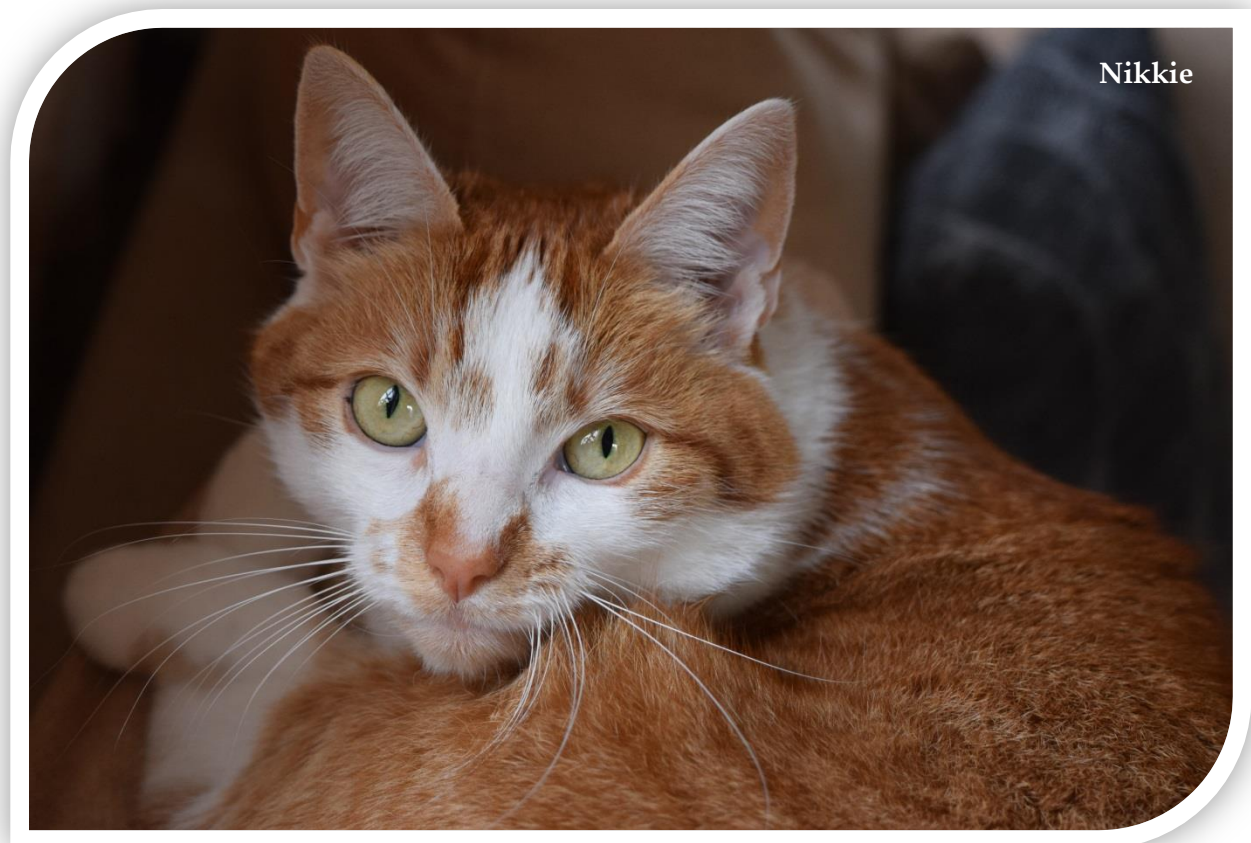


Correlation between deworming history and patent infections with enteric helminths in cats.



By: **M.C.P.M. Coenen**
Student number: 3589285
Date: April - June 2015
Supervisor: E.R. Nijse
In cooperation with: Sandra Vink

Clinical Infectiology
Infectious diseases and Immunology
Faculty of Veterinary Medicine
Utrecht University

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Abstract

The correlation between deworming history and patent infections with enteric helminths and protozoa was studied in cats in the Netherlands. Faecal samples of 372 cats (household cats and cats living in catteries) were examined on endoparasites with the Baermann and CSF-technique. 28 cats were tested positive (7,5%), of which most were infected with *Giardia intestinalis* (2,4%). *Isospora* spp. (1,9%), *Toxocara cati* (1,6%), *Sarcocystis* spp. (0,8%), *Capillaria aerophila* (0,8%), *Cystoisospora* spp. (0,3%), *Toxoplasma gondii* (0,3%), *Opisthorchis felinus* (0,3%), *Toxascaris leonina* (0,3%), *Ancylostoma tubaeforme* (0,3%) and *Aelurostrongylus abstrusus* (0,5%) were found as well.

Questionnaires were answered by cat owners. This included questions concerning the practiced deworming schedule, duration of activity of an anthelmintic and motivation and reason for deworming. Most cat owners dewormed their cat two or three times a year (35,1%), while 26,9% followed no specific deworming schedule at all. 46,2% of the cat owners thought the duration of activity of an anthelmintic was two or three months. The motivation for deworming was stimulated by the advice of the veterinarian for 36,8% of the owners. The cat's health was by far the most answered reason for deworming (84,0%), while 12,0% dewormed because of the public's health.

The only correlation that was found was the correlation between deworming more than four times a year and more infection with enteric helminths. It was also found that the other correlations, like the last time of deworming and infection and use of a specific anthelmintic and infection, did not exist.

Introduction

At this moment circa 2,6 million cats are kept as a pet in the Netherlands, in different environments and families(1). These families may not all deworm their cat regularly, while they would like to have their cat healthy and save. Most household cats in the Netherlands are healthy, but some cats can also carry infectious diseases without showing any clinical symptoms. In some cases this can be dangerous for humans as well as for other animals within the same environment(2).

In most cases kittens (less than six months old) and older cats (older than twelve years old) are infected more often. The lifestyle of the cat seems to be an important risk factor, for example cats living with other animals or cats eating raw meat(2, 3). Even cats who live completely indoors may be exposed by catching a mouse that ended up in the house, from a new animal joining the family or by transmission of infective eggs via shoes or clothes of the owner(4, 5).

When a cat is infected, the cat can show some clinical symptoms, but an ideal parasite would not cause any serious health problems in its host. However, once parasite populations reach too high numbers, the cat will show clinical symptoms. In general, changes in the appearance of the cat's faeces is seen when intestinal worms are causing a problem. This may include the passage of mucus or blood and a decline in the cat's general health. Symptoms like diarrhoea, anaemia, loss of weight and decreased apatite are seen in cats infected with worms(4).

Some parasites have a zoonotic potential, infections of humans can either occur indirect through exposure to a contaminated environment or through close contact with parasitized animals(6). The symptoms of these zoonotic parasitoses in humans can vary per causative agent, but include neurologic, visual, respiratory, dermatologic and enteric disorders(7).

Intestinal parasites in cats

Intestinal parasites can be subdivided into two groups: protozoans and helminths. The last group can be subdivided into three other groups: nematodes, cestodes and trematodes(8). In the Netherlands, several of these intestinal parasites can cause feline infections. The most common parasitic nematode is *Toxocara cati* (or *Toxocara mystax*). This is a zoonotic infection. Other (potential) zoonotic endoparasites are *Giardia intestinalis* (protozoan), *Ancylostoma tubaeforme* (nematode), *Toxoplasma gondii* (protozoan), *Cryptosporidium parvum* (protozoan) and *Opisthorchis felinus* (trematode). Non-zoonotic endoparasites are *Ollulanus tricuspis* (nematode), *Toxascaris leonina* (nematode), *Taenia taeniaeformis* (cestode), *Cystoisospora* spp. (protozoan), *Sarcocystis* spp. (protozoan), *Hammondia hammondi* (protozoan), *Dipylidium caninum* (cestode), *Capillaria aerophila* (nematode) and *Aelurostrongylus abstrusus* (nematode). The prevalence of these parasites in the Netherlands is low(8, 9). For example, the prevalence of *Toxocara cati* and *Ancylostoma tubaeforme* in household cats in the Netherlands is estimated to be 5% and 4% respectively(9).

As examples for intestinal parasites, *Toxocara cati* and *Giardia intestinalis*, both parasites with a high expected prevalence, will be described shortly.

Toxocara cati

Toxocara cati is used to be a decisive factor in composing deworming schedules. This is why it is important to take a closer look at this nematode. Normally, adult cats do not show any clinical symptoms when infected with *T. cati*. Meanwhile, a female *T. cati* can produce a number of 200.000 eggs per day and these eggs will be infective within three to six weeks after being shedded(9). This number of eggs can infect a lot of cats and humans sharing the same environment. A study of Havasiová-Reiterová et al. (1995) suggested that less than 500 eggs are needed for an infection. Even five eggs caused infection in some of the animals that were tested(10). After ingestion of these eggs, the *T. cati* larvae will hatch the eggs and will start a migration route within the cat.

Life cycle of *Toxocara cati*

T. cati has a complex direct life cycle (Figure 1). After ingestion of eggs containing an infective L₃ larva, the larvae arrive in the stomach, penetrate the wall of the small intestines and migrate to the liver, lungs and trachea. After being coughed up, they will end up in the intestinal tract and exuviate to L₄(8). After predation of *Toxocara*-infected paratenic hosts by a cat, larvae are released and may develop directly to adult worms in the intestinal tract. In this case, the life cycle is non-migratory(3, 8).

The lactogenic route is a common way of infection (transmammary) of kittens, this route is the most important. Prenatal infection does not occur(8).

