Research Article

Prevalence of Ectoparasites Infestation among Companion Animals in Nsukka Cultural Zone

Nneka Gladys Agu[1], Ikem Chris Okoye[1], Chigozie Godwin Nwosu[1]*, Ifeanyichukwu Onyema[2], Chijioke Nwabueze Iheagwam[3] and Toochukwu Joy Anunobi[4]

[1]*Parasitology and Public Health Unit, Department of Zoology and Environmental Biology, University of Nigeria, Nsukka, Nigeria;*
[2]*Department of Veterinary Pathology and Microbiology, Faculty of Veterinary Medicine, University of Nigeria, Nsukka, Nigeria;*
[3]*Department of Veterinary Parasitology and Entomology, Faculty of Veterinary Medicine, University of Nigeria, Nsukka, Nigeria;*
[4]*Department of Science Laboratory Technology, School of Technology, Federal Polytechnic, Idah, Nigeria*

Corresponding author:
Chigozie Godwin Nwosu, Parasitology and Public Health Unit, Department of Zoology and Environmental Biology, University of Nigeria,
E-mail: gozzynwosu@gmail.com

Abstract

A study on ectoparasites of companion animals in Nsukka cultural zone was undertaken to investigate their prevalence on the animals within the area. Four major markets in the study area, 20 households in each community as well as the Veterinary Teaching Hospital of University of Nigeria Nsukka were sampled. A total of 420 dogs and 72 cats were examined for ectoparasites. Purposive sampling was used to select the markets, communities and households. The animals were examined for ectoparasites and identification was made using standard procedures and stereomicroscopy. From the result, 203 dogs and 12 cats had infestation of ectoparasites with significant ($p<0.05$) prevalence of 48.3% and 16.7% respectively. The exotic, males and adult dogs had more ectoparasites prevalence when compared with their counterparts. Conversely, all the cats infested were locals, females and of younger ages. The ectoparasites of dogs recovered include ticks (40.7%), fleas (6.7%), mites (0.7%) and lice (0.2%). All the cats were infested with fleas (16.7%). The most prevalent tick species found was *Rhipicephalus sanguineus* (37.6%) while the least was *Argas* spp (0.2%). The fleas are *Ctenocephalides canis* (6.0%), *C. felis* (0.5%) and *Diamanus mortanus* (0.2%). The mite species was *Sarcoptes scarbiei var canis* (0.7%). In conclusion, the high ectoparasite prevalence in the pets suggests that these parasites can lead to public health issues. The study therefore recommends prompt education of the populace within the study area on the need for scaled up healthy and hygienic practices so as to prevent transmission of zoonotic diseases by the animals.

Keywords: Prevalence; Ectoparasites; Infestation; Dogs; Cats; Nsukka Cultural Zone

Introduction

Ectoparasites are parasites that live on the surface of the host. They play a role in the transmission of a variety of diseases and cause hypersensitivity disorders in both animals and humans. Ectoparasites are common on dogs and cats, and can cause pruritic and non-pruritic skin disorders in dog and cats. [1] They also may cause life-threatening anaemia in young or weakened animals. [2] Studies have shown that ectoparasites infestation is common in animals such as dogs, cats, goats, chicken, pig etc. [3,4] Thus, ectoparasites which are mainly arthropods live as blood-sucking parasites on domestic dogs and cats causing severe dermatitis. [5,6] Cats and dogs are the most commonly owned companion animals worldwide. For instance, 60% - 70% of households in America own at least one companion animal. [7] In Nigeria, many families own dogs and cats. Dogs are kept for guarding, hunting or as pets, especially in large towns; while cats are kept for hunting house rodents. [8] Ectoparasitism presents adverse impact on domestic animals especially dogs and cats. [9,10] Ectoparasites infestation causes a serious loss in health and economy. They can cause annoyance, irritation, skin infection, anaemia, tick fever as well as act as a vector for various devastating diseases. There is paucity of information on ectoparasites infesting dogs and cats in Nsukka. This work therefore provides baseline data on the prevalence of ectoparasites infestation of dogs and cats in Nsukka Cultural Zone.

