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Ectoparasites infesting animals living in close contact with human beings: a real trouble for One Health perspective?

[*Ectoparasitos infestando animais que vivem em contato próximo com seres humanos: um problema real para a perspectiva Saúde Única?*]

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ABSTRACT

The number of domestic animals living with human beings is rapidly increasing in parallel with an enhanced risk of transmission of their parasites and the pathogens they might carry. The aim of this study was to assess the occurrence of hematophagous arthropods infesting domestic animals from Northeastern Brazil and to remark the implications of their occurrence on the epidemiology and control of selected veterinary and human diseases. From January 2017 to April 2019, ectoparasites infesting domestic cats, dogs and horses were collected for their respective hosts and identified. Overall, ectoparasites were sampled from 86 domestic animals, living in different anthropic settings. A total of 401 specimens (344 ticks and 57 fleas) were collected from different hosts [i.e., 10 (2.49%), 96 (23.94%) and 295 (73.57%) from cats, dogs and horses, respectively]. Two flea (i.e., *Ctenocephalides canis* and *Ctenocephalides felis*) and 5 tick species (i.e., *Amblyomma ovale*, *Amblyomma sculptum*, *Dermacentor nitens*, *Rhipicephalus microplus* and *Rhipicephalus sanguineus sensu lato*) were identified. This study provides data on the ectoparasite fauna infesting domestic animals from Northeastern Brazil. The diagnosis and treatment of these parasites should not be underestimated, considering the role that hematophagous arthropods display as vectors of pathogens of medical and veterinary concern.

Keywords: dog, cat, flea, horse, tick

RESUMO

O número de animais domésticos infestados por ectoparasitos vivendo em estreito contato com seres humanos está aumentando, elevando o risco de infecção pelos patógenos transmitidos por vetores. Objetivou-se neste estudo avaliar a ocorrência de ectoparasitos infestando animais do nordeste do Brasil e discutir as implicações desse parasitismo na epidemiologia e no controle de doenças de importância médico-veterinária. De janeiro de 2017 a abril de 2019, artrópodes foram coletados de gatos, cães e cavalos, e identificados morfologicamente. Ectoparasitos foram removidos de 86 animais infestados provenientes de áreas urbanas e rurais. Foram identificados 401 espécimes (344 carrapatos e 57 pulgas) coletados de diferentes hospedeiros (10 (2,49%), 96 (23,94%) e 295 (73,57%) de gatos, cães e cavalos, respectivamente. Duas espécies de pulgas (Ctenocephalides canis e Ctenocephalides felis) *e cinco espécies de carrapatos* (Amblyomma ovale, Amblyomma sculptum, Dermacentornitens, Rhipicephalus microplus e Rhipicephalus sanguineus sensu lato) *foram identificadas. Este estudo fornece informações sobre a ectofauna de animais domésticos do nordeste do Brasil. Portanto, o diagnóstico e o tratamento desses parasitos não devem ser subestimados, considerando que os artrópodes aqui relatados podem veicular patógenos de importância médico-veterinária.*

Palavras-chave: cão, gato, pulga, cavalo, carrapato

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INTRODUCTION

Over the last decades, the number of domestic animals living alongside human beings has undoubtedly increased (Esch and Petersen, 2013). Dogs and cats represent the most widespread pets worldwide in both urban and rural settings, acquiring a great social importance in our daily modernity and society (Krause-Parello, 2012). Similarly, horses have also established a deeper relationship with humans, not just relying to their historic use in military operations (Digard, 2012). Although the importance of these domestic animals on several facets of the modern human society is indisputable, this connection also encourages the risk of transmission of zoonotic pathogens (Esch and Petersen, 2013).

Among ectoparasites, hematophagous arthropods, including ticks and fleas, are able to parasitize a wide number of vertebrate hosts including domestic animals, wildlife and humans (Mencke, 2013). Ectoparasites show a variegated geographical distribution, mainly influenced by the environmental and biotic factors influencing their epidemiology (Dantas-Torres and Otranto, 2016). For instance, in Brazil, more than 60 species of ticks and fleas have been reported (Zimmermann *et al.*, 2018; Linardi, 2017) and currently considered as vectors of at least 24 pathogens of zoonotic concern, causing borreliosis, rickettsiosis and plague (Linardi, 2017; Dantas-Torres and Otranto, 2016). Interestingly, several vector-borne diseases known to occur only in rural or wild environments (Moraes-Filho, 2017), are now diagnosed also in urban areas (Gonçalves *et al.*, 2015) as a likely consequence of the high degree of adaptability some ectoparasite species display (Limongi *et al.*, 2013; Kumsa *et al.*, 2019). In this context, anthropic actions, such as animal trading, farming, or transport, have contributed to the expansions of several ectoparasites alongside the vector-borne pathogens they carry (Dantas-Torres and Otranto, 2016).

