STUDIES ON DOG POPULATION IN MAKURDI, NIGERIA (II): A SURVEY OF ECTOPARASITE INFESTATION AND ITS PUBLIC HEALTH IMPLICATIONS.

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ABSTRACT
This study investigated the current status of dog infestation by ectoparasites, compared infestation between stray and restricted dogs and investigated some beliefs and practices by dog owners in Makurdi. Ectoparasites were collected using the body brushing and hand-picking methods and identified by standard methods. Dog owners' attitude and perceptions were investigated using structured questionnaires. The prevalence of infestation with ectoparasites among male dogs was 31.5%, though this rate was higher when compared with female dogs that had infestation rate of 23.5%. The difference was not statistically significant ($X^2 = 11.4$, df = 1, P > 0.05). Male dogs accounted for 57.8% of the total ectoparasites collected during this study. Stray dogs accounted for 56% of total dogs examined during this study and 58.3% of the ectoparasites were recovered from them. The infestation rates between stray and restricted dogs was statistically significant ($X^2 = 14$, df =1, P<0.05). The relative abundance of Rhipicephalus species (53.5%) was statistically highest. Other species of ticks encountered were Boophilus (31.4%) and Amblyomma (8.4%). Lice and fleas recovered from the dogs during this study belong to Linognathus and Ctenocephalis species respectively. Of the dog-borne disease listed, rabies was the most frequently mentioned by 56% of respondents while only 5.2% mentioned tick infestation as potential health risk to dogs and humans. Bathing dogs with brush, soap and detergents (59.6%) was the most popular method of cleaning dogs in Makurdi. This study demonstrated that several dog owners in Makurdi do not have the adequate dog-care information that will protect the health of their pets and safe-guard human health.

***Key words**: Ectoparasites infestation, Dogs, Zoonotic implications, Prevalence, Makurdi.*

INTRODUCTION

Many arthropods such as ixodid ticks, fleas and lice live as blood sucking ectoparasites on dogs causing severe dermatitis and also act as vectors of various microorganisms. Some of these microorganisms are capable of causing severe disease conditions in dogs, other domestic animals and in humans. In Nigeria, several studies on the ectoparasites of dogs have shown that infestation by ticks, lice and fleas is extremely widespread (Ugochukwu and Nnadozie 1985, Etim *et al.*, 1996, James-Rugu and Iwuala, 1998, James-Rugu 2000, Omudu *et al.*, 2006, Omudu *et al.*, 2007, Agbolade *et al.*, 2008). Other parts of Africa and the world have also been reporting heavy dogs infestations with ectoparasites (Kietzmann 1987, Bryson *et al.*, 2000, Gonzalez *et al.*, 2004, Durdeen *et al.*, 2005, Nithikathkul *et al.*, 2005, Jeong-Hung *et al.*, 2008). Though the prevalence of infestation differs markedly between the studies, the clinical consequences resulting from damage to skin by vesication, irritation, invasion of tissue and stimulation of allergic responses are common.

There has been an increasing interest amongst residents of Makurdi metropolis to keep dogs as pets and/or security alert; this has consequently increased the population of dogs roaming the streets (Omudu and Amuta 2007). However, the prevailing socio-economic conditions have made it difficult to many dog owners to adequately provide food, shelter and basic health needs for their dogs. The dogs are therefore left to scavenge for

food on the streets thereby increasing interactions amongst themselves and increasing the risk of ectoparasites infestation. The burden of ectoparasites on dogs belonging to resource -poor communities and affluent communities has been a subject of research interest in many parts of the world (Eckersley *et al.*, 1992, Hohn *et al.*, 1992, Bryson *et al.*, 2000).
Studies on dog infestations by ectoparasites in Nigeria have not attempted to link the burden of infestation to socio-economic status of owners. There is however a need to investigate demographic characteristics of dog owners and whether these characteristics influence the burden of external and internal parasites coupled with malnutrition. Studies of this nature are critical to ensuring more responsible pet ownership.