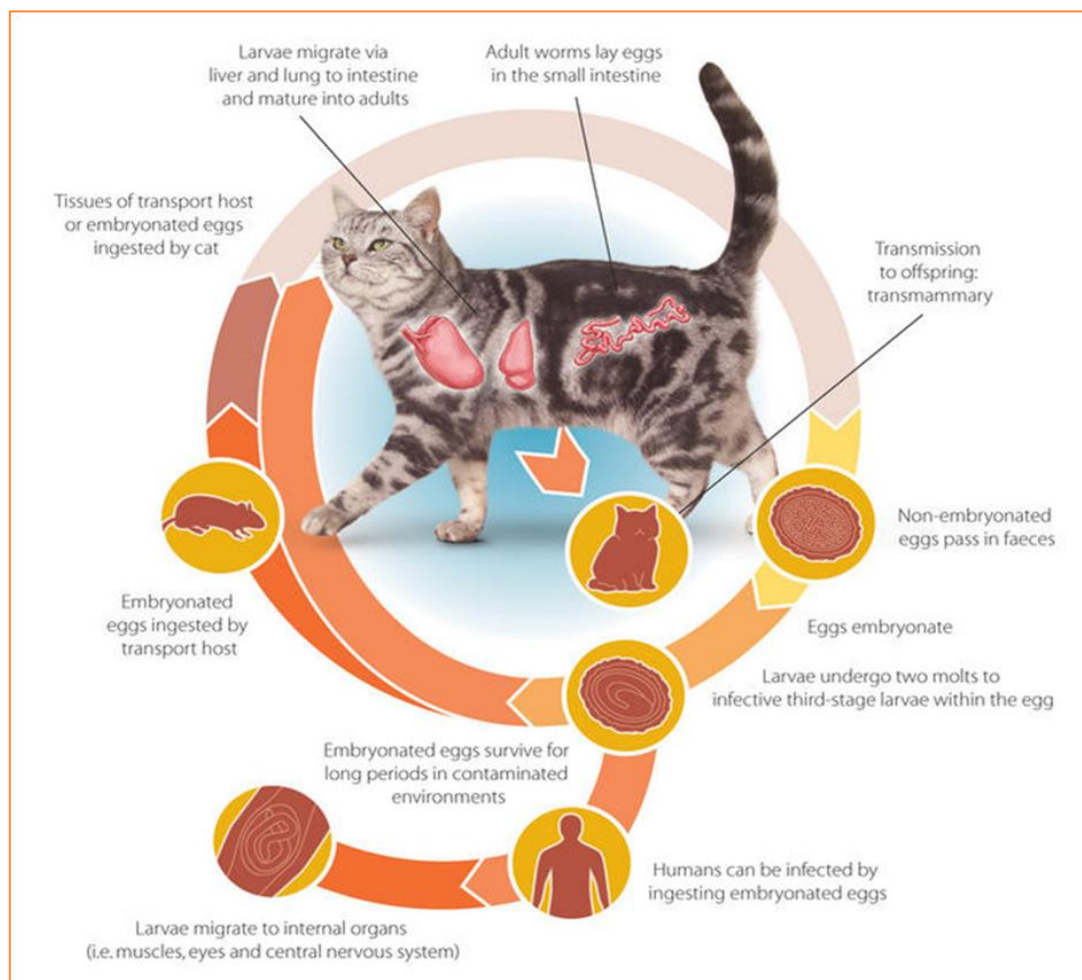


Figure 1: The life cycle of *T. cati* (11)

Giardia intestinalis

When *T. cati* is used to be a motive in deworming schedules, *Giardia intestinalis* is not, while it is less sensitive for some anthelmintics, like Milbemax®. However, it is important to be familiar with more parasites to achieve a suited deworming schedule. Unlike *T. cati*, *Giardia* is a protozoa, which means a different treatment is needed. Besides, seven different molecular subtypes (assemblages) of *Giardia* have been identified, named A to G. The assemblage F is seen in cats, whereas A and B are the main assemblages seen in humans. It is, therefore, possible that it is not zoonotic at all(12). However, a study of Overgaauw et al. (2009) isolated *Giardia* assemblage A in one dog and one cat sample(5). Therefore, in this study it is called potentially zoonotic.

Life cycle of *Giardia intestinalis*

Giardia intestinalis has a direct life cycle (Figure 2). It colonizes in the small intestine of a cat in its trophozoite form, where it remains either free or attached to the mucosa. The trophozoites in the intestinal lumen replicate by binary fission and finally encyst while they transit toward the colon. Trophozoites and environmentally resistant cysts both can be found in faeces in case of diarrhoea. This is usually seen after five to seven days of infection (prepatent period)(12, 13).

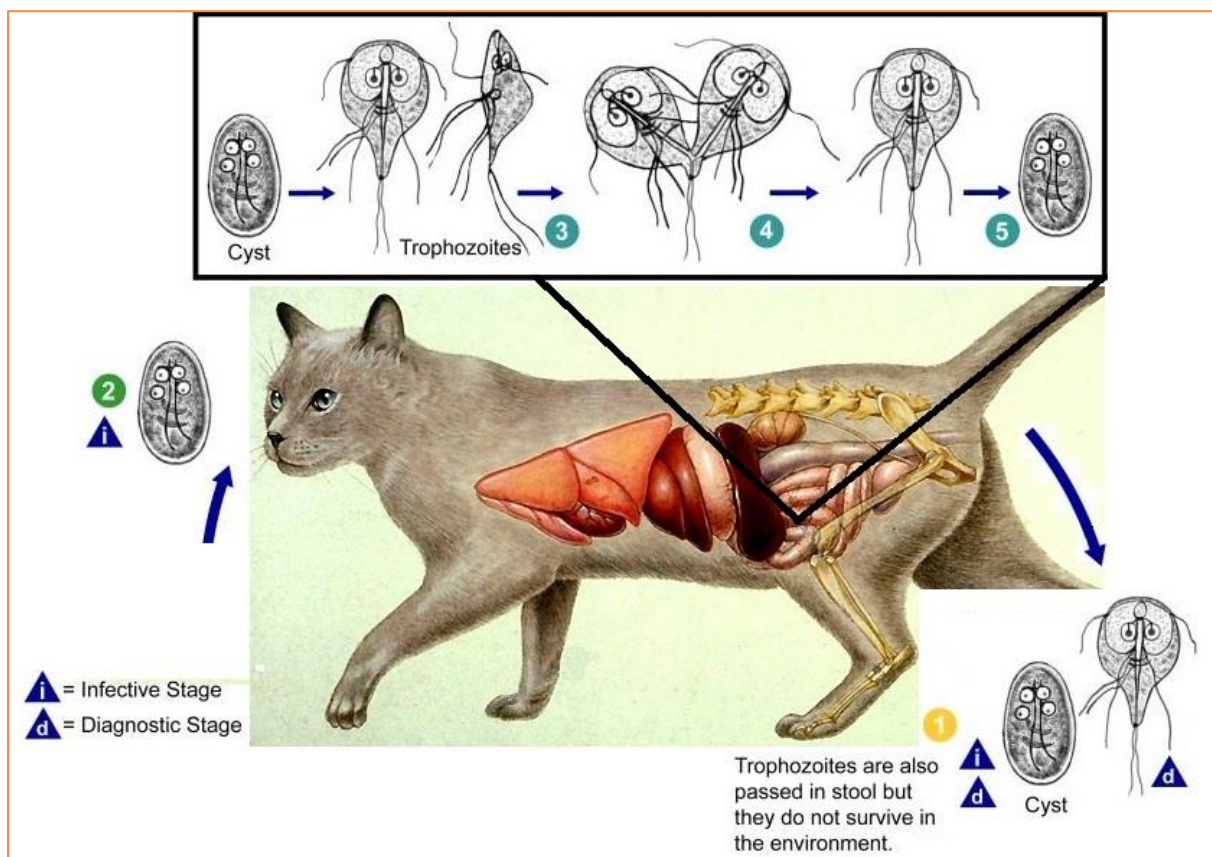


Figure 2: The life cycle of *Giardia*

Deworming

At this moment, a lot of anthelmintics are available in Benelux (Appendix 1). Anyone can buy an anthelmintic in a veterinary practice, a pet store, the internet and even in a supermarket. In places like a supermarket or the internet no advice will be given to the pet owner. It is possible that this person does not know how to use this product and may just deworm because he can. In general, a lot of deworming is performed without any reason. This can be one of the reasons why intestinal parasite infections in cats continue to be a problem(14). Therefore, it is considered to be important to advise the pet owner when buying an anthelmintic. Another reason to advise a pet owner is because not all enteric parasites can be treated with the same anthelmintic. A precise diagnosis is required for a medication to be safe and effective. The medication should also be given precisely as directed. Side effects, such as vomiting and diarrhoea, must be differentiated from toxic reactions. All anthelmintics are poisons, they are more poisonous to the parasites than to cats. For these reasons, it is said to be important to deworm a cat only under veterinary supervision(4). However, it is not always possible to achieve, because lots of anthelmintics are available in shops with no employees that have any veterinary education.

Most veterinarians in the United States of America recommend that adult cats should only be dewormed when there is specific evidence of an infection, like (oö)cysts or worm eggs in faeces. A microscopic faecal examination is the most effective way of making an exact diagnosis and choosing the best anthelmintic(4).

In the Netherlands, there is not a specific protocol to deworm your cat. Most of the published pet deworming schedules are based on information of parasitic infections in dogs, while they are scarce for cats. This is an important problem since a cat can be more important than dogs in spreading zoonotic infections. This is because in the Netherlands cats probably predate more often than dogs do, which, for some parasites, is linked to the development of patent infections, and they defecate more often in private gardens. These are usually places where kids play and people come in contact with soil(15). Furthermore, cats lay on peoples beds, walk over the kitchen table or sink. Although, a cat's fur is "cleaner" than that of dogs, because they clean their coat more intensively, the prevalence of patent infections in cats in the Netherlands may be higher than in dogs(5).

Resistance

In general, a few reported cases of anthelmintic resistance in dogs and cats are observed(2). So far, no method is invented yet to detect anthelmintic resistance in dogs and cats, other than through counting egg reduction in faecal samples before and after treatment. A more accurate test method is needed to control the efficacy of a product, which will contain molecular techniques(2). This is important, because resistance can be seen genotypically. Only if these genes reach fairly high levels, it becomes expressed phenotypically. Benzimidazole resistance cannot be detected using phenotypic-based assays, like egg hatch or faecal egg count reduction tests, until 25% of the gastrointestinal nematodes is resistant(16). Therefore, prevention of resistance can be aimed at reducing the rate with which resistance alleles accumulate. Besides, strategies designed to slow the resistance process must be integrated early on in the process of resistance evolution. Even before there is any clinical evidence of reduced drug effect. This can be accomplished by following practices that ensure maintenance of an adequate level of refugia: a term used to describe

the proportion of a parasite population that is not exposed to a particular drug, thereby escaping selection for resistance(16).