Nowadays some species are in a so-called urbanization process, with a dramatic impact of the circulation of pathogens (Trotta *et al.*, 2012), requiring a general reconsideration on the modalities these diseases should be managed. With a One Health approach, for instance, animal, human and environmental health are considered as a unique entity, connected among themselves (Cunningham *et al.*, 2017). It has been demonstrated for instance that the presence of dogs seropositive to Lyme disease is a risk factor for the occurrence of the human infection by *Borrelia* spp. (Liu *et al.*, 2019). Similarly, the presence of dogs and horses exposed to *Rickettsia* spp. favor the occurrence of Spotted Fever (Pacheco *et al.*, 2011). The aim of this study was to assess the occurrence of ectoparasites infesting cats, dogs and horses living alongside humans in an area of North-eastern Brazil and to report on the implications of these findings on the epidemiology of zoonotic ectoparasite.

MATERIAL AND METHODS

The study was conducted in 14 different municipalities of the state of Pernambuco, North-eastern Brazil (Figure 1). The area is featured by an altitude of 842 m above sea level (asl), semi-arid climate with mean annual temperature of 22 °C (from 17 °C to 30 °C), mean rainfall of 147 (from 25 mm to 295 mm) and relative air humidity of 80%.

The Ethics Committee for Animal Experimentation (ECAE) of Universidade Federal Rural de Pernambuco approved the procedures herein performed on animals (license number: 94/2018). From January 2017 to April 2019, domiciled cats, dogs and horses were examined for the presence of ticks, fleas and lice. Animals were sampled by convenience irrespective of their gender, age or breed, and data recorded in individual clinical charts. Animals were carefully inspected for the presence of arthropods over 5 minutes through the examination of the following body regions: head, ears, breast-neck, thorax, abdomen, fore and hind limbs, axilla, tail, inguinal area and, only for cats and dogs, inter-digital areas (Dantas-Torres *et al.*, 2013). All specimens collected were stored in plastic tubes containing 70% ethanol for morphological analysis. Ectoparasites were separated according to their gender and stage, being morphologically identified at species level using dichotomous keys (Aragão and Fonseca, 1961; Linardi and Guimarães, 2000; Guimarães *et al.*, 2001).