The objectives of this current study were to investigate the current status of dog infestation by ectoparasites, compare infestation between stray dogs and restricted and/or well-cared-for dogs in Makurdi, Nigeria, and investigate some demographic characteristics of dog owners and how these influence their pet-keeping attitudes and practices.

MATERIALS AND METHODS

Study Area

Makurdi, the capital of Benue State, Nigeria, is fast becoming a metropolitan centre with attendant health, social, housing and environmental problems. The town lies between latitude $7^0 15'$ $7^0 45'$N and longitude $8^0 15$ - $8^0 40'$E. The town lies in the guinea savanna vegetative belt and on the bank of the second largest river in Nigeria, River Benue. The river divides the town into North and South banks and the town covers an area of $16km^2$. The river constitutes the main source of water supply for the inhabitants of the town. The sudden influx of commercial and developmental activities that resulted from rapid urbanization has side-lined many indigenous people and urban migrants, consequently, the populations of poorer residential areas such as Wadata, Wurukum and North bank are beginning to swell. These areas were selected for this study because of high human population density and number of dogs sighted on the streets during our advocacy visits. In addition to these areas, High Level and Low Levels areas of the town were included as more affluent residential areas. The housing and sanitary conditions of these settlements have previously been described by Omudu and Amuta (2007).

Advocacy visits and recruitment of participants

Pre-survey visits were made to identify premises with dog(s), to interact with residents and obtain their consent to participate in the study. Consent was obtained through verbal acceptance to participate in the study by responding to questions and making their dogs available for examination. Appointment was booked with consenting dog owners to make themselves and their dogs available for questioning and examination respectively. Premises selected for the study were marked during the pre-survey visits and asigned identification codes.

Interviews and Questionnaire Administration

Using semi-structured questionnaire, interviews were conducted with dog owners to investigate prevailing attitude and perception of pet ownership and responsibilities of pet owners. Based on the descriptive information obtained from these interviews, a structured questionnaire was developed. It included 10 questions on reasons for keeping dogs, knowledge of dog-borne diseases, presence or absence of ticks and methods of tick control and medical history of dogs. The questionnaire was administered in the premises of the dog owners with the dog available for examination afterwards.

Physical examination of dogs for Ectoparasites

Ectoparasites were collected from dogs with the assistance of dog owners. Ticks were collected using the hand picking and hair brushing methods (James-Rugu, 2000). The entire animal's body was inspected and brushed with special attention paid to the ears, the area around the eyes, the axillae and the groin and other anatomical areas of the dogs as recommended by (Shah-Fischer and Say, 1989, Bryson *et al.*, 2000). Fleas, mites and lice were collected by combing and brushing the dog's entire body surface onto a white cloth dipped in formalin to prevent fleas from jumping and mites and lice from creeping away (Wentworth 1988).

Preservation and Identification:

Ectoparasites collected were transferred to the laboratory in clearly labeled specimen bottles containing 70% alcohol. The sex and breed of the dog from which the parasites were collected was noted and recorded on each specimen bottle. Ticks, lice, mites and fleas were identified using the keys and illustrations in Shah-Fischer and Say (1989) and Wentworth (1988).

Data Analysis

Data was analysed using simple percentages and these were tested for significance using Chi square. Questionnaire was analysed using SPSS computer package analysing responses by location.

RESULTS

One hundred and eighteen (27.8%) of the 425 dogs examined had one or more ectoparasitic arthropods. The highest infestation rate of 38.0% was recorded in the High Level area of the town (Table 1). A total of 379 ectoparasites were recovered from dogs examined and ticks accounted for 93.4%, lice 5.5% and fleas 1.1% respectively (Table 1). The prevalence of ectoparasites among male and female dogs were 31.5% and 23.5% respectively. The difference was not statistically significant (X^2 = 11.4, df = 1, $P > 0.05$). Male dogs accounted for 57.8% of the total ectoparasites collected during this study (Table 2).

