MAKERERE UNIVERSITY

# PREVALENCE OF GASTROINTESTINAL HELMINTHS AND ASSOCIATED RISK FACTORS IN DOGS IN SELECTED BREEDING KENNELS IN THE GREATER KAMPALA AREA

**BY**

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**AUGUST, 2026**

## DECLARATION AND APPROVAL

I, **Simon Abongomera,** affirm that this research report is original and has not been submitted for any other degree award to any other university before.

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# DEDICATION

To my family and friends, whose support, advice and encouragement have made my academic journey fruitful and enjoyable.

**ACKNOWLEDGEMENTS**

I am grateful to my supervisor, Dr Charles Drago Kato for this guidance and support during the design and execution of this study. I also thank my family and friends for their advice and encouragement during the course of this study.

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## ABSTRACT

Gastrointestinal helminths remain a major health challenge in dogs, compromising dog welfare, productivity, and posing public health risks. Despite the large dog population in the greater Kampala area, data on the prevalence of gastrointestinal helminths and associated risk factors among dogs kept by dog breeders remains limited. This study aimed to determine the prevalence of gastrointestinal helminths and identify factors associated with gastrointestinal helminth infestation among dogs in dog breeding kennels in the greater Kampala area. A cross-sectional study was conducted involving 90 dogs purposively selected from three dog breeding kennels. Fresh fecal samples were collected per rectum and examined using standard floatation and sedimentation techniques at the Central Diagnostic laboratory (CDL), Makerere University. Data on dog demographics and management practices were collected using a semi-structured questionnaire. Descriptive statistics and chi-squared tests were performed using Stata version 14.2. This study detected only nematodes, 57 of the 90 (63.3%) sampled dogs had gastrointestinal helminths with a prevalence of 63.3% for strongyles and 15.6% for strongyloides spp. Body condition scores appeared better in Kennels which had less helminth prevalence. Kennel location and deworming interval were associated with helminth infestation among the sampled dogs ($p < 0.001$). These findings reveal a high burden of gastrointestinal nematodes among dogs kept in breeding kennels in the greater Kampala area. Implementing regular deworming strategies targeting nematodes especially strongyles is recommended to reduce gastrointestinal helminth infestation and transmission, improve canine health and minimize potential public health risks from gastrointestinal helminths.

# CHAPTER ONE

# INTRODUCTION

## 1.1 Background

In the history of domestication of animals, a resounding species remains the dog (*Canis lupus familiariais*) that has relatively co-evolved with the human species (*Homo sapiens*) (Cucchi and Arbuckle, 2021), providing companionship in various ways including but not limited to, emotional support (Rodriguez *et al.*, 2020), guide to the blind, criminal investigation and rescue operations as military dogs (Hart and Yamamoto, 2016). In addition, dogs are routinely used to guard and herd livestock and also provide security to humans. Given this close interaction of the dogs with humans (Payne et al., 2015) and livestock, a complex epidemiological triad is created that allows for sharing and transmission of pathogens among the different species (Marrana, 2022; Hassell *et al.*, 2023). These pathogens, inter alia, include the *Strongyloides spp*, *Echinococcus spp* and several other helminths, and viruses such as rabies that are zoonotic. (Hendrix and Robinson, 2022; Aleem, Munir and Shakoor, 2023).

Several studies carried out around the world have reported a high prevalence of nematodes in dogs. A study by (Yacob *et al.*, 2007) in Ethiopia noted that by coproscopical examination, 51% of the dogs in the study were positive for nematode eggs out of which 23.5% were mixed infection. Necropsy even inflated the positivity of the cases with up to 95% of the dogs being positive for presence of adult nematodes. Their results also alluded to a significant difference in the prevalence of mixed infection between the adult and young dogs with the young dogs having a higher prevalence of mixed infections (40.9%) (Yacob *et al.*, 2007). These findings allude to the silent gravity and pains that these pets are faced with. Research works by (Ochieng *et al.*, 2025) in the contiguity of Bwindi and Queen Elizabeth National Parks shades light of a more daunting situation in Uganda where he reported that up to 90.8% of the 258 dogs examined for gastrointestinal parasites had at least two parasites within the system. Nonetheless, even with this finding, the situation within Kampala, that has a reportedly high number of dogs, remains rather unclear. (Okwee-Acai *et al.*, 2024) reported that canine parvoviruses was the most common condition treated at the Small Animal Clinic in Makerere University amounting to 13.9% but not even a single case of helminthiasis was reported. This therefore creates a knowledge gap in terms of the spectra of helminths that dogs in breeding kennels in greater Kampala have and therefore would create a difficulty in the investigation of antiparasitic resistance profiles once they arise.

The purpose of this research therefore aimed to fill the knowledge gap in terms of gastrointestinal helminth spectra in dogs within the greater Kampala area through a cross-sectional survey employing laboratory techniques.

### 1.2 Problem Statement

Gastrointestinal helminthiasis presents as one of the most prevalent disease conditions documented by a number of other studies in several parts of the world (Chidumayo, 2018; Mulinge *et al.*, 2021; Ntampaka *et al.*, 2021; Hendrix and Robinson, 2022; Tumusiime et al., 2022; Bihon *et al.*, 2025) yet the prevalence of these pathogens in the case of dogs in breeding kennels in the greater Kampala area is not known. In addition, dog breeder practices contribution towards existence of helminth burden have not been reported. It was therefore imperative that a study is conducted to provide critical information to address this knowledge gap; and the findings of this study would contribute key data for strategic recommendation of the gastrointestinal helminth control strategies to dog breeders and policy makers especially in the public health sector.

### 1.3 General Objective

To determine the prevalence of gastrointestinal helminths and associated risk factors in dogs in selected breeding kennels in the greater Kampala area.

### 1.4 Specific Objectives

i. To determine the prevalence of helminths in dogs in selected breeding kennels in the greater Kampala area.
ii. To identify the risk factors for development of helminthiasis in dogs in selected breeding kennels in the greater Kampala area.

### 1.5 Research Questions

1. What is the prevalence of helminths in dogs in selected breeding kennels in the greater Kampala area?
2. What are the risk factors contributing to the development and maintenance of helminths in dogs in selected breeding kennels in the greater Kampala area?