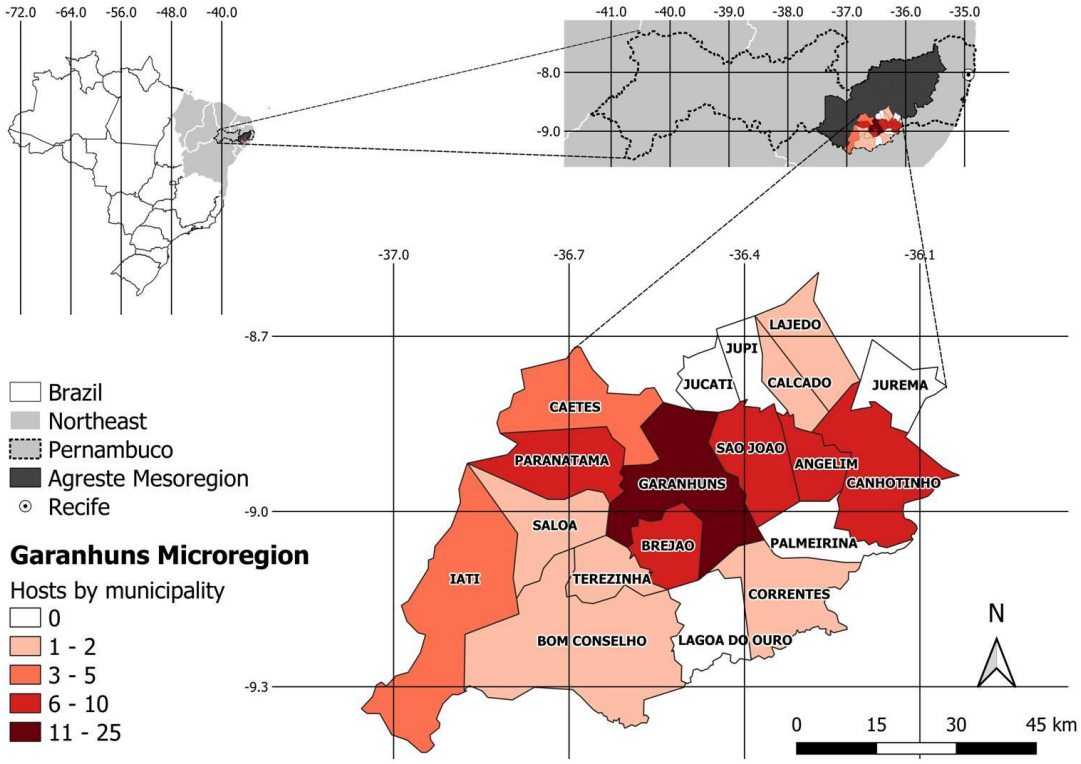

Figure 1. Distribution of the sampled animals (i.e., hosts) according to the municipalities of the Microregion of Garanhuns, state of Pernambuco, Northeastern Brazil.

A descriptive analysis was performed to obtain absolute and relative frequencies. The Friedman test was used to compare the difference between genders of ectoparasites (i.e., males vs females). In addition, the difference of ectoparasites collected in rural and urban areas were analyzed using the Chi-square (χ^2) test. No statistical analysis was performed to assess the difference among ectoparasites sourced from dogs, cats and horses due to the great difference on the number of specimens collected in each vertebrate host. The significance level was set up at 5%. All analyses were carried out using the statistical software BioEstat version 5.0 (Ayres *et al.*, 2007).

The mean intensity was calculated based on the formula proposed by Bush *et al.* (1997). Maps were constructed using the Quantum Geographic Information System (QGIS 3.2 Zanzibar), and the optimization Jenks method was used to categorize the data (Jenks and Caspall, 1971).

RESULTS

A total of 86 domestic animals (i.e., 8 cats; 22 dogs and 56 horses) infested by ectoparasites and from urban (n = 37) and rural (n = 49) areas were included in this study (Table 1).

401 ectoparasite specimens (i.e., 344 ticks and 57 fleas; χ^2 = 206.038; P=0.0000) were collected, with the majority of arthropods sampled from horses (i.e., 295 individuals, 73.57%) followed by dogs (10, 2.49%) and cats (96, 23.94%), respectively (Table 2). Cats were parasitized exclusively by fleas, horses only by ticks and dogs were co-infested by both ectoparasites. No lice were detected.

Table 1. Frequency and mean intensity of infestation by flea and tick species collected on cats, dogs and horses

Animal	Cat			Dog			Horse		
Ectoparasites	N	%	Mean intensity (min. – max.)	N	%	Mean intensity (min. – max.)	N	%	Mean intensity (min. – max.)
Fleas									
Ctenocephalides canis	0	0	0	3	13.64	1.66 (1 – 3)	0	0	0
Ctenocephalides felis	8	100	1.25 (1 – 2)	19	86.36	2.21 (1 – 3)	0	0	0
Ticks									
Amblyomma ovale	0	0	0	1	100	1 (1)	0	0	0
Amblyomma sculptum	0	0	0	0	0	0	3	5.36	17.33 (1 – 24)
Dermacentor nitens	0	0	0	0	0	0	50	89.29	4.68 (1 – 9)
Rhipicephalus microplus	0	0	0	0	0	0	3	5.36	3 (2 – 4)
Rhipicephalus sanguineus s.l.	0	0	0	21	95.45	2.28 (1 – 3)	0	0	0

Table 2. Number of domestic animals sampled, their origin and ectoparasites collected shown per stage/gender