The distribution of ectoparasites according to the age-group of the dogs showed no specific preference to a particular age category. However, 119 (31.4%) of the 375 ectoparasites recovered were from dogs within the age-bracket of 2-3 years (Fig. 1). 72.7% of the dogs above 8 years haboured ectoparasites and this was statistically significant when compared to only 10.4% infestation rate for dogs under two years (X^2 = 9.2, df = 1, $P < 0.05$). The distribution of ectoparasites on the body parts of infested dogs as shown in Fig. 2 reveals that the ears, legs and paws had the highest infestation rates of 28.2%, 23.2% and 22.4% respectively. The occurrence of ectoparasites on the ears, legs and paws was statistically significant in comparison to other parts of the body (P

<0.05).

Stray dogs accounted for 56% of total dogs examined during this study and 58.3% of the ectoparasites were recovered from them (Table 3). The infestation rates between stray and restricted dogs was statistically significant ($X^2 = 14$, df =1, P<0.05). They were more stray dogs encountered Wadata, High level, and Wurukum areas of the town, however this was not specifically peculiar to these areas nor dependent on sanitary and housing conditions in such areas. The distribution of ectoparasites infestation in relation to the breed of dogs revealed that 77.6% of dogs examined were mongrels and accounted for 80.5% of the overall infestation rate (Table 4). The infestation rate of mongrels (57.5%) was significantly higher than in Alsatian dogs (42.5%) ($X^2 = 6.8$, df = 1, P < 0.05).

The relative abundance of *Rhipicephalus* species (53.5%) was statistically highest. Other species of ticks encountered were *Boophilus* (31.4%) and *Amblyomma* (8.4%).

Lice and fleas recovered from the dogs during this study belong to *Linognathus* and *Ctenocephalis* species respectively (Table 5). The monthly distribution of the ectoparasites showed highest recovery (23.2%) in January (Fig 3), though infestation did not follow any consistence pattern during the period of the study.

Dog Owner's Attitude and Practices

Of the dog-borne disease listed by respondents, Rabies was the most frequently mentioned (56%) and only 5.2% of respondents mentioned tick infestation as potential health risk to dogs and humans (Table 6). A significant proportion of respondents (48.0%) who kept dog could not mention any dog disease or disease transmitted by dogs. The methods of removing ticks from dogs employed by dog owners are summarised in Table 7. Bathing the dogs with brush, soap and detergents (59.6%) was the most employed method and this had statistically highest occurrence (P < 0.05).

Table 1: Prevalence of ectoparasites of dogs in relation to study locations in Makurdi

Location	Number of dogs examined	Number with ectoparasites (%)	Ticks (%)	Lice (%)	Fleas (%)	Total number of ectoparasites (%)
Wurukum	110	36 (32.7)	133 (90.4)	11 (7.5)	3 (2.0)	147 (38.8)
N /Bank	105	25 (23.8)	76 (95.0)	4 (5.0)	0 (0.0)	80 (21.1)
Wadata	90	17 (18.9)	56 (98.2)	1 (1.8)	0 (0.0	57 (15.0)
H /Level	70	21 (30.0)	58 (90.6)	5 (7.8)	1 (1.5)	64 (16.9)
L /Level	50	19 (38.0)	31 (100.0)	0.(0.0)	0 (0.0)	31 (8.2)
Total	**425**	**118 (27.8)**	**354 (93.4)**	**21 (5.5)**	**4 (1.1) 379**	**379**

($X^2 = 2.11$, df = 4, P < 0.05)

Table 2: Prevalence of ectoparasites in dogs in relation to sex in Makurdi, Nigeria

Location	Male dogs						Female dogs					
	Number of dogs Examined	No. with Ectoparasites (%)	Tick	Lice	Fleas	Total	Number of dogs Examined	No. with Ectoparasites (%)	Tick	Lice	Fleas	Total
Wurukum	62	25 (40.3)	66	5	1	72	48	1 (22.9)	67	6	2	75
N/ Bank	63	16 (25.4)	57	2	0	59	42	9 (21.4)	19	2	0	21
Wadata	46	11 (23.9)	38	1	0	39	44	6 (13.6)	18	0	0	18
H/Level	35	11 (31.4)	33	4	0	37	35	10 (28.6)	25	1	1	27
L/Level	19	8 (42.1)	12	0	0	12	31	11 (35.5)	19	0	0	19
Total	**225**	**71 (31.5)**	**206(94.1)**	**12(5.5)**	**1 (0.4)**	**219 (57.8)**	**200**	**47 (23.5)**	**148 (92.5)**	**9 (5.6)**	**3 (19)**	**160 (42.2)**

