

## Research Article

# Prevalence of Zoonotic Gastrointestinal Helminth Parasite among Dogs in Suryabinayak, Nepal

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Received 24 February 2023; Revised 13 May 2023; Accepted 20 May 2023; Published 30 May 2023

Academic Editor: Carlos Alberto Hussni

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Dogs are popular pets around the world and have always had a very close relationship with humans. Zoonotic gastrointestinal helminth parasites are a great threat to both stray and pet dogs. This study was carried out to determine the prevalence of zoonotic gastrointestinal helminths in dogs. 400 samples were collected, including 200 from pet dogs and 200 from stray dogs. The samples from pet dogs were collected from the ground immediately after voiding with the help of the owner, whereas stray dogs were caught by using a dog catcher, and the samples were collected directly from the rectum by using a gloved index finger. All collected samples were examined under a microscope using sedimentation and flotation techniques. The overall prevalence of infection was found to be 59.50%, with a significantly higher prevalence in stray dogs (70%) than that in pet dogs (49%). *Ancylostoma* spp., *Toxocara* spp., *Trichuris* spp., *Capillaria* spp., *Dipylidium caninum*, and *Taenia/Echinococcus* spp. were six different species found in the current study. The study showed the highest prevalence of *Ancylostoma* spp. (49.16%) and the least prevalence of *Capillaria* spp. (0.84%). In the age-wise study, puppies had a significantly high infection rate (86.96%). Similarly, we recorded a significantly higher prevalence of intestinal helminths among nondewormed pet dogs (78.65%) than among dewormed pet dogs (25.23%). This study highlights the severe environmental contamination shed by dogs, causing a higher risk of zoonotic transmission. It indicates the urgent need to manage these parasites in dogs and educate the public on how to care for their pets and the parasites they shed.

## 1. Introduction

Dogs are very popular pets around the world and have always had a very close relationship with humans. The gastrointestinal helminth parasites (GIHPs) are a great threat to both stray and pet dogs. Most of them are zoonotic parasites. More than 60 distinct zoonotic disease subtypes are associated with dogs. The majority of them pose a great threat to human health [1–5]. *Giardia*, *Cystoisospora*, *Taenia*, *Echinococcus*, *Dipylidium*, *Toxocara*, *Ancylostoma*, *Capillaria*, and *Trichuris* are some of the most common intestinal parasites that infect dogs [5, 6]. The most significant epidemiologically include *Toxocara*, *Ancylostoma*, and *Echinococcus* [3, 7]. *Echinococcus*, *Giardia*, *Toxocara*, and *Cryptosporidium* are common zoonotic GIHPs of dogs. They may spread to people causing different illnesses, including

hydatidosis, giardiasis, toxocariasis, and cryptosporidiosis [8]. Stray and semidomesticated dogs have a greater frequency of parasites because they reside in lower resource habitat, which have more favourable environmental conditions for the growth of parasites [9]. Overcrowding and environmental contamination may also contribute to the spread and maintenance of parasitic infections among dogs. In order to manage parasitic infections in stray and semidomesticated dogs, specific treatment may be required [10]. The prevalence of gastrointestinal parasites among dogs is high in developing countries such as Nepal [11] because dogs in these countries are not or rarely treated for parasitic diseases and there is a lack of policies for pet ownership [12]. Therefore, dogs pose a serious threat to public health even though they are helpful pet animals [13], specially in developing countries.

The trend of raising dogs as pets is growing, and the number of stray dogs has also sharply grown in Suryabinayak municipality. All the stray dogs and most of the semidomesticated dogs wander and defecate freely on the streets and public areas. Moreover, the pet owners also bring their dogs in the public areas for pooping. Large numbers of infective stages (oocysts, cysts, eggs, and larvae) of intestinal parasites are excreted by infected dogs through their faeces and are left behind in parks, playgrounds, gardens, roadways, and other public areas, which pose a danger of infection to humans. Therefore, dogs serve as both reservoirs and transmitters of many parasites [14]. Transmission of these infective stages occur accidentally through the contaminated soil or by ingesting contaminated food, raw vegetables, or water or by direct contact with an infected dogs [3, 7]. Children are especially susceptible to the infections due to their frequent interactions with dogs, as well as the fact that they play frequently in open areas such as parks, playgrounds, public gardens, temples, and roadways with poor cleanliness standards [3, 15]. To reduce the hazards to humans, it is crucial to understand the epidemiology of zoonotic parasite diseases in close-knit animals such as dogs. There are very few reports available about the risk of dog-man infection in Nepal's rural and suburban regions. Many stray, semi-domesticated, and domestic dogs wander freely in the majority of these localities with little to no veterinary care. The aim of this study is to assess the prevalence of zoonotic gastrointestinal parasites in dogs in Suryabinayak municipality, Nepal.

