No. Of lice	Heterodoxus spiniger		Haematopinus spp.	
		No.	(%)	No.	%		No.	%	No.	%		No.	%	No.	%
Summer	309	309	100.00^{aA}	0	0.00^{aC}	404	199	49.26^{aB}	205	50.74^{aB}	78	78	100.00^{aA}	0	0.00^{bC}
Autumn	149	149	100.00^{aA}	0	0.00^{aD}	245	145	59.18^{aB}	100	40.82^{aBC}	71	49	69.01^{abB}	22	30.99^{abC}
Winter	56	45	80.36^{bA}	11	$19.6^{a}4^{D}$	207	81	39.13^{BCD}	126	60.87^{aABC}	49	32	65.31^{bAB}	17	34.69^{aCD}
Spring	252	249	98.81^{abA}	3	1.19^{aC}	336	150	44.64^{aB}	186	55.36^{aB}	53	53	100.00^{aA}	0	0.00^{bC}
Total	766	752	98.2	14	1.83	1192	575	48.24	617	51.76	251	212	84.46	39	15.54

a, b & c: There is no significant difference (P>0.05) between any two means, within the same column have the same superscript letter. A, B & C: There is no significant difference (P>0.05) between any two means, within the same row have the same superscript letter

Concerning the seasonal prevalence of ectoparasites among dog breeds, the highest infestation significantly rate was (38.4%) in stray dogs all over the year, (3.47%) in Huskey, (3.47%, 2.1%) in German and rottweiler, respectively, (1.57%) in Lolo, (1.77%) in Pitbull, (1.4%, .74% and .37%) in Chihuahua, Golden and Dalmatian; respectively **(**Table 3).

Upon studying the seasonal dynamics of ectoparasites infesting different breeds of dogs, it was clear that the infestation with ticks, fleas, and lice peaked in summer (40.34%,33.89 %, and 31.08%; respectively) (Table 4).

Table 3 Seasonal prevalence of ectoparasites infestation in different breeds of dog

season	No. of examined	No. of infested	% of infestation on different breeds								
			stray	golden	Chihuahua	Pitbull	Lolo	rottweiler	German	Huskey	dalmatian
Summer	66	34	9.60^{aA}	0.7^{bB}	0.37^{bBC}	0.00^{bC}	0.37^{bBC}	0.37^{aBC}	0.7^{aB}	0.00^{bC}	0.37^{aBC}
autumn	73	38	9.60^{aA}	1.20^{aB}	1.20^{aB}	0.7^{aBC}	1.20^{aB}	0.00^{bD}	0.00^{bD}	0.37^{aCD}	0.00^{bD}
winter	60	35	9.60^{aA}	0.37^{bBC}	0.37^{bBC}	0.70^{aB}	0.00^{cC}	0.70^{aB}	0.00^{bC}	0.37^{aBC}	0.00^{bC}
spring	72	37	9.60^{aA}	1.20^{aB}	1.20^{aB}	0.70^{aB}	0.00^{cC}	0.70^{aB}	0.70^{aB}	0.00^{bC}	0.00^{bC}
Total	271	144	38.40^{A}	3.47^{B}	3.14^{B}	2.10^{BC}	1.57^{BC}	1.77^{BC}	1.40^{BC}	0.74^{C}	0.37^{C}

a, b & c: There is no significant difference (P>0.05) between any two means, within the same column have the same superscript letter. A, B & C: There is no significant difference (P>0.05) between any two means, within the same row have the same superscript letter.

Table 4 Total Seasonal dynamics of different ectoparasites infesting different breeds of dogs.

Season	Ticks no.	%	Fleas	%	Lice no	%
Summer	309	40.34^{aA}	404	33.89^{aA}	78	31.08^{aA}
Autumn	149	19.45^{bA}	245	20.55^{bA}	71	28.29^{aA}
Winter	56	7.31^{bB}	207	17.37^{bAB}	49	19.52^{aA}
Spring	252	32.90^{aA}	336	28.19^{abAB}	53	21.12^{aB}
Total	766	100	1192	100	251	100

a, b & c: There is no significant difference (P>0.05) between any two means, within the same column have the same superscript letter. A, B & C: There is no significant difference (P>0.05) between any two means, within the same row have the same superscript letter.

Concerning the monthly dynamics of ectoparasitic infestation, August was significantly ($p< 0.05$) the highest month of tick infestation (18.28%). While fleas and lice had no month specificity, they could infest dogs in different months of the year without significant variations ($p> 0.05$) (Table 5).