Worms in refugia provide a pool of genes susceptible to anthelmintics, thus diluting the frequency of resistant genes. As the relative size of the refugia increases, the rate of evolution toward resistance decreases(16).

In the Netherlands, lots of owners use anthelmintics to deworm their cats. Which means that the relative size of the refugia will be relatively high and the evolution toward resistance could be increasing. This is, because of the reproduction of resistant parasites(17).

The cat owners awareness and role of veterinarians

An owner might think that the pet's health is the main reason for deworming, while it may be more important to deworm for public health reasons. An owner with a pet without any clinical symptoms is not intrinsically motivated to deworm, while it can be important to deworm a pet even if it shows no clinical symptoms and is infected(18). For example, *Toxocara* spp. have a prepatent period over four weeks. In this case a monthly treatment of the animal is recommended in families with small children when the animal goes outside unattended regularly. If this animal is treated annually or biannually, it will not be prevented against *T. cati* and may develop a patent infection, depending on which anthelmintic is used(2). In conclusion, not based on evidence, a minimum of four times a year is recommended in this case. A monthly or three-monthly examination of the cat faeces is an alternative(2).

Proper information about zoonosis and the social concept of responsible cat ownership is required. Veterinarians should advise about effective anthelmintics, deworming schedules and how to prevent spreading of parasite eggs(3).

In a study of Palmer et al. (2008) in Australia it was discovered that many veterinarians were providing incorrect, minimal or out-to date information. It was speculated that veterinarians were uncertain to advise clients about parasites, because they were not confident with the subject matter and did not want to alarm their clients(19). A study of Overgaauw en Boersema (2006) showed similar results in the Netherlands. Veterinarians had to fill in a questionnaire about deworming. More than half of the number of questions were answered wrongly, which suggests that the advice given to the owners about deworming may also be insufficient(20).

In another study, a of Stull et al. (2007) it was discovered that many veterinarians were not actively educating clients on the zoonotic risk of endoparasites in companion animals. Besides that, a majority of veterinarians acknowledged the existence of an established deworming protocol, but not all veterinarians at the practice followed this protocol. It is a crucial service of veterinarians to recommend appropriate deworming schedules to their clients in order to decrease zoonotic diseases. Maybe, they should consider posting worm control recommendations on their website to reach prospective and established breeders and animals prior to their first routine examination(7).

Another possibility to educate pet owners is via the government. While results from a study of Overgaauw et al. 1996 suggested that it had a useful effect, it concluded also that the knowledge of *Toxocara* and toxocarosis was low or nearly absent in all investigated groups in the study both before and after the educational campaign. Therefore, it is still important

to continue veterinary education of parasitology and deworming(21). Information like the deworming frequency and the importance of deworming are needed to be discussed.

Aims of the study

The aims of this study were to assess whether a correlation exists between a practiced deworming history and the presence of patent infections of enteric helminths in cats and to determine the owners motivation of deworming in general.

Materials and methods

Enrolment of cat owners

At first, cat owners in the Netherlands were made aware of this research. This was done using social media, like facebook, and verbal advertising. In addition, posters were made and placed in veterinary practices and pet shops. The poster and social media text can be found in Appendix 2A and 2B.

Cat owners that were willing to participate could send an email to a specific email address, in order to be registered. After registering, the participating cat owners received an email with more information about this study (Appendix 3). They were asked to mention their addresses and the number of cats which they wanted to participate with. All addresses were collected in one file and every cat owner had its own unique code. For logistic reasons, each owner was allowed to submit faeces of a maximum of five cats. Catteries that participated were asked to submit with a maximum of three cats, because otherwise the number of cats was too much.

Sampling and examination

Packages containing: a plastic bag, a small plastic container with cover, tissues, a sealbag, a padded envelope with return address, and instructions about the sampling and sending of the package were send to the registered cat owners (Appendix 4). If the owner had more than one cat, the package contained multiple of these sets. When a package was send, the owner received an email with information about the sending.

The cat owners send faecal samples to Utrecht University after they had received these packages and had sampled the faeces. Then, the faecal samples were examined for parasites. This was performed by centrifugal sedimentation/flotation using a sucrose solution (specific gravity = 1,27-1,30) and the Baermann test, followed by microscopy.

The faeces were first registered on a form (Appendix 5A), which contained the date of sampling and the name of the cat. Then, the faeces were examined on consistency and documented on another laboratory form (Appendix 5B). The faecal examination results were also documented on this form and each faecal sample got its own unique lab-code.

Centrifugal sedimentation/flotation

A protocol has been made for the CSF technique and can be found in Appendix 6A.

In this study, a faecal sample of four grams was placed in a pestle with 55 ml of water. This suspension was made with a mortar and later filtered and poured into a test-tube. The test-tube was placed into a centrifuge and it centrifuged for two minutes at 3000 rpm. Hereafter, the supernatant was poured carefully and the test-tube was filled with a small amount of the sucrose solution. This was suspended with a vortex mixer, after which the test-tube was filled until a positive meniscus appeared. A cover glass was placed on top of this meniscus and then centrifuged again for two minutes at 3000 rpm. After that, the cover glass was removed in a vertical movement and placed onto a microscope slide containing the lab-code. This slide was analysed microscopically.

Baermann technique

A protocol has been made for the Baermann technique and can be found in Appendix 6B.

In this study, a Baermann glass was filled with water until the filter was half under water. The lab-code of each faecal sample was written on each glass, after which three grams of faeces was placed on the filter (Figure 3). The Baermann needed to remain standing for 24 hours. The fluid from the very bottom of the glass was transported into a small petri dish using a transfer pipette. The fluid in the small petri dish was analysed under a dissecting microscope. When moving larvae were seen, a few drops of the fluid containing the larvae were dropped on an object glass and analysed under a microscope, after a cover glass was placed.



Figure 3: Baermann

Questionnaire

The cat owner received an email when the faecal sample was received by the University. In this mail, the owner was asked to answer an online questionnaire via the following link: <https://nl.surveymonkey.com/s/maagdarmwormonderzoekkat>. This questionnaire was in Dutch and provided more information about the cat's health, its age, gender, breed, living conditions, diet and deworming history. There was also a section about the use of anthelmintics. The complete questionnaire can be found in Appendix 7.

The results of the faecal examination were emailed to the cat owner after completion of the questionnaire. This was used as an incentive for owners to answer the questionnaire. If the cat was infected with a parasite, the owner received a deworming advice or an advice to visit their veterinarian for a specific treatment.

Statistical analysis

Faecal examination

The information of the faecal examination was documented in a table. The fraction of positive cats (p) can be determined by dividing the number of positive cats by the number of all sampled cats (n). The prevalence (π) was determined by multiplying the fraction of positive cats (p) with 100. Then, a 95% confidence interval was calculated to determine if the results were reliable. This was calculated using the following formula(22):

$$p - 1,96\sqrt{(p(1-p)/n)} < \pi < p + 1,96\sqrt{(p(1-p)/n)}$$

Questionnaire: Descriptive statistics

The descriptive statistics were found in the questionnaire, which was collected in excel. The information about deworming was also found in the questionnaire. Tables and graphics can be found in Appendix 8 and 9.

Correlation deworming and endoparasites

One of the aims of this study is to assess whether a correlation exists between a practiced deworming history and the presence of patent infections of enteric helminths in cats. An analysis needs to be made in order to determine whether a correlation exists. Therefore, cross tables were made and the Chi-square test was used in SPSS 22 for Windows. Some qualifications are needed using the Chi-square test. All expected frequencies should have a minimum of one and the expected frequency in any one of the four cells (2x2 table) should be more than five (< 20%). If this is less, a Fisher's exact test should be employed(23).

The hypothesis were:

H₀: There is no correlation between deworming history and prevalence of patent infections with enteric helminths in cats.

H₁: There is a correlation between deworming history and prevalence of patent infections with enteric helminths in cats.

If the p-value calculated by SPSS was less than 0,05 (α), H₀ was rejected.

Results

Faecal examination

Faecal samples were analysed from a total of 372 cats coming from 191 cat owners. A number of 28 cats of 23 different owners were found positive for intestinal parasites, this is 7,5%. Of one positive tested cat, the parasite was not determined.

Eight cats were found positive for multiple intestinal parasites (2,2%). Two of these eight cats were infected with *Isospora* spp. and *Capillaria aerophila* at the same time and two other cats were infected with *Isospora* spp. and *Sarcocystis* spp. at the same time. Other combinations were *Toxocara cati* and *Isospora* spp. (Figure 4), *Toxocara cati* and *Toxascaris leonina*, *Toxocara cati* and *Aelurostrongylus abstrusus*, and *Sarcocystis* spp. and *Cystoisospora* spp.

Out of the eight catteries that participated, three of the 22 cats were tested positive. Two were positive for *Giardia intestinalis* and one was positive for both *Toxocara cati* and *Toxascaris leonina*. The two positive tested cats with *Giardia intestinalis* were coming from the same cattery.



Figure 4: Multiple oocysts of *Isospora* spp. (I) and eggs of *Toxocara cati* (T) in a faecal sample

With CSF, nine cats were found positive for *Giardia intestinalis*, seven for *Isospora* spp., six for *Toxocara cati*, three for *Sarcocystis* spp. and *Capillaria aerophila* and one for *Cystoisospora* spp., *Toxoplasma gondii*, *Opisthorchis felinus*, *Toxascaris leonina* and *Ancylostoma tubaeforme*. Two cats were positive *Aelurostrongylus abstrusus*, which was found using the Baermann technique. Table 1 shows the number of positive samples, the prevalence including the 95% confidence interval for all intestinal parasites that were found.