Materials and Methods

Study area

Geographically, Nsukka has coordinate location at 6°51"24'N 7°23"45'E. Nsukka cultural zone comprises seven (7) Local Government Areas: Igbo-Eze North, Igbo-Eze South, Udenu, Igbo-Etiti, Isi-Uzo, Nsukka, and Uzo-Uwani. Nsukka vegetation is mainly of the rainforest with trees and mountains surrounding it. Nsukka shares the northern climate which is mainly of cool weather throughout the year and especially during the rainy season.

Study design

The study adopted a cross-sectional survey design. From each

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Local Government Area, one major market and one community were included in the study. Inclusion criteria for household recruitment were: Ownership of dogs and/or cat, and consent to examine the dogs/cats. Also, University of Nigeria Nsukka Veterinary Teaching Hospital was visited for sample collection from dogs brought to the hospital for treatment. Purposive sampling method was employed in the selection of the study communities that were sampled. All Cat and/or dog owning households within the selected communities were included in the study. Major markets sampled were Ibagwa-Nkwo, Obollo-Afor, Eke-Ozi and Orba markets. Communities sampled were Aku (in Igbo-Etiti LGA), Ibagwa (in Igboeze-South LGA), Obukpa (in Nsukka LGA), Enugu-Ezike (in Igboeze-North LGA) and Adaba (in Uzo-Uwani LGA).

Examination of companion animals for ectoparasites

Pet owners' consent for examination of pets was obtained, and were further educated on the risk involving ectoparasite infestation. Animals were restrained by using a mouth guard to cover the mouth of the animals in order to avoid animal bite. Cats and dogs were thoroughly examined for the presence of ectoparasites during regular examinations that lasted for six (6) days per month. The host skin and fur were brushed with a fine comb after being rubbed with ether soaked in a piece of cotton. [11] Blunt forceps were used to remove live ticks if present on the animals; while fleas and lice were brushed off the animals' fur onto white paper using a brush and plastic comb. All the body regions of the animals were combed beginning from the head, neck, dorsum, truck, limb and tails. Ear and nose openings were also examined for ectoparasites. All animals were assigned a number prior to parasite examination.

Preservation and identification of ectoparasites

All ectoparasites collected were preserved in a solution of 70% ethanol and transported to the University of Nigeria Parasitology and Public Health Laboratory in a container for analysis. Within the laboratory, the samples were emptied into Petri dishes; lactophenol was added for clearance. The parasite numbers were determined and recorded. For species level identification, these parasites were mounted using polyvinyl alcohol unto clean glass slides under cover slips. Upon drying of the mountant on day 3, the slides were examined at 40x magnification of the light microscope. All transported parasites were properly identified under a stereomicroscope according to the standard morphological identification keys as described. [12-14] Parasites identified were counted and recorded according to the body regions of the animals from where the parasites were collected.

Statistical analysis

Data collected in this survey were entered into Microsoft Excel sheets and all statistical analyses carried out using Statistical Package for Social Science (SPSS Inc., Chicago, IL, USA) software version 20.0. The Chi-square (χ^2) test was used to determine differences in prevalence of ectoparasites between parasites species that were recorded by testing the association between categorical variables. Differences in values were statistically significant at $p<0.05$ (95% confidence interval).

Results and Discussion

Prevalence of ectoparasite infestation of companion Animals in Nsukka Cultural Zone

The overall prevalence of ectoparasite infestation of companion or pet animals in the study area is presented on Table 1. It was observed that 203 dogs were infested with ectoparasite out of the 420 dogs examined. Also, infested cats were 12 out of the 72 examined. The result revealed that the infestation prevalence of ectoparasite in dogs is 48.3%, while that of cats is 16.7%. The prevalence of ectoparasite infestation for both the dogs and cats were significant ($p<0.0001$) when compared with their non-infested counterparts.