Table 5 Month prevalence of ectoparasites in different breeds of dogs

Month	Ticks		Fleas		Lice	
	No.	(%)	No.	(%)	No.	(%)
June	76	9.92^{bcB}	132	11.07^{abB}	44	17.53^{aA}
July	93	12.14^{bA}	114	9.56^{abAB}	17	6.77^{cB}
August	140	18.28^{aA}	158	13.26^{aB}	17	6.77^{cC}
September	86	11.23^{bcA}	97	8.14^{abAB}	18	7.17^{cB}
October	45	5.87^{cdeA}	83	6.96^{bA}	16	6.37^{cA}
November	18	2.35^{eC}	65	5.45^{B}	37	14.74^{abA}
December	16	2.09^{eB}	70	5.87^{bA}	20	7.97^{cA}
January	23	3.00^{deA}	63	5.29^{bA}	14	5.58^{cA}
February	17	2.22^{eB}	74	6.21^{bA}	15	5.98^{cA}
March	90	11.75^{bcA}	102	8.56^{abB}	15	5.98^{cB}
April	68	8.88^{bcdA}	106	8.89^{abA}	25	9.96^{bcA}
May	94	12.27^{bA}	128	10.74^{abA}	13	5.18^{cB}
Total	766	100.00	1192	100.00	251	100.00

a, b & c: There is no significant difference (P>0.05) between any two means, within the same column have the same superscript letter. A, B & C: There is no significant difference (P>0.05) between any two means, within the same row have the same superscript letter.

Upon determining the effect of sex on ectoparasitic infestation in different dog breeds, there were significant increases ($p< 0.05$) in the prevalences of ectoparasites infestation of stray dogs male and female (20.30%, 15.87%; respectively). Generally, male dogs were higher by ectoparasitic infestation than females (27.68, 25.46; respectively) without significant difference (Table 6).

Table 6 Effect of sex on the prevalence of ectoparasites in different breeds of dogs.

Breed	Total Number examined	Male Infested		Female Infested	
		No. infested	%	No. infested	%
Stray	125	55	20.30^{aA}	43	15.87^{aB}
Husky	38	5	1.85^{bB}	9	3.32^{bA}
German	29	6	2.21^{bA}	3	1.11^{bcA}
Rottweiler	19	2	0.74^{bA}	4	1.48^{bcA}
Lolo	22	2	0.74^{bA}	3	1.11^{bcA}
Pitbull	17	3	1.11^{bA}	2	0.74^{bcA}
Chihuahua	10	1	0.37^{bA}	3	1.11^{bcA}
Golden	4	0	0.37^{bA}	2	0.00^{cA}
Dalmatian	7	1	0.00^{bA}	0	0.74^{bcA}
Total	271	75	27.68^{A}	69	25.46^{A}

a, b & c: There is no significant difference (P>0.05) between any two means, within the same column have the same superscript letter. A, B & C: There is no significant difference (P>0.05) between any two means, within the same row have the same superscript letter.

Regarding single and mixed infestation by different ectoparasites in male dogs, the single fleas infestation was significantly higher ($p< 0.05$) in both male Dalmatine (50%) and Chihuahua (25%) compared to other breeds. The single lice infestation was much among in stray dogs (7.04%) with no significant difference ($p> 0.05$) compared to other breeds. Pitbull breed showed significantly ($p< 0.05$) the highest ~~of~~ single tick infestation (11.11%) compared to other breeds. On the other hand, mixed infestations with fleas and ticks and with fleas, lice, and ticks were the highest among stray dogs (36.62% and 12.68%; respectively) compared to other breeds. However, stray, German, and lolo breeds were significantly ($p< 0.05$) more infested with mixed infestation with fleas and lice (11.27%, 6.25%, and 11.11%; respectively) (Table 7).

In female dogs, the single infestation with fleas was the highest among females golden breed (20%) without significant difference ($p> 0.05$) with other breeds, whereas Pitbull breed was significantly higher ($p<0.05$) than other breeds in single lice and ticks infestations (25% and 12.50%; respectively). Mixed infestation with fleas and ticks and mixed infestation with fleas, ticks, and lice significantly showed its peak in female stray dogs (57.41% and 5.56%; respectively) compared to other breeds. On the other side, the female rottweiler breed displayed the highest mixed infestation with fleas and lice (10%) compared to other breeds (Table 8).