The first three samples that were received, were not tested with the Baermann technique because it had not been decided yet to perform that test. From ten faecal samples the Baermann technique could not be done, because of a minimal amount of faeces. Two samples were too obscure to analyse after using the Baermann technique.

Parasite	Number	Prevalence	95% confidence interval
<i>Giardia intestinalis</i>	9	2,4%	0,9% - 4,0%
<i>Isospora</i> spp.	7	1,9%	0,5% - 3,3%
<i>Toxocara cati</i>	6	1,6%	0,3% - 2,9%
<i>Sarcocystis</i> spp.	3	0,8%	0,0% - 1,7%
<i>Capillaria aerophila</i>	3	0,8%	0,0% - 1,7%
<i>Aelurostrongylus abstrusus</i>	2	0,5%	0,0% - 1,3%
<i>Cystoisospora</i> spp.	1	0,3%	0,0% - 0,8%
<i>Toxoplasma gondii</i>	1	0,3%	0,0% - 0,8%
<i>Opisthorchis felineus</i>	1	0,3%	0,0% - 0,8%
<i>Toxascaris leonina</i>	1	0,3%	0,0% - 0,8%
<i>Ancylostoma tubaeforme</i>	1	0,3%	0,0% - 0,8%

Table 1: Total intestinal parasites found during this study

Questionnaire: Descriptive statistics

In total, 184 cat owners had filled in the questionnaire. Three cat owners did not complete the questionnaire and five did not fill in the questionnaire at all. Information of a total of 355 cats was registered through the questionnaire that had been send to the owners.

In this study, 168 queens and 187 tomcats participated of which 34 queens and 26 tomcats were not castrated. The age of all cats was variable, most of the participated cats were 1 year old (20,3%). The distribution by age can be found in Appendix 8A.

A total number of 162 cats was classified as outdoor cats (45,6%) of which 15 cats were positive (9,3%). Out of the 193 indoor cats (54,4%), 11 were tested positive (5,7%). Most of the cats defecated in a litter box (83,4%), while 14,4% defecated outside as well as in a litter box and 2,0% defecated only outside.

In the whole study, a number of 142 cats were fed raw meat (40,0%) and 69 cats were fed with raw fish (19,4%). A percentage of 15,5 was fed with both raw meat and raw fish. Out of the 26 positive tested cats and of which cat owners had answered this question 15 (57,7%) were fed with raw meat, raw fish or both. Chicken (31,7%) and cattle (24,4%) are most eaten raw by a cat. Besides, 15,8% of all cats ate preys of which four cats were tested positive in this study (7,1%). An overview can be found in Appendix 8B.

Eleven (3,1%) of the 355 cats have been in an animal shelter somewhere in the past six months. A number of 76 (21,4%) were told to show signs of a decreased health and the most noticed abnormality was that the faeces seemed more diarrhoea-like.

Deworming

Out of 355 cats, 15 (4,2%) have never been dewormed. Reasons were: it is not needed (13,3%), it is an indoor cat (53,3%) and other reasons. A summary can be found in Appendix 9A. One of these 15 cats was tested positive (6,7%).

If the cat owner did deworm, they were asked to fill in their motivation for deworming. Eight categories were made: after faecal examination (I), advice of a veterinarian (II), advice of a pet shop (III), advice of a friend (IV), information on the internet (V), information coming from school or work (VI), found (oö)cysts or worm eggs in faeces (VII) and another

information source (XI). A lot of cat owners filled in “information coming from another source”, therefore this was categorized again after the results had been analysed: advice of a breeder/cattery (VIII), for health reasons (IX) and because it is needed (X). The cat owners were able to fill in more than one answer. Most of them dewormed because of veterinarian advice (36,8%), information coming from school or work (17,7%) and information on the internet (7,7%). More information of the motivation can be found in figure 5 and Appendix 9B. The reason for deworming was asked as well. Three categories were made in this case: the cat’s health, the public’s health and because it is needed. Most of the cat owners answered because of the cat’s health (84,0%) and 12,0% filled in because of the public’s health. More information about this can be found in Appendix 9B as well.

When those motives are subdivided into intrinsic and extrinsic influence of information, most of the cat owners are influenced extrinsically.

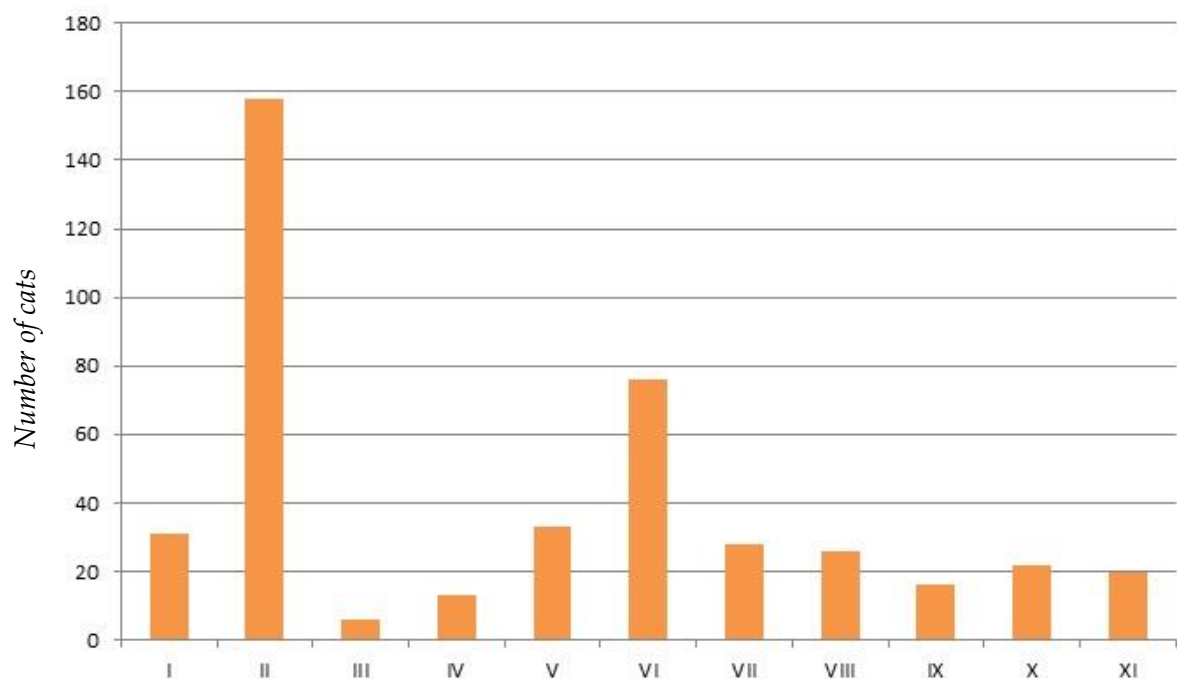


Figure 5: Motivation of deworming.

I: After faecal examination, II: Advice of a veterinarian, III: Advice of a pet shop, IV: Advice of a friend, V: Information on the internet, VI: Information coming from school or work, VII: Found (oö)cysts or worm eggs in faeces, VIII: Advice of a breeder/cattery, IX: For health reasons, X: Because it is needed, XI: Another information source.

Of 342 cats the deworming schedule was determined. 27,0% of the cats had been following no deworming schedule at all, while 35,2% of the cats have been dewormed two or three times a year. Only 2,3% of the cats have been dewormed for more than four times a year, of which some of them six or twelve times a year (figure 6). Owners were also asked to fill in on which ground they were following this deworming schedule. Answers like advice given by a veterinarian (48,8%), information coming from school or work (15,4%) and my own opinion (8,7%) were answered most often. More information about the deworming schedule and on which ground it is based, can be found in Appendix 9C.

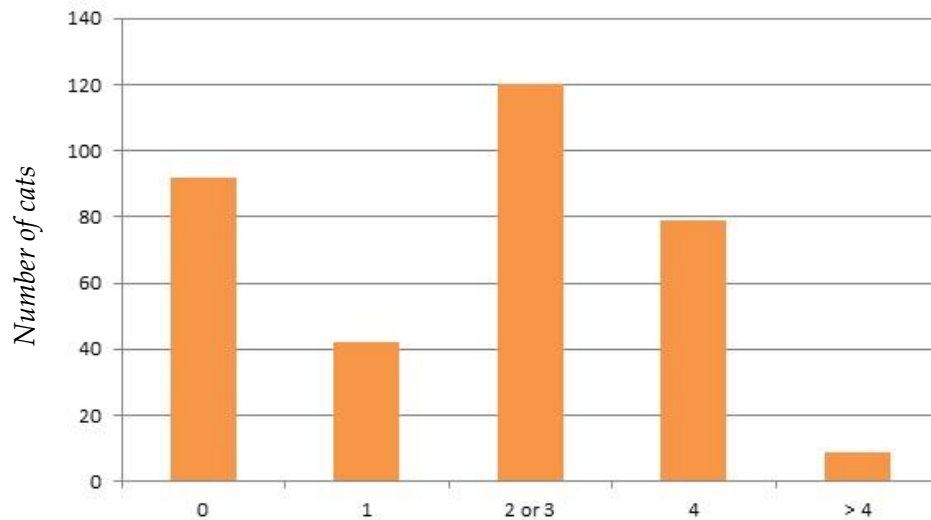


Figure 6: Deworming schedule.

0: No schedule, 1: Once a year, 2 or 3: Two or three times a year, 4: Four times a year, > 4: More than four times a year.

Out of 130 cat owners that answered the question: “What is the duration of activity of an anthelmintic according to you?”, 60 answered two up to three months (46,2%), 31 filled in short, only a couple of days (23,9%) and 20 did not know what the duration of activity was (15,4%) (Appendix 9D).

Sixteen different brands of anthelmintics were used by the cat owners, which can be seen in Appendix 9E. Milbemax® is the most popular anthelmintic by far, which was used 154 times to deworm a cat (44,5%). A number of 62 cats were dewormed with an unknown product (17,9%). These unknown products were most bought in a veterinary practice (63,2%) or in a pet shop (23,7%).