The overall prevalence of ectoparasite infestation of companion or pet animals in Nsukka cultural zone according to sex, age and breed are presented on Tables 2, 3 and 4 respectively. Among the dogs examined, it was observed that there were no significant ($p \geq 0.05$) differences in prevalence in relation to sex [Table 2]. However, the cats showed significant ($p<0.05$) differences in sex prevalence (χ^2=11.520, df=1, p=0.001). Ectoparasite was more prevalent among the male dogs and female cats. In relation to age, the dogs showed non-significant ($p \geq 0.05$) differences in prevalence, while the cats were all young [Table 3]. However, adult dogs had more ectoparasite infestation than the young dogs. There were significant ($p<0.05$) differences in the prevalence of ectoparasite among the dog breeds (χ^2=10.512,

Table 1: Overall prevalence of ectoparasites of pet animals in Nsukka Cultural Zone.

Animal	No. Examined	No. Infested	Prevalence (%)	No. Non-infested (%)	χ^2	*p*-value
Dogs	420	203	48.3	217 (51.7)	420.000	0.0001
Cats	72	12	16.7	60 (83.3)	72.000	0.0001

Significant difference at $p<0.05$

Table 2: Overall prevalence of ectoparasite infestation of pet animals in Nsukka Cultural Zone according to sex.

Animal	Sex	Prevalence (%)	Non-Infested (%)	Total (%)
Dogs	Males	100 (50.0)	100 (50.0)	200 (47.6)
	Females	103 (46.8)	117 (53.2)	220 (52.4)
	Total	203 (48.3)	217 (51.7)	420 (100.0)
		χ^2=0.425, *df*=1, p=0.515		
Cats	Males	0 (0.0)	32 (100.0)	32 (44.4)
	Females	12 (30.0)	28 (70.0)	40 (55.6)
	Total	12 (16.7)	60 (83.3)	72 (100.0)
		χ^2=11.520, *df*=1, p=0.001		

Significant difference at $p<0.05$

Table 3: Overall prevalence of ectoparasite infestation of pet animals in Nsukka Cultural Zone according to age.

Animal	Age	Prevalence (%)	Non-Infested (%)	Total (%)
Dogs	Young	113 (47.7)	124 (52.3)	273 (56.4)
	Adults	90 (49.2)	93 (50.8)	183 (43.6)
	Total	203 (48.3)	217 (51.7)	420 (100.0)
		χ^2=0.093, *df*=1, p=0.760		
Cats	Young	12 (16.7)	60 (83.3)	72 (100.0)
	Total	12 (16.7)	60 (83.3)	72 (100.0)

Significant difference at $p<0.05$

df=2, p=0.005). The exotic breed was the most prevalent group that was infested with ectoparasite among dogs, whereas all the cats were local breed [Table 4].

The comparison of sex, age, and breed-related prevalence of ectoparasite infestation between the companion or pet animals in Nsukka cultural zone are presented on Tables 5, 6 and 7 respectively. From the result, it was observed that the dogs had significantly (p<0.05) more ectoparasite prevalence than the cats both among the males and females [Table 5]. Similarly, the age-related prevalence showed that young dogs had higher prevalence of ectoparasite infestation than the young cats (χ^2=22.049, df=1, p<0.0001). Also, the adult pet animals were all dogs [Table 6]. In relation to breed, there was significant (p<0.05) difference in the prevalence of ectoparasite, the dogs were presented with higher infestation prevalence than the cats. However, this was observed only for the local breed (χ^2=21.030, df=1, p<0.0001). None of the sampled cats were of exotic or hybrid breed [Table 7].

Table 8 showed the prevalence of ectoparasite infestation of companion or pet animals in Nsukka cultural zone according to the studied markets. Among the dogs, there were significant (p<0.05) differences in the ectoparasite prevalence of the difference markets studied (χ^2=8.320, df=3, p=0.040). The ectoparasite was most prevalent among dogs examined at Orba (40, 80.0%) and least at Obollo Afor (36, 55.4%). The cats' ectoparasites were recovered at Nkwo Ibagwa [Table 8].