## 1.6 Justification of the study

This study elucidates key information that would allow for an understanding of dog helminthiasis in terms of prevalence and would therefore allow for the judicious use of available antiparasitic agents mitigating and therefore reducing the potential for the development of their resistance. Subsequently, identification of the prevalence and establishment risk factors would also allow for an understanding of the potential risk for transmission of zoonotic pathogens. This therefore would allow for strategic institution of public health policies that would help in containment of such outbreaks once they arise.

## 1.7 Significance of the study

For dog owners, the findings from this study allow for improvement in the health care practices for their pets and therefore improved productivity/performance for their major role at the different residencies. The Veterinarians would also benefit from this study as the knowledge of the prevalence and risk factors would provide key back up information that would aid in diagnosing of infection and treatment in resource poor settings where laboratory services may not be readily available. Policy makers would also appreciate the findings from this research as strategic decisions like the frequency of deworming guided by the dog management strategies employed by pet owners (indoor, out door, roaming behavior) would inadvertently accrue. Lastly, the findings from this study would contribute to knowledge addition in the academia sphere.

# CHAPTER TWO

# LITERATURE REVIEW

## 2.1 Overview of gastrointestinal helminths in dogs

Gastrointestinal helminths of dogs include nematodes and cestodes. Nematodes are notorious for blood sucking and usually cause diarrhea especially in puppies, lead to anemia and loss of body condition in infested dogs. Cestodes are less pathogenic but some have zoonotic and public health implications (Minnaar and Krecek, 2001; Deplazes *et al.*, 2011; Aleem, Munir and Shakoor, 2023; Velusamy, Annamalai and Vijayasarathi, 2023).

## 2.2 Major gastrointestinal helminths of dogs in Sub-Saharan Africa

### 2.2.1 Gastrointestinal nematodes of dogs

A wide spectrum of nematodes infests the gastrointestinal tract of dogs. The commonly reported nematodes include Ancylostoma spp, Toxocara spp, Strongyloides species, Trichuris spp, Toxoscara spp, *Uncinaria stenocephala* and *Spirocerca lupi* (Gordon, 1968; Velusamy, Annamalai and Vijayasarathi, 2023).

***Ancylostoma caninum***

*A. caninum* is a reddish-grey worm of dogs inhabiting the small intestines. This worm infests dogs, foxes and occasionally humans. *A. caninum* is distributed worldwide and the migratory phase of the worm is associated with tissue migrans. *A. caninum* is acquired through of contaminated food and puppies can acquire it through milk form infected dams. *A. caninum* is notable for blood loss anemia in pups and loss of body condition in dogs. Other species of the worm, *A. braziliense* and *A. tubaeforme* have a limited distribution globally but have the same epidemiology and pathology in dogs (Gordon, 1968; Velusamy, Annamalai and Vijayasarathi, 2023).

***Toxocara canis***

*T. canis* is a large white/cream worn infesting the small intestines of dogs. This worm infests dogs and foxes and is found worldwide. Transmission of *T. canis* is by the feco-oral route. Larval forms migrate and may cause anemia while adult forms have been associated with mucoid enteritis, complete occlusion of the intestines and perforation of the gut (Gordon, 1968; Velusamy, Annamalai and Vijayasarathi, 2023).

***Strongyloides stercoralis***

*S. stercoralis* is a slender hair-like worm inhabiting the small intestines of dogs and only female worms are parasitic and infest dogs, cats and humans. *S. stercoralis* causes severe infection in pups leading to bloody diarrhea and sometimes death. Transmission of *S. stercoralis* may be by oral or percutaneous route (Gordon, 1968; Velusamy, Annamalai and Vijayasarathi, 2023).

***Uncinaria stenocephala***

*U. stenocephala* is small intestinal worm of dogs. It infests canids and felids and is common in groups of sporting and working dogs, though its distribution is limited to temperate and sub-arctic regions. *U. stenocephala* are not voracious blood suckers but cause low grade anemia and diarrhea in heavily infested pups. Notably, *U. stenocephala* has been associated with hypersensitivity induced pedal-interdigital dermatitis in adult dogs (Gordon, 1968; Velusamy, Annamalai and Vijayasarathi, 2023).

### 2.2.2 Gastrointestinal cestodes of dogs

Unlike nematodes, fewer cestodes infest the gastrointestinal tract of dogs. Dipylidium caninum, Taenia spp and Echinococcus spp (Gordon, 1968; Velusamy, Annamalai and Vijayasarathi, 2023).

***Dipylidium caninum***

*D. caninum* a short tapeworm of dogs and infests dogs, cats and rarely humans. *D. caninum* infests fleas (*Ctenocephalides spp*., *Pulex irritans*) and biting lice (*Trichodectes canis*) as intermediate hosts and the tapeworm is distributed worldwide. This worm in non-pathogenic but causes anal discomfort and itching in affected dogs (Gordon, 1968; Velusamy, Annamalai and Vijayasarathi, 2023).

***Echinococcus spp***

*E. granulosus* is the commonest tapeworm in this genus. *E. granulosus* is a dwarf tapeworm, infests dogs and wild canids as final hosts and infests domestic and wild ruminants, humans and primates as intermediate hosts. *E. granulosus* is distributed worldwide, the adult tapeworm is not pathogenic and inhabits the small intestines of dogs without clinical signs (Gordon, 1968; Velusamy, Annamalai and Vijayasarathi, 2023).

*E. granulosus* has two lifecycles, pastoral and sylvatic. In the pastoral cycle the dog is always involved, being infected by the feeding of ruminant offal containing hydatid cysts. The domestic intermediate host will vary according to the local husbandry but the most important is the sheep, which appears to be the natural intermediate host, scolices from these animals being the most highly infective for dogs. In parts of the Middle East the camel is the main reservoir of hydatids, while in northern Europe and northern Russia it is the reindeer. The pastoral cycle is the primary source of hydatidosis in humans, infection being by accidental ingestion of oncospheres from the coats of dogs, or from vegetables and other foodstuffs contaminated by dog faeces. The sylvatic cycle occurs in wild canids and ruminants and is based on predation or carrion feeding. It is less important as a source of human infection, except in hunting communities where the infection may be introduced to domestic dogs by the feeding of viscera of wild ruminants (Gordon, 1968; Velusamy, Annamalai and Vijayasarathi, 2023). Other species, *E. multilocularis*, *E. oligarthrus*, and *E. vogeli* have been reported but have not been routinely reported in Sub-Saharan Africa (Gordon, 1968; Velusamy, Annamalai and Vijayasarathi, 2023).