With respect to the monthly effect of age on ectoparasitic infestation among different breeds of dogs, it was declared that the highest infestation rate was significantly ($p< 0.05$) at age of 7 month-1year (15.86%), while the lowest infestation rate was at the age of 1-6 month (8.11%). It was noted that dogs at an age of less than one month, 7 m-1year, and > 1-2years were significantly($p> 0.05$) more infested in February (16.67%, 27.78%, and 16.67%; respectively). While dogs at the age of 1-6m and > 2 years were more infested in July and September (28.57% and 23.81; respectively) (Table 9).

Concerning the effect of fur color on the monthly rate of ectoparasitic infestation among different breeds of dog. Or result revealed that dark-colored dogs black and brown showed the highest infestation rate (19.19%, and 18.45%; respectively) compared to dogs of another fur color, while gray-colored dogs had the lowest infestation (3.32%). It was noted that the dogs of black colored fur had a higher infestation rate in July (28.57%) and that of white and gray fur dogs showed the highest infestation in February (11.11%). While dogs with brown fur are mostly infested in January (28.57%). Moreover, dogs with mixed-colored fur were more infested in February (22.22%) (Table 10).

Dealing with the effect of lactation and pregnancy on the ectoparasitic infestation of dogs, there was significant effect of lactation on the degree of infestation in different months of the year ($p> 0.05$), where May was the highest month of infestation (66.67%) compared to the other months. On the contrary the pregnant females revealed a significantly ($p< 0.05$) higher infestation rate in December, February and April (100% each) compared to other months (Table 11).

It was prevalent that the weight of the dog had a great effect on the monthly prevalence of ectoparasites where the dog of weights ranged from (≥ 25) kg (large size) showed significantly ($p< 0.05$) a high infestation rate (24.35%) throughout the year compared to dogs weighting (10-25) kg (Medium size) and that of small size (≤10) kg It was clear that the infestation rate in dogs of (≥ 25) kg was significantly ($p< 0.05$) most prevalent in March(38.1%), while dogs of other sizes showed no prevalent variations ($p> 0.05$) upon comparing infestation rate in different months (Table 12). Upon examination the distribution of ectoparasites on dog body, it was prominent that the highest number of ticks (n=280) was seen on head area ($p< 0.05$). Meanwhile, lice were distributed on different areas of the body without a significant predilection site ($p> 0.05$). Generally, ticks were significantly ($p< 0.05$) more recorded on head and limbs (n= 280, 219; respectively) than lice (n= 58, 18; respectively) (Table 13).

Table 7 Prevalence of single and mixed infestations with different ectoparasites in different breeds of male dogs.

Breed	No. examined	Infested with fleas		Infested with lice		. Infested with ticks		Infested with fleas + ticks		. Infested with fleas + lice		Infested with fleas + ticks+ lice	
		No.	%	No.	%	No.	%	No.	%	No.	%	No.	%
Stray	71	4	5.63^{deBC}	5	7.04^{aBC}	0	0.00^{bC}	26	36.62^{aA}	8	11.27^{aB}	9	12.68^{aB}
Husky	19	3	15.79^{bcdA}	0	0.00^{aB}	0	0.00^{bB}	3	15.79^{bcA}	0	0.00^{bB}	0	0.00^{bB}
German	16	1	6.25^{deB}	0	0.00^{aB}	0	0.00^{bB}	4	25.00^{bA}	1	6.25^{abB}	0	0.00^{bB}
Rottweiler	9	2	22.22^{bA}	0	0.00^{aB}	0	0.00^{bB}	0	0.00^{dB}	0	0.00^{bB}	0	0.00^{bB}
Lolo	9	1	11.11^{cdA}	0	0.00^{aB}	0	0.00^{bB}	0	0.00^{dB}	1	11.11^{aA}	0	0.00^{bB}
Pitbull	9	1	11.11^{cdA}	0	0.00^{aB}	1	11.11^{aA}	1	11.11^{cA}	0	0.00^{bB}	0	0.00^{bB}
Chihuahua	4	1	25.00^{aA}	0	0.00^{aB}	0	0.00^{bB}	0	0.00^{dB}	0	0.00^{bB}	0	0.00^{bB}
Golden	2	0	0.00^{eA}	0	0.00^{aA}	0	0.00^{bA}	0	0.00^{dA}	0	0.00^{bA}	0	0.00^{bA}
Dalmatian	2	1	50.00^{aA}	0	0.00^{aB}	0	0.00^{bB}	0	0.00^{dB}	0	0.00^{bB}	0	0.00^{bB}
Total	141	14	9.93^{CB}	5	3.55^{BC}	1	0.71^{C}	34	24.11^{aA}	10	7.09^{BC}	9	6.38^{BC}

a, b & c: There is no significant difference (P>0.05) between any two means, within the same column have the same superscript letter. A, B & C: There is no significant difference (P>0.05) between any two means, within the same row have the same superscript letter