Overall, the anthelmintics were bought in a veterinary practice (53,8%), on the internet (23,9%), in a pet shop (19,0%) or in a supermarket/garden centre (3,3%). The most used route of administration was a tablet (73,6%) (Appendix 9E).

A Chi-square test has been done to determine whether a correlation exists between the use of a specific anthelmintic and infection with helminths or protozoa. There was no correlation found between these variables, because the p-value was over 0,05 (α): Infection (0,938), helminths (0,448) and protozoa (0,828). However, the test was not reliable, because more than 20% of the cells had an expected count less than five. All results can be seen in Appendix 9E.

From 336 cats, the cat owners were able to determine the last moment they had dewormed their cat. Answers like more than six months ago (26,2%) and one or two months ago (19,6%) were answered the most (Appendix 9F). To determine a correlation between last time of deworming and an infection, the Chi-square test has been done. The p-value of the test was 0,655, which means that the null-hypothesis will not be rejected and that there is no correlation between the last time of deworming and an infection (Appendix 9F). However, the test was not reliable, because 50% of the cells had an expected count of less than five. In table 2 an overview is shown of the number of positive cats within each group of last deworming. The most positive cats were last dewormed more than six months ago (28,0%) and one or two months ago (20,0%).

Correlation between deworming history and the patent infections with enteric helminths in cats.

Last time of deworming	Positive	Helminths	Protozoa	Parasites
< 1 week	1	0	1	<i>Isospora</i> spp.
1 – 2 weeks	2	1	1	<i>Isospora</i> spp. and <i>Sarcocystis</i> spp., <i>T. cati</i> and <i>T. leonina</i>
2 weeks – 1 month	2	1	1	<i>T. cati</i> and <i>A. abstrusus</i> , <i>Isospora</i> spp.
1 – 2 months	5	2	3	<i>T. gondii</i> , <i>A. abstrusus</i> , <i>G. intestinalis</i> (2), <i>C. aerophila</i>
2 – 3 months	3	1*	3*	<i>Sarcocystis</i> spp. and <i>Cystoisospora</i> spp., <i>T. cati</i> and <i>Isospora</i> spp., <i>Isospora</i> spp. and <i>Sarcocystis</i> spp.
3 – 4 months	3	2	1	<i>O. felinus</i> , <i>A. tubeaforme</i> , <i>G. intestinalis</i>
5 – 6 months	2**	1	0	<i>T. cati</i>
> 6 months	7	3*	6*	<i>T. cati</i> , <i>G. intestinalis</i> (4), <i>Isospora</i> spp. and <i>C. aerophila</i> (2)
Total	25			

Table 2: Number of positive cats per last time of deworming.

* Cats infected with both a helminth and a protozo are separated in this column.

** Of one positive tested cat, the parasite was not determined

Schedule	Positive	Helminths	Protozoa	Parasites
No schedule	9	4*	7*	<i>T. cati</i> , <i>A. abstrusus</i> , <i>G. intestinalis</i> (4), <i>Sarcocystis</i> spp. and <i>Cystoisospora</i> spp., <i>Isospora</i> spp and <i>C. aerophila</i>
Once a year	0	0	0	-
Two or three times a year	10**	6*	4*	<i>T. cati</i> , <i>T. gondii</i> , <i>O. felinus</i> , <i>G. intestinalis</i> , <i>A. tubeaforme</i> , <i>C. aerophila</i> , <i>T. cati</i> and <i>A. abstrusus</i> , <i>T. cati</i> and <i>Isospora</i> spp., <i>Isospora</i> spp. and <i>Sarcocystis</i> spp.
Four times a year	3	1	2	<i>T. cati</i> and <i>T. leonina</i> , <i>G. intestinalis</i> (2)
More than four times a year	3	0	3	<i>Isospora</i> spp. (2), <i>Isospora</i> spp. and <i>Sarcocystis</i> spp.
Total	25			

Table 3: Number of positive cats per deworming schedule

* Cats infected with both a helminth and a protozo are separated in this column.

** Of one positive tested cat, the parasite was not determined

Correlation deworming schedule and infection

Cat owners of 25 positive tested cats had answered the question about their deworming schedule. Nine positive tested cats followed no particular deworming schedule (36,0%), null had been dewormed once a year (0,0%), ten had been dewormed two or three times a year (40,0%), three had been dewormed four times a year (12,0%) and another three had been dewormed for more than four times a year (12,0%). An overview of this can be seen in table 3.

The Chi-square test has been used to determine whether a correlation exists between deworming history and prevalence of patent infections with enteric helminths in cats.

The cross tables and Chi-square tests can be found in Appendix 10.

In table 4, the results of the Chi-square test are outlined. First, the test was performed over all schedules (*schedule*) and later performed by each schedule separately. There was no correlation found between (not) using a deworming schedule and infection, deworming once a year and infection, deworming two or three times a year and infection and four times a year and infection. However, there was a correlation found between deworming more than four times a year and infection. Although this correlation is found, these results were not reliable, because the expected cell counts in the crosstab were between one and five. Therefore, the Fisher's exact test was done. The p-value of the test was 0,015, which leads to a rejection of the H_0 hypothesis and acceptance of the H_1 hypothesis: There is a correlation between deworming more than four times a year and prevalence of patent infections with enteric helminths in cats.

Deworming schedule	P-value	Correlation	Fisher's exact test
No schedule	0,291	No	0,348
Schedule	0,884	No	1,000
Once a year	0,052*	No	0,056
Two or three times a year	0,601	No	0,665
Four times a year	0,169	No	0,221
More than four times a year	0,001*	Yes	0,015
* For these factors, the Chi-square test is not reliable, because the expected cell counts in the crosstab are between one and five (>20%).			

Table 4: Chi-square test results

Discussion

Faecal examination

In the Netherlands, several studies have been done on the prevalence of enteric parasites in dogs and cats. Overall, the prevalences of parasites that have been reported in the Netherlands are low. In this study the prevalence of endoparasites was lower comparing to other studies. The prevalence of *T. cati* in this study is 1,6%, while it was reported to be 5% in the book of Overgaauw and Claerebout (2002)(9). However, the prevalence of *Giardia intestinalis* was higher than expected. The study of Robben et al. (2004) researched helminth and protozo prevalences in cats from animal shelters(24), while in this present study cats coming from different households and catteries were studied. The prevalence of *G. intestinalis* reported in the study of Robben et al. (2004) was 1,0% while it was 2,4% in the present study. However, cats coming from shelters may have a different lifestyle and origin than household cats. A study of Overgaauw et al. (2009) collected faecal and hair samples from healthy household dogs and cats in Dutch veterinary practices. From 13,6% of the cat faeces *Giardia* was isolated, which is more than the 2,4% found in the present study and the 1,0% that was found in the study of Robben et al. (2004). However, in the study of Overgaauw et al. (2009) the faeces were investigated by microscopy, ELISA and PCR, while in the present study as well as the study of Robben et al. (2004) only microscopy was done(5).

A study of Bouzid et al. (2015) researched the prevalence of *Giardia* infection in dogs and cats through systematic review and meta-analysis of prevalence studies from faecal samples. It showed that studies on *Giardia* with direct microscopy will significantly underestimate prevalence compared to other detection methods, like immune-based or PCR detection methods. It acknowledged also that microscopy is not as standardised as the other methods and that preparation/concentration steps can dramatically influence the sensitivity of the technique(25). The big advantage of microscopy is that it is not limited to one parasite and therefore more can be detected, which may be important in determining the cause of non-specific symptoms, such as diarrhoea(26).

The overall low prevalence (7,5%) may be due to the fact that only one faecal sample was examined per individual cat, which means that the observations were performed at one moment for each cat. Due to the fact that the natural life cycle of parasites, which include intermittent (oö)cyst/egg shedding, this may have underestimated the observed prevalence. However, most studies examined only one faecal sample per individual cat, like studies of Villeneuve et al (2015) and Barutzki and Schaper (2011)(27, 28).

If a cat is infected with a parasite that sheds eggs or (oö)cysts intermittently, like *Giardia intestinalis*, it is needed to examine faeces of three days in a row(29). Collecting one faecal sample per cat may have contributed to missing a patent infection with *G. intestinalis* and *A. abstrusus* for example(29, 30). However, the prevalence of *G. intestinalis* was higher than expected, which suggests that this will be even higher when more faecal samples per cat are examined. A study of Dirven et al. (2012) stated that infection with *A. abstrusus* is believed to be uncommon, it conducted a prevalence study evaluating adult shelter cats in the area where kittens were found. A prevalence of 3,5% was found in a population of 173 cats(31). This suggests that comparing to the study of Dirven et al. (2012), the prevalence found in the

present study (0,5%) is less than expected. This substantiates the fact that it could be due to the examination of just one faecal sample.

Besides, the period between sampling and faecal examination was different because of the postal services and days off or weekends in between. In one case, a period of seven days between sampling and analysing occurred. In most cases the samples were received within two or three days after sending. A consequence was the limited survival period of *A. abstrusus* larvae in faeces. Hamilton and McCaw (1967) showed that the number of active larvae will decrease with 50% in three to six days. Faeces can be cooled for about three days before analysing and thereafter faeces cannot be used for diagnosis using the Baermann technique. Then, the larvae are too slow to crawl through the filter(32). However, for example ascarid nematode eggs, like eggs of *Toxocara cati*, can survive and remain infective in the environment for years(33), which means that eggs of these kind of parasites can be found despite the period between sampling and faecal examination.

Information coming from the questionnaire

In the questionnaire different aspects of the lifestyle of the cat were asked and answered by the cat owners. A notable fact is that many cats defecated in the litter box (83,4%) or were indoor cats (54,4%), which means that the chance of contact with infective stages of parasites may be less than cats that defecated outside or were outdoor cats. In the studies of Jansen (2012) and Koolwijk (2012) there were relations found between a patent infection with *T. cati* and defecating outside. More outdoor cats were tested positive than indoor cats(30, 34), which substantiates the fact that defecating outside is a risk factor for patent infection with enteric helminths. Besides, sampling faeces was more practical for owners of which the cat defecated in the litter box. In this way it is possible that owners with cats that defecated outside were not participating, because it was too difficult to sample faeces. This suggests that the group of cats that was examined may not be representative for all cats in the Netherlands, because lots of cats defecate outside and may not defecate on a litter box at all. There are no specific numbers published whether cats in the Netherlands defecate outside more than in a litter box, which means that no conclusions can be made.