Table 9 showed the prevalence of ectoparasite infestation of companion or pet animals in Nsukka cultural zone according to the studied markets. There were no significant ($p \geq 0.05$) differences in the ectoparasite prevalence among the dogs of the difference Local Government Areas studied (χ^2=7.539, df=4, p=0.110). Although, the result recorded highest prevalence for ectoparasite among dogs examined at Uzo-Uwani (10, 31.2%) and least at Igbo-Etiti (2, 7.7%). No cats' ectoparasites were recovered from the Local Government Areas sampled in the present study [Table 9].

Ectoparasite species prevalence among companion animals in Nsukka Cultural Zone

The prevalence of the different parasites species infestation of the companion or pet animals in the study area is presented on Table 10. From the result, ticks, fleas, mites and lice were recovered from the dogs. The cats were infested with fleas. The dogs' ectoparasites species infestation varied significantly (χ^2=182.470, df=9, p<0.0001). It was observed from the result that *Rhipicephalus sanguineus* was the most prevalent (158, 37.6%) ectoparasite species recovered from the dogs and

Table 4: Overall prevalence of ectoparasite infestation of pet animals in Nsukka Cultural Zone according to breed.

Animal	Breed	Prevalence (%)	Non-Infested (%)	Total (%)
Dogs	Exotic	23 (76.7)	7 (23.3)	30 (7.1)
	Local	160 (45.8)	189 (54.2)	349 (83.1)
	Hybrid	20 (48.8)	21 (51.2)	41 (9.8)
	Total	203 (48.3)	217 (51.7)	420 (100.0)
		χ^2=10.512, *df*=2, p=0.005		
Cats	Local	12 (16.7)	60 (83.3)	72 (100.0)
	Total	12 (16.7)	60 (83.3)	72 (100.0)

Significant difference at p<0.05

Table 5: Sex-related prevalence of ectoparasite infestation between the pet animals in Nsukka Cultural Zone.

Sex	Animals	Prevalence (%)	Non-Infested (%)	Total (%)
Males	Dogs	100 (50.0)	100 (50.0)	200 (86.2)
	Cats	0 (0.0)	32 (100.0)	32 (13.8)
	Total	100 (43.1)	132 (56.9)	232 (100.0)
		χ^2=28.121, *df*=1, p<0.0001		
Females	Dogs	103 (46.8)	117 (53.2)	220 (84.6)
	Cats	12 (30.0)	28 (70.0)	40 (15.4)
	Total	115 (44.2)	145 (55.8)	260 (100.0)
		χ^2=3.881, *df*=1, p=0.049		

Significant difference at p<0.05

Table 6: Age-related prevalence of ectoparasite infestation between the pet animals in Nsukka Cultural Zone.

Age	Animals	Prevalence (%)	Non-Infested (%)	Total (%)
Young	Dogs	113 (47.7)	124 (52.3)	237 (76.7)
	Cats	12 (16.7)	60 (83.3)	72 (23.3)
	Total	125 (40.5)	184 (59.5)	309 (100.0)
		χ^2=22.049, *df*=1, p<0.0001		
Adults	Dogs	90 (49.2)	93 (50.8)	183 (100.0)
	Total	90 (49.2)	93 (50.8)	183 (100.0)

Significant difference at p<0.05

Table 7: Breed-related prevalence of ectoparasite infestation between the pet animals in Nsukka Cultural Zone.

Breed	Animals	Prevalence (%)	Non-Infested (%)	Total (%)
Exotic	Dogs	23 (76.7)	7 (23.3)	30 (100.0)
	Total	23 (76.7)	7 (23.3)	30 (100.0)
Local	Dogs	160 (45.8)	189 (54.2)	349 (82.9)
	Cats	12 (16.7)	60 (83.3)	72 (17.1)
	Total	172 (40.9)	249 (59.1)	421 (100.0)
		χ^2=21.030, *df*=1, p<0.0001		
Hybrid	Dogs	20 (48.8)	21 (51.2)	41 (100.0)
	Total	20 (48.8)	21 (51.2)	41 (100.0)

Significant difference at $p<0.05$

Table 8: Prevalence of ectoparasite of infested pet animals in Nsukka Cultural Zone according to studied markets.