Table 8 Prevalence of single and mixed infestations with different ectoparasites in different breeds of female dogs.

Breed	No. examined	No. of infested with fleas		Infested with lice		. Infested with ticks		Infested with fleas + ticks		. Infested with fleas + lice		Infested with fleas + ticks+ lice	
		No.	%	No.	%	No.	%	No.	%	No.	%	No.	%
Stray	54	2	3.70^{cB}	2	3.70^{bB}	0	0.00^{bB}	31	57.41^{aA}	3	5.56^{aB}	3	5.56^{aB}
Husky	19	3	15.79^{aA}	1	5.26^{bB}	0	0.00^{bB}	4	21.05^{cA}	0	0.00^{aB}	0	0.00^{aB}
German	13	2	15.38^{abA}	0	0.00^{bB}	0	0.00^{bB}	1	7.69^{deAB}	0	0.00^{aB}	0	0.00^{aB}
Rottweiler	10	1	10.00^{abcB}	0	0.00^{bC}	0	0.00^{bC}	2	20.00^{cA}	1	10.00^{aB}	0	0.00^{aC}
Lolo	13	1	7.69^{bcAB}	0	0.00^{bB}	0	0.00^{bB}	2	15.38^{cdA}	0	0.00^{aB}	0	0.00^{aB}
Pitbull	8	0	0.00^{cC}	2	25.00^{aA}	1	12.50^{aB}	0	0.00^{eC}	0	0.00^{aC}	0	0.00^{aC}
Chihuahua	6	1	16.67^{abB}	0	0.00^{bC}	0	0.00^{bC}	2	33.33^{bA}	0	0.00^{aC}	0	0.00^{aC}
Golden	5	1	20.00^{aA}	0	0.00^{bB}	0	0.00^{bB}	0	0.00^{eB}	0	0.00^{aB}	0	0.00^{aB}
Dalmatian	2	0	0.00^{cA}	0	0.00^{bA}	0	0.00^{bA}	0	0.00^{eA}	0	0.00^{aA}	0	0.00^{aA}
Total	130	11	8.46^{B}	5	3.85^{B}	1	0.77^{B}	42	32.31^{A}	4	3.08^{B}	3	2.31^{B}

a, b & c: There is no significant difference (P>0.05) between any two means, within the same column have the same superscript letter. A, B & C: There is no significant difference (P>0.05) between any two means, within the same row have the same superscript letter.

Table 9 Monthly effect of age on ectoparasitic infestation in dogs.

Month	No.of dogs	Age of dogs Less than 1 month		1 to 6 month		7 m -1 year		More than 1-2 year		More than 2 years	
		No infected	(%)	No infected	(%)	No infected	(%)	No infected	(%)	No infected	(%)
June	22	2	9.09^{abcdB}	6	27.27^{abA}	2	9.09^{cdB}	2	9.09^{abcB}	0	0.00^{fC}
July	21	3	14.29^{abB}	6	28.57^{aA}	0	0.00^{dC}	2	9.52^{abcB}	3	14.29^{abcdB}
August	23	3	13.04^{abcAB}	4	17.39^{bA}	4	17.39^{bcA}	2	8.70^{abcB}	3	13.04^{bcdeAB}
September	21	2	9.52^{abcdBC}	1	4.76^{cdC}	3	14.29^{bcB}	1	4.76^{bcC}	5	23.81^{aA}
October	27	3	11.11^{abcAB}	0	0.00^{dC}	4	14.81^{bcA}	3	11.11^{aAB}	2	7.41^{defB}
November	25	3	12.00^{abcB}	0	0.00^{dC}	3	12.00^{cB}	1	4.00^{cC}	5	20.00^{abA}
December	21	3	14.29^{abAB}	0	0.00^{dC}	4	19.05^{abcA}	3	14.29^{abAB}	2	9.52^{cdefB}
January	21	1	4.76^{bcdC}	1	4.76^{cC}	5	23.81^{abA}	2	9.52^{abBC}	3	14.29^{abcdB}
February	18	3	16.67^{aB}	0	0.00^{dC}	5	27.78^{aA}	3	16.67^{aB}	1	5.56^{defC}
March	21	0	0.00^{dB}	1	4.76^{cB}	4	19.05^{abcA}	3	14.29^{abA}	4	19.05^{abcA}
April	26	3	11.54^{abcB}	0	0.00^{dC}	5	19.23^{abcA}	3	11.54^{abB}	1	3.85^{efC}
May	25	1	4.00^{cdB}	3	12.00^{cA}	4	16.00^{bcA}	4	16.00^{aA}	0	0.00^{fB}
Total	271	27	9.96^{AB}	22	8.11^{B}	43	15.86^{ABC}	29	10.7^{AB}	29	10.7^{AB}

