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Zoonotic Ectoparasite Burden in House Rats (*Rattus spp.*) in Selected Urban and Rural Areas of NCR and CALABARZON

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ABSTRACT

Rats and other mammalian species co-inhabiting or living in proximity with humans can serve as potential reservoir hosts and may contribute to the transmission of parasitic infections. Aside from endoparasites, ectoparasites such as lice, mites, ticks, and fleas, can also serve as vectors of various pathogens inducing diseases and contaminating the environment. This study aimed to determine the prevalence rate of *Polyplax spinulosa* (spiny rat louse) infestation among house rats in selected urban and rural areas in the Philippines. A total of 60 Rattus spp. were captured and examined. The overall prevalence rate of *Polyplax spinulosa* was 71.7% (43/60). Of the infestations, 23.3% (14/60) were recorded in Metro Manila while 48.3% (29/60) were recorded in CALABARZON. These results have revealed that rodents like rats play an important role in both direct and indirect transmission of zoonotic diseases since these pests themselves could be host to a variety of diseases. As a result, there is an immediate need to provide education and raise awareness about the role of rodents as reservoir hosts and vectors of these zoonotic diseases to develop long-term strategies for controlling and preventing rodent populations and the transmission of zoonotic ectoparasite infestation.

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INTRODUCTION

A large number of human infectious diseases have been identified to have zoonotic potentials (WHO, 2019). Zoonotic infections, which are mostly connected with rodents and other animals, represent an imminent risk to human health (Cleaveland *et al.*, 2001). Recent studies have revealed an increasing prevalence of parasitic zoonosis in some countries worldwide which may be attributed to overpopulation, habitat modification, urbanization and mass migration (Han *et al.*, 2015; Hassell *et al.*, 2017; WHO, 2019). Given the increase in zoonotic diseases, urban residential areas constitute a major concern since they provide suitable environments for certain types of wild animals, resulting in frequent increasing interaction with humans (Luniak, 2004).

Rodents, particularly *Rattus* spp., are the most harmful of the animals found in urban environments because of their zoonotic potential, high reproductive capability, and proclivity for close contact with people (Battersby, 2002). Arthropod ectoparasites such as lice, fleas, ticks, and mites are also common among house rats, specifically in *Rattus norvegicus*. Two of the most common ectoparasite in rats are *Echinolaelaps echidnius*

(mite) and *Polyplax spinulosa* (louse). *E. echidnius* are medium-sized, vertebrates covered with coarse hair and spines. On the other hand, *P. spinulosa* is an obligate intracellular blood sucking louse that has a thick, slender, yellow-brown color and 0.6mm to 1.5 mm long almost oval body (Claveria *et al.*, 2005).

Some of the ectoparasites possess zoonotic potential which allows them to transmit zoonotic pathogens to both animals and humans. Transmission of these ectoparasites is through direct contact and it moves gradually to stick and burrows in the deeper parts of the superficial layers of the skin of the host. These ectoparasites infest the fur of the neck, shoulder, and midbody of the rats. Once infested, the clinical manifestations include scratching, small wounds, or may even induce dermatitis and anemia if heavy infestations are left untreated. However, the studies regarding these ectoparasites are very scarce.

Despite being neglected, louse, fleas, hard ticks, and mites may potentially constitute a direct or indirect zoonosis due to their agility, comprehensive host range, and the capacity to penetrate human skin as they act as vectors to weaken the health of other species (Mohd *et al.*, 2012). The aim of this study is to determine the prevalence rate of *Polyplax spinulosa* (spiny rat louse) infestation among house rats in selected urban and rural areas in the Philippines.

MATERIALS AND METHODS

Description of Collection Sites

The collection sites of Pasig City (14°35'8.39" N 121°03'24.00" E), Quezon City (14° 40' 34.3488" N 121° 2' 37.8996" E), Manila City (14.5995° N, 120.9842° E), and Muntinlupa City (14° 24' 29.278" N 121° 2' 29.28" E) represent the urban areas of Metro Manila while Binangonan, Rizal (14.4765° N, 121.1957° E), Imus, Cavite (14.4064° N, 120.9405° E), and Biñan, Laguna (14.3036° N, 121.0781° E) cover the rural areas of Region IV-A CALABARZON. Rats were caught in houses near swamps, landfills, rivers, and rice paddies. The urban and rural locations were carefully chosen based on parasitic disease reports in municipal health offices and published research, as well as feasibility of sample collection due to COVID-19 community quarantine regulations. This study was carried out in the field until the targeted population of rats was reached, between November 2020 and February 2021.

