PREVALENCE OF *Ancylostoma* sp., *Dipylidium* sp., *Toxocara* sp., *Trichuris* sp., and *Cystoisospora* sp. IN HOUSEHOLD CATS AND DOGS FROM SELECTED CITIES IN CAVITE, PHILIPPINES

Louis Jay Jerome Ayson, Faith A. Casayuran, Rose Anna B. Delfin, Maria Cecilia E. Landicho, Linea Isabel G. Wenceslao, and Adrian Miki C. Macalanda*
College of Veterinary Medicine and Biomedical Sciences
Cavite State University, Indang, Cavite
*Corresponding author

ABSTRACT

This study determined the prevalence of intestinal helminths and protozoa among household cats and dogs in the cities of Bacoor, Dasmariñas, General Trias, and Imus. A total of 385 samples of dogs (n=301) and cats (n=84), were randomly selected in the stated cities. The owners were interviewed using a prepared questionnaire containing probable factors associated with intestinal helminths and protozoan infection. The intestinal parasitic ova and oocysts from the fecal samples were detected using direct fecal smear, simple sugar flotation, and passive sedimentation techniques. The most prevalent parasites in dogs was *Ancylostoma sp.* (25.9%), followed by *Trichuris* sp. (11.0%), *Toxocara* sp. (7.0%), *Cystoisospora* sp. (0.7%), and *Dipylidium* sp. (0.3%). In cats, the most prevalent parasites were *Ancylostoma* sp. (22.6%), followed by *Trichuris* sp. (11.0%), *Toxocara* sp. (16.7%), *Cystoisospora* sp. (4.8%), and *Dipylidium* sp. (1.2%). There was no *Trichuris* sp. detected in cats. Several factors such as location, sex, age, breed, deworming status, and rearing practices were the parameters with significant influence on the prevalence of intestinal parasitism. With regards to fecal analysis, the simple sugar flotation technique had the highest positivity rate in detecting ova of *Ancylostoma* sp., *Toxocara* sp., *Trichuris* sp., and *Cystoisospora* sp. oocysts, while the sedimentation technique in *Dipylidium* sp. ova in dogs. Meanwhile, in cats, the simple sugar flotation technique had the highest positivity rate in detecting ova of *Ancylostoma* sp., *Dipylidium* sp., *Toxocara* sp., and *Cystoisospora* sp. oocysts.

Keywords: *Cavite, intestinal helminths, protozoa, prevalence, household dogs and cats, zoonosis*

INTRODUCTION

Canine and feline intestinal helminths and protozoa can be a major cause of disease, especially in the young and immunocompromised. Intestinal parasites can be acquired through different routes including but not limited to vector transmitted, direct contact, oro-fecal transmission, transplacental, and transmammary (Castro et al., 2019; Taylor et al., 2015). Clinical signs of helminths and protozoa infection may vary depending on species but generally, this includes signs like pale gums and weakness due to anemia, weight loss, bloody diarrhea, dull and dry hair coat, or failure to grow properly (Nemzek et al., 2015).

One study in Iloilo City by Lopez et al, (2016) revealed that Ancylostoma sp. was the most dominant gastrointestinal helminth in domestic dog with 30.0 percent prevalence followed by Trichuris sp. with 26.7 percent and Toxocara sp. with 10.0 percent prevalence. According to World Health Organization (WHO), globally there are millions of cases of ascariasis, 750-1050 million cases of trichuriasis, and 740 - 1300 million cases of hookworm infestation (Kumar et al., 2014).

Close contact between companion animals and humans increases the risk of transmission of different zoonotic diseases (Moro & Abah, 2019). All hookworms, Toxocara sp. might cause zoonotic diseases and as the population of dogs and cats continue to increase, this is considered a public health concern, causing self-limiting cutaneous larva migrans (CLM) or ‘ground itch’ in humans (Mulinge et al., 2020). Dipylidium caninum infection on the other hand is asymptomatic in humans (Neafie & Marty., 1993; Samkari et al., 2008; Narasimham et al., 2013).

Detection of parasitic ova and oocyst can be done using various techniques like direct fecal smear, fecal flotation, and sedimentation (Dantas-Torres et al., 2020).

The objective of the study is to determine the prevalence of intestinal helminths and Cystoisospora sp. from households' dogs and cats among the selected cities of Cavite in relation to age, sex, breed, type of rearing, co-existence with other pets, deworming status, and positivity rate using different methods of detection.

METHODOLOGY

Research Design

This study used a descriptive study design specifically a cross-sectional survey to know the prevalence of intestinal helminths and Cystoisospora sp. infection in selected cities of Cavite, Philippines.

Study Area

Various households from different barangays in cities of Bacoor, Dasmariñas, General Trias, and Imus, Cavite were chosen in the study. Bacoor has 73 barangays, Dasmariñas has 75 barangays, General Trias has 33 barangays and Imus has 97 barangays. The selection for the barangays was at random for at least 50 percent of the total barangays for each city.

Sample size

A total of 385 samples were collected consisting of 301 samples from household cats.

Data collection

Consent was given to owners of the animals intended to collect in the household. The consent includes the condition that the owner will have to give some personal information solely for study. The study will comply with Republic Act 10173 – Data Privacy Act of 2012. Upon agreeing with the consent, a survey form was given which includes the address, name of both owner and patient, species, breed, deworming status, number of other pets, daily activities of the patients, and contact number of the owner. All data was encoded into a spreadsheet.

Sample Collection

Random sampling method was done on household dogs and cats regardless of age, sex, and breed. Approximately 10 grams of fresh stool were carefully collected directly from the animal’s area of defecation then placed in 50mL sterile screw-capped fecal containers, labeled with the pet's information, and stored in a chest filled with ice. Ninety-six fecal samples were obtained from each cities of Bacoor, General Trias, and Imus while 97 fecal samples were obtained from Dasmariñas City, Cavite for a total of 385 fecal samples from feline and canine subjects.