Host (n)	Host per origin (n)	Ectoparasites (n)	*Nymphs (ticks)*	*Male*	*Female*
Cat (8)	Rural (3)	*Ctenocephalides felis* (3)	-	0	3
	Urban (5)	*Ctenocephalides felis* (7)	-	2	5
Dog (22)	Rural (6)	*Ctenocephalides felis* (8)	-	0	8
		Rhipicephalus sanguineus s.l. (31)	0	13	15
	Urban (16)	*Ctenocephalides canis* (5)	-	5	0
		Ctenocephalides felis (34)	-	9	25
		Amblyomma ovale (1)	0	0	1
		Rhipicephalus sanguineus s.l. (17)	2	3	12
Horse (56)	Rural (40)	*Amblyomma sculptum* (52)	3	15	34
		Dermacentor nitens (170)	29	27	114
		Rhipicephalus microplus (9)	0	2	7
	Urban (16)	*Dermacentor nitens* (64)	9	20	35

The majority of fleas were females (71.93%) followed by males (28.07%) (Fr = 3.0000; P=0.0833), whereas 63.37% ticks were females and 23.26% males (Fr = 4.0000; P=0.0455). Most of ticks collected were adults (86.63%), with only a few nymphs detected (13.37%). No larval stages were found. Dogs and cats were the main animals in urban area while horse lived in rural zones. Accordingly, fleas predominated in urban areas while ticks in rural zones (χ^2 = 56.942; P=0.0000). The distribution of ectoparasites and respective hosts according to the municipality is summarized in Figure 2. The municipalities in color were sampled for this study.

DISCUSSION

This survey reports on the prevalence of ectoparasitic infestation in domestic animals from northeastern Brazil. Results indicate that domestic cats, dogs and horses are exposed to two species of fleas (*C. canis* and *C. felis*) and five species of ticks (*A. ovale*, *A. sculptum*, *D. nitens*, *R. microplus* and *R sanguineus* s.l.) across the sampling area.

The high number of ticks counted in this study is probably due to the large number of horses screened (n = 56), compared to cats and dogs (n = 30). It is known that ixodids are amongst the most common ectoparasites affecting animals, and that, in the case of horses, concomitant infestations by several tick species normally occur (Horak *et al.*, 2017). Similarly, co-infestation by ticks and fleas in dogs is a frequent diagnostic finding, especially in tropical climatic areas where favorable conditions allow those arthropods to thrive (Kumsa *et al.*, 2019). The absence of ticks in cats was expected since felids are rarely parasitized by ixodids.