## 2. Materials and Methods

**2.1. Study Area and Study Population.** The Suryabinayak municipality of central Nepal was the study area (Figure 1), which is located in the southern part of Bhaktapur district. The municipality has been divided into ten wards and covers 42.45 km<sup>2</sup> area [16]. According to Census conducted by Central Bureau of Statistics (CBS), Suryabinayak municipality had total population of 140,085 [17]. Unfortunately, the official record of the dog population in the municipality was not available. However, it is common to see dogs in the streets in and around human settlement area and many households keep dogs as pets. Samples were collected from both stray dogs and pet dogs. For sample collection, 20 pet dogs and 20 stray dogs were selected from each ward. So, there were a total of 400 samples including 200 from pet dogs and same numbers from stray dogs. We gave red mark to the stray dog after collection of sample to avoid repetition. Stratified random sampling technique was used for the collection of samples. Pet dogs were classified into four age groups as puppies (0–6 months), young dogs (>6 months to 12 months), adults (>12 months to <10 years), and old (10 years and older) as per information obtained through interview with the owner.

**2.2. Sample Size Determination.** The formula was used to determine sample size [18] with a 95% confidence level. The expected prevalence of GIHPs in the dogs of Kathmandu was 46.7% [19].

$$n = \frac{1.96^2 \times p(1-p)}{d^2}, \quad (1)$$

where  $n$  represents the required sample size;  $p$  represents the expected prevalence, i.e., 46.7%; and  $d$  represents the desired absolute precision, 5%.

The minimum sample size given by using the above formula was 383, but the final sample size was 400.

**2.3. Questionnaire Survey.** Different structured questionnaires were prepared and interviewed among pet owners. The questionnaires were set to assess the sex and age of pet dogs, deworming schedule, and awareness about canine intestinal parasitic zoonosis.

**2.4. Sample Collection.** The stray dogs were caught by using dog catcher and stool sample was taken directly from the rectum by using gloved index finger. Samples from pet dogs were collected from the ground instantly after pooping with the help of the owner. The purpose of the research work was shared with the pet owners, who were also instructed to collect stool samples from the ground instantly after pooping by using a polythene bag while they took out their dogs. All the collected samples were kept in appropriately labelled leak-proof containers and transported to the laboratory for immediate examination, and a 1-2% formalin solution was used for preservation whenever immediate examination was not possible. Total 400 samples were collected from the study area during the study period with an equal number of samples ( $N=200$ ) from both pet and stray dogs.

**2.5. Faecal Examinations.** The samples were first checked with naked eye for any adult stage of the parasites and then these were prepared for microscopic examination. Each faecal sample was examined qualitatively using the formal-ether sedimentation technique [20] and salt floatation techniques [21]. The result was considered positive if either any adult stage of the parasite was detected during the macroscopic examination, at least one parasite egg was found during the microscopic examination, or both [22]. The parasite stages and eggs of parasite were identified by using standard morphological criteria [23].

**2.6. Statistical Data Analysis.** Statistical analysis was performed by using R version 3.2.2. The Pearson's chi-square test was used to evaluate bivariate relationships between the result and specific explanatory factors.  $P < 0.05$  was taken as statistically significant for all analysis.