Sample Processing and Microscopic Examination

Direct Fecal Smear

A few drops of 0.9 percent NaCl solution were instilled at each glass slide mixed with a small amount of feces using a wooden stick and leaving it unstained. Coverslips were placed and directly examined under 40x and 100x magnification.

Simple Sugar Flotation Method

A 2g of unpreserved fecal sample was weighed in the analytical balance and then suspended with 20mL of 56 percent table sugar solution. It was mixed and the filtrate was then transferred to a 10mL test tube until it filled the brim. A coverslip was placed on the test tube and sifted for 10 minutes. The wet side of the coverslips was placed in a clean glass slide and examined under 40x and 100x magnification.

Passive Sedimentation Method

The mixture from the previous step was decanted until there was a minuscule amount of liquid and residue remaining. It is then aspirated by a disposable Pasteur pipette. A few drops were placed on a glass slide and examined under 40x and 100x magnification.

Statistical analysis

Pearson's chi-square test was used in the analysis of data to compare the categorical variables, with a p-value of <0.05 regarded as statistically significant. The Statistical Package for Social Sciences (SPSS) version 26 statistical tool was used for statistical data analysis and Cramer's V value for the strength of the correlation coefficient (Elharoun et al., 2018).

RESULTS AND DISCUSSION

Dogs

Among the 301 samples of dogs, Ancylostoma sp. was the most prevalent gastrointestinal parasite, while Dipylidium sp. was the least prevalent (Table 1). This was observed in the study of Urgel et al. (2019), wherein Ancylostoma sp. was the dominant gastrointestinal parasite detected in feces of dogs with 38 percent prevalence.

Location

A weak significant relationship existed between the prevalence of Ancylostoma sp. and the dog's location (Table 3). General Trias was the most prevalent city among the sample locations. The high prevalence of Ancylostoma sp. in General Trias suggested that the environmental conditions in that city was more conducive to the survival and transmission of the parasite than the 3 cities.

Cavite is agricultural land and according to the Office of the Provincial Agriculturist, General Trias has the most agricultural land area with 31.84 percent while Bacoor, Imus and, Dasmariñas have an agricultural land area of 2.13 percent, 11.04 percent, 19.5 percent respectively (Research, Statistics, Monitoring, and Evaluation Division Provincial Planning and Development Office, 2021). Therefore, the likelihood of transmission of Ancylostoma sp. also increases relative to increased soil area which protects and aids the development of this parasitic ova before becoming infective to the next host (Bowman et al., 2021).

There was no significance between location and Dipylidium sp. Toxocara sp., Trichuris sp. and Cystoisospora sp. in dogs (Table 3). According to CAPC (2022), there are several factors that influence the likelihood that a dog or cat will be infected with Dipylidium caninum including the geographic region and the opportunity the animal may have to ingest an infected flea. Lower detection among dogs could be due to the inherent characteristic of Cystoisospora sp. to shed oocysts intermittently as a large number of oocysts may be shed by an infected animal within a short time (Andrews, 2023).

Risk Factors

A moderately significant relationship has existed between the prevalence of Toxocara sp. and the dog's age (Table 5). This suggests that the prevalence of Toxocara sp. was moderately dependent on the dog's age. Toxocara canis can be prenatal and lactational transmitted. Vertical transmission occurs when the gestational sac is invaded during the third trimester of pregnancy, infecting the developing embryos and leading to puppies born with pre-patent worms (Schwartz et al., 2021; Roberts et al., 2013; Schnieder et al., 2011; Lloyd et al., 1983). As larvae can be transferred lactogenically to the newborn pups, vertical transmission continues postpartum (Schwartz et al., 2021; Ma et al., 2019; Burke & Roberson, 1985). There is no significant relationship existed between the prevalence of other gastrointestinal parasites and the dog's age.

A weak significant relationship exists between the prevalence of Toxocara sp. and the dog's sex (Table 5). This result was in accordance with the study of Lamsal and Prajapati (2020), where the prevalence rate in female dogs (15.63%) was slightly higher than in male dogs (10.87%). There is no significant relationship between the prevalence of other gastrointestinal parasites and the dog's sex (Table 5).

A weak significant relationship exists between the prevalence of Ancylostoma sp. and Trichuris sp. with the dog's breed (Table 5). This result is in accordance with the study conducted by Ramírez-Barrios et al. (2004) wherein there was a significantly greater prevalence of parasites in mixed-breed dogs (40.3%) as compared with pure-breed dogs (30.8%). An increased prevalence among mixed breeds was explained by a biased outlook of pet owners wherein purebreds were more favored by the owners to be dewormed than the mongrel. These observations were in accordance with another study by Gonzalez-Saldivar et al. (2023), wherein there was a higher frequency of positive cases in the mongrel breed in agreement with the report by Plúas & Sánchez (2021) and the relationship of mongrel dogs to their economic value was little as compared to that of purebred dogs (Ojo et al., 2019). There is no significant relationship existed between the prevalence of other gastrointestinal parasites and the dog's breed.

A strong significant relationship exists between the prevalence of Ancylostoma sp. and the dog's rearing type (Table 5). Dogs with access to the street were two times more likely to get gastrointestinal infections. This could be because stray animals with gastrointestinal parasites shed ova into their feces, and these can live for months or years. As a result, there will be contamination in public places (Campos et al., 2016). Surprisingly, Ancylostoma sp. was still detected in dogs who were indoors, this may be due to the paratenic hosts of this parasite that may have entered the house and become prey (Bowman et al., 2010). There is no significant relationship between the prevalence of other gastrointestinal parasites and the dog's rearing practices.