***Taenia spp***

*T. hydatigena* is distributed worldwide, infests dogs, foxes and other wild canids. Wild (deer) and domestic (sheep, goat, cattle and horse) ruminants act as intermediate hosts. Adult worms are asymptomatic but heavy infestation may cause diarrhoea. Other species of the tapeworm, *T. ovis*, *T. multiceps*, *T. serialis*, *T. taeniaeformis* and *T. pisiformis* have been reported in dogs but cause non-clinical pathology (Gordon, 1968; Velusamy, Annamalai and Vijayasarathi, 2023).

***Mesocestoides lineatus***

*M. lineatus* infests dogs and cats as final hosts and infests oribatid mites, birds, amphibians, reptiles, and small mammals as intermediate hosts. This worm is distributed worldwide but has minor pathogenic significance and infections are usually subclinical (Gordon, 1968; Velusamy, Annamalai and Vijayasarathi, 2023).

## 2.3 Prevalence of gastrointestinal helminths in dogs

### 2.3.1 Prevalence of gastrointestinal helminths in dogs in Sub-Saharan Africa

The overall prevalence of gastrointestinal helminths in dogs has been reported to be 71%, with a prevalence of 59% in West Africa, 81% in East Africa and 81% in Southern Africa

(Chidumayo, 2018). *Ancylostoma spp*. are the most prevalent (41%), followed by *Strongyloides spp*. (23%), *Toxocara spp*. (22%), then *Dipylidium caninum* (20%), *Taenia spp*. (9%), *Uncinaria stenocephala* (7%), *Spirocerca lupi* (7%), *Trichuris vulpis* (5%), *Echinococcus spp*. (5%) and *Toxascara spp*. (3%). The prevalence of these helminths varies from country to country (Chidumayo, 2018).

### 2.3.2 Prevalence of gastrointestinal helminths of dogs in Uganda

Limited comprehensive studies have been undertaken to establish the occurrence of gastrointestinal helminths of dogs in Uganda. Ochieng et al., reported the prevalence of *A. caninum* to be 14.1%, *Trichuris vulpis* at 21%, *Toxocara canis* at 17%, *Toxascaris spp.* at 11.3%, *Spirocerca lupi* at 9%, *Ascaris spp*. at 11%, and *Strongyloides spp*. at 5% in dogs at the wildlife interface (Ochieng *et al.*, 2025). Other studies have reported the prevalence of Echinococcus spp. to be 12.2 – 66.3% in Moroto and Bukedea districts (Inangolet *et al.*, 2010; Oba *et al.*, 2016).

### 2.3.3 Risk factors for gastrointestinal helminths in dogs

Several factors including age, sex, housing and feeding of the dog have been reported to be associated with helminth infestation in dogs. You dogs have been reported to suffer more helminth infestation than adult dogs and male dogs tend to have more helminths than female dogs, this could be attributed to movement patterns(Chidumayo, 2018; Bihon *et al.*, 2025) . Housed dogs with limited movement have been reported to have low helminth infestation that free roaming or unconfined dogs (Merga and Sibhat, 2015; Ezema *et al.*, 2019). Dogs that are fed clean and home prepared food are reported to have lower burden of gastrointestinal helminths that dogs that eat unmonitored (Ntampaka *et al.*, 2021).

## 2.4 Laboratory detection of gastrointestinal nematodes in dogs

The cheapest detection of gastrointestinal helminths of dogs is through fecal floatation or sedimentation techniques (Hendrix and Robinson, 2022).

For floatation, approximately 2 grams of the fecal sample are picked using a spatula and added to 10 ml of the floatation solution in a beaker. The resulting mixture is then mixed thoroughly and the suspension is then poured in a test tube and more floatation solution added to fill the tube to the top. A cover slip is placed on the surface of the liquid and the setup was left to stand for 10 minutes. The cover slip is then lifted vertically, placed on a slide and examined under a microscope (Hendrix and Robinson, 2022).

For sedimentation, five grams of faeces are weighed and added to 200ml of water mixed with liquid soap in a 250ml beaker and mixed thoroughly. The fecal suspension is filtered through a tea strainer into a second beaker. The mixture is allowed to sediment for 30 minutes. The supernatant is removed very by slowly pouring it off. The sediment is again mixed with 200ml of water and mixed thoroughly to wash the sediment and reduce on the amount of debris. Steps three to five are repeated at least 3 times until the supernatant was clear. After removing the supernatant for the last time, the sediment is transferred into a Petri dish and a drop of methylene blue is added. A sample of the sediment is then placed onto a microscope slide and the slide was mounted on the microscope to examine the eggs (the methylene blue stains the background). Other techniques like serology for sero-surveys are utilized and polymerase chain reaction (PCR) for molecular characterization of helminths can be used but these techniques are very expensive and require massive funding (Hendrix and Robinson, 2022).

### 2.5 Control of gastrointestinal helminths in dogs

Control and prevention of gastrointestinal helminths in dogs is achieved by routing deworming (use of anti-helminthics) and strict hygiene practices. Deworming of dogs is recommended at every 3 months using broad-spectrum anti-helminthics (Mebendazole, Fenbendazole and albendazole). Cleaning of kennels, change of dog bedding and disinfection of contaminated kennels is recommended to minimize helminth infestation (Gordon, 1968; Velusamy, Annamalai and Vijayasarathi, 2023).

### 2.6 Public health and zoonotic importance of gastrointestinal helminths in dogs

Larvae of *Ancylostoma spp.* have been implicated in tissue larval migrans in humans. The metacestodes of *Echinococcus spp.* are a serious public health problem especially in pastoral communities (Minnaar and Krecek, 2001; Deplazes *et al.*, 2011; Aleem, Munir and Shakoor, 2023).

# CHAPTER THREE

# MATERIALS AND METHODS

## 3.1 Study design

A cross-sectional case study was employed from March to May 2026 to investigate gastrointestinal helminth infection in dogs as described by John W. Creswell and J. David Creswell, (2014). This study design enabled dogs kept by dog breeders in the greater Kampala area be investigated for the prevalence of gastrointestinal helminths and associated factors at a single point in time.