($X^2 = 11.4$, df = 1, $P > 0.05$)

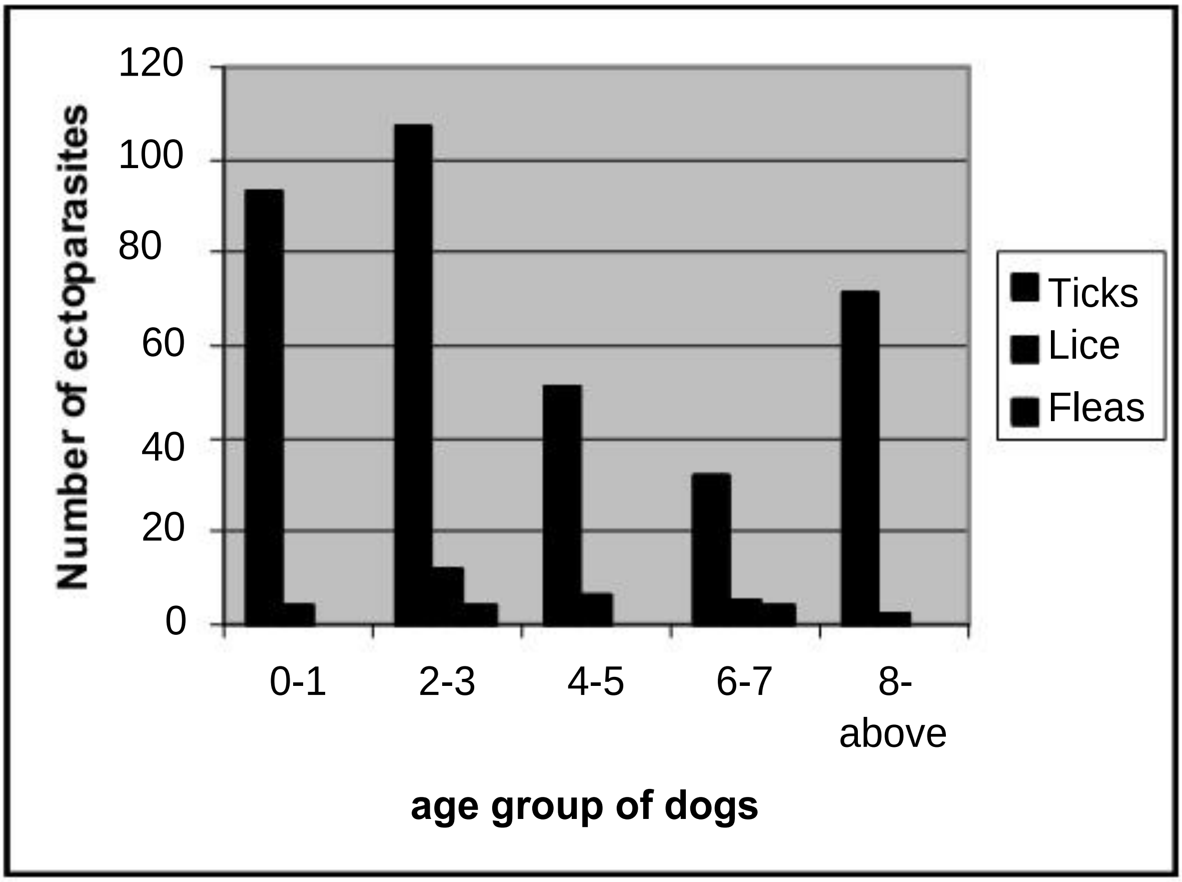

Fig. 1: Prevalence of ectoparasites in dogs in relation to age-group (years) in Makurdi.