a, b & c: There is no significant difference (P>0.05) between any two means, within the same column have the same superscript letter. A, B & C: There is no significant difference (P>0.05) between any two means, within the same row have the same superscript letter.

Table 10 Monthly effect of fur color on ectoparasitic infestation in dogs.

Month	No. of examined dogs	Fur color Black		White		Gray		Brown		Mixed color	
		No infected	(%)	No Infected	(%)	No infected	(%)	No infected	(%)	No infected	(%)
June	22	2	9.09^{eB}	1	4.55^{bC}	1	4.55^{bcC}	5	22.73^{abA}	1	4.55^{bcC}
July	21	6	28.57^{aA}	1	4.76^{abD}	0	0.00^{cE}	5	23.81^{abB}	2	9.52^{bC}
August	23	5	21.74^{bA}	1	4.35^{bC}	0	0.00^{cD}	4	17.39^{bcB}	0	0.00^{cD}
September	21	5	23.81^{abA}	1	4.76^{abC}	1	4.76^{abcC}	5	23.81^{abA}	2	9.52^{bB}
October	27	3	11.11^{deB}	3	11.11^{aB}	1	3.70^{bcC}	5	18.52^{bA}	2	7.41^{bBC}
November	25	4	16.00^{cdA}	2	8.00^{abB}	2	8.00^{abB}	2	8.00^{dB}	0	0.00^{cC}
December	21	4	19.05^{bcA}	2	9.52^{abB}	2	9.52^{abB}	4	19.05^{bA}	0	0.00^{cC}
January	21	4	19.05^{bcB}	2	9.52^{abC}	0	0.00^{cE}	6	28.57^{aA}	1	4.76^{bcD}
February	18	3	16.67^{cdB}	2	11.11^{aC}	2	11.11^{aC}	4	22.22^{abA}	4	22.22^{aA}
March	21	5	23.81^{abA}	1	4.76^{abC}	0	0.00^{cD}	2	9.52^{dB}	1	4.76^{bcC}
April	26	5	19.23^{bcA}	1	3.85^{bC}	0	0.00^{cC}	3	11.54^{cdB}	2	7.69^{bB}
May	25	6	24.00^{abA}	1	4.00^{bB}	0	0.00^{cB}	5	20.00^{bA}	0	0.00^{B}
Total	271	52	19.19^{A}	18	6.64^{B}	9	3.32^{B}	50	18.45^{A}	15	5.53^{B}

a, b & c: There is no significant difference (P>0.05) between any two means, within the same column have the same superscript letter. A, B & C: There is no significant difference (P>0.05) between any two means, within the same row have the same superscript letter.

Table 11 The effect of lactation and pregnancy on the monthly prevalence of ectoparasitic infestation in female dogs.

Month	Lactating dogs No. lactating female	No. infested	(%)	Pregnant dogs No. pregnant female	No. infested	(%)
June	5	2	40.00^{aA}	2	1	50.00^{abA}
July	4	0	0.00^{aA}	0	0	0.00^{bA}
August	4	2	50.00^{aA}	4	1	25.00^{abA}
September	3	1	33.33^{aA}	3	1	33.33^{abA}
October	5	3	60.00^{aA}	2	1	50.00^{abA}
November	6	1	16.67^{aA}	2	0	0.00^{bA}
December	4	0	0.00^{aB}	2	2	100.00^{aA}
January	2	1	50.00^{aA}	3	2	66.67^{abA}
February	2	0	0.00^{aB}	2	2	100.00^{aA}
March	5	1	20.00^{aA}	4	2	50.00^{abA}
April	2	0	0.00^{aB}	5	5	100.00^{aA}
May	6	4	66.67^{aA}	4	2	50.00^{abA}
Total	48	15	31.25^{B}	33	19	57.57^{A}

a, b & c: There is no significant difference (P>0.05) between any two means, within the same column have the same superscript letter. A, B & C: There is no significant difference (P>0.05) between any two means, within the same row have the same superscript letter.