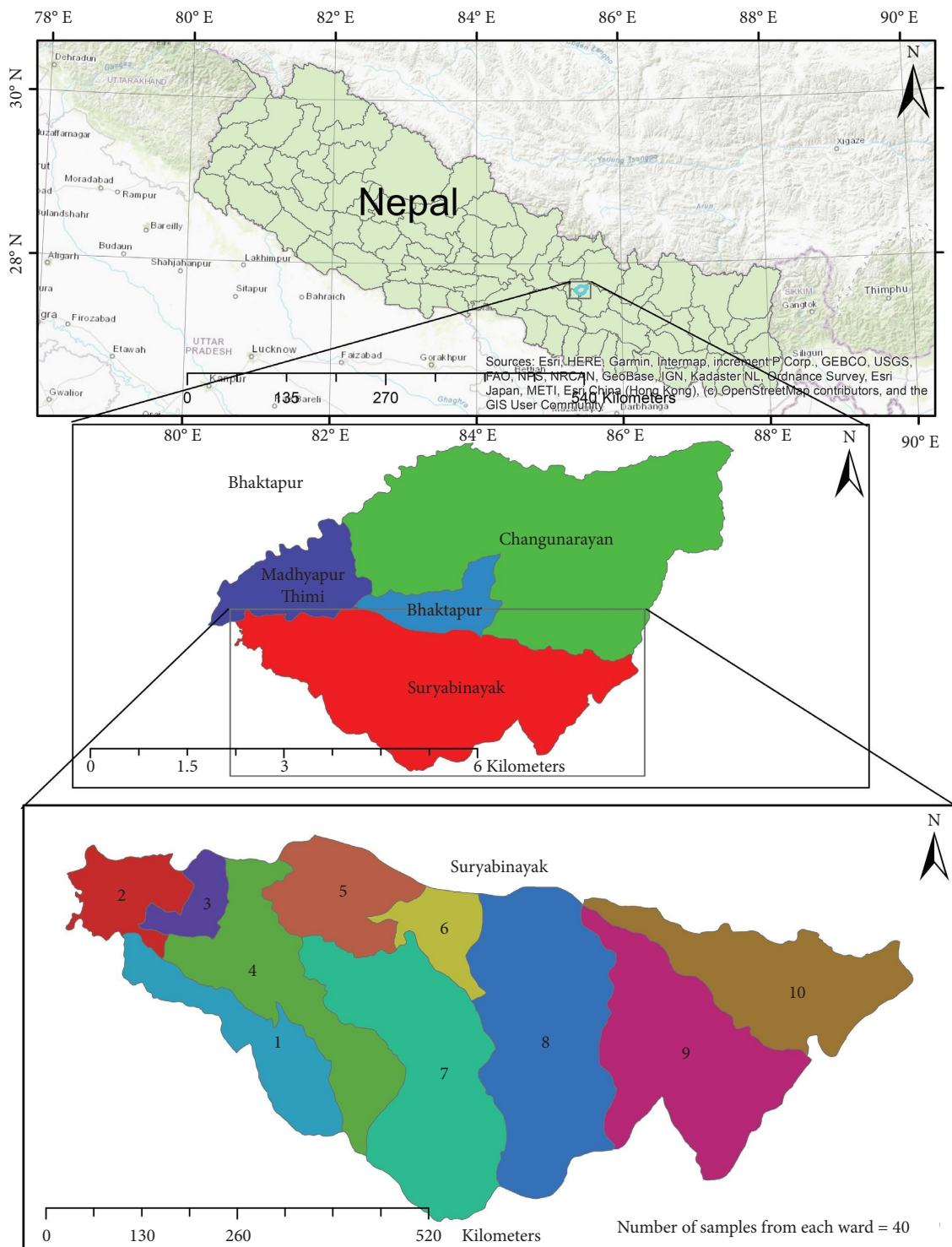


FIGURE 1: Study area.

### 3. Results

Present study revealed overall prevalence of infection with zoonotic GIHPs being 59.50% (238/400) (Table 1). Equal number of faecal samples were collected from both stray and pet dogs i.e., 200 from each. The significantly higher prevalence was found in stray dogs (70%) than that in pet

dogs (49%). Among 400 samples, 243 were from male and 157 were from female dogs. The sex-wise prevalence showed higher infection of zoonotic GIHPs in male dogs (63.79% v/s 52.87%) but the sex was found statistically insignificant ( $P > 0.05$ ). The males of both stray and pet dogs were found highly infected by zoonotic GIHPs. In the age-wise prevalence, the highest (86.96%) prevalence of intestinal

TABLE 1: Prevalence of intestinal helminth parasites.

	Male dogs	Female dogs	Pet dogs	Stray dogs	Dewormed pet dogs	Nondewormed pet dogs	General
Total	243	157	200	200	111	89	400
Positive no. (%)	155 (63.79)	83 (52.87)	98 (49.00)	140 [70.00]	28 (25.23)	70 (78.65)	238 (59.50)
<i>P</i> value		0.063		2.97e-5		1.72e-13	
$\chi^2$		3.46		17.44		54.30	

helminths was found in puppies and the least (31.58%) was among the old dogs (Figure 2). The age of the dog was found to be statistically significant ( $P < 0.05$ ).