No significant relationship existed between the prevalence of gastrointestinal parasites and the dog's co-existence with other pets (Table 5).

Deworming Status

There was a weak significant relationship between the deworming status of dogs and the prevalence of Ancylostoma sp. (Table 7). Moderately significant relationships were found to have existed between the deworming status of dogs and the prevalence of Toxocara sp. and Trichuris sp.

In this study, an observable Cystoisospora sp. infection was found in the non-dewormed and non-updated deworming group. This result is not suggestive of the direct effects of deworming status on Cystoisospora sp. infection as Cystoisospora sp. specifically responds to the administration of triazone drugs, paromomycin, amprolium, and nitazoxanide. Sulfonamides, when combined with specific diaminopyrimidines make these drugs more effective against first- and second-stage coccidian meronts as they are coccidiostatic at low doses and coccidiocidal at higher doses (Beugnet et al., 2018).

Positivity Rate of Each Test

It can be concluded that the most sensitive test used in detecting Ancylostoma sp., Toxocara sp., Trichuris sp., and Cystoisospora sp. was flotation while sedimentation was the most sensitive test used in detecting Dipylidium sp. (Table 9).

Cats

Ancylostoma sp. was the most prevalent while Dipylidium sp. was the least prevalent gastrointestinal parasite among the 84 samples of cats (Table 2). This adheres to the statement of Jitsamai et al., (2021) that Ancylostoma sp. was the most dominant endoparasite in cats with 67.5 percent prevalence which was also seen in four Southeast Asian countries, Indonesia, Laos, Malaysia and Vietnam. The findings regarding Dipylidium sp., was also in agreement with Beugnet et al. (2014), wherein the dogs are carrying more infected fleas but being balanced out by the cats due to their higher grooming activity than dogs.

Location

There was no significant relationship between the prevalence of Ancylostoma sp., Dipylidium sp., Toxocara sp., Cystoisospora sp. and the cat's location (Table 4).

Risk Factors

There is no significant relationship between the prevalence of gastrointestinal parasites and the cat's age, breed and co-existence (Table 6). It was found that a moderately significant relationship had existed between the prevalence of Ancylostoma sp. and the cat's sex. This is in relation to the findings of several research that female cats and dogs have a higher prevalence of intestinal helminths than male cats and dogs which may be because female animals go through more stress and spend more time with their young, which may contribute to re-infection (Ridwan et al., 2023). A very strong significant relationship was found to have existed between the cat's rearing type and the prevalence of Ancylostoma sp. (Table 4).

The prevalence of Ancylostoma sp. is strongly dependent on whether the cat is reared inside or outside. These results further strengthen the findings of Arruda et al. (2021) that rearing practices may contribute to the increasing prevalence of parasitism. Cats with access to streets were three times more likely to get a gastrointestinal infection, primarily hookworm infection, than cats without access to the street. Even as a domiciled animal, due to the cat's predatory behavior, access to the street may have favored the cat's exposure to contaminated environments and to potential paratenic hosts that can be preyed on.

Deworming Status

There was a very strong significant relationship between the deworming status of cats and the prevalence of Ancylostoma sp. (Table 8).

No significant relationship was found to have existed between the cat's deworming status and the prevalence of Toxocara sp., Trichuris sp., Dipylidium sp., and Cystoisospora sp. (Table 8). The very strong significant relationship between the deworming status of cats and the prevalence of Ancylostoma sp. further solidifies the findings of Soe et al. (2023) that the deworming practice was linked to gastrointestinal parasites.

Positivity Rate of Each Test

The results have shown that flotation was the most sensitive test used in detecting Ancylostoma sp., Dipylidium sp., Toxocara sp., and Cystoisospora sp. (Table 10). However, Trichuris sp. was not detected in all three tests in cats.

CONCLUSION AND RECOMMENDATIONS

CONCLUSION

This study yields a wealth of fundamental understanding on the prevalence and the associated risk factors of Ancylostoma sp., Toxocara sp., Trichuris sp., Dipylidium sp., and Cystoisospora sp. Interestingly, it was found that several risk factors had a significant relationship in contracting different parasitic helminths. In Ancylostoma sp., it was revealed that the prevalence was dependent on the location, breed, rearing practices, and deworming status. In Toxocara sp., it was dependent on age, sex, and deworming status while Trichuris sp. was dependent on breed and deworming status. Moreover, the result in deworming status highlights the importance of regular deworming both in cats and dogs.

RECOMMENDATIONS

The study revealed that Ancylostoma sp. was the most common intestinal helminth found in dogs and cats owned. This result provides data on intestinal parasitism in Cavite, it may also be used as a guide by the Local Government Unit (LGU), Non-Government Organizations (NGO), and Education Institutions like schools and universities for more efficient diagnosis, regular parasitological monitoring and treatment. A proposal for an educational drive for the importance of proper and routine deworming of not only cats and dogs but also other companion animals can be made to increase the population's awareness about the harm of the parasites possess and the potential zoonotic risk and disease spillover.

Owners of household dogs and cats that tested positive for intestinal parasitism were also contacted and advised to bring their pet to the nearest veterinary clinic/hospital to have their pet a general checkup and to receive treatment.

Improvement in fecal analysis methods and techniques was recommended to increase the accuracy of species detection in the samples observed. ELISA and PCR tests were proven to be essential in making the right identification of helminths ova and protozoan oocyst.

Since it was found out that rearing practices have a strong significant relationship in the prevalence of Ancylostoma sp. in dogs and cats, it is recommended to educate the owners to limit or not let their pets freely roam outside their house particularly to areas with soil. Educating pet owners about the prevention of environmental contamination and improving hygiene procedures will help to reduce the infection of this parasitic helminth.