Another notable fact is that a lot of cats were fed with raw meat, raw fish or both (43,9%) and 15,8% ate preys. It is possible that owners were not aware of the cat eating preys, which explains the low percentage. Eating preys may lead to a higher chance of infection for some parasites, while raw meat or raw fish may be more safe, because of hygiene measures in the husbandry of commercially kept slaughter animals(35). A study of Afonso et al. (2007) suggested that the variability of prevalence in cats could depend on the variability of infection in prey. It showed that different prey species represented unequal infection risks for predators(36). This may suggest that in this study less cats actually consumed these (infected) preys. Besides, the high number of cats that were fed with raw meat may be due to the fact that the social media message was placed on a BARF-forum. This suggests that the examined group may not be representative for all cats in the Netherlands. In a study of Opsteegh et al. (2012) cat owners were asked about feeding raw meat. Out of the 333 cats for whom the question was answered, 36 were fed with raw meat (10,8%)(37). This is lower than in the present study, which may be due to the fact that more cat owners are feeding their cat(s) raw meat or that the examined group was not representative for all cats in the Netherlands.

Information coming from answers in the questionnaire were assumed to be true. However, because the answers of the questionnaire were self-administered, it is possible that answers were given too fast, in a socially way or without thinking. Besides, some cat owners just skipped too many questions. This leads to missing information while it is important to receive enough answers for a statistical analysis. In the present study enough answers were given for a statistical analysis. Another problem that was seen in the questionnaire was inaccurate questioning. For example the question about the motivation for deworming, some owners answered "another information source" because they could write something (open answer) and then wrote something like: "horses", "while entering" or "because I won an anthelmintic". These answers were not expected of them and in this study we could not use these answers, because they were too vague.

Deworming

In this study it was found that by far most of the cat owners deworm because of the cat's health (84,0%) instead of the public's health (only 12,0%), while, in a country like the Netherlands where zoonotic helminths are the most prevalent, but almost never cause clinical problems in adult final hosts, it is necessary to deworm because of the public's health. Most of the owners that answered "because of the cat's health" dewormed based on a veterinarian's advice (42,4%). In a study of Overgaauw (1998) it was concluded that the overall basic knowledge in relation to anthelmintic strategy and public health aspects was moderate among veterinary practitioners(38). This may explain the number of owners that deworm because of the cat's health and were advised by a veterinarian. Therefore, it is important to educate veterinarians as well as pet owners that, under the current circumstances, it is necessary to deworm their animals in the Netherlands because of public health risks.

In this study, it was determined that there was no correlation found between infection and the use of anthelmintics in general. The correlation was not tested for each anthelmintic individually, while it may be different for each anthelmintic because not all enteric parasites can be treated with the same anthelmintic.

A notable result was that more cats were infected with a protozo than with a helminth when the cat was dewormed. This is due to the fact that most anthelmintics used, were effective against nematodes, like *T. cati* and *A. tubaeforme* (Appendix 9E). Some anthelmintics were also effective against cestodes (*Dipylidium caninum* and *Taenia* spp.), like Milbemax®, Vitaminthe® and Profender® (39-47). If the cat was not dewormed at all, it may have been infected with both a protozo and a helminth instead of only with a protozo.

Besides, one positive tested cat was dewormed with Milbemax® less than one week ago. This cat was infected with a protozo. The instructions of use showed that Milbemax® is only effective against infections with several intestinal parasites at the same time, like cestodes and nematodes(42). It is not effective against protozoa at all, which explains the fact that the cat that was dewormed less than one week ago, was tested positive.

Therefore examining faeces before deworming a cat that is showing aspecific symptoms that could be explained by a enteric parasitic infection can be important, while not every parasite can be treated with the same anthelmintic. Deworming a cat that shows no symptoms is not always necessary because if a cat is not infected, an anthelmintic will not work. It usually does not work preventive and with a faecal examination a veterinarian can decide if it is

necessary to deworm and afterwards can check the efficacy. In this way a specific treatment can be performed for the parasite that has been found. A study of Jansen (2012) also suggested this, but described that there is a disadvantage for this solution. The faecal examination and the (possible) treatment have to be paid by the owner(34), which may be a reason for the owner to deworm without an examination.

Motivation

The motivation for deworming a cat is different for every cat owner. Some cat owners do not want to deworm their cat, because they think anthelmintics are a chemical substance that might be hazardous to their cat or they think it is useless. Most of these cat owners gave as reason that their cat was an indoor cat (53,33%) and therefore it was not needed to deworm their cat. This suggests that cat owners are not aware of the risk that (oö)cysts or worm eggs could be transmitted via shoes or clothes of the owner, via other pets or in other ways(5). Therefore, it is important to inform pet owners of this risk. A veterinarian should also explain the short duration of activity of an anthelmintic, because 46,2% cat owners answered that the duration of activity of an anthelmintic was two or three months. Most of these people dewormed based on the advice of a veterinarian. This suggests that veterinarians are explaining the duration of activity of an anthelmintic is two or three months while giving advice to the cat owner. However, it is possible that the veterinarian had told, but the owner forgot. Besides, it is also needed to explain a pet owner that anthelmintics are only affective against patent infections. The ESCCAP recommends that awareness of parasitic zoonoses, including clinical manifestations in people and particularly children, should be created in the medical profession through information brochures. These brochures can be placed in veterinary practices, pet shops, posters or specific websites(48). Although these brochures have more information, not every pet owner is likely to read it. Which is why a single note by a veterinarian may be more effective.

In this study, it was discovered that breeders and catteries gave information about deworming too. It is not known if that information is correct or that they just tell an owner what they heard about anthelmintics from a veterinarian. In a study of Jansen (2012) a questionnaire was answered by pet shops. It showed that 35,8% of the pet shop owners thinks that deworming is a preventive measure and that the duration of activity of an anthelmintic is long-lasting. When a pet shop owner advises a pet owner about the deworming product, incorrect information will be received by the owner(34). If this is also the case with breeders and catteries, than more incorrect information will be received by more pet owners.

Most of the cat owners that deworm their cats regularly, had "advice of a veterinarian" as motivation for deworming. Although 36,8% of the cat owners dewormed because of advice of a veterinarian, more owners (53,8%) bought an anthelmintic in a veterinary practice. This may be due to the fact that there were also veterinarians and veterinary medicine students participating, which means that they may have answered because of "information from school/work" as motivation for deworming, while they bought anthelmintics in a veterinary practice.

Another notable answer was that 23,9% bought an anthelmintic on the internet. While buying something on the internet is increasing, no advice will be given when buying an

anthelmintic. However, more information about those anthelmintics and their use can be found on the internet.

Deworming history

In the Netherlands, schedules to deworm a cat are scarce. Besides, cat owners are not aware of parasitological risks(3) or deworming schedules and not many studies have been done to determine a correlation between these two variables. In this study, the Chi-square test was done to determine whether a correlation exists between a deworming schedule and a present patent helminthic infection. It was found that there was no correlation between a deworming schedule and infection, while there was a correlation found between deworming more than four times a year and more infection with endoparasites. However, more research should be done to substantiate this correlation, because in this study a number of three cats was tested positive and followed a deworming schedule of more than four times a year. In total eight cats of the 341 cats followed a deworming schedule of more than four times a year.

It is possible that the lack of a correlation found with the other schedules, because developing a patent infection is multifactorial (immunity, age, exposure, etc.). Cats that are immune to some parasites are not likely to be reinfected with that parasite. ESCCAP recommends that veterinarians should consider the age, reproductive status, health status, history, environment and more before advising a specific deworming schedule to a pet owner(48).

It was also expected that there was a correlation between the previous moment of deworming and infection. The prediction was the longer the cat had not been dewormed, the higher the chance of infection. However, this counts for a period that lasted longer than the prepatent period and it depends on contamination of the environment. Although 28,0% of the cats that were tested positive had been dewormed more than six months ago, there were only two cats tested positive that had been dewormed five or six months ago (8,0%). Besides, 20,0% was tested positive and had been dewormed one or two months ago. This substantiates again the fact that there was no correlation found using the Chi-square test.

Overall, most cat owners dewormed their cat two or three times a year, while most of these cat owners were advised by a veterinarian. This suggests that most veterinarians advise that pet owners should deworm their cat two or three times a year, while an anthelmintic has a short duration of activity. As described above, the study of Overgaauw (1998) concluded that the overall knowledge of veterinarians about anthelmintic strategy was moderate(38), which explains the answers given in the questionnaire. Besides, information could be given by another source, like a pet shop or a breeder, which may be incorrect as well. Another possibility is that there may be something wrong with the communication between the veterinarian and the cat owner which was also described earlier.

Limitations in this study

Some limitations in this study are already described above. Another limitation was for example, the limited period in this study. This led to a maximum of faecal samples that could be processed in that period. The more faecal samples examined, the smaller the

confidence interval and the more reliable the results will be. In a next study it is recommended to examine faecal samples during a longer period of time. In this study it was only three months, while the study of Villeneuve et al. (2015) examined faecal samples during seven months. In that study 636 cats were examined in different animal shelters in Canada, of which 31,8% was tested positive(27). A study of Barutzki and Schaper (2011) examined faecal samples during seven years. In that study seasonal shedding of (oö)cysts and worm eggs were determined. *T. cati* and *Giardia* spp. were most often found from November until January and October until December, respectively. *Isospora* spp. were more frequently found in August and September(28). This may also explain the low prevalence found in this study, because it was performed from March to June.

Fifteen faecal samples were not tested using the Baermann technique because of the minimal amount of faeces. In a follow-up study the minimal amount of faecal samples should be explained in the instructions about the sampling, so that there is enough faeces to examine with both techniques (Baermann and CSF).