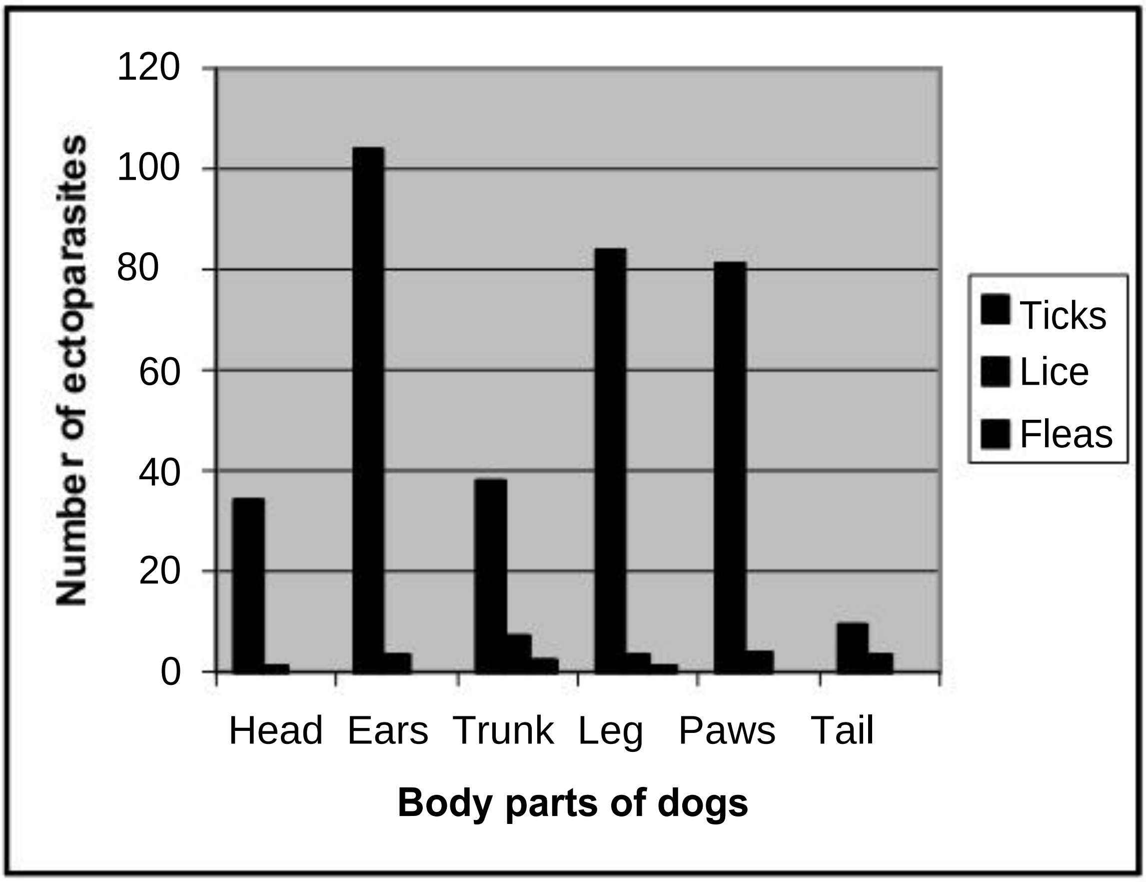

Fig. 2: Distribution of ectoparasites on the body parts of dogs in Makurdi

Table 3: Distribution of ectoparasites in relation to stray and restricted dogs in Makurdi, Nigeria.

location	Restricted Dogs						Stray Dogs					
	Number examined	Number with ectoparasites	Ticks	Lice	Fleas	Total	Number examined	Number with ectoparasites	Ticks	Lice	Fleas	Total
Wurukum	52	21	63	7	0	70	58	15	70	4	3	77
North Bank	50	9	29	1	0	30	55	16	47	3	0	50
Wadata	36	5	21	0	0	21	54	12	35	1	0	36
High Level	26	7	24	2	0	26	44	14	34	3	1	37
Low Level	23	8	11	0	0	11	27	11	20	0	0	20
Total	**187 (44.0)**	**50 (42.3)**	**148 (93.6)**	**10 (6.3)**	**0 (0.0)**	**158 (41.7)**	**238 (56.0)**	**68 (57.7)**	**206 (93.2)**	**11 (4.9)**	**4 (1.8)**	**221 (58.3)**

(X^2= 14, df =1, $P<0.05$).