ACKNOWLEDGMENTS

The researchers thank Dr. Emmanuel Mago and Dr.

Rezin Bahia, technical critic and discussant respectively, for their suggestions and comments for the enhancement of this study. We also thank Ms. Sofia Jean Tenorio and Ms. Jamace Caga-anan, statisticians, for their expertise and all the owners, pets, and the community who took time and effort to participate in the study.

LITERATURE CITED

REFERENCES

Andrews, A. (2023, June 2). Coccidiosis of Cats and Dogs. MSD Veterinary Manual. https://www.msdvetmanual.com/digestive-system/coccidiosis/coccidiosis-of-cats-and-dogs

Arruda, I. F., Ramos, R. C. F., Barbosa, A. D. S., Abboud, L. C. S., Dos Reis, I. C., Millar, P. R., & Amendoeira, M. R. R. (2021). Intestinal parasites and risk factors in dogs and cats from Rio de Janeiro, Brazil. *Veterinary parasitology*, regional studies and reports, 24, 100552. https://doi.org/10.1016/j.vprsr.2021.100552

Beugnet, F., Halos, L. & Guillot, J. (2018). Textbook of clinical parasitology in dogs and cats.

Beugnet, F., Labuschagne, M., Fourie, J., Jacques, G., Farkas, R., Cozma, V., Rehbein, S. (2014). Occurrence of *Dipylidium caninum* in fleas from client- owned cats and dogs in Europe using a new PCR detection assay. *Veterinary Parasitology*, 205(1-2), 300–306. doi:10.1016/j.vetpar.2014.06.008

Bowman, D. D. (2014). Class Cestoda. Georgi's Parasitology for Veterinarians. 10th ed. St Louis, Missouri: Saunders Elsevier, 137-55.

Bowman, D. D., Montgomery, S. P., Zajac, A. M., Eberhard, M. L., & Kazacos, K. R. (2010). Hookworms of dogs and cats as agents of cutaneous larva migrans. *Trends in Parasitology*, 26(4), 162–167. https://doi.org/10.1016/j.pt.2010.01.005

Bowman, D. D., Lucio-Forster, A., & Janeczko, S. (2021). Internal parasites. Infectious Disease Management in Animal Shelters, 393-418.

Campos, D. R., Oliveira, L. C., De Siqueira, D. F., Perin, L. R., Campos, N. C., Aptekmann, K. P., & Martins, I. V. F. (2016). Prevalence and Risk Factors Associated with Endoparasitosis of Dogs and Cats in Espírito Santo, Brazil. *Acta Parasitologica*, 61(3), 544–548. https://doi.org/10.1515/ap-2016-0072

Castro, P. D. J., Howell, S. B., Schaefer, J. J., Avramenko, R. W., Gilleard, J. S., & Kaplan, R. M. (2019). Multiple drug resistance in the canine hookworm *Ancylostoma* caninum: An emerging threat? *Parasites and Vectors*, 12(1), 1– 15. https://doi.org/10.1186/s13071-019-3828-6

Council, C. a. P. (2022, November 22). *Dipylidium caninum*. Companion Animal Parasite Council. https://capcvet.org/guidelines/*Dipylidium*-caninum/

Dantas-Torres, F., Ketzis, J., Mihalca, A. D., Baneth, G., Otranto, D., Tort, G. P. Watanabe, M., Linh, B. K., Inpankaew, T., Castro, P. D. J., Borrás, P., Arumugam, S., Penzhorn, B. L., Ybañez, A. P., Irwin, P., Traub, R. J. (2020). TroCCAP recommendations for the diagnosis, prevention and treatment of parasitic infections in dogs and cats in the tropics. *Veterinary Parasitology*, 283. https://doi.org/10.1016/j.vetpar.2020.109167.

Elharoun, Marwa & Shahdah, Usama & El-Badawy, Sherif. (2018). DEVELOPING A MODE CHOICE MODEL FOR MANSOURA CITY IN EGYPT. *International Journal for Traffic and Transport Engineering (IJTTE)*. 8. 528 - 542. 10.7708/ijtte.2018.8(4).10.

Gonzalez-Saldívar, D. S., Trasviña, E., López Valencia, G., Haro, P., Monge Navarro, F. J., Herrera Ramírez, J. C., Castro del Campo, N., & Gaxiola Camacho, S. (2023). Frequency and risk factors of intestinal parasites in pet dogs from Mexicali, Mexico. *Austral Journal of Veterinary Sciences*, 55(2), 131–136. Retrieved from http://ajvs.cl/index.php/ajvs/

article/view/265

Jitsamai, W., Khrutkham, N., Hunprasit, V., Chandrashekar, R., Bowman, D., & Sukhumavasi, W. (2021). Prevalence of Endoparasitic and Viral Infections in Client-owned Cats in Metropolitan Bangkok, Thailand, and the Risk Factors Associated with Feline Hookworm Infections. *Veterinary Parasitology: Regional Studies and Reports*, 25 (August 2020), 100584. https://doi.org/10.1016/j.vprsr.2021.100584

Kumar, B. H., Jain, K., & Jain, R. (2014). A study of prevalence of intestinal worm infestation and efficacy of anthelminthic drugs. *Medical Journal Armed Forces India*, 70(2), 144–148. https://doi.org/10.1016/j.mjafi.2013.12.009

Lopez, J. C., Aguirre, M. J., Dalisay, J. (2016). Occurrence of Intestinal Helminth Parasites in Domestic Dogs (*Canis familiaris domesticus*) in Arevalo, Iloilo City, Philippines Using the Parasep Fecal Parasite Concentration Tenchnique. http://www.publiscience.org/wp-content/uploads/2020/04/Occurrence-of- Intestinal-Helminth-Parasites-in-Domestic-Dogs-Canis-familiaris-domesticus in-Arevalo-Iloilo-City PhilippinesUsingtheParasepFecalParasiteConcentration-Tenchnique.pdf

Ma, G., Rostami, A., Wang, T., Hofmann, A., Hotez, P. J., Gasser, R. B. (2020). Chapter Fourteen Global and regional seroprevalence estimates for human toxocariasis: A call for action. *Academic Press*, 109, 275-290. https://doi.org/10.1016/bs.apar.2020.01.011.