Among the 200 samples collected from pet dogs, 111 were from dewormed dogs within six months, and the remaining 89 samples were from nondewormed pet dogs. The prevalence of gastrointestinal helminths was found significantly higher among samples from nondewormed pet dogs (78.65%) than from dewormed pet dogs (25.23%) ( $P < 0.05$ ). The study revealed six different types of zoonotic GIHPs (*Ancylostoma* spp., *Toxocara* spp., *Trichuris* spp., *Capillaria* spp., *Dipylidium caninum*, and *Taenia/Echinococcus* spp.) belonging to two different classes (nematoda and cestoda). Among them, *Ancylostoma* spp. was the most common helminth (49.16%) parasite and *Capillaria* spp. was found to be the least prevalent (0.84%). The parasites of the class nematoda were found to be higher (73.95%) than cestoda (Table 2). The highest prevalence (72.50%) was found in ward number nine and the lowest (45.00%) prevalence was found in ward number two (Figure 3), but the ward was found statistically insignificant ( $P > 0.05$ ).

**3.1. Limitations of the Current Study.** The type of anthelmintic drugs used and the type of food materials served to pet dogs were not investigated during this research work. Similarly, the teeth of the stray dogs were not studied, hence the age-wise prevalence of zoonotic GIHPs for the stray dogs was not calculated.

## 4. Discussion

The zoonotic GIHPs are a serious health problem among dogs in developing countries including Nepal and cause great threat to human health. Understanding the epidemiology of zoonotic parasitic infections in dogs helps to minimize the risk to humans. The overall prevalence of intestinal helminths found in the present study was found to be 59.5%. This result was comparable with earlier studies conducted in Rupandehi 58.75% [24]; Mampong, Ghana 52.60% [15]; Mazandaran, Iran 59.50% [1]; Nigeria 52.60% [25]; Guimaraes, Portugal 57.20% [26]; 56% in Sidama, Ethiopia [27]; and Italy 52.50% [28]. But the prevalence of present study was higher than the previous studies conducted in Kathmandu 46.7% [19], Lower Dir district, Pakistan 26.8% [29]; Tabasco, Mexico 19.20% [30]; Lodz, Poland 37.40% [3]; Hamadan, Iran 20.40% [31]; Thailand 40.10% [32]; La Habana, Cuba 43.90% [33]; Zaria, Nigeria 33.90% [34]; Iran 19.10% [35]; Osaka, Japan 39.20% [4]; Venezuela 35.50% [36]; and Czech Republic 17.60% [6]. Interestingly, the higher prevalence of GIHPs was recorded in India 88.9% [37]; more than 80% in Mexico [13, 38]; 80%–

95.2% in Iran [39–41]; 76.27% in Ethiopia [42]; 83.60% in Brazil [22]; 71.60% in Catalonia, Spain [10]; 90% in Kandy, Peradeniya [11]; 98.60% in Italy [2]; 80% in Yucatan, Mexico [13]; and 90.70% in Uttar Pradesh, India [37]. These variations are probably due to differences in climate and geographical location. The prevalence of zoonotic helminths in stray dogs was higher (70%) than in pet dogs (49%), which is similar with the previous result from different parts of the globe [3, 19, 24, 29, 31, 34]. Stray dogs roam the open areas, exposing them to risk factors of disease transmission. The lack of anthelmintic treatment is another reason for the higher positivity in stray dogs.

The number of intestinal helminth parasite species registered in the survey (i.e., six) was within the range of 5–10 species documented worldwide [4, 19, 26, 37, 41]. *Ancylostoma* spp. had the highest prevalence, followed by *Toxocara canis*, which has zoonotic importance. This finding is also supported by the previous studies in Nepal [19, 24], India [13, 37], Ethiopia [27], and Mexico [13, 37]. Application of the One Health concept has to be encouraged to improve the management of intestinal helminth parasites and to reduce the risk of exposure for both dogs and humans. The study needs to be replicated in other districts of Nepal to give an overall variation of helminth infection among dogs. Sex-wise prevalence showed higher infection in male dogs than in females. A study from Rupandehi also showed similar findings [24]. The result is also supported by results obtained in Iran, Italy, India, and Mexico [28, 38, 41].