## 3.2 Study Area

This study was conducted in the greater Kampala area. The greater Kampala area is located at an elevation of 1176.22 meters (3858.99 feet) above sea level, and has a Tropical rainforest climate. The city's average yearly temperature is 23.03ºC (73.45ºF) and it is -0.44% lower than Uganda's averages. The greater Kampala area is composed of Wakiso and Kampala is neighbored by Mukono on the East and South East and Mpigi on the South West. The newspaper in their coverage of the rabies vaccination in dogs in Kyanja, reported Dr Nabaasa reported that Kampala alone is a home to about 20,000 dogs, out of which 6,000 are stray ones without ownership, about 2,000 dogs have owners who do not care about them and about 12000 are controlled and cared for by their owners (Ainebyoona, 2021). Backing this, (Wallace *et al.*, 2017) reported Uganda having an estimated 729,486 owned dogs thus the number reported by Monitor relative to the total number of dogs for Uganda makes Kampala an ideal site for this study. In addition, Uganda has a total of 36 registered dog breeders as of May 5, 2025 and majority of them are from Kampala. Dogs in kennels at breeding sites share same spaces and are usually congested (Figure 1).

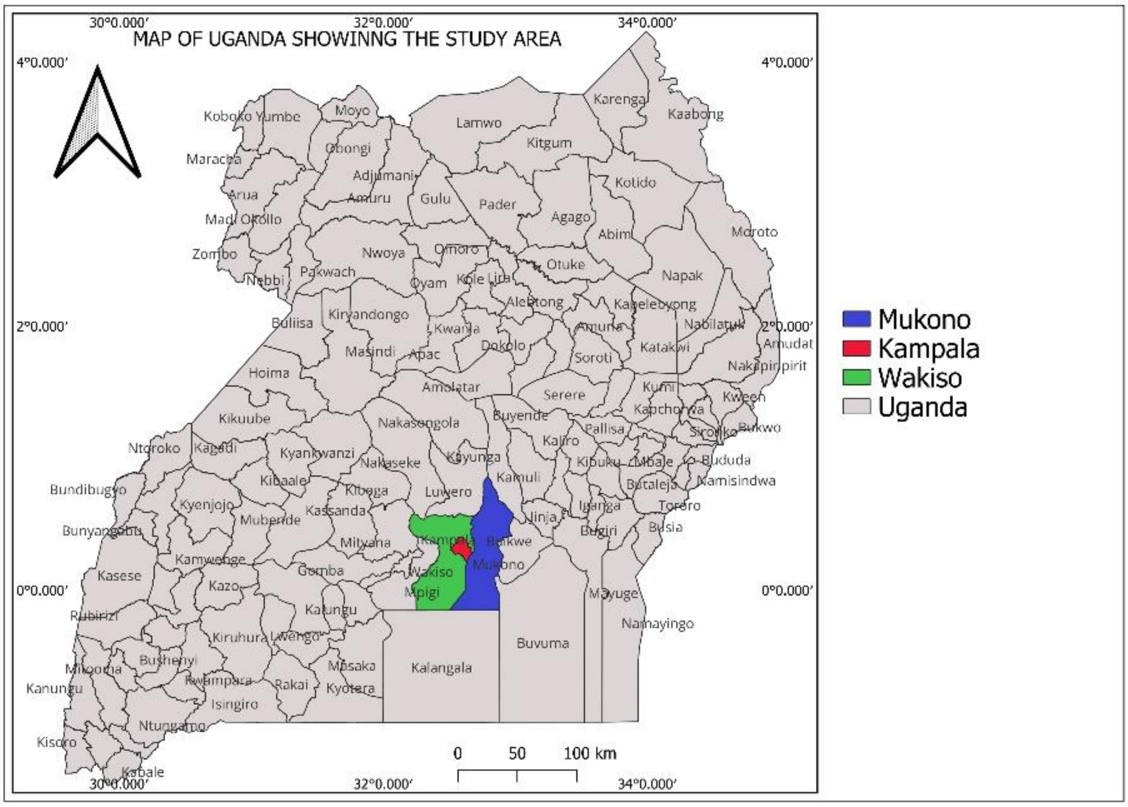


**Figure 1: Map of Uganda showing the study area: (Designed in QGIS version 4.4.4)**

### 3.3 Sample size

The sample size for this study was determined using the Cochran's formula as described by (Nanjundeswaraswamy and Divakar, 2021). A study by Kalyango, 2023 reported an overall prevalence of 35.5% in dogs in Nakawa and Kawempe division (Kalyango, 2023), Kampala City.

$$n = \frac{Z^2 p(1-p)}{e^2}$$

$$n = \frac{1.96^2 * 0.355(1-0.355)}{0.05^2}$$

Where n is the sample size, Z is the z score of the error considered, and p is the reported prevalence. The error considered during calculation was 0.05 and this corresponds to a Z score of 1.96 at 5% level of significance. Given that Kampala has 5 divisions and three were chosen and given logistical reasons and time limitations, 90 dogs were sampled in this study.

### 3.4 Sampling criteria and procedure

#### 3.4.1 Inclusion Criteria

Dog breeders that accepted to participate in the research and who owned two or more dogs of different breeds and sexes were included in this study.

#### 3.4.2 Exclusion criteria

All dogs that were recently dewormed (1 week prior) were excluded from this study.

#### 3.4.3 Sampling procedure

Participating kennels included in the study were picked based on convenience and their location within the greater Kampala area. Three breeding kennels with a minimum of 40 dogs each were used for the sampling. A target of 3 breeding kennels each having both male and female dogs of the same breed or 2 dogs of different breeds was set to provide fecal samples to form a total of 30 dogs each. Dogs from each breeding kennel were selected using a simple random sampling strategy and 90 fecal samples were collected from the 3 breeding kennels.

### 3.5 Data Collection procedures and tools

#### 3.5.1 Kennel and dog attribute assessment

A semi-structured questionnaire was designed to capture dog demographics (breed, age, sex, weight, body condition, and the health state), kennel attributes and practices (location, size and dog management practices). This tool was deployed through kobo toolbox and deployed for field data collection on a mobile hand phone. The list of breeding kennels were obtained from the Canine Association of Uganda from which their contacts were also be obtained. The breeding kennels were contacted and appointments were scheduled to conduct the face-to-face interviews and fecal sample collection from dogs.