Animal	Markets	Prevalence (%)	Non-Infested (%)	Total (%)
Dogs	Nkwo Ibagwa	60 (70.6)	25 (29.4)	85 (32.7)
	Orba	40 (80.0)	10 (20.0)	50 (19.2)
	Eke Ozi	40 (66.7)	20 (33.3)	60 (23.1)
	Obollo Afor	36 (55.4)	29 (44.6)	65 (25.0)
	Total	176 (67.7)	84 (32.3)	260 (100.0)
		χ^2=8.320, *df*=3, p=0.040		
Cats	Nkwo Ibagwa	12 (24.0)	38 (76.0)	50 (100.0)
	Total	12 (24.0)	38 (76.0)	50 (100.0)

Significant difference at $p<0.05$

Table 9: Prevalence of ectoparasite infestation of pet animals in Nsukka Cultural Zone according to the studied Local Government Areas.

Animal	LGAs	Prevalence (%)	Non-Infested (%)	Total (%)
Dogs	Nsukka	5 (16.7)	25 (83.3)	30 (18.8)
	Uzo-Uwani	10 (31.2)	22 (68.8)	32 (20.0)
	Igbo-Etiti	2 (7.7)	24 (92.3)	26 (16.2)
	Igbo-Eze North	5 (13.9)	31 (86.1)	36 (22.5)
	Igbo-Eze South	4 (11.1)	32 (88.9)	36 (22.5)
	Total	26 (16.2)	134 (83.8)	160 (100.0)
		χ^2=7.539, *df*=4, p=0.110		
Cats	Uzo-Uwani	0 (0.0)	8 (100.0)	8 (100.0)
	Igbo-Etiti	0 (0.0)	14 (100.0)	14 (100.0)
	Total	0 (0.0)	22 (100.0)	22 (100.0)

Significant difference at $p<0.05$

Table 10: Prevalence of parasites species infestation of pet animals in Nsukka Cultural Zone.

Animal	Ectoparasite	Parasites Species	Number Recovered	Infestation (%)	Prevalence (%)
Dogs	Ticks	*Rhipicephalus sanguineus*	158	77.8	37.6
		Amblyoma hebraeum	5	2.5	1.2
		Ixodes ricinus	3	1.5	0.7
		Haemaphysalis leachi leachi	4	2.0	1.0
		Argas spp	1	0.5	0.2
		Total	171	84.2	40.7
	Fleas	*Ctenocephalides canis*	25	12.3	6.0
		Ctenocephalides felis	2	1.0	0.5
		Diamanus montanus	1	0.5	0.2
		Total	28	13.8	6.7
	Mites	*Sarcoptes scarbiei var canis*	3	1.5	0.7
	Lice	*Linognathus setosus*	1	0.5	0.2
					χ^2=182.470, *df*=9, p<0.0001
Cats	Fleas	*Ctenocephalides felis*	12	100.0	16.7
	Others	Ticks/mites/lice	0	0.0	0.0
					χ^2=72.000, *df*=1, p<0.0001

Significant difference at $p<0.05$

was significantly (p<0.05) higher than the rest of recovered ectoparasites species. The ectoparasite, *Ctenocephalides canis* was observed to be second in prevalence (25, 6.0%), while the least prevalent ectoparasites were *Argas* spp (1, 0.2%), Diamanus montanus (1, 0.2%), and *Linognathus setosus* (1, 0.2%). *Ctenocephalides felis* infestation 12 (16.7%) was the only prevalent ectoparasite species in cats [Table 10].

Table 11 showed the prevalence of ectoparasite species infestation of companion or pet animals in Nsukka Cultural Zone according to the studied markets. From the result, there were significant (p<0.05) differences in the ectoparasite prevalence (χ^2=53.801, df=30, p=0.005). It was observed that on the overall, *R. sanguineus* (158, 73.5%) was the most prevalent ectoparasite recovered in this study. This was followed by *C. canis* (25, 11.6%). The least are the trio of *Argas* sp, *D. montanus*, and *L. setosus* with prevalence of 1 (0.5%) each. Majority of the ectoparasites were recovered at Nkwo Ibagwa [Table 11].