Although studies have divided the age of the host into several groups, there is universal agreement that puppies have a greater frequency of intestinal helminth parasites than adults. Horizontal transmission by the consumption of larvae from vertebrate or invertebrate paratenic hosts or the eating of embryonated eggs from the environment, as well as vertical transmission, trans-placental, and/or trans-mammary transmission, and other means infect puppies [7]. The parasite-specific immunity is often developed with age, most likely as a result of one or more encounters [36]. According to the current study, dogs under a year old were more than twice as likely as older dogs to get helminth parasites. Similar results were previously reported from Kathmandu and Rupandehi in Nepal [19, 24], Osaka in Japan [4], and in Nigeria [25]. The significantly higher prevalence of gastrointestinal helminths in nondewormed pet dogs (78.65%) than in dewormed pet dogs (25.23%) illustrates the effectiveness of anthelmintic usage in dogs. The highest positivity for zoonotic GIHPs was associated with a lack of knowledge about canine zoonotic diseases among local people, semidomestication of pet dogs, failure to provide anthelmintic drugs to pet dogs, and an open sanitary system. So, it was found different for different wards

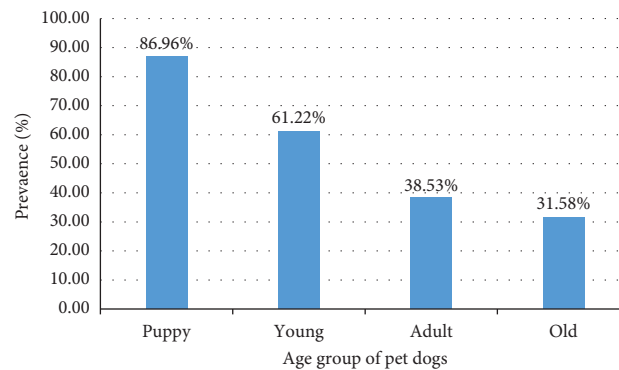


FIGURE 2: Age-wise prevalence of intestinal helminth parasites in pet dogs ( $P$  value =  $3.54e-5$ ;  $\chi^2 = 23.28$ ).

TABLE 2: Intestinal helminth parasites identified in the dogs of Suryabinayak municipality.

Class	Parasite	Dogs		Overall positive number (prevalence (%))
		Stray No. (%)	Pet No. (%)	
Nematoda	<i>Ancylostoma</i> spp.	67 (47.86)	50 (51.03)	117 (49.16)
	<i>Toxocara</i> spp.	36 (25.71)	16 (16.33)	52 (21.85)
	<i>Trichuris</i> spp.	5 (3.57)	0 (0.00)	5 (2.10)
	<i>Capillaria</i> spp.	2 (1.43)	0 (0.00)	2 (0.84)
Cestoda	<i>Dipylidium caninum</i>	8 (5.71)	20 (20.41)	28 (11.77)
	<i>Taenia/Echinococcus</i> spp.	22 (15.71)	12 (12.24)	34 (14.29)

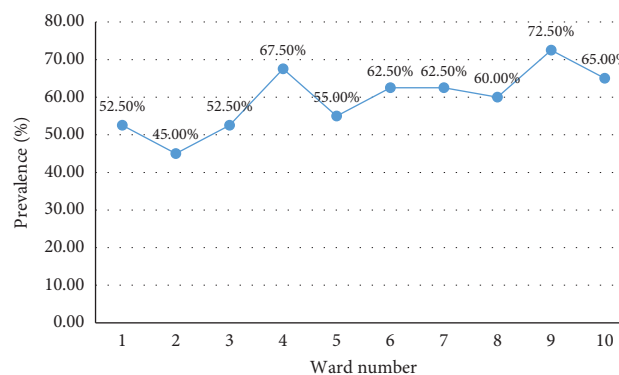


FIGURE 3: Ward-wise prevalence of intestinal helminth parasites ( $P$  value = 0.34;  $\chi^2 = 10.13$ ).

of Suryabinayak municipality. The highest prevalence (72.50%) was found in ward number nine and the lowest (45.00%) prevalence was found in ward number two. The highest prevalence of zoonotic GIHPs among the dogs of ward number nine might be due to lack of awareness among local people, carelessness of dog owner, practice of semi-domestication of dogs, and an open sanitary system throughout the area of ward number nine. Whereas the lowest prevalence of zoonotic GIHPs in the dogs of ward number two might be due to proper management of the sanitary system and full domestication of pet dogs.