#### 3.5.2 Fecal sample collection

The selected dogs were properly restrained by placing a muzzle and manually holding it between the handler’s legs. Difficult dogs were restrained appropriately and safely using a dog catcher. Upon restraint, a pair of latex gloves were donned on and lubricated using mineral oil. 50 grams of fresh fecal samples per dog were collected per rectum using a well lubricated finger and placed in fecal sample collection containers. The sample bottles were labelled with a unique identifier and packed in a cool box maintained at < 8 ºC and slated for immediate analysis at the Central Diagnostic Laboratory (CDL) in Makerere University within 12 hours of sample collection.

### 3.6 Laboratory sample analysis

The study employed the floatation and sedimentation technique for assessment of the spectra of helminths affecting the sampled dogs based the helminth eggs. The floatation methods bases on the principle that light helminth eggs rise or float once the fecal matter is mixed with a saturated sugar or salt solution while the sedimentation method relies on the principle that heavy helminth eggs sink once the specific gravity of water is lowered. This study employed the standard operating procedures as per the central diagnostic laboratory (CDL) in Makerere University.

#### 3.6.1 Floatation technique

Briefly, approximately 2 grams of the fecal sample were picked using a spatula and added to 10 ml of the floatation solution in a beaker. The resulting mixture was then mixed thoroughly and the suspension was then poured in a test tube and more floatation solution added to fill the tube to the top. A cover slip was placed on the surface of the liquid and the setup was left to stand for 10 minutes. The cover slip was then lifted vertically, placed on a slide and examined under a microscope.

#### 3.6.2 Sedimentation

Briefly, five grams of faeces were weighed and added to 200ml of water mixed with liquid soap in a 250ml beaker and mixed thoroughly. The fecal suspension was filtered through a tea strainer into a second beaker. The mixture was allowed to sediment for 30 minutes. The supernatant was removed very by slowly pouring it off. The sediment was again mixed with 200ml of water and mixed thoroughly to wash the sediment and reduce on the amount of debris. Steps three to five were repeated at least 3 times until the supernatant was clear. After removing the supernatant for the last time, the sediment was transferred into a Petri dish and a drop of methylene blue was added. A sample of the sediment was then placed onto a microscope slide and the slide was mounted on the microscope to examine the eggs (the methylene blue stains the background).

### 3.7 Data Management and analysis

The collected data were downloaded from Kobo Toolbox as an excel file. The data was cleaned and then imported into Stata version 14.2 (StataCorp, College Station, 4905 Lakeway Dr, United States) for analysis. The dog demographics and prevalence of gastrointestinal helminths were summarized using frequencies and percentages. Bivariate analysis was conducted using the chi-squared test at 5% level of significance for factors associated with helminth infestation in the sampled dogs. The results were presented using tables and figures.

### 3.8 Ethical considerations

The dog breeders provided voluntary written consent after being taken through the details of the research study. Dog welfare protocols were observed throughout the sampling process to minimize stress on the sampled dogs. All data obtained from the dog breeders was kept confidential and only used for purposes of this study. In addition, a support letter was obtained from the Dean, School of Veterinary Medicine and Animal Resources (SVAR), Makerere University prior to data collection.

# CHAPTER FOUR

# RESULTS

## 4.1 Attributes of dogs sampled from Kampala

In this study, ninety dogs were sampled from dog breeders in the greater Kampala area. Most (58.9%) of the dogs sampled were females, majority (64.4%) were large sized dogs and more than half (51.1%) had a body condition score of 3 (Ideal) on a scale of 1 (Emanciated) – 5 (Obese). The mean age, body weight and rectal temperature of the sampled dogs were 2.2 years, 16.1 Kgs and 38.3 ºC respectively as sown in Table 1.

**Table 1: Attributes of the sampled dogs from dog breeders in Kampala**

| Attribute | Summary measure |
|---|---|
| **Sex, n (%)** | |
| Male | 37 (41.1) |
| Female | 53 (58.9) |
| **Breed /Size, n (%)** | |
| Small | 14 (15.6) |
| Medium | 18 (20.0) |
| Large | 58 (64.4) |
| **Body condition score (1-5), n (%)** | |
| 2(Thin) | 41 (45.6) |
| 3(Ideal) | 46 (51.1) |
| 4(Over conditioned) | 4 (3.3) |
| **Age in years, mean (sd)** | 2.2 (1.7) |
| **Body weight in Kg, mean (sd)** | 16.1 (9.2) |
| **Rectal temperature (ºC), mean (sd)** | 38.3 (1.8) |

*sd – standard deviation

## 4.2 Prevalence of gastrointestinal helminths in dogs in breeding kennels in the greater Kampala area.

From this study, only nematodes (strongyles and strongyloides) were detected in 57 of the 90 dog fecal samples. The prevalence of the strongyles in the sampled dogs was 63.3% (n = 57) and that of strongyloides was 15.6%. The prevalence of the two nematode genera were significantly different ($p$ = 0.001). Fifty-seven dogs (63.3%) were infested with both strongyles and strongyloides (Table 2).

**Table 2: Prevalence of gastrointestinal helminths in dogs sampled from dog breeders**

| Helminth | Number positive (n) | Prevalence (%) | 95%CI | Z(*p*-value) |
|---|---|---|---|---|
| Strongyles | 57 | 63.3 | 52.7 – 72.8 | 3.2(0.001) |
| Strongyloides | 14 | 15.6 | 9.3 – 24.8 | |
| Mixed | 57 | 63.3 | 52.7 – 72.8 | |

### 4.3 Prevalence of gastrointestinal helminths by kennel location of the sampled dogs

From this study, dogs from Location A kennels had the highest prevalence of gastrointestinal helminths (93.3%), followed by those from Location B kennels (86.7%) and then from Location C Kennels (10.0%) as shown in Figure 2.