Moro, K. K., & Abah, A. E. (2019). Epizootiology of zoonotic parasites of dogs in Abua area of Rivers State, Nigeria. *Veterinary and Animal Science*, 7. https://doi.org/10.1016/j.vas.2018.100045

Mulinge, E., Njenga, S. M., Odongo, D., Magambo, J., Zeyhle, E., Mbae, C., Kagendo, D., Kanyi, H., Traub, R. J., Wassermann, M., Kern, P., & Romig, T. (2020). Molecular identification of zoonotic hookworms in dogs from four counties of Kenya. *Journal of Helminthology*, 94, 1–8. https://doi.org/10.1017/S0022149X1900018X

Murugan S, Kara & .B, Govindarajan. (2023). Statistical

Narasimham, M., Panda, P., Mohanty, I., Sahu, S., Padhi, S., & Dash, M. (2013). *Dipylidium caninum* infection in a child: A rare case report. *Indian Journal of Medical Microbiology*, 31(1), 82. doi:10.4103/0255-0857.108738

Neafie, R. C., & Marty, A. M. (1993). Unusual infections in humans. *Clinical Microbiology Reviews*, 6(1), 34-56.

Nemzek, J. A., Lester, P. A., Wolfe, A. M., Dysko, R. C., & Myers, D. D. (2015). Biology and Diseases of Dogs. In Laboratory Animal Medicine: Third Edition. https://doi.org/10.1016/B978-0-12-409527-4.00012-2

Ojo, G & Adekeye, Taiwo & Awobode, Henrietta. (2019). Prevalence of single and mixed parasitic infections of dogs in Egbeda communities, Ibadan, Oyo State, Nigeria. *Sokoto Journal of Veterinary Sciences*. 17. 25-34. 10.4314/sokjvs.v17i4.4.

Research, Statistics, Monitoring, and Evaluation Division Provincial Planning and Development Office. (2021). Chapter 3: Population and Social Profile,Cavite Ecological Profile 2020. Https://Cavite.Gov.Ph/. Retrieved June 9, 2023, from https://cavite.gov.ph/

Ridwan, Y., Sudarnika, E., Isyani, T., Dewi, T., & Budiono, N. (2023). Gastrointestinal Helminth Parasites of Pets : Retrospective Study at the Veterinary Teaching Hospital , IPB University , Bogor , Indonesia. 16, 1043–1051.

Samkari, A., Kiska, D. L., Riddell, S. W., Wilson, K., Weiner, L. B., & Domachowske, J. B. (2008). *Dipylidium Caninum* Mimicking Recurrent *Enterobius Vermicularis* (Pinworm) Infection. *Clinical Pediatrics*, 47(4), 397–399. doi:10.1177/0009922807310247

Schwartz, R., Bidaisee, S., Fields, P. J., Macpherson, M. L. A., & Macpherson, C. N. L. (2021). The epidemiology and control of *Toxocara canis* in puppies. *Parasite epidemiology and control*, 16, e00232. https://doi.org/10.1016/j.parepi.2021.e00232

Soe, BK, Su Hlaing K, Naing TW, Thaw ZH, and Myint W (2023). The first study on the prevalence of gastrointestinal parasites in owned and sheltered cats in Yangon, Myanmar. *Veterinary World*, 16 (2): 414–420. www.doi.org/10.14202/vetworld.2023.414-420

Taylor, M. A., Coop, R. L., Wall, R. L. (2015). Veterinary Parasitology, 4th Edition. Wiley-Blackwell.

Urgel, M. F. M., Ybañez, R. H. D., & Ybañez, A. P. (2019).

The detection of gastrointestinal parasites in owned and shelter dogs in Cebu, Philippines. *Veterinary world*, 12(3), 372–376. https://doi.org/10.14202/vetworld.2019.372-376

Table 1. Prevalence of *Ancylostoma sp., Dipylidium sp., Toxocara sp., Trichuris sp.,* and *Cystoisospora sp.* from fecal samples of dogs

SPECIES	TOTAL NO. OF SAMPLES	POSITIVE	NEGATIVE	PREVALENCE %
Ancylostoma sp.	301	78	223	25.9
Dipylidium sp.	301	1	300	0.3
Toxocara sp.	301	21	280	7.0
Trichuris sp.	301	33	268	11.0
Cystoisospora sp.	301	2	299	0.7

Table 2. Prevalence of *Ancylostoma sp*., *Dipylidium sp., Toxocara sp., Trichuris sp.,* and *Cystoisospora* sp. from fecal samples of cats

SPECIES	TOTAL NO. OF SAMPLES	POSITIVE	NEGATIVE	PREVALENCE %
Ancylostoma sp.	84	19	65	22.6
Dipylidium sp.	84	1	83	1.2
Toxocara sp.	84	14	70	16.7
Trichuris sp.	84	0	0	0
Cystoisospora sp.	84	4	80	4.8

Table 3. Prevalence of *Ancylostoma sp., Dipylidium sp., Toxocara sp., Trichuris sp.,* and *Cystoisospora sp.* relative to location in dogs