The prevalence of ectoparasite species infestation of companion or pet *animals* in Nsukka Cultural Zone according to the studied Local Government Areas is presented on Table 12. From the result, there were significant (p<0.05) differences in the ectoparasite prevalence (χ^2=53.132, df=36, p=0.033). It was observed that on the overall, *R. sanguineus* (158, 78.2%) was the most prevalent ectoparasite recovered in this study. This was followed by *C. canis* (25, 12.3%). The least are the trio of *Argas* sp, *D. montanus*, and *L. setosus* with prevalence of 1 (0.5%) each. Majority of the ectoparasites were recovered at Igbo-Etiti Local Government Area, although Uzo-Uwani Local Government Area had most ectoparasites' species [Table 12].

Prevalence of ectoparasite infestation of companion animals in Nsukka Cultural Zone

The overall prevalence of ectoparasite in dogs was 203 (48.3%), while that of cats was 12 (16.7%). The infestation status for both

Table 11: Prevalence of ectoparasite species infestation of pet animals in Nsukka Cultural Zone according to the studied markets.

Ectoparasites Species	Market (%)				
	Nkwo Ibagwa	Orba	Eke Ozi	Obollo Afor	Total
R. sanguineus	80 (50.6)	20 (12.7)	28 (17.7)	30 (19.0)	158 (73.5)
A. hebraeum	2 (40.0)	3 (60.0)	0 (0.0)	0 (0.0)	5 (2.3)
I. ricinus	0 (0.0)	0 (0.0)	3 (1.4)	0 (0.0)	3 (1.4)
H. leachi leachi	2 (50.0)	2 (50.0)	0 (0.0)	0 (0.0)	4 (1.9)
Argas spp	1 (0.5)	0 (0.0)	0 (0.0)	0 (0.0)	1 (0.5)
C. canis	10 (40.0)	5 (20.0)	2 (8.0)	8 (32.0)	25 (11.6)
C. felis	0 (0.0)	1 (50.0)	0 (0.0)	1 (50.0)	2 (0.9)
D. montanus	0 (0.0)	1 (100.0)	0 (0.0)	0 (0.0)	1 (0.5)
S. scarbiei var canis	2 (66.7)	1 (33.3)	0 (0.0)	0 (0.0)	3 (1.4)
L. setosus	1 (100.0)	0 (0.0)	0 (0.0)	0 (0.0)	1 (0.5)
*C. felis***	12 (100.0)	0 (0.0)	0 (0.0)	0 (0.0)	12 (5.6)
Total	110 (51.3)	33 (15.3)	33 (15.3)	39 (18.1)	215 (100.0)

χ^2=53.801, *df*=30, p=0.005

R. sanguineus, *Rhipicephalus sanguineus*; ***A. hebraeum***, *Amblyoma hebraeum*; ***I. ricinus***, *Ixodes ricinus*; ***H. leachi leachi***, *Haemaphysalis leachi leachi*; ***Argas* spp**, *Argas* species; ***C. canis***, *Ctenocephalides canis*; ***C. felis***, *Ctenocephalides felis*; ***D. montanus***, *Diamanus montanus*; ***S. scarbiei var canis***, *Sarcoptes scarbiei var canis*; ***L. setosus***, *Linognathus setosus*.
Ectoparasite in Cats**
Significant difference at p<0.05

Table 12: Prevalence of ectoparasite species infestation of pet animals in Nsukka Cultural Zone according to the studied Local Government Areas.