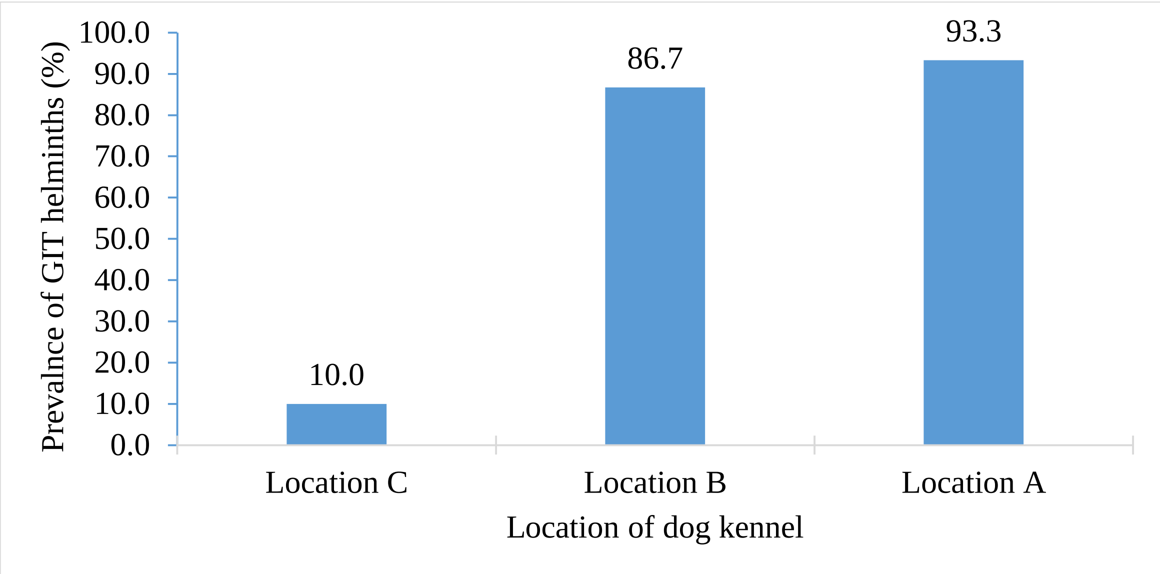


**Figure 2: Prevalence of gastrointestinal helminths in different dog kennels**

### 4.4 Prevalence of gastrointestinal helminths by body condition of the sampled dogs

From this study, the prevalence of helminths in the sampled dogs decreased with increase in body condition of the sampled dogs. Thin dogs had the highest prevalence of helminths while fat dogs had no helminths (Figure 3).

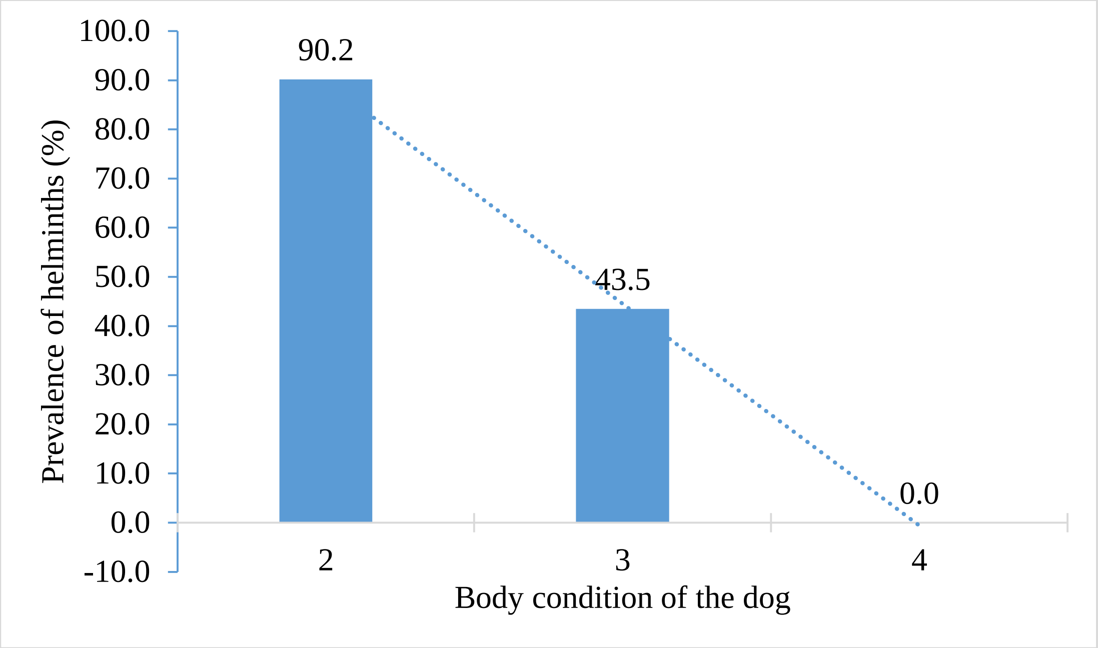


**Figure 3: Occurrence of helminths by body condition score of the sampled dogs**

### 4.5 Factors associated with gastrointestinal helminths in dogs in breeding kennels in the greater Kampala area

From this study, kennel location ($p < 0.001$) and the interval of deworming dogs ($p < 0.001$) were associated with presence of helminths in the feces of the sampled dogs. These findings are summarized in Table 3.

**Table 3: Factors associated with gastrointestinal helminth infestation in the sampled dogs**

| Variable | Helminth status, n (%) | | Chi-squared (*p* – |
|---|---|---|---|
| | Positive (n=57) | Negative (n=33) | |
| **Sex of the dog** | | | |
| Male | 23 (62.2) | 14 (37.8) | 0.04 (0.847) |
| Female | 34 (64.2) | 19 (35.9) | |
| **Breed (Size) of the dog** | | | |
| Small | 11 (78.6) | 3 (21.4) | 2.0 (0.360) |
| Medium | 12 (66.7) | 6 (33.3) | |
| Large | 34 (58.6) | 24 (41.4) | |
| **Age of the dog in years** | | | |
| < 1 | 14 (58.3) | 10 (41.7) | 4.3 (0.117) |
| 1 – 2 | 18 (81.8) | 4 (18.2) | |
| > 2 | 25 (56.8) | 19 (43.2) | |
| **Kennel location** | | | |
| Location C | 3 (10.0) | 27 (90.0) | 55.4 (< **0.001**) |
| Location B | 26 (86.7) | 4 (13.3) | |
| Location A | 28 (93.3) | 2 (6.7) | |
| **Deworming interval** | | | |
| < 1 month | 2 (66.7) | 1 (33.3) | 42.7 (< **0.001**) |
| 2 months | 3 (11.5) | 23 (88.5) | |
| > 2 months | 52 (85.3) | 9 (14.7) | |

# CHAPTER FIVE

## DISCUSSION

This study investigated the prevalence of gastrointestinal helminths and associated risk factors in dogs kept by dog breeders in the greater Kampala area. Only nematodes were detected and 63.3% of the sampled dogs had gastrointestinal helminths, strongyles had a higher prevalence (63.3%) than strongyloides (15.6%). Location of the dog kennel and deworming interval used by the dog breeders were the only factors associated with gastrointestinal helminth infestation in the sampled dogs.