Table 4: Breed-retated distribution of ectoparasites in dogs in Makurdi, Nigeria

Location	Mongrel						Alsatian					
	Number Examined	Number with Ectoparasites	Ticks	Lice	Fleas	Total	Number Examined	Number with Ectoparasites	Ticks	Lice	Fleas	Total
Wurukum	81	27	77	8	3	88	29	9	56	3	0	59
North/ Bank	90	22	43	4	0	47	15	3	33	0	0	33
Wadata	71	14	35	1	0	36	19	3	21	0	0	21
H/Level	49	16	24	5	1	30	21	5	34	0	0	34
L/Level	39	16	17	0	0	17	11	3	14	0	0	14
Total	330 (77.6)	95 (80.5)	196 (55.4)	18 (5.7)	4 (100.0)	218 (57.5)	95 (22.4)	23 (19 .5)	158 (44.6)	3 (14.3)	0 (0.0)	161 (42.5)

(X^2 = 6.8, df = 1, P < 0.05).

Table 5: Species of ectoparasites infesting dogs in Makurdi.

Type	Species	Number collected (%)	Number of dogs infested
Ticks	*Rhipicephalus*	203 (53.5)	106
	Amblyomma	32 (8.4)	27
	Boophilus	119 (31.4)	87
Lice	*Linognathus*	21 (5.5)	13
Fleas	*Ctenocephalis*	4 (1.1)	4
Total		379 (100)	