LOCATION	SPECIES	TOTAL NO. OF SAMPLES	POSITIVE	NEGATIVE	PREVALENCE %
Bacoor					
	Ancylostoma sp.	80	18	62	22.5^{WS}
	Cystoisospora sp.				
	Dipylidium sp.	80	0	0	0
	Toxocara sp.	80	1	79	1.3^{NS}
	Trichuris sp.	80	5	75	6.3^{NS}
		80	7	73	8.8^{NS}
Dasmariñas					
	Ancylostoma sp.	75	18	57	24.0^{WS}
	Cystoisospora sp.				
		75	1	74	1.3^{NS}
	Dipylidium sp.				
	Toxocara sp.	75	0	75	0
	Trichuris sp.	75	6	69	8.0^{NS}
		75	11	64	14.7^{NS}
General Trias					
	Ancylostoma sp.	65	27	38	41.5^{WS}
	Cystoisospora sp.				
		65	1	64	1.5^{NS}
	Dipylidium sp.				
	Toxocara sp.	65	0	65	0
	Trichuris sp.	65	7	58	10.8^{NS}
		65	11	54	16.9^{NS}
Imus					
	Ancylostoma sp.	81	15	66	18.5^{WS}
	Cystoisospora sp.				
		81	0	0	0
	Dipylidium sp.				
	Toxocara sp.	81	0	81	0
	Trichuris sp.	81	3	78	3.7^{NS}
		81	4	77	4.9^{NS}

NS: Not Significant; WS: Weakly Significant

Table 4. Prevalence of *Ancylostoma sp., Dipylidium sp., Toxocara sp., Trichuris sp., and Cystoisospora sp.* relative to location in cats

LOCATION	SPECIES	TOTAL NO. OF SAMPLES	POSITIVE	NEGATIVE	PREVALENCE %
Bacoor					
	Ancylostoma sp.	16	5	11	31.3^{NS}
	Cystoisospora sp. *Dipylidium* sp.	16	1	15	16.3^{NS}
	Toxocara sp.	16	0	16	0
	Trichuris sp.	16	4	12	25^{NS}
		16	0	16	0
Dasmariñas					
	Ancylostoma sp.	22	4	18	18.2^{NS}
	Cystoisospora sp. *Dipylidium* sp.	22	2	20	9.1^{NS}
	Toxocara sp.	22	0	22	0
	Trichuris sp.	22	2	20	9.1^{NS}
		22	0	22	0
General Trias					
	Ancylostoma sp.	31	5	26	16.1^{NS}
	Cystoisospora sp. *Dipylidium* sp.	31	1	30	3.2^{NS}
	Toxocara sp.	31	1	30	3.2^{NS}
	Trichuris sp.	31	4	27	12.9^{NS}
		31	0	31	0

Table 4. Continued

LOCATION	SPECIES	TOTAL NO. OF SAMPLES	POSITIVE	NEGATIVE	PREVALENCE %
Imus					
	Ancylostoma sp.	15	5	10	33.3^NS
	Cystoisospora sp.	15	0	15	0
	Dipylidium sp.	15	0	15	0
	Toxocara sp.	15	4	11	26.7^NS
	Trichuris sp.	15	0	15	0

NS: Not Significant

Table 5. Relation of age, sex, breed, type of rearing, and co-existence with other pets with the prevalence of gastrointestinal parasite in dogs

VARIABLES	CATEGORIES	PARASITE	TOTAL NO. OF SAMPLES	POSITIVE	NEGATIVE	PREVALENCE %
Age	<1 year old					
		Ancylostoma sp.	61	17	44	27.9^NS
		Cystoisospora sp.	61	2	59	3.3^NS
		Dipylidium sp.	61	0	61	0
		Toxocara sp.	61	10	51	16.4^MS
		Trichuris sp.	61	7	54	1.5^NS
	1 to 2 years old					
		Ancylostoma sp.	67	14	53	20.9^NS
		Cystoisospora sp.	67	0	67	0
		Dipylidium sp.	67	0	67	0
		Toxocara sp.	67	2	65	3.0^MS
		Trichuris sp.	67	7	60	10.4^NS

Table 5. Continued

VARIABLES	CATEGORIES	PARASITE	TOTAL NO. OF SAMPLES	POSITIVE	NEGATIVE	PREVALENCE %
	2 to 6 years old	*Ancylostoma* sp.	131	37	94	28.2^{NS}
		Cystoisospora sp.	131	0	131	0
		Dipylidium sp.	131	1	130	0.76^{NS}
		Toxocara sp.	131	8	123	6.1^{MS}
		Trichuris sp.	131	16	115	12.2^{NS}
	7 to 11 years old	*Ancylostoma* sp.	37	9	28	24.3^{NS}
		Cystoisospora sp.	37	0	37	0
		Dipylidium sp.	37	0	37	0
		Toxocara sp.	37	1	36	2.7^{MS}
		Trichuris sp.	37	2	35	5.4^{NS}
	>12 years old	*Ancylostoma* sp.	5	1	4	24.3^{NS}
		Cystoisospora sp.	5	0	5	0
		Dipylidium sp.	5	0	5	0
		Toxocara sp.	5	0	5	0
		Trichuris sp.	5	1	4	20^{NS}
Sex	Female	*Ancylostoma* sp.	130	32	98	24.6^{NS}
		Cystoisospora sp.	130	0	130	0
		Dipylidium sp.	130	1	129	0.8^{NS}
		Toxocara sp.	130	15	115	11.5^{WS}
		Trichuris sp.	130	11	119	8.5^{NS}
	Male	*Ancylostoma* sp.	171	46	125	26.9^{NS}
		Cystoisospora sp.	171	2	169	1.2^{NS}
		Dipylidium sp.	171	0	171	0
		Toxocara sp.	171	6	165	3.5^{WS}
		Trichuris sp.	171	22	149	12.9^{NS}