Table 12 Relation between ectoparasitic infestation and weights of dogs in different months of the year.

Month	Total examined	Weights of dogs: Large size (≥ 25) kg		Medium size (10-25) kg		small size (≤10) kg	
		Infected No.	(%)	Infected No.	(%)	Infected No.	(%)
June	22	5	22.73^{cdA}	4	18.18^{aB}	3	13.64^{abB}
July	21	5	23.81^{bcdA}	3	14.29^{aB}	4	19.05^{aAB}
August	23	5	21.74^{cdA}	4	17.39^{aB}	3	13.04^{abB}
September	21	4	19.05^{cdA}	4	19.05^{aA}	4	19.05^{aA}
October	27	6	22.22^{cdA}	5	18.52^{aA}	1	3.70^{cB}
November	25	7	28.00^{bcA}	5	20.00^{aB}	1	4.00^{cC}
December	21	5	23.81^{bcdA}	5	23.81^{aA}	2	9.52^{abB}
January	21	5	23.81^{bcdA}	5	23.81^{aA}	1	4.76^{cB}
February	18	6	33.33^{abA}	3	16.67^{aB}	3	16.67^{abB}
March	21	8	38.10^{aA}	3	14.29^{aB}	1	4.76^{cC}
April	26	6	23.08^{cdA}	4	15.38^{aB}	2	7.69^{bcC}
May	25	4	16.00^{dB}	6	24.00^{aA}	2	8.00^{bcC}
Total	271	66	24.35^{A}	51	18.82^{B}	27	9.96^{C}

a, b & c: There is no significant difference (P>0.05) between any two means, within the same column have the same superscript letter. A, B & C: There is no significant difference (P>0.05) between any two means, within the same row have the same superscript letter.

Table 13 Disrtibution of ticks and lice on different areas on dog body.

Ectoparasites	Head	Back	Belly	Limbs	Genitalia	Total
No. of Ticks	280^{aA}	105^{aBC}	109^{aBC}	219^{aAB}	53^{aC}	766
No. of Lice	58^{bA}	65^{aA}	104^{aA}	18^{bA}	6^{aA}	251

a, b & c: There is no significant difference (P>0.05) between any two means, within the same column have the same superscript letter. A, B & C: There is no significant difference (P>0.05) between any two means, within the same row have the same superscript letter.

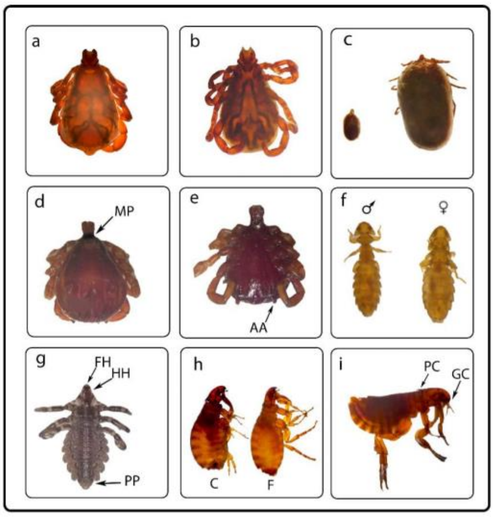

Plate 1 Ectoparasites infest different breeds of dogs. a: Dorsal view of R. sanguineus male , b: Ventral view of R. sanguineus male, c: Dorsal view of R. sanguineus female, d: Dorsal view of Hyalomma spp male, e:ventral view of Hyalomma spp, f; Heterodoxus spiniger male and female , g:Hematopinus male, h: Ctenocephalides females, i: Ctenocephalides male. Abbreviations: MP: mouth part, AA: anal plate, FH:fore head, HH: hind head, PP: pseudopenis, C:canis, F:felis, PC: pronotal comp, GC: genal comp.