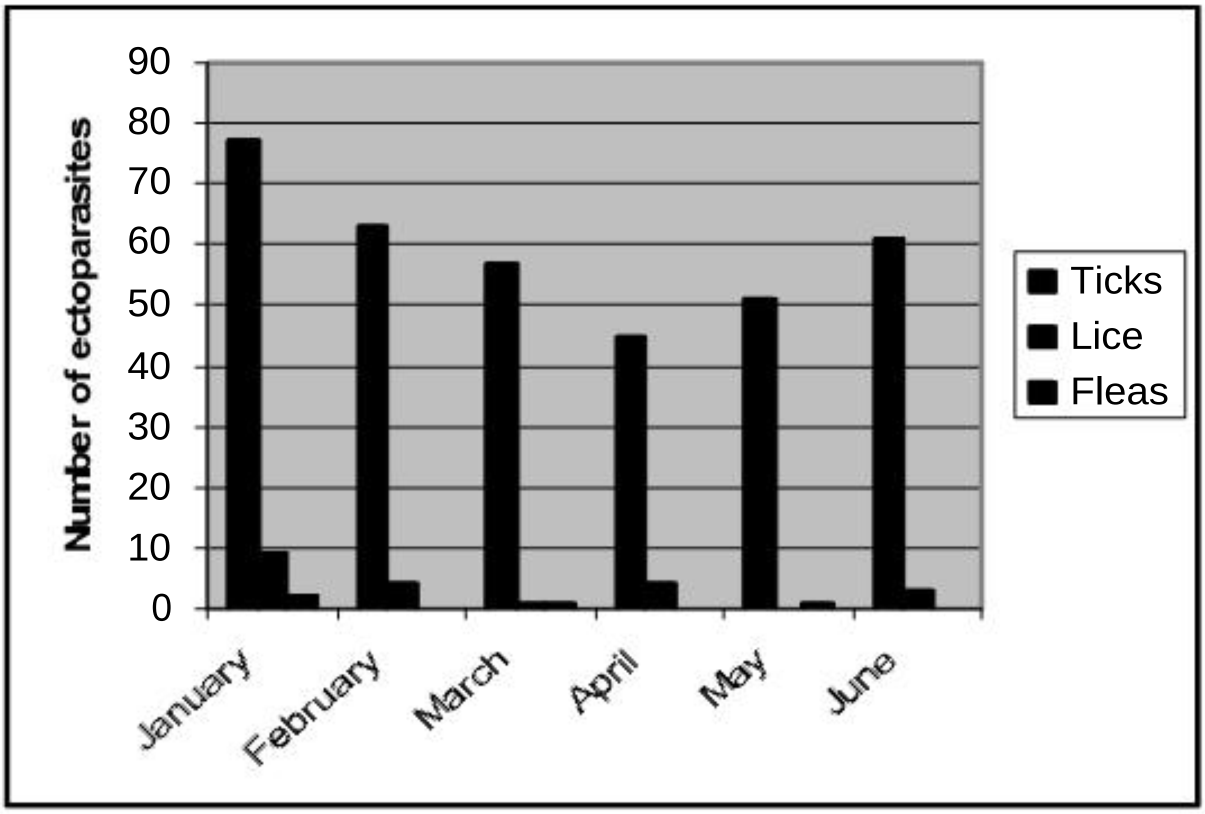

Fig. 3: Monthly collection/distribution of ectoparasites during the period of study in Makurdi.

Table 6. Dog-borne infections/ diseases listed by respondents.

Perceived disease	H/level n = 50 yes (%)	L/level n = 50 yes (%)	N/bank n = 50 yes (%)	Wadata n = 50 yes (%)	Wurukum n = 50 yes (%)	Total n = 250 yes (%)
Rabies	27 (54.0)	22 (44.0)	24 (48.0)	23 (46.0)	44 (88.0)	140 (56.0)
Tick infestation	3 (6.0)	3 (6.0)	5 (10.0)	0 (0.0)	2 (4.0)	13 (5.2)
Ring worm	0 (0.0)	1 (2.0)	1 (2.0)	0 (0.0)	1 (2.0)	3 (1.2)
Worms	1 (2.0)	0 (0.0)	4 (8.0)	0 (0.0)	0 (0.0)	5 (2.0)
AIDS	2 (4.0)	0 (0.0)	0 (0.0)	0 (0.0)	1 (2.0)	3 (1.2)
Dont know	22 (44.0)	28 (56.0)	26 (52.0)	27 (54.0)	17 (34.0)	120 (48.0)

Table 7: Methods of controlling tick infestation on dog employed by respondents in Makurdi.

Control measures	H/level n = 50 yes (%)	L/level n = 50 yes (%)	N/bank n = 50 yes (%)	Wadata n = 50 yes (%)	Wurukum n = 50 yes (%)	Total n = 250 yes (%)
Removal with bare hands	17 (34.0)	17 (34.0)	18 (36.0)	12 (24.0)	19 (38.0)	83 (33.2)
Bath dog with soap and detergents	19 (38.0)	30 (60.0)	27 (54.0)	38 (76.0)	35 (70.0)	149 (59.6)
Bath dog with kerosene	12 (24.0)	25 (50.0)	28 (56.0)	23 (46.0)	32 (64.0)	120 (48.0)
Removal by brushing	7 (4.0)	9 (18.0)	8 (16.0)	12 (24.0)	17 (34.0)	53 (21.2)

DISCUSSION

The infestation of domestic dogs by ectoparasites of veterinary and medical importance in Makurdi is epidemiologically significant and has severe consequences for arthropod-borne zoonotic diseases. The infestation rate reported in this current study is lower than the previous studies conducted in the same area (Omudu *et al*., 2006, Omudu and Amuta 2007, Omudu *et al,* 2007). This could be as a result of awareness on potential health risk associated with tick infestation created after the earlier studies through dissemination activities. The species of ectoparasites encountered during this current study corroborates our previous surveys in Makurdi, and others reported elsewhere in Nigeria (Ugochukwu and Nnadozie 1985, Etim *et al.,* 1996, JamesRugu and lwuala 1998, James-Rugu 2000, Agbolade *et al.*, 2008). The predominance of ticks, especially species incriminated in transmission of babesiosis in dogs has serious implications for animal health. Omudu *et al.* (2007) investigated canine babesiosis in Makurdi and reported a 10. 2% prevalence.