The sampling of the faeces was done by the cat owners, which could not be controlled if it was done the right way. The cat owner had to unravel which faecal sample belonged to which cat as well, which was probably not done at all. Some faecal samples could not be examined, because there was contamination with soil or plants. In this way many free-living larvae were found in the sample which made it difficult to examine the faeces on parasitic larvae.

All questions of the questionnaire were answered by cat owners per cat. In this way information about all individual cats was received, but some question had been answered the same by cat owners for each cat. Some information should be received per owner instead of each cat. The correlations were also determined per cat, while cats living in the same environment may have similar parasitic diseases, the so called "cluster effect". In a follow-up study data of cats living in the same environment should be corrected for clustering, so that information will not be received twice or more.

Conclusion

It was determined that most cat owners deworm because of veterinary advice and because of the cat's health, while, in a country like the Netherlands where among the enteric helminths zoonotic helminths are the most prevalent, but almost never cause clinical problems in adult final hosts, it is necessary to deworm mainly because of the public's health. Therefore, it is important to educate pet owners as well as veterinarians that, under the current circumstances, it is necessary to deworm their animals in the Netherlands because of public health risks. Information, like the duration of activity and parasites in general should be given too.

Besides, deworming schedules were scarce for cats and most cat owners deworm their cat two or three times a year based on advice of a veterinarian. The only correlation that was found was the correlation between deworming more than four times a year and more patent infections with enteric helminths. It was also found that the other correlations, like the last time of deworming and infection, and use of a specific anthelmintic and infection, did not exist.

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Appendix

Appendix 1: Cat anthelmintics available in Benelux

Active substance	<i>Toxocara</i>	<i>Toxascaris</i>	Hookworms	<i>Taenia</i>	<i>Dipylidium</i>
<u>Benzimidazoles</u>					
Pyrantel/ Praziquantel	x	x	x	x	x
Fenbendazole	x	x	x	x	<i>Giardia</i>
Flubendazole	x	x	x	x	
Mebendazole	x	x	x	x	
Oxibendazole/ Niclosamid	x	x	x	x	x
<u>Avermectin and Milbemycin</u>					
Milbemycin/ Praziquantel	x		x	x	x
Moxidectin/ Imidacloprid	x	x	x		
Selamectin/ Abamectin	x		x		
<u>Depsipeptids</u>					
Emodepsid/ Praziquantel	x	x	x	x	x
<u>Other</u>					
Piperazin	x	x	x		Only adult worms
Pyrantel	x		x		Only adult worms
Praziquantel				x	x

Appendix 2: Advertising

Appendix 2A: Poster

KATTENPOEP GEZOCHT!



Universiteit Utrecht

Heeft u of kent u iemand met een kat en wilt u een **GRATIS onderzoek naar maagdarmwormen** bij de kat laten uitvoeren? Dat is nu tijdelijk mogelijk.

Als studenten van de faculteit Diergeneeskunde aan de Universiteit Utrecht doen wij onderzoek naar het voorkomen van de haakworm *Ancylostoma tubaeforme* bij de kat. Natuurlijk wordt er ook gekeken of er andere darmparasieten in de ontlasting te vinden zijn.



Door mee te doen helpt u gelijk mee aan een onderzoek naar de noodzaak voor ontworming en krijgt u bericht of uw kat op dit moment eitjes uitscheidt en dus ontwormd moet worden.

Er zijn zoveel mogelijk katten nodig!

Wilt u meedoen? Meldt u dan nu aan en geef uw emailadres op, zodat wij contact met u kunnen opnemen.

Sandra Vink en Manon Coenen

Naam	Emailadres
1.	
2.	
3.	
4.	
5.	
6.	
7.	
8.	
9.	
10.	
11.	
12.	
13.	
14.	
15.	
16.	
17.	
18.	
19.	
20.	

Appendix 2B: Social media

Voor een onderzoek van de faculteit Diergeneeskunde vragen wij het volgende:

KATTENPOEP GEZOCHT!

Heb jij of ken jij iemand met een kat en wil je een GRATIS onderzoek naar maagdarmwormen bij de kat laten uitvoeren? Dat is nu tijdelijk mogelijk.

Als studenten van de faculteit Diergeneeskunde aan de Universiteit Utrecht doen wij onderzoek naar het voorkomen van de haakworm *Ancylostoma tubaeforme* bij de kat. Natuurlijk kijken we ook of er andere darmparasieten in de ontlasting te vinden zijn.

Door mee te doen help je gelijk mee aan een onderzoek naar de noodzaak voor ontworming en krijg je bericht of jouw kat op dit moment eitjes uitscheidt en dus ontwormd moet worden.

Hoe werkt het?

- Wij zorgen voor materiaal zodat je de ontlasting op een veilige manier bij ons laboratorium kunt krijgen.
- Jij stuurt ontlasting op voorzien van de naam van het dier en een door ons gegeven code.
- Je krijgt een link voor een vragenlijst die je op jouw computer /smartphone kunt invullen.
- Als wij je vragenlijst hebben ontvangen en de uitslag is bekend, dan sturen wij jouw dit op, voorzien van een eventueel ontwormingsadvies.

Om tot een betrouwbaar resultaat te komen zijn veel katten nodig. Dit mogen dus binnenkatten, maar ook buitenkatten zijn.

Wil je meedoen? Stuur een mail naar parasietenwijzer@uu.nl onder vermelding van maagdarmwormonderzoek kat.

Mvg,

Sandra Vink en Manon Coenen

Appendix 3: Email to participating cat owners

Beste meneer/mevrouw,

Hartelijk dank voor uw interesse en deelname aan het onderzoek.

Om verder deel te kunnen nemen aan het onderzoek dient u de ontlasting van uw kat(ten) te verzamelen en dit op een veilige wijze op te sturen naar de faculteit Diergeneeskunde.

Voor het juist verpakken en versturen van de ontlasting wordt er een pakketje met een beschrijving naar uw huis verzonden. Hiervoor hebben wij nog enkele gegevens van u nodig, voor zover u deze nog niet heeft opgegeven. Graag willen wij van u weten:

- > met hoeveel katten u wilt deelnemen aan het onderzoek (max. 5), inclusief de namen
- > daarnaast hebben wij uw postadres nodig voor het opsturen van het pakketje.

Let op: *Indien u niet woonachtig bent in Nederland, kunt u helaas niet mee doen aan het onderzoek. Mocht er in de toekomst alsnog een onderzoek bij katten gedaan worden buiten Nederland, dan bent u van harte welkom om deel te nemen aan het onderzoek. Uw gegevens worden opgeslagen in een bestand met geïnteresseerden.*

De antwoorden op het bovenstaand gevraagde kunt u ons via de mail laten weten via parasietenwijzer@uu.nl. Ook eventuele vragen kunt u kwijt via dit e-mail adres.

Nadat de gegevens aan ons zijn doorgegeven, kunt u een pakketje verwachten. Daarna heeft u de mogelijkheid om de ontlasting van uw kat(ten) in het pakketje naar de faculteit Diergeneeskunde op te sturen. In het verzendpakket bevindt zich ook een retourenveloppe zodat u dit kosteloos kunt opsturen.

Let bij het verzamelen van de ontlasting op dat u niet de katten door elkaar haalt. Elke kat krijgt namelijk zijn eigen bakje.

Zodra de ontlasting door ons is ontvangen sturen wij u een bevestigingsmail met daarin een link naar een vragenlijst. Wij willen u vragen om in het belang van het onderzoek deze vragenlijst over de levensstijl en eventuele ontworming van uw kat(ten) in te vullen. De vragenlijst betreft dus geen papieren versie, maar kunt u vinden via de link in onze bevestigingsmail. Wanneer wij de antwoorden op de vragen binnen hebben krijgt u de uitslag van het onderzoek.

Alle gegevens worden vertrouwelijk behandeld en bewaard in een databank.

Met vriendelijke groet,
Sandra Vink en Manon Coenen

Studentes Diergeneeskunde

Appendix 4: Instructions about the sampling and sending (package)

Geachte heer/mevrouw,

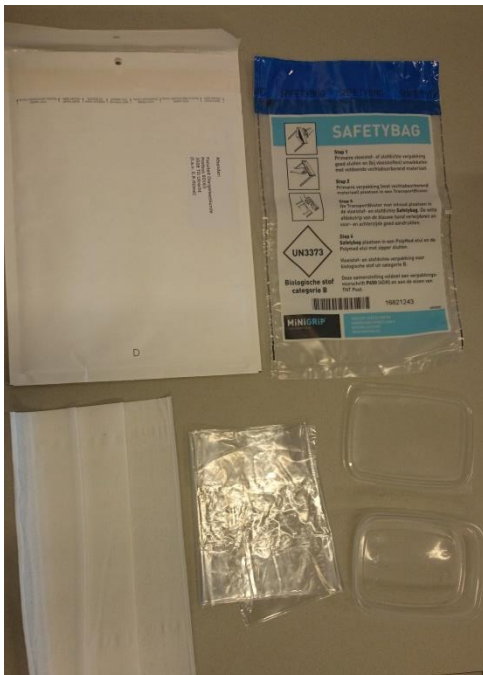
Bedankt voor uw deelname aan ons onderzoek.

Hierbij ontvangt u het deelname pakket en vindt u per kat het volgende:

1. Een plastic zakje om ontlasting in te doen
2. Een plastic bakje met deksel
3. Tissues
4. Een sealbag (per 2 katten 1 sealbag)
5. Een gewatteerde verzendenveloppe

In één gewatteerde verzendenveloppe passen 3 monsters, deelnemers met meerdere katten kunnen dus 3 monsters van verschillende katten in één enveloppe verzenden.

Figuur 1: De inhoud van het pakket.