Ectoparasite Species	LGAs (%)					
	Nsukka	Uzo-Uwani	Igbo-Etiti	Igbo-Eze North	Igbo-Eze South	Total
R. sanguineus	30 (19.0)	20 (12.7)	50 (31.6)	50 (31.6)	8 (5.1)	158 (78.2)
A. hebraeum	1 (20.0)	2 (40.0)	0 (0.0)	2 (40.0)	0 (0.0)	5 (2.5)
I. ricinus	1 (33.3)	1 (33.3)	1 (33.3)	0 (0.0)	0 (0.0)	3 (1.5)
H. leachi leachi	1 (25.0)	2 (50.0)	1 (25.0)	0 (0.0)	0 (0.0)	4 (2.0)
Argas spp	0 (0.0)	1 (100.0)	0 (0.0)	0 (0.0)	0 (0.0)	1 (0.5)
C. canis	10 (40.0)	2 (8.0)	5 (20.0)	3 (12.0)	5 (20.0)	25 (12.3)
C. felis	1 (50.0)	0 (0.0)	1 (50.0)	0 (0.0)	0 (0.0)	2 (1.0)
D. montanus	0 (0.0)	1 (0.5)	0 (0.0)	0 (0.0)	0 (0.0)	1 (0.5)
S. scarbiei var canis	0 (0.0)	2 (66.7)	1 (33.3)	0 (0.0)	0 (0.0)	3 (1.5)
L. setosus	0 (0.0)	1 (0.5)	0 (0.0)	0 (0.0)	0 (0.0)	1 (0.5)
Total	44 (21.7)	32 (15.8)	59 (29.1)	55 (27.1)	13 (6.4)	203 (100.0)

χ^2=53.132, *df*=36, p=0.033

R. sanguineus, *Rhipicephalus sanguineus*; ***A. hebraeum***, *Amblyoma hebraeum*; ***I. ricinus***, *Ixodes ricinus*; ***H. leachi leachi***, *Haemaphysalis leachi leachi*; ***Argas* spp**, *Argas* species; ***C. canis***, *Ctenocephalides canis*; ***C. felis***, *Ctenocephalides felis*; ***D. montanus***, *Diamanus montanus*; ***S. scarbiei var canis***, *Sarcoptes scarbiei var canis*; ***L. setosus***, *Linognathus setosus*.
Ectoparasite in Cats**
Significant difference at p<0.05

animals was observed to be significant ($p<0.05$) when compared with the non-infested counterparts. According to other findings in Iran and in Nigeria, dogs and cats can be reservoirs for ectoparasites. [15-17] These high prevalences especially among the dogs suggest that these ectoparasites are very common and present most important and frequently encountered dermatologic problems with regard to the health, use and performances of these companion animals in the study area. Higher prevalences to the present study have been documented in southern Ethiopia, [2] amongst dogs (99.5%) and cats (91.0%). It also agrees with reports from elsewhere in the world. [1,18-20] Further works on companion dogs' ectoparasites reported higher prevalences of 98.5%, 70.4%, 79.0% and 88.6% respectively. [21-24] However, lower prevalences of dogs' ectoparasites of 43.75%, 44.3%, and 28.57% had also been reported by earlier researchers respectively. [25-27] The higher prevalence of ectoparasite recorded on dogs than on cats in the present study, which agrees with the work of Kumsa and Mekonnen [2] could be traceable to the more efficient grooming behaviour of cats as most probable as suggested by Eckstein and Hart. [28,29]

All the cats infested with ectoparasites were females ($p<0.05$, Table 2). The ectoparasite prevalence was more among the male dogs, although was not statistically significant ($p \geq 0.05$). Thus, slightly greater susceptibility to ectoparasite infestation was observed among male dogs than the female dogs. The present study contradicts reports from other researchers that the female dogs are more susceptible to ectoparasite infestation. [22,24,29] However, our work is consistent with previous studies [27,30-32] that found the prevalence of ectoparasites to be more frequent among male dogs than females without significant difference. They argued that both sexes are susceptible to the infestation of ectoparasites. This had been opined earlier that gender generally does not play a major role in susceptibility to parasitic infections in dogs. [33] Besides, differences in findings may be related to the characteristics of the population studied, which could be either predominantly males or females. [32]

The adult dogs were non-significantly ($p \geq 0.05$) higher than the younger dogs in ectoparasite infestation prevalence, whereas for the cats, they were all of young ages. Our finding is incoherent with earlier reports from other researchers [2,22,24,32] that opined that the younger animals are more susceptible to ectoparasites than the older pets of their kind. The slightly higher prevalence of ectoparasites among the adult dogs than the young dogs could be as a result of access to outdoors and mixing with other animals. However, considering the high prevalence of ectoparasites among the young animals, which is comparable with that of the adult, we partly agree that factors such as confinement to houses leading to greater exposure to ectoparasites re-infestation as well as less efficient grooming behaviour than adults [28] could predispose young animals to high risk of ectoparasite susceptibility. Additionally, older animals may acquire immunity overtime, whereas the young ones appear to be most susceptible to the ectoparasites being immunologically naïve.