Though the study locations differ significantly in respect of sanitary and housing conditions, ectoparasites infestation showed no specific preferences for areas with poor sanitation and housing. Dogs from both affluent and poor residential areas had significant infestation rates. Bryson *et al.,* (2000) reported a similar trend in North West province of South Africa. However, dogs restricted within residential compound had lower infestation rates than dogs allowed to room and scavenge for food. The reason for this lower infestation may be as a result of little or no interaction with other dogs, studies have suggested that dogs that roam and frequently interact with other dogs or livestock has higher risk of infestation (Bryson *et al*., 2000, Omudu and Amuta 2007, Nwoke 2001). Similar studies among stray dog populations in Afghanistan reveal heavy infestation rate with ectoparasites, especially flea (*Ctenocephalis canis* and *Pulex irritans*) (Le Riche *et al.*, 1988). Two breeds of dogs were encountered during this current study and ectoparasites infestation in the mongrel was significantly higher than the Alsatian. This finding corroborates our earlier studies (Omudu *et al.,* 2007). Though the reason for this trend is unclear, it is however attributed to immunological and genetic character of the dogs (James-Rugu 2000).

The public health implications of our finding in this current study are in two folds. The first aspect is the ability of some of these arthropods ectoparasites to occasionally bite humans and trigger-off allergic conditions. Ticks encountered in this study belong to same species reported to be parasitizing humans and dogs in Uruguay (Pacheco *et al.,* 2003). Ade-Serrano and Ejezie (1981) reported 41.5% human infestation with *Tunga penetrans*, a flea species in southeastern Nigeria and blamed the high infestation on human association with large pig population that roamed freely in the area. Nwoke (2004) had observed that the closeness between and his pets has resulted in the emergence of new zoonotic infection considering the unprecedented human and animal contact. The second aspect is the ability of both restricted and stray dogs to seed the environment with pathogenic organisms that is capable of causing disease conditions in humans. Previous studies have been able to establish gross contamination of residential premises with ova of *Toxocara canis* (Omudu and Amuta 2007, Omudu *et al.*, 2003). There is therefore the urgent need for public health authorities to enforce roaming animals' regulations and responsible pet ownership.

Our results revealed that dog owners in Makurdi keep dogs as pets and house-guard/ security alert and majority of them allow roaming freely and scavenging for food in the neighborhood. Dog owners were generally aware of the ability of dogs to bite humans and transmit rabies. They were however ignorant and unaware of other zoonotic consequences of dog-keeping. This again reinforces the need for public health education that will educate dog owners and general public on potential health risks in dog-keeping. This will also go a long way to encourage routine health check-up at the veterinary clinics in town. Records at the clinics revealed low patronage and inadequate human and material resources to provide comprehensive veterinary care.

The practice of removing ticks from dogs employed by dog owners involved activities that could compromise the health of the dog and its owners. It necessarily implies that dog owners need to be adequately educated especially on the health hazards associated with the use of environmentally unsafe chemicals in bathing dogs (Pipano 2002, Agbolade *et al*., 2008). The practice of bathing dogs with detergents and kerosene has been reported to have no impact on infestation or re-infestation with ectoparasites in Nigeria. Studies in South Western Nigeria reported that dogs bathed with water, detergent and water kerosene had significant ectoparasites infestation similar to dogs that were not bathed at all (Agbolade *et al.,* 2008). This study demonstrated that several dog owners in Makurdi do not have the adequate dog-care information that will protect the health of their pets and safe-guard human health. The need for veterinary and public health officers to address areas of erroneous beliefs and practices cannot be over-stressed. Public health education is a critical component of tick control and encouraging responsible dog ownership.

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