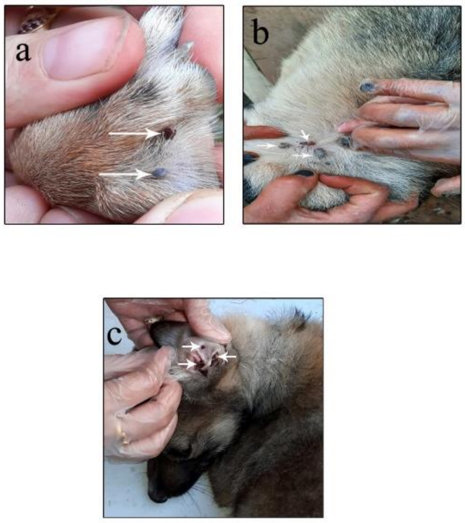

Plate 2 Distribution of R. sanguineus on different areas of dog body. a: on toe, b: on neck, c: on ear.

4. DISCUSSION

In the present study the overall infestation was (53.14%). the collected ectoparasites were ticks spp. (Rhipicephalus sanguineus), fleas spp. (Ctenocephalides felis and Ctenocephalides canis), lice spp. (Heterodoxus spriniger) and Haematopinus spp. This finding was previously recorded by other studies (Nasution et al., 2018; Abdulkareem et al., 2019; Nataraj et al., 2021; Aboelela et al 2022; Sarkar et al., 2023).

In the present study, Rhipicephalus sanguineus recorded the highest infestation percentage (98.2%). This result agreed with (Abdulkareem et al., 2019) who recorded that Rhipicephalus sanguineus was the most common tick spp. infesting dogs in Nigeria. On the contrary, (Abdullah et al., 2019) in Uk proved that Ixodes hexagonus was the common tick spp. recorded in dogs. (Saleh et al., 2019)in USK who declared that Dermacentor variabilis had the highest prevalence than the other spp. of ticks infesting dogs. Although. Male Hyalomma dromedarii was recorded to infest dogs for the first time in our current study in Egypt (1.83%) this agreed with (Zeb et al., 2023) who also found the same tick spp. on dogs in Pakistan (15.9%). In addition, several investigations have found H. dromedarii in hyenas, dogs, ostriches, reptiles, and humans (Apanaskevich et al., 2008; Shemshad et al., 2012; Guglielmone et al., 2020; Zeb et al., 2023). This may be attributed to evidence growing changes are the result of climate change, habitat disruption, and the globalization of human activity (Léger et al., 2013). Regarding fleas, Ctenocephalides canis was recorded infesting dogs with a prevalence of 51.76% which was higher than C. felis prevalence (48.24%). These results agreed with (Abuzeid, 2015) who proved that the prevalence of C. canis was higher than that of C. felis by 100 % in infested dogs in Egypt. (González et al., 2004) declared that C. canis was the only flea species found on the examined dogs in Argentina,(Klimpel et al., 2010) who showed that C. canis and C. felis infesting dogs with percentage of 39.1% and 17.4%; respectively in Brazil. However, these results disagreed with (Abdullah et al., 2019) in Nigeria and (Morariu et al., 2006) in Romania who found that C. felis was more prevalent in dogs than C. canis this difference may be due to changes in housing and population size of dogs and cats.

The prevalence of two species of sucking lice was recorded infesting dogs in the present study which were

Heterodoxus spriniger (84.46%) and Haematopinus spp. (15.54%). In this respect, (Klimpel et al., 2010)found Heterodoxus spiniger (67.4%) infesting Brazilian dogs, (González et al., 2004) found Heterodoxus spriniger by (62.9%) in Argentina, (Abuzeid, 2015)found them (46%) in Egypt, (Rao et al., 2013) get Heterodoxus spiniger infesting dogs with a percentage (43.27%) in Indian dogs. It was the first record of Haematopinus spp. (15.54%) infesting dogs in Egypt which were found accidentally in dogs as unusual hosts (Nataraj et al., 2021).

In the current study we found that stray dogs had the highest breed of infestation rate compared to other breeds (38.4%) this finding agreed with (Sarkar et al., 2023) who found stray dogs harboring the highest infested dogs (79.80%) in Tripura. This may be due to increased changes of infestation among fee dogs.