The findings of this study revealed a high burden of gastrointestinal nematodes in the sampled dogs. Infestation of dogs with gastrointestinal nematodes has been associated with anemia and loss of body condition and this compromises dog welfare and necessitates regular deworming of dogs. No comprehensive study has investigated the prevalence of gastrointestinal helminths in dogs in Uganda before. However, a one health study conducted by Upadhayay reported the prevalence of helminths in dogs from the livestock-wildlife interface to be 40% (Upadhayay *et al.*, 2026). Another study by Ochieng et al reported the prevalence of gastrointestinal helminths in dogs to be 17.9% (51.285) in dogs sampled from the livestock-wildlife interface (Ochieng *et al.*, 2025). These differences in the burden of gastrointestinal helminths could be attributed to varying environmental and dog management practices. Studies in Kenya and Tanzania have reported prevalence of gastrointestinal helminths in dogs to be 65% and 50.53% (Mulinge *et al.*, 2021; Rubagumya et al., 2024).

This study showed that location of the kennel and deworming interval of the dogs was associated with occurrence of gastrointestinal helminths. The difference in helminth infestation levels according to location could be attributed to varying dog management practices. In addition, long deworming intervals promote re-infestation of dogs with helminths. However, age and sex of the were not associated with gastrointestinal helminth infestation in the sampled dogs. Other studies have reported age, sex and feeding practices of dogs to be risk factors for infestation of gastrointestinal helminths in dogs (Chidumayo, 2018; Ntampaka *et al.,* 2021; Bihon *et al.,* 2025).

This study reveals a high burden of gastrointestinal nematodes in dogs. Dog owners should adopt regular dog deworming intervals not exceeding two months to minimize worm infestation and ensure good dog health. Despite the small sample size of dogs and basic microscopy used in identifying gastrointestinal helminths of dogs, this study highlights the burden of gastrointestinal helminths of dogs and the potential threat they pose to public health in the areas surrounding dog kennels.

# CHAPTER SIX

# CONCLUSION AND RECOMMENDATIONS

## 6.1 Conclusion

This study revealed a higher prevalence of strongyles (63.3%) than strongyloides (15.6%) in the sampled dogs in the greater Kampala area. Kennel location, the appetite of the dog, the quality of the dog's haircoat, the interval of deworming dogs and the color of the dog's mucus membranes were associated with presence of helminths in the feces of the sampled dogs. These findings highlight the burden strongyles pose on dogs. Gastrointestinal helminth control strategies in dogs should target strongyles to boost the health of dogs kept in dog breeding kennels in the greater Kampala area.

## 6.2 Recommendations

- Deworming strategies in dogs should target nematodes especially gastrointestinal strongyles.
- Future studies should investigate loads of gastrointestinal helminths and associated management practices to avail further basis for helminth control in dogs.

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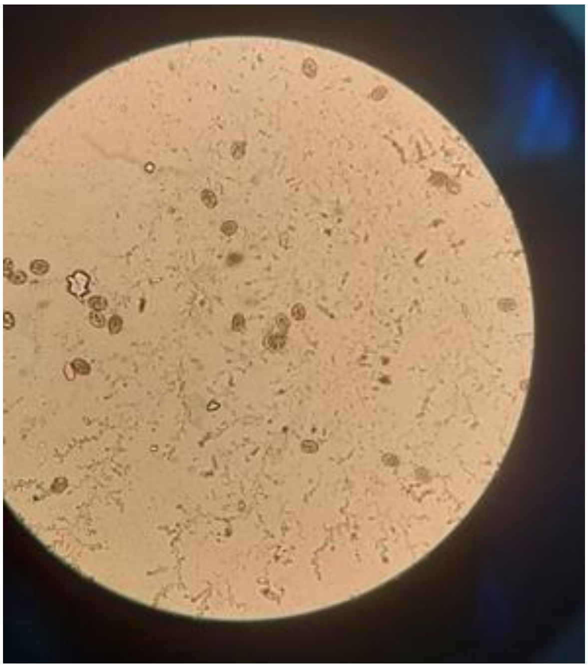
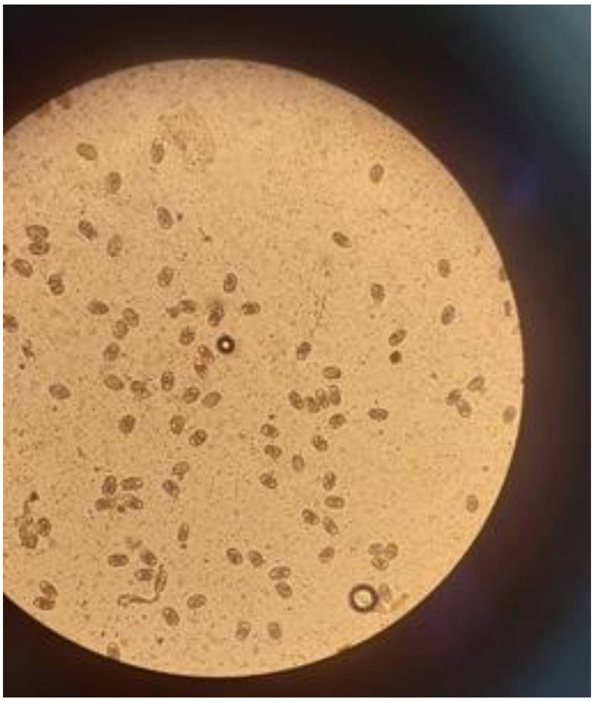
# APPENDICES

## Appendix I: Research evidence pictorials



*Strongyle eggs*



*Mixed infection of Strongyle and Strongyloide eggs.*

**Appendix II: Kennel-Level Questionnaire**

**Study Title:**

**Prevalence of gastrointestinal helminths and associated risk factors in dogs in dog breeding kennel in the greater Kampala area**

**INFORMED CONSENT.**

I have been informed about the objectives of this study. I understand that my participation is voluntary, the information provided will remain confidential, and I may withdraw at any time without penalty.