Table 5. Continued

VARIABLES	CATEGORIES	PARASITE	TOTAL NO. OF SAMPLES	POSITIVE	NEGATIVE	PREVALENCE %
Breed	Mixed	*Ancylostoma* sp.	162	54	108	33.3^{WS}
		Cystoisospora sp.	162	1	161	0.6^{NS}
		Dipylidium sp.	162	1	161	0.61^{NS}
		Toxocara sp.	162	15	147	9.3^{NS}
		Trichuris sp.	162	26	136	16.0^{WS}
	Pure breed	*Ancylostoma* sp.	139	24	115	17.3^{WS}
		Cystoisospora sp.	139	1	138	0.7^{NS}
		Dipylidium sp.	139	0	139	0
		Toxocara sp.	139	6	133	4.3^{NS}
		Trichuris sp.	139	7	132	5.0^{WS}
Rearing practices	Inside	*Ancylostoma* sp.	175	26	149	14.9^{SS}
		Cystoisospora sp.	175	1	174	0.6^{NS}
		Dipylidium sp.	175	0	175	0
		Toxocara sp.	175	9	166	5.1^{NS}
		Trichuris sp.	175	13	162	7.4^{NS}
Rearing practices	Outside	*Ancylostoma* sp.	126	52	74	41.3^{SS}
		Cystoisospora sp.	126	1	125	0.8^{NS}
		Dipylidium sp.	126	1	125	0.79^{NS}
		Toxocara sp.	126	12	114	9.5^{NS}
		Trichuris sp.	126	20	106	15.9^{NS}
Co-existence with other pets	With other pets	*Ancylostoma* sp.	223	59	164	26.5^{NS}
		Cystoisospora sp.	223	2	221	0.9^{NS}
		Dipylidium sp.	223	0	223	0
		Toxocara sp.	223	14	209	$6.3\%^{NS}$
		Trichuris sp.	223	24	199	10.8^{NS}
	Without other pets	*Ancylostoma* sp.	78	19	59	24.4^{NS}
		Cystoisospora sp.	78	0	78	0
		Dipylidium sp.	78	1	77	1.28^{NS}
		Toxocara sp.	78	7	71	$9.0\%^{NS}$
		Trichuris sp.	78	9	69	11.5^{NS}

MS: Moderately Significant; NS: Not Significant; SS: Strongly Significant; WS: Weakly Significant

Table 6. Relation of age, sex, breed, type of rearing, and co-existence with other pets with the prevalence of gastrointestinal parasites in cats

VARIABLES	CATEGORIES	PARASITE	TOTAL NO. OF SAMPLES	POSITIVE	NEGATIVE	PREVALENCE %
Age	<1 year old	*Ancylostoma* sp.	20	3	17	15^{NS}
		Cystoisospora sp.	20	1	19	5^{NS}
		Dipylidium sp.	20	1	19	5
		Toxocara sp.	20	2	18	10^{NS}
		Trichuris sp.	20	0	20	0
	1 to 6 years old					
		Ancylostoma sp.	62	16	46	25.8^{NS}
		Cystoisospora sp.	62	3	59	4.8^{NS}
		Dipylidium sp.	62	0	62	0
		Toxocara sp.	62	11	51	17.7^{NS}
		Trichuris sp.	62	0	62	0
	7 to 10 years old					
		Ancylostoma sp.	1	0	1	0
		Cystoisospora sp.	1	0	1	0
		Dipylidium sp.	1	0	1	0
		Toxocara sp.	1	1	0	100^{NS}
		Trichuris sp.	1	0	1	0
	>10 years old					
		Ancylostoma sp.	1	0	1	0
		Cystoisospora sp.	1	0	1	0
		Dipylidium sp.	1	0	1	0
		Toxocara sp.	1	0	1	0
		Trichuris sp.	1	0	1	0
Sex	Female					
		Ancylostoma sp.	45	14	31	31.1^{MS}
		Cystoisospora sp.	45	31	14	6.7^{NS}
		Dipylidium sp.	45	1	44	2.2^{NS}
		Toxocara sp.	45	10	35	22.2^{NS}
		Trichuris sp.	45	0	45	0
	Male					
		Ancylostoma sp.	39	5	34	12.8^{MS}
		Cystoisospora sp.	39	1	38	2.6^{NS}
		Dipylidium sp.	39	0	39	0
		Toxocara sp.	39	4	35	10.3^{NS}
		Trichuris sp.	39	0	39	0

Table 6. Continued

VARIABLES	CATEGORIES	PARASITE	TOTAL NO. OF SAMPLES	POSITIVE	NEGATIVE	PREVALENCE %
Breed	Mixed	*Ancylostoma* sp.	34	10	24	29.4^{NS}
		Cystoisospora sp.	34	2	32	5.9^{NS}
		Dipylidium sp.	34	1	33	2.94^{NS}
		Toxocara sp.	34	6	28	17.6^{NS}
		Trichuris sp.	34	0	34	0
	Pure breed	*Ancylostoma* sp.	50	9	41	18.0^{NS}
		Cystoisospora sp.	50	2	48	4^{NS}
		Dipylidium sp.	50	0	50	0
		Toxocara sp.	50	8	42	16^{NS}
		Trichuris sp.	50	0	50	0
Rearing practices	Inside	*Ancylostoma* sp.	48	6	42	12.5^{VSS}
		Cystoisospora sp.	48	2	46	4.2^{NS}
		Dipylidium sp.	48	0	48	0
		Toxocara sp.	48	7	41	14.6^{NS}
		Trichuris sp.	48	0	48	0
	Outside	*Ancylostoma* sp.	36	13	23	36.1^{VSS}
		Cystoisospora sp.	36	2	34	5.6^{NS}
		Dipylidium sp.	36	1	35	2.77^{NS}
		Toxocara sp.	36	7	29	19.4^{NS}
		Trichuris sp.	36	0	36	0
Co-existence with other pets	With other pets	*Ancylostoma* sp.	72	18	54	25^{NS}
		Cystoisospora sp.	72	4	68	5.6^{NS}
		Dipylidium sp.	72	1	71	1.38^{NS}
		Toxocara sp.	72	13	59	18.1^{NS}
		Trichuris sp.	72	0	72	0
	Without other pets	*Ancylostoma* sp.	12	1	11	8.3^{NS}
		Cystoisospora sp.	12	0	12	0
		Dipylidium sp.	12	0	12	0
		Toxocara sp.	12	1	11	8.3^{NS}
		Trichuris sp.	12	0	12	0