The exotic breed of dogs examined showed higher ectoparasite infestation prevalence than their counterparts. This might be related to poor management of these exotic species of dogs by their owners as most probable. By this we mean poor treatment attitude and practices of the pet owners. Furthermore, inactivity from confinement could make these exotic dogs to be less efficient in grooming behaviour [28] with high risk of re-infestation especially when poorly managed. The local dogs were the least infested, which probably explains greater adaptability to ectoparasites by their effective grooming behaviour and activity even with little or no good management. All the examined cats in the present study were of local breed. The present study is not consistent with earlier report [24] that overall prevalence rate of ectoparasites in breed data showed that local breeds were affected more than cross breed dogs.

Ectoparasite species prevalence among companion animals in Nsukka Cultural Zone

Ectoparasites of dogs recovered were ticks, fleas, mites and lice. Fleas were the only ectoparasites recovered from the cats examined. In the overall, the ectoparasite species recorded highest was *Rhipicephalus sanguineus* (37.6%), followed by *Ctenocephalides canis* (6.0%) for dogs, whereas the cats were exclusively infested with *Ctenocephalides felis* (16.7%). In relation to locations, *R. sanguineus* was most prevalent in Nkwo Ibagwa market (80, 50.6%), and Igbo-Etiti and/or Igbo-Eze North Local Government Areas (50, 31.6%). The present study showed that ticks were the most abundant ectoparasites, followed by fleas. This corroborates the work of Troyo et al. [34] that reported *Rhipicephalus sanguineus* as the most common tick recovered, which also agrees with previous reports. [26,35,36]

There are two species of fleas that have been mostly recognized including *Ctenocephalides canis* and *Ctenocephalides felis*, which is in agreement with other studies. [15,16] These fleas have been found to be the predominant species parasitizing dogs and cats in several studies conducted in the United Kingdom. [26,37] In relation to the ectoparasites of cats, the present study is consistent with earlier studies that found *Ctenocephalides felis* as the most prevalent species in cats. [1,2,23] On the overall *Ctenocephalides felis* recorded in this study was the second most abundant flea recovered which agrees with the findings of Bahrami et al. [38] However, the present work is not in agreement with previous reports that implicated *Ctenocephalides felis* as the most common ectoparasite amongst both animal groups. [19,20,39-41] These differences in research reports may be attributed to several factors such as variations in agroecology, time of study, weather, seasonal variations, geographical location, intrinsic resistance, animal management and particularly the age of the animals examined. Hence, this discrepancy is not easy to explain, however ecological, environmental and epidemiological factors relating to urban or rural ways of life might play a role. Nonetheless more studies are pivotal in order to understand the biology of these ectoparasite species, as well as their geographical distribution trends. [32]

Conclusion

The present study identified high prevalence of ectoparasites

amongst two common pet animals, with the dogs having more prevalence of ectoparasites infestation than cats. The male, adult and exotic dogs were presented with more ectoparasites prevalences when compared with their counterparts. All the cats infested were females, locals and of younger ages when compared with their non-infested counterparts. Ticks were the most abundant ectoparasites, followed by fleas. *Rhipicephalus sanguineus* is the most common tick among dogs, and most prevalent in Nkwo Ibagwa market, followed by Igbo-Etiti and/or Igbo-Eze North Local Government Areas, while *Ctenocephalides felis* is the flea exclusively found in cats.

Competing Interests

The authors declare that they have no competing interests. All the listed authors contributed significantly to the conception and design of study, acquisition, analysis, and interpretation of data and drafting of the manuscript, to justify authorship.

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