Uw persoonlijke deelnamenummer tijdens dit onderzoek:

Gelieve dit nummer ergens te noteren. Dit nummer blijft gedurende het hele onderzoek gelijk en dient u te noteren op de deksel van het bakje waar de ontlasting in gaat. Indien u met meerdere katten mee doet, dient u dit nummer op elk dekseltje te vermelden. Dit nummer dient u ook bij de enquête in te vullen. Wanneer u vragen stelt via de mail kunt u hier ook dit nummer in het onderwerp vermelden.

Uitleg over de monstername:

De ontlasting dient u in het plastic zakje te doen. Zorg ervoor dat er geen/zo min mogelijk ander materiaal in komt, zoals kattengrit. Knoop het zakje vervolgens dicht met zo min mogelijk lucht erin. Indien u niet in de gelegenheid bent om het pakketje direct op te sturen, adviseren wij de ingepakte ontlasting tijdelijk (niet langer dan één dag) koel te bewaren.

Uitleg opsturen monster: (zie fotoserie aan het einde)

1. Het zakje met de ontlasting stopt u in het plastic bakje met de deksel erop
2. Schrijf de naam van de kat, het deelnamenummer en de datum van verzamelen op de deksel
3. Het plastic bakje wikkelt u in een tissue
4. Stop dit in zijn geheel in de sealbag, plak deze met de zelfklevende rand dicht met zo min mogelijk lucht erin.
5. De sealbag gaat in de envelop

Deze stuurt u naar het volgende adres (envelop is al gestickerd):

*Faculteit Diergeneeskunde
VMDC (wormonderzoek kat)
Antwoordnummer 57526
3507 WB Utrecht*

Hier hoeft dus géén postzegel op!

Uitleg enquête:

1. Wanneer de ontlasting bij ons binnenkomt, krijgt u van ons een e-mail met bevestiging van ontvangst.
2. Via deze e-mail ontvangt u ook de link naar de enquête.
3. Volg de stappen van de enquête.
4. De enquête zal ongeveer 10 minuten van uw tijd in beslag nemen.
5. De enquête wordt, wanneer deze volledig is ingevuld, automatisch naar ons gestuurd.
6. Pas als de ingevulde enquête bij ons binnen is, krijgt u uitslag van het onderzoek met een eventueel ontwormingsadvies.

Wij willen u vragen om ons via een mailtje te laten weten dat u het pakketje heeft opgestuurd.

In slechts een enkel geval kan het voorkomen dat een pakketje tijdens het vervoer met de post zoek raakt. Op deze manier kunnen wij dit in de gaten houden.

Bij vragen kunt u te allen tijde contact met ons opnemen via onderstaand e-mailadres o.v.v.

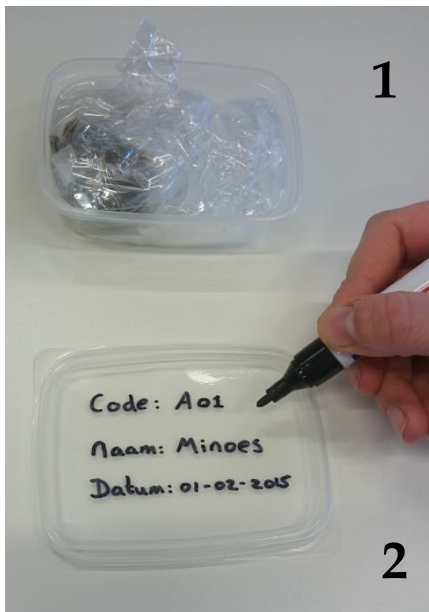
Uw deelnamenummer en “Maagdarmwormonderzoek kat”: parasietenwijzer@uu.nl

Met vriendelijke groet,

Sandra Vink en Manon Coenen

Correlation between deworming history and the patent infections with enteric helminths in cats.

Gebruik van het pakket:



Appendix 5: Laboratory forms

Appendix 5A: Date form



Code	Kat	Binnengekomen	Ontlasting verzameld

Appendix 5B: Laboratory form

DATUM:							
Deelname num	labnummer	Consist	naam kat	uitslag lab	grootte	hoeveelhe	Baermann



Hoeveelheid

- = geen
- + = enkele per preparaat
- ++ = bijna ieder gezichtsveld (10x4) w
- +++ = zit "stampvol"

Scoring	benoeming	Omschrijving
1	Waterige ontlasting	Die ontlasting is zo waterig dat hij vloeiend loopt.
2	Dunne ontlasting	Vloerbare ontlasting maar niet lopend.
3	Zacht ontlasting	Normaal uitziende ontlasting maar bij aanraking verandert de vorm.
4	Stevig ontlasting	Stevige ontlasting die netjes bij elkaar blijft bij op pakken. Lichten aanraking.
5	Harde ontlasting	Breekbaar maar bij aanraking verandert de vorm niet. Ook niet bij stevige aanraking.
6	Hele harde ontlasting	Bijna niet breekbaar. Je kunt het kloppen.
7	Brokkelig ontlasting	Valt uit elkaar bij aanraking

Appendix 6: Protocols laboratory techniques

Appendix 6A: Centrifugal sedimentation/flotation

1. Prepare a suspension of the feces sample in water. If the feces is too solid, use a mortar.
2. Pour the suspension over a strainer.
3. Stir the strained suspension before filling a test-tube (the eggs lie at the bottom). Place the test-tube inside the centrifuge. Make sure that two equally filled test-tubes always oppose each other.
4. Close the lid of the centrifuge and turn it on.
5. Keep the centrifuge running for 1 minute at 3000 rpm.
6. Wait until the centrifuge has completely stopped and open the lid.
7. Pour the supernatant out of the test-tube with a slow turning motion.
8. Fill the test-tube for about 50% with a sucrose suspension. Mix the sediment with a small spatula.
9. Place the test-tube back inside the centrifuge and fill the test-tube complete with sucrose suspension until a small meniscus forms.
10. Place a cover glass on top of the meniscus. Press the cover glass firmly onto the testtube with a nail.
11. Keep the centrifuge running for 2 minutes at 3000 rpm.
12. Take off the cover glass perpendicular from the test-tube and put it on an object glass.
13. Systematically search the preparation for worm eggs.

Appendix 6B: Baermann technique

1. Place a strainer in a Baermann glass.
2. Fill the glass with tap water until the strainer is 50% filled.
3. Place the feces that needs to be analyzed in the strainer filled with water.
4. Leave the Baermann standing for 24 hours at room temperature.

Checking the Baermann after 24 hours:

5. Put a small balloon on a pipette.
6. Take the strainer out of the glass and put the pipette in the glass all the way to the tip with the small balloon squeezed between two fingers.
7. Let go of the small balloon so that the pipette can fill with fluid.
8. Take the pipette out of the glass and squeeze it empty into a small Petridis.
9. Place the small Petridish under a preparation microscope and systematically search for worm larvae.

Appendix 7: Questionnaire

Dank u wel voor uw deelname aan dit onderzoek.

De informatie die u verstrekt, wordt vertrouwelijk behandeld en alleen gebruikt voor dit onderzoek.

De uitslagen worden losgekoppeld van uw persoonlijke gegevens.

Op een vraag met een * is een antwoord noodzakelijk om verder te kunnen gaan met het invullen van de enquête. Er zijn geen goed/foute antwoorden.

Het invullen van de enquête zal afhankelijk van het aantal katten gemiddeld 10-15 minuten in beslag nemen, deze tijd is niet af te lezen aan de voortgangsbalk bovenin.

LET OP: Pak voor het invullen van deze enquête zo mogelijk de verpakking van uw ontwormingsmiddel en/of ontvlooiingsmiddel erbij.

Gegevens kat

Allereerst vragen wij u de gegevens van uw kat(ten) in te vullen.

Deze gegevens zullen alleen voor de identificatie tijdens dit onderzoek gebruikt worden.

***1. Voer hieronder uw persoonlijke deelnamenummer (code) in.**

A [][]

Gegevens van uw kat

***2. Vul hieronder de gegevens van uw enige/eerste kat in.**

Als het ras en/of geslacht niet bekend zijn, vult u hier dan "onbekend" in. De naam is wel verplicht ter identificatie.

Als u met meerdere katten mee wilt doen aan dit onderzoek, komen deze later aan bod. De volgorde van de verschillende katten is niet van belang.

Aantal katten: []

Naam van de (enige)

deelnemende kat: []

Ras: []

***3. Wat is het geslacht van deze kat?**

- Poes gesteriliseerd
- Poes niet gesteriliseerd
- Kater gecastreerd
- Kater niet gecastreerd
- Onbekend

Gegevens van uw kat

***4. Vul hieronder de leeftijd van uw kat in, het liefst met een geboortedatum.**

- Jonger dan 6 maanden
- 6 maanden tot 1 jaar
- 1 jaar
- 2 jaar
- 3 jaar
- 4 jaar

- 5 jaar
- 6 jaar
- 7 jaar
- 8 jaar
- 9 jaar
- 10 jaar
- 11 jaar
- 12 jaar
- 13 jaar
- 14 jaar
- Ouder dan 14 jaar

Geboortedatum (dd/mm/jjjj) (als niet bekend, vul dan "onbekend" in): []

Ontwormingschema

***5. Is uw kat wel eens ontwormd?**

- Ja
- Nee

Motivatie ontwormingschema

***6. Wat is de belangrijkste reden om een kat in het algemeen te ontwormen?**

- De gezondheid van de kat te waarborgen
- De gezondheid van de mens te waarborgen
- Omdat het moet

***7. Wat is uw motivatie om uw kat te ontwormen? (er zijn meerdere antwoorden mogelijk)**

- Na een ontlastingsonderzoek
- Op advies van de dierenarts
- Op advies van de dierenspecialzaak
- Op advies van een kennis
- Door informatie van het internet
- Door informatie vanuit mijn opleiding of werk
- Ik heb wormen/eipakketjes gevonden in de kattenbak/mandje van de kat
- Anders, namelijk []

***8. Welk ontwormingschema zou u graag voor deze kat willen aanhouden?**

- Geen voorkeur
- 1 maal per jaar
- 2-3 maal per jaar
- 4 maal per jaar
- > 4 maal per jaar, namelijk (aantal invullen): []

***9. Welk ontwormingschema houdt u