Ectoparasites infestation among dogs was observed all over the year and in different seasons in Qalyubia governate, Egypt. This observation was previously encountered by (Rinaldi et al., 2007) in Italy and (Bahrami et al., 2012) in Iran. However, summer showed the highest season of ectoparasitic infestation as previously noted by (Xhaxhiu et al., 2009) in Albania and (Sarkar et al., 2023) in Tripura. However (Hassissen et al., 2019; Kumar and Shekhar, 2020) reported that the highest prevalence of ectoparasites was in the rainy season followed by the summer season. Moreover, the peak month of ectoparasitic infestation in the current study was recorded in August and this finding agreed with (Shaw et al., 2004) in Germany. Summer which extends from June to August was the most abundant season for ectoparasites, this agreed with (Bahrami et al., 2012; Zeb et al., 2023), who proved that the most severe ectoparasite infestation was reported in June, also similar findings had been reported in Germany (Shaw et al., 2004), where the maximum month occurrence of ectoparasites in dogs was found between June and August in Italy (Rinaldi et al., 2007).

In the current study, it was recorded that male dogs were slightly higher ectoparasitic than females (27.68%, and 25.46%; respectively) without significance. This finding was consistent with prior reports by (Otranto et al., 2009; Mosallanejad et al., 2012; Kumsa et al., 2019) found no significant difference between male and female dogs by ectoparasitic infestation, this may be due to the type of housing. On the other hand, (Mosallanejad et al., 2012) established that male dogs had a higher prevalence (35.82%) than females (20.34%), and (Tadesse et al., 2019) ~~who~~ revealed a higher ectoparasites infestation in males than in females.

The single infestation by fleas was recorded to be slightly higher in male dogs (9.93%) compared with females (8.46%). This was lower than (Abuzeid, 2015) in Ismalia, who emphasized that fleas infestation is 100% in all dogs and (Mosallanejad et al., 2012) denoted ~~to~~ fleas an ectoparasite of high rate of (83%) followed by ticks. In contrast, the present result disagreed with (González et al., 2004) who ensured that ticks had the highest infestation rate (73%) than other ectoparasites. Our result revealed that the highest mixed infestation by fleas and ticks was (24.11%) in male dogs compared to females (32.31%) in this respect (Costa et al., 2013) in Brazil, reported a lower prevalence of mixed infestation by fleas and ticks 11.4%, while (González et al., 2004) found that (39.6%) of dogs had a double infestation, with ticks and fleas, this may be due to changes in rearing methods of dogs.

It was noted in the current study that dogs of 7 months to 1 year of age had a higher ectoparasite infestation (15.86%) than other ages. This finding was similar to (Sarkar et al., 2023), who declared that the highest infestation rate was noted in dogs at the age of 6 months to 1 year (79.66%), while (Abdulkareem et al., 2019; Shoorijeh et al., 2008) who mentioned that the prevalence of ectoparasite infestation was the highest in dogs aged from 1 to 6 months (9.4%) in Iran and Nigeria; respectively. The differences recorded in the present study may be attributed to the difference in dog's breeds or environmental factors.

The present study proved that dogs of black and brown color fur had the highest infestation (19.19%, 18.45%; respectively) than dogs of other fur color. This agreed with Aboelela et al. (2022), who mentioned that ectoparasites were more prevalent in dogs with dark hair in Eygptand (Bahrami et al., 2012) Iran and Iraq.

Ectoparasites were found in 57.57% of pregnant dogs and 31.25% of nursing dogs examined in the study. This finding agreed with (Wright, 2017) who emphasized the role of immunological alterations in individual animals that may influence parasitic diseases.

In this present research, it was observed that large-size canines weighing (≥ 25) kg had a higher infestation rate (24.35%) than other dogs of smaller weight. In this point, (Lefkaditis et al., 2016) found that large-size dogs are more infested by ectoparasites than small-size dogs. this may be attributed to the habit of the parasite, which leaves anemic, emaciated, and feverish animals and trans to a healthy body.

The head and neck regions were the predilection site of tick infestation recorded in this study which coincided with the results of (Bahrami et al., 2012; Thamer and Faraj, 2019) in Iraq and Iran; respectively. Mainly ectoparasites prefer this part of the body than other parts of the body because these places are difficult to reach by the animal to disturb attachment of ticks (Emmanuel et al., 2017).

5. CONCLUSIONS

It could be concluded that stray dogs were more susceptible to ectoparasites infestation than dog breeds. Fleas are more common followed by ticks, so control measures must be carried against them in dogs.

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