## 5. Conclusion

The present study noticeably verified that the most important zoonotic gastrointestinal helminths are present in both stray and pet dogs in Suryabinayak municipality, Nepal. They are great challenges for public health. The result indicates the necessity for a reduction in the number of stray dogs in Suryabinayak municipality in order to minimize risks of zoonotic gastrointestinal helminth parasitic infection to humans. Local authorities should implement effective strategies for homeless dog population control, such

as the creation of new shelters with adequate veterinary care, large-scale sterilization of animals, deworming programs for both stray and pet dogs, as well as greater enforcement of laws concerning pet ownership and educating owners.

## Data Availability

The data used to support the findings of this study are available from the corresponding author upon reasonable request.

## Conflicts of Interest

The authors declare that they have no conflicts of interest.

## Authors' Contributions

PRS was the project leader, made conceptual and editorial contributions, performed the statistical work, and provided valuable comments on the manuscript. ST was responsible for data collection and preparation of the manuscript. All authors revised and approved the final version of the manuscript.

## Acknowledgments

This study was funded by grants from the University Grants Commission, Nepal (UGC Award no. SRDIG-76/77-S&T-7). The author is also grateful to the Bhaktapur Multiple Campus and Veterinary Centre Bhaktapur, the local government of Suryabinayak Municipality, and pet owners.