MS: Moderately Significant; NS: Not Significant; VSS: Very Strongly Significant

Table 7. Association between deworming status and prevalence of gastrointestinal parasites in dogs

DEWORMING STATUS	PARASITE	TOTAL NO. OF SAMPLES	POSITIVE	NEGATIVE	PREVALENCE %
Updated					
	Ancylostoma sp.	80	11	69	13.8^{WS}
	Cystoisospora sp.	80	0	80	0
	Dipylidium sp.	80	0	80	0
	Toxocara sp.	80	2	78	2.5^{MS}
	Trichuris sp.	80	2	78	2.5^{MS}
Not updated					
	Ancylostoma sp.	95	23	72	24.2^{WS}
	Cystoisospora sp.	95	1	94	1.1^{NS}
	Dipylidium sp.	95	0	95	0
	Toxocara sp.	95	3	92	3.2^{MS}
	Trichuris sp.	95	8	87	8.4^{MS}
No Deworming					
	Ancylostoma sp.	126	44	82	34.9^{WS}
	Cystoisospora sp.	126	1	125	0.8^{NS}
	Dipylidium sp.	126	1	125	0.79^{NS}
	Toxocara sp.	126	16	110	12.7^{MS}
	Trichuris sp.	126	23	103	18.3^{MS}

MS: Moderately Significant; NS: Not Significant; WS: Weakly Significant

Table 8. Association between deworming status and prevalence of gastrointestinal parasites in cats

DEWORMING STATUS	PARASITE	TOTAL NO. OF SAMPLES	POSITIVE	NEGATIVE	PREVALENCE %
Updated					
	Ancylostoma sp.	18	0	18	0
	Cystoisospora sp.	18	0	18	0
	Dipylidium sp.	18	0	18	0
	Toxocara sp.	18	1	17	5.6^{NS}
	Trichuris sp.	18	0	18	0
Not updated					
	Ancylostoma sp.	27	4	23	14.8^{NS}
	Cystoisospora sp.	27	0	27	0
	Dipylidium sp.	27	0	27	0
	Toxocara sp.	27	5	22	18.5^{NS}
	Trichuris sp.	27	0	0	0

Table 8. Continued

DEWORMING STATUS	PARASITE	TOTAL NO. OF SAMPLES	POSITIVE	NEGATIVE	PREVALENCE %
No Deworming					
	Ancylostoma sp.	39	15	24	38.5[NS]
	Cystoisospora sp.	39	4	35	10.3[NS]
	Dipylidium sp.	39	1	38	18.5[NS]
	Toxocara sp.	39	8	31	18.5[NS]
	Trichuris sp.	39	0	39	0

NS: Not Significant

Table 9. Dogs' positivity rate of each test used in detecting gastrointestinal parasites

TEST	PARASITE	TOTAL NO. OF SAMPLES	POSITIVE	NEGATIVE	POSITIVITY RATE %
Direct Fecal Smear					
	Ancylostoma sp.	301	47	254	15.6
	Cystoisospora sp.				
	Dipylidium sp.	301	1	300	0.3
	Toxocara sp.				
	Trichuris sp.	301	0	301	0
		301	16	285	5.3
		301	19	282	6.3
Flotation					
	Ancylostoma sp.	301	76	225	25.2
	Cystoisospora sp.				
	Dipylidium sp.	301	2	299	0.7
	Toxocara sp.				
	Trichuris sp.	301	0	301	0
		301	20	281	6.6
		301	28	273	9.3
Sedimentation					
	Ancylostoma sp.	301	57	244	18.9
	Cystoisospora sp.				
	Dipylidium sp.	301	0	301	0
	Toxocara sp.				
	Trichuris sp.	301	1	300	0.3
		301	17	284	5.6
		301	17	284	5.6

Table 10. Cats' positivity rate of each test used in detecting gastrointestinal parasites

TEST	PARASITE	TOTAL NO. OF SAMPLES	POSITIVE	NEGATIVE	POSITIVITY RATE %
Direct Fecal Smear					
	Ancylostoma sp.	84	9	75	10.7
	Cystoisospora sp.	84	2	82	2.4
	Dipylidium sp.				
	Toxocara sp.	84	0	84	0
	Trichuris sp.	84	11	73	13.1
		84	0	84	0
Flotation					
	Ancylostoma sp.	84	19	65	22.6
	Cystoisospora sp.	84	4	80	4.8
	Dipylidium sp.				
	Toxocara sp.	84	1	83	1.2
	Trichuris sp.	84	12	72	14.3
		84	0	84	0
Sedimentation					
	Ancylostoma sp.	84	12	72	14.3
	Cystoisospora sp.	84	1	83	1.2
	Dipylidium sp.				
	Toxocara sp.	84	0	84	0
	Trichuris sp.	84	8	76	9.5
		84	0	84	0