Collection of Samples

In each study site, twenty (20) rat trap wire cages (45 cm L x 15 cm W x 15 cm H) were numbered and placed in randomly selected houses with food baits. A total of 60 rats weighing 150 to 450g were collected, 31 from urban and 29 from rural areas. While rats were transported to the laboratory for further assessment, they were given food pellets and water (Estopa and Estopa, 2016). Both the sex and weight of the rats were recorded. *Rattus* species were identified by examining their morphological characteristics. Due of the COVID-19 pandemic, the collection of samples diligently adhered to the community quarantine standards enforced by the local authorities.

Anesthetic Used for Laboratory Examination

Chloroform was utilized as an inhalant anesthetic to euthanize the rats prior to necropsy. Chloroform was the primary choice to induce anesthesia due to its rapid and most effective inhalant activity. This was performed using open drop method, where a clean cotton was placed at the bottom of the container with an ample amount of chloroform. The lid was then carefully closed after each rat had been placed into the container. The rats were observed for symptoms of anesthetic effectiveness such as slower breathing, slower heart rate, lack of movement, and awareness after a few minutes. The dissection process began once the rat was fully asleep (AVMA, 2007; Munoz, 2018).

Detection of Ectoparasites

The ectoparasite, *Polyplax spinulosa*, was targeted after the death of the host. This study employed the collection of ectoparasites which dropped in the container with water underneath the hanged cold body after death for one hour. The water was then examined carefully under a stereomicroscope for detection of any ectoparasites. Collected ectoparasites was mounted on slides with glycerin and was photo documented for the identification using published standard key for taxonomy (Carabin *et al.*, 2015).

Data Analysis

The prevalence rate of ectoparasites was expressed using non-parametric statistical analysis. The prevalence rate was computed based on the formula:

$$\text{Prevalence Rate (\%)} = \frac{\text{Total Number of Infested Rats}}{\text{Total Number of Samples}} \times 100$$

Ethical Considerations

All animal experiments done in this study were performed following the ethical guidelines for the use of animal samples set by the Research Ethics Office (REO) of De La Salle University. All rats were anesthetized with chloroform before they were sacrificed.

RESULTS AND DISCUSSION

From November 2020 until February 2021, sixty (60) rats were captured in urban and rural areas. Thirty-one (51.7%) of the rats were collected from houses in selected cities of Metro Manila and twenty-nine (48.3%) were caught from residences in selected provinces of Region IV-A, CALABARZON.

Two rat species were identified, namely *Rattus norvegicus* (33.3%) and *Rattus tanezumi* (66.7%). Some rats had brown to gray dorsal fur with dark ventral fur, bi-colored light grayish-white tail, and feet with extended inner metatarsal tubercle indicative of *R. norvegicus* while others had olive brown dorsal fur with very light ventral fur, dark gray tail and a longer foot with dark gray spots suggestive of *R. tanezumi* (Figure 1). These *Rattus* species are two of the most common and widely distributed rats in the country (Claveria *et al.*, 2005).

Figure 1. Morphological comparison of *Rattus* species captured in this study. A.) *Rattus norvegicus* showing brown to gray dorsal fur, B.) with dark ventral fur, C.) Bi-colored light grayish-white tail, D.) foot with an extended inner metatarsal tubercle (arrow) E.) *Rattus tanezumi* showing an olive brown dorsal fur, F.) with a very light ventral fur, G.) dark gray tail, and H.) a longer foot with dark gray spots.

Majority of the *Rattus norvegicus* (75%) were caught in Metro Manila than in provinces (25%) while *Rattus tanezumi* were almost evenly distributed in the cities and provincial areas with 40% and 60%, respectively. Overall, the collected rats were evenly numbered in terms of sex with 30 female rats (50%) and 30 male rats (50%). However, in terms of location, more female rats (73.3%) were captured in the cities and more male rats (70%) were captured in the provinces. The rats captured were a mixture of adults (70%) and young (30%) but the female rats weighed heavier as compared to male rats.

Figure 2. Heavy infestation with *Polyplax spinulosa* which have resulted to dermatitis.

The overall prevalence of *P. spinulosa* infestation was 71.7%. In Metro Manila, 14 rats (45.2%) were infested while all of the 29 rats (100%) from the provinces of CALABARZON were positive with this ectoparasite. The spined rat louse, also known as *P. spinulosa*, is a blood sucking louse which belongs to the order Phthiraptera. It is present in the fur of the neck, shoulders, and midbody. *P. spinulosa* was observed to be slender, yellow-brown in color with a thick body that was approximately 0.6 mm to 1.5 mm long with a brown tinge. It has a rounded head with five segmented antennae on two sides. The *Rattus* spp. infested with *P. spinulosa* had skin revealed nits of about 0.2 to 0.7 mm that appeared as bunch or clustered sores attached to the hair shaft (Figure 2).

***Rattus* spp. as vectors of zoonotic parasites**

Rattus spp. are widely distributed, can proliferate rapidly, and can adapt to a range of environments, including those that have been altered and urbanized (Seifollahi *et al.*, 2016). A major issue in both urban and rural areas, aside from their many adverse impacts on humans, is the role which reservoir hosts serve in the spread of zoonoses that result in epidemics. Rodents that cohabit alongside humans in both natural and modified habitats may carry a variety of ecto- and endoparasites, endangering human health and increasing the risk of contracting diseases spread by rodents (Singleton *et al.*, 2003). Both of these

rodent species, *Rattus norvegicus* and *Rattus tanezumi*, inhabit urban cities and rural provinces. They are commonly found around rice fields, dumpsites, swamps, drainage, sewer systems and even in residential houses nearby. Both *Rattus* spp. revealed susceptibility to diverse kinds of ectoparasites in all sites.

Polyplax spinulosa, most commonly known as lice, recorded prevalence rates of 45% and 100% in Metro Manila (urban) and CALABARZON (rural), respectively. The occurrence of these ectoparasites is affected by different variables which are mostly associated with environmental conditions in a given area. The result of the study conforms with the study done by Claveria *et al.*, (2005); Mohd Zain *et al.* (2012) where the most common ectoparasite species found is the blood sucking louse, *P. spinulosa.* Mild infestations of these parasitic louse may not be immediately detected in other animals but will consequently show up if the health of the host animal deteriorates or if they become immunocompromised due to severe stress. However, in rodents, manifestations of ectoparasites include scratching, hair loss and skin changes (Claveria *et al.*, 2005). Apart from harboring and transmitting perilous pathogens, ectoparasites also have the capacity to cause skin irritations to humans and other mammals which may lead to varying degrees of dermatitis (Nadchatram and Ramalingam, 1973).

The adaptability of rat parasites, as well as the host's vast ability to sustain parasites' physiological, behavioral, and developmental needs, is evidenced by their diversity. The rats were weakened and less active as a result of significant ectoparasite infestation with *Polyplax spinulosa*, indicating a rat host-parasite interrelationship. In addition, these *Rattus* spp. may serve as vectors of these ectoparasites to humans. Rats can greatly facilitate parasite transmission to humans and other susceptible animal hosts due to the diversity and zoonotic nature of rat parasites, as well as the poverty conditions prevailing in communities where *Rattus* spp. thrive and proliferate.

CONCLUSION

Polyplax spinulosa was isolated in the *Rattus* species from selected urban and rural areas of Metro Manila and CALABARZON with an overall prevalence rate of 71.7%. %. Of these, 23.3% were recorded in Metro Manila while a much significantly higher prevalence of 48.3% in CALABARZON. These ectoparasites exhibit zoonotic potential that can transmit infestations to humans. The prevalence rates are greater among house rats captured in rural areas of CALABARZON than in urban areas of Metro Manila. The significant risk factor identified that is associated in high prevalence and density is the environmental and impoverish condition which pose potential threats of rodent-borne disease transmission to areas that lack proper hygiene and sanitation facilities. Therefore, there is an immediate need to provide education and to promote awareness on the role of rodents as reservoir host and vectors of these zoonotic diseases to launch approaches for control and prevention of rodent populations and the spread of these zoonotic diseases.

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