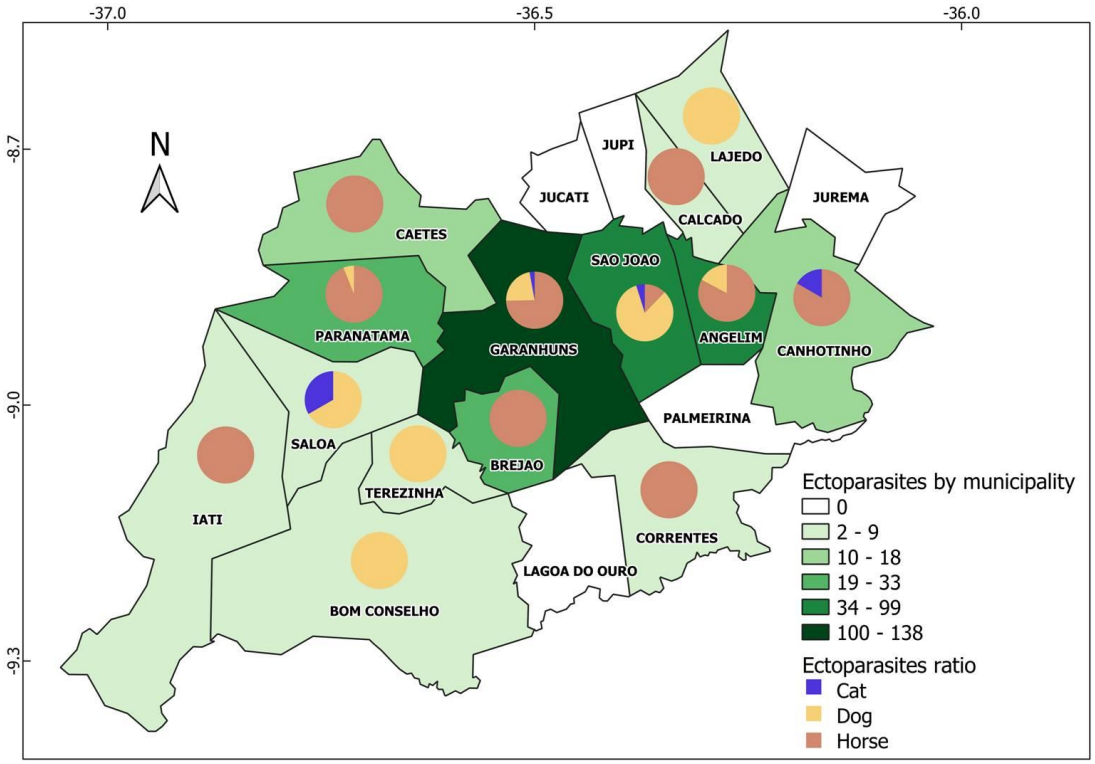

Figure 2. Distribution of fleas and ticks collected from cats, dogs and horses according to the study area.

Whether this due to the behavior of cats or to the low infestation pressure in the examined premises is hard to be defined, also taking into account to small number of cats enrolled (Dantas-Torres, 2009). Nonetheless, the majority of ticks collected on dogs and horses were adults (n = 298) and only a small proportion were nymphs (n = 43). This finding could be explained for by the size of the adult stages instead of a lack in host preference. Indeed, nymphs of *R. sanguineus* s.l. and *D. nitens* preferentially feed on dogs and horses, respectively. Conversely, although the immature stages of *A. sculptum* show very low host specificity, horses are considered the preferential host.

From an epidemiological standpoint, the variety of ectoparasites herein reported is of great relevance due to the potential role that these hematophagous arthropods display in the transmission of several diseases. For instance, horses are frequently parasitized by *A. sculptum*, which represent the main tick species involved in the epidemiology of Spotted Fever in Brazil (Moraes-Filho, 2017). This species is widespread in different Brazilian biomes, included the Caatinga biome (Moraes-Filho, 2017). Recently, phylogenetic studies have designated *A. sculptum* as member of the *A. cajennense* species complex, composed of five other species (Nava *et al.*, 2014).

Dogs showed the highest variety of ectoparasites (up to four species) amongst the hosts herein enrolled. Besides the detection of ticks normally found on dogs (e.g., *R. sanguineus*), the occurrence of *A. ovale* deserves a special mentioning. It is known that this tick species is common in wild carnivores (Labruna *et al.*, 2000) living in fragments of Atlantic Forest (Moraes-Filho, 2017), thus suggesting that this ixodid species is shared between wild and domestic animals (Labruna *et al.*, 2000), favoring the dispersion of pathogens. Interestingly, *C. felis* was found more in dogs than in cats.

This flea species has been observed in dogs and frequently overcomes the presence of *C. canis* in these animals (Slapeta *et al.*, 2011). Most likely, the great ability of adaptation to different environmental conditions has been the key factor for the success of *C. felis* compared to other

species (Slapeta *et al.*, 2011). Although in this study a few number of cats was assessed, it is believed that dogs are more exposed than cats to ectoparasites, most likely the features of fur and the poor hygienic behavior presented by canids provide suitable conditions for the infestation and establishment of ectoparasites (Cañón-Franco and Pérez-Bedoya, 2010).

Data obtained in this study are pivotal to better know the species of ectoparasites infesting domestic animals (cats, dogs and horses) in this area, as well as to understand the potential risk that humans living in close contact with jeopardized animals. Some species herein reported are accounted as important vector of pathogens. For instance, *C. felis* has been important in the life cycle and transmission of the *Rickettsia typhi* and *Rickettsia felis* (Peniche-Lara *et al.*, 2015), whereas *A. sculptum* is the most important vector of *R. rickettsii* to humans (Moraes-Filho, 2017). It is important to highlight that *A. ovale* is the main tick involved in transmission *R. parkeri* strain Atlantic rainforest (Moraes-Filho, 2017), and although until now in Brazil the role *R. sanguineus* as vector of *R. rickettsii* has not been fully elucidated, this tick species is a competent vector for this bacteria in Mexico and United States (Owen *et al.*, 2019).

From a One Health perspective it is important to highlight that the study area presents suitable conditions for the emergence and re-emergence of vector-borne pathogens, since animals live in close contact with humans, anthropic actions has modified the natural environment, and some species of ectoparasites herein reported present a great ability as potential vector.

CONCLUSION

In conclusion, this study provides important information on the ectoparasites infesting domestic animals in this area. Therefore, preventive measures against these arthropods should be encouraged on the light of One Health perspective to reduce the threat of emerging and re-emerging pathogens.

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