## References

- [1] A. Amouei, H. Jahandar, A. Daryani et al., "Carnivores as important reservoirs of intestinal helminthic infections in mazandaran province, northern Iran," *Iranian Journal of Parasitology*, vol. 13, no. 2, pp. 251–257, 2018.
- [2] L. Rinaldi, A. Biggeri, S. Carbone et al., "Canine faecal contamination and parasitic risk in the city of Naples (southern Italy)," *BMC Veterinary Research*, vol. 2, no. 1, p. 29, 2006.
- [3] K. Szwabe and J. Błaskowska, "Stray dogs and cats as potential sources of soil contamination with zoonotic parasites," *Annals of Agricultural and Environmental Medicine*, vol. 24, no. 1, p. 5, 2017.
- [4] A. Kimura, Y. Morishima, S. Nagahama et al., "A coprological survey of intestinal helminthes in stray dogs captured in Osaka prefecture, Japan," *Journal of Veterinary Medical Science*, vol. 75, no. 10, pp. 1409–1411, 2013.
- [5] P. Deplazes, F. van Knapen, A. Schweiger, and P. A. M. Overgaauw, "Role of pet dogs and cats in the transmission of helminthic zoonoses in Europe, with a focus on echinococcosis and toxocarosis," *Veterinary Parasitology*, vol. 182, no. 1, pp. 41–53, 2011.
- [6] S. Dubná, I. Langrová, J. Nápravník et al., "The prevalence of intestinal parasites in dogs from Prague, rural areas, and shelters of the Czech Republic," *Veterinary Parasitology*, vol. 145, no. 1–2, pp. 120–128, 2007.
- [7] P. A. M. Overgaauw and F. van Knapen, "Veterinary and public health aspects of *Toxocara* spp.," *Veterinary Parasitology*, vol. 193, no. 4, pp. 398–403, 2013.
- [8] D. Otranto, F. Dantas-Torres, A. D. Mihalca, R. J. Traub, M. Lappin, and G. Baneth, "Zoonotic parasites of sheltered and stray dogs in the era of the global economic and political crisis," *Trends in Parasitology*, vol. 33, no. 10, pp. 813–825, 2017.
- [9] F. Dantas-Torres and D. Otranto, "Dogs, cats, parasites, and humans in Brazil: opening the black box," *Parasites & Vectors*, vol. 7, no. 1, p. 22, 2014.
- [10] A. Ortuño, V. Scorza, J. Castellà, and M. Lappin, "Prevalence of intestinal parasites in shelter and hunting dogs in Catalonia, Northeastern Spain," *The Veterinary Journal*, vol. 199, no. 3, pp. 465–467, 2014.
- [11] P. Perera, R. Rajapakse, and R. Rajakaruna, "Gastrointestinal parasites of dogs in hantana area in the Kandy district," *J Natn Sci Foundation Sri Lanka*, vol. 41, no. 2, p. 81, 2013.
- [12] U. S. Ugboimoiko, L. Ariza, and J. Heukelbach, "Parasites of importance for human health in Nigerian dogs: high prevalence and limited knowledge of pet owners," *BMC Veterinary Research*, vol. 4, no. 1, p. 49, 2008.
- [13] R. I. Rodríguez-Vivas, E. Gutierrez-Ruiz, M. E. Bolio-González et al., "An epidemiological study of intestinal parasites of dogs from yucatan, Mexico, and their risk to public health," *Vector Borne and Zoonotic Diseases*, vol. 11, no. 8, pp. 1141–1144, 2011.
- [14] K. K. Yadav and B. Shrestha, "Prevalence of zoonotic gastrointestinal helminth parasites in pet and stray dogs of Rupandehi district, Nepal," *Microbiol Infect Dis*, vol. 1, no. 2, pp. 1–7, 2017.
- [15] P. K. Amissah-Reynolds, I. Monney, L. M. Adowah, and S. O. Agyemang, "Prevalence of helminths in dogs and owners' awareness of zoonotic diseases in Mampong, ashanti, Ghana," *Journal of Parasitology Research*, vol. 2016, Article ID 1715924, 6 pages, 2016.
- [16] S. Municipality, "Brief introduction suryabinayak municipality," 2023, <https://www.suryabinayakmun.gov.np/en/node/4>.
- [17] C. B. S. Population, "National population and housing census," 2021, <https://censusnepal.cbs.gov.np/results/population?province=3&district=29&municipality=4>.
- [18] M. V. Thrusfield and R. Christley, *Veterinary Epidemiology*, Wiley, Hoboken, NJ, USA, 4th edition, 2018.
- [19] R. Satyal, S. Manandhar, S. Dhakal et al., "Prevalence of gastrointestinal zoonotic helminths in dogs of Kathmandu, Nepal," *Int J Infection & Microbiol*, vol. 2, no. 3, pp. 91–94, 2013.
- [20] A. V. Allen and D. S. Ridley, "Further observations on the formol-ether concentration technique for faecal parasites," *Journal of Clinical Pathology*, vol. 23, no. 6, pp. 545–546, 1970.
- [21] K. Demelash, M. Abebaw, A. Nagash, B. Alene, M. Zemene, and M. Tilahun, "A review on diagnostic techniques in veterinary helminthology," *Nature ans Science*, vol. 14, no. 7, pp. 109–118, 2016.
- [22] G. Lorenzini, T. Tasca, and G. A. D. Carli, "Prevalence of intestinal parasites in dogs and cats under veterinary care in Porto Alegre, Rio Grande do Sul, Brazil," *São Paulo*, vol. 44, no. 2, p. 9, 2007.
- [23] W. J. Foreyt, *Veterinary Parasitology Reference Manual*, John Wiley & Sons, Hoboken, NJ, USA, 5th edition, 2013.
- [24] K. K. Yadav and B. Shrestha, "Prevalence of zoonotic gastrointestinal helminth parasites in pet and stray dogs of rupandehi district, nepal," 2017, <http://www.scivisionpub.com/pdfs/prevalence-of-zoonotic-gastrointestinal-helminth-parasites-in-pet-and-stray-dogs-of-rupandehi-district-nepal-187.pdf>.