Breeder Name ____________________

Signature _______________________

Date ___________________________

Interviewer _____________________

**SECTION A. IDENTIFICATION**

Kennel Code ___________________

Date _______________________

District ___________________

Division __________________

Parish ____________________

Village ___________________

GPS Coordinates __________________

Interviewer ____________________

**SECTION B. KENNEL CHARACTERISTICS**

**B1. Years involved in commercial dog breeding**

______ years

**B2. Number of breeding females**

---

**B3. Number of breeding males**

---

**B4. Number of puppies currently on the premises**

---

**B5. Total number of dogs**

---

**B6. Main breeds kept**

☐ German Shepherd

☐ Belgian Malinois

☐ Rottweiler

☐ Boerboel

☐ Cane Corso

☐ Labrador Retriever

☐ Doberman

☐ Crossbreed

☐ Other ____________

**SECTION C. KENNEL MANAGEMENT**

**C1. Housing system**

☐ Individual kennels

☐ Group housing

☐ Mixed

**C2. Kennel floor**

☐ Concrete

☐ Soil

☐ Raised wooden

☐ Other ___________

**C3. Drainage**

☐ Good

☐ Fair

☐ Poor

**C4. How often are kennels cleaned?**

☐ Twice daily

☐ Daily

☐ Every 2–3 days

☐ Weekly

**C5. Are disinfectants used?**

☐ Yes

☐ No

If Yes

Specify ___________________

**C6. Is clean water always available?**

☐ Yes

☐ No

**SECTION D. BIOSECURITY**

**D1. Are newly purchased dogs quarantined?**

☐ Yes

☐ No

If Yes

Duration

☐ Less than 2 weeks

☐ 2–4 weeks

☐ More than one month

**D2. Are visitors allowed into kennels?**

☐ Yes

☐ No

**D3. Footbath available?**

☐ Yes

☐ No

**D4. Rodent control programme?**

☐ Yes

☐ No

**D5. Stray dogs enter premises?**

☐ Frequently

☐ Occasionally

☐ Never

**SECTION E. FEEDING**

**E1. Main feed**

☐ Commercial dog food

☐ Home-made ration

☐ Raw meat

☐ Offal

☐ Mixed feeding

**E2. Source of meat**

☐ Slaughterhouse

☐ Butchery

☐ Home slaughter

☐ Other ___________

**E3. Is untreated raw offal fed?**

☐ Yes

☐ No

**SECTION F. HELMINTH CONTROL PROGRAMME**

**F1. Do you follow a routine deworming programme?**

☐ Yes

☐ No

**F2. Frequency**

☐ Monthly

☐ Every 2 months

☐ Every 3 months

☐ Every 6 months

☐ Irregular

**F3. Anthelmintic(s) commonly used**

☐ Fenbendazole

☐ Albendazole

☐ Pyrantel pamoate

☐ Praziquantel

☐ Combination product

☐ Other ___________

**F4. How is the dose determined?**

☐ Body weight

☐ Estimated

☐ Manufacturer's recommendation

**F5. Who advises on deworming?**

☐ Veterinarian

☐ Veterinary paraprofessional

☐ Self

☐ Agrovet

**SECTION G. ENVIRONMENTAL MANAGEMENT**

**G1. Feces removed**

☐ Twice daily

☐ Daily

☐ Every 2–3 days

☐ Weekly

**G2. Disposal method**

☐ Burial

☐ Burning

☐ Compost

☐ Garbage

**G3. Standing water near kennels?**

☐ Yes

☐ No

**G4. Livestock kept on same premises?**

☐ Yes

☐ No

**SECTION H. OPEN-ENDED QUESTIONS**

1. What challenges do you experience in controlling intestinal worms in your kennel?

---

2. What measures have worked well in preventing worm infections?

---

3. What improvements would you recommend for parasite control in breeding kennels?

---

---

**DOG-LEVEL RECORD SHEET**

**Complete one sheet for each sampled dog (approximately 90 sheets).**

**SECTION A. IDENTIFICATION**

Kennel Code ____________

Dog ID ____________

Sample ID ____________

Date ____________

Examiner ____________

**SECTION B. DOG INFORMATION**

Breed

☐ German Shepherd

☐ Belgian Malinois

☐ Rottweiler

☐ Boerboel

☐ Cane Corso

☐ Labrador Retriever

☐ Doberman

☐ Crossbreed

☐ Other __________

Sex

☐ Male

☐ Female

Age

_____ months

Weight

_____ kg

Body Condition Score (1–5)

---

Breeding status

☐ Stud

☐ Brood bitch

☐ Replacement breeding stock

☐ Puppy

☐ Retired breeder

Pregnant

☐ Yes

☐ No

Lactating

☐ Yes

☐ No

**SECTION C. HEALTH HISTORY**

Diarrhea

☐ Yes

☐ No

Vomiting

☐ Yes

☐ No

Poor appetite

☐ Yes

☐ No

Weight loss

☐ Yes

☐ No

Poor hair coat

☐ Yes

☐ No

Visible worms previously

☐ Yes

☐ No

**SECTION D. DEWORMING HISTORY**

Last dewormed

Date ___________

Drug used

Dose based on body weight?

☐ Yes

☐ No

**SECTION E. PHYSICAL EXAMINATION**

Temperature ______ °C

Hydration

☐ Normal

☐ Mild dehydration

☐ Moderate dehydration

☐ Severe dehydration

Mucous membranes

☐ Pink

☐ Pale

☐ Congested

Abdominal distension

☐ Yes

☐ No

Perianal contamination

☐ Yes

☐ No

Body condition score ________

**SECTION F. FECAL SAMPLE**

Date collected ___________

Consistency

☐ Normal

☐ Soft

☐ Diarrheic

Colour ____________________

Blood present

☐ Yes

☐ No

Mucus present

☐ Yes

☐ No

**SECTION G. LABORATORY FINDINGS**

**Flotation**

☐ Positive

☐ Negative

**Sedimentation**

☐ Positive

☐ Negative

**Helminths detected (tick all that apply)**

☐ *Toxocara* spp.

☐ *Ancylostoma* spp.

☐ *Trichuris vulpis*

☐ *Strongyloides* spp.

☐ *Dipylidium caninum*

☐ *Taenia* spp.

☐ *Spirocerca lupi*

☐ Other ____________________

Mixed infection

☐ Yes

☐ No

Overall laboratory result

☐ Positive

☐ Negative

Examined by _____________________

Date ____________________________