- [25] I. C. Okoye, N. R. Obiezue, C. E. Okorie, and I. E. Ofoezie, "Epidemiology of intestinal helminth parasites in stray dogs from markets in south-eastern Nigeria," *Journal of Helminthology*, vol. 85, no. 4, pp. 415–420, 2011.
- [26] V. Silva, J. Silva, M. Gonçalves, C. Brandão, and N. Vieira e Brito, "Epidemiological survey on intestinal helminths of stray dogs in Guimarães, Portugal," *Journal of Parasitic Diseases*, vol. 44, no. 4, pp. 869–876, 2020.
- [27] T. Dubie, S. Sire, G. Fentahun, and F. Bizuayehu, "Prevalence of gastrointestinal helminths of dogs and associated factors in hawassa city of Sidama region, Ethiopia," *Journal of Parasitology Research*, vol. 2023, Article ID 6155741, 7 pages, 2023.
- [28] G. Simonato, A. Frangipane di Regalbono, R. Cassini et al., "Copromicroscopic and molecular investigations on intestinal parasites in kenneled dogs," *Parasitology Research*, vol. 114, no. 5, pp. 1963–1970, 2015.
- [29] W. Khan, N. N. Nisa, S. Ullah et al., "Gastrointestinal helminths in dog feces surrounding suburban areas of Lower Dir district, Pakistan: a public health threat," *Brazilian Journal of Biology*, vol. 80, no. 3, pp. 511–517, 2020.
- [30] O. M. Torres-Chablé, R. A. García-Herrera, M. Hernández-Hernández et al., "Prevalence of gastrointestinal parasites in domestic dogs in Tabasco, southeastern Mexico," *Revista Brasileira de Parasitologia Veterinaria*, vol. 24, no. 4, pp. 432–437, 2015.
- [31] K. Sardarian, A. H. Maghsood, S. A. Ghiasian, and A. H. Zahirnia, "Prevalence of zoonotic intestinal parasites in household and stray dogs in rural areas of Hamadan, Western Iran," *Tropical Biomedicine*, vol. 32, no. 2, pp. 240–246, 2015.
- [32] W. Pumidonming, D. Salman, D. Gronsang et al., "Prevalence of gastrointestinal helminth parasites of zoonotic significance in dogs and cats in lower Northern Thailand," *Journal of Veterinary Medical Science*, vol. 78, no. 12, pp. 1779–1784, 2016.
- [33] L. E. J. Puebla, F. A. Núñez, L. R. Rivero, Y. R. Hernández, I. A. Millán, and N. Müller, "Prevalence of intestinal parasites and molecular characterization of *Giardia duodenalis* from dogs in La Habana, Cuba," *Veterinary Parasitology: Regional Studies and Reports*, vol. 8, pp. 107–112, 2017.
- [34] C. I. Ogbaje, R. A. Ofukwu, and I. A. Ajogi, "Zoonotic gastrointestinal parasite burden of local dogs in Zaria, Northern Nigeria: implications for human health," *International Journal of One Health*, vol. 1, pp. 32–36, 2015.
- [35] M. H. Kohansal, A. Fazaeli, A. Nourian, A. Haniloo, and K. Kamali, "Dogs' gastrointestinal parasites and their association with public health in Iran," *Journal of Veterinary Research*, vol. 61, no. 2, pp. 189–195, 2017.
- [36] R. A. Ramírez-Barrios, G. Barboza-Mena, J. Muñoz et al., "Prevalence of intestinal parasites in dogs under veterinary care in Maracaibo, Venezuela," *Veterinary Parasitology*, vol. 121, no. 1–2, pp. 11–20, 2004.
- [37] V. Sudan, A. K. Jaiswal, D. Shanker, D. Kanojiya, and A. Sachan, "Prevalence of endoparasitic infections of non descript dogs in Mathura, Uttar Pradesh," *Journal of Parasitic Diseases*, vol. 39, no. 3, pp. 491–494, 2015.
- [38] C. Alvarado-Esquível, D. Romero-Salas, M. Aguilar-Domínguez, A. Cruz-Romero, N. Ibarra-Priego, and A. Pérez-de-León, "Epidemiological assessment of intestinal parasitic infections in dogs at animal shelter in Veracruz, Mexico," *Asian Pacific Journal of Tropical Biomedicine*, vol. 5, no. 1, pp. 34–39, 2015.
- [39] A. Adinezhadeh, E. B. Kia, M. Mohebbali et al., "Endoparasites of stray dogs in mashhad, khorasan razavi province, northeast Iran with special reference to zoonotic parasites," *Iranian Journal of Parasitology*, vol. 8, no. 3, pp. 459–466, 2013.
- [40] A. Siyadatpanah, S. Gholami, A. Daryani, S. Sarvi, M. Sharif, and M. Seguel, "The prevalence of intestinal helminths in free-ranging canids of mazandaran, northern iran," 2019, <https://publish.kne-publishing.com/index.php/IJPA/article/view/2098>.
- [41] S. R. Emamapour, H. Borji, and A. Nagibi, "An epidemiological survey on intestinal helminths of stray dogs in Mashhad, North-east of Iran," *Journal of Parasitic Diseases*, vol. 39, no. 2, pp. 266–271, 2015.
- [42] T. Abere, B. Bogale, and A. Melaku, "Gastrointestinal helminth parasites of pet and stray dogs as a potential risk for human health in Bahir Dar town, north-western Ethiopia," *Veterinary World*, vol. 6, no. 7, pp. 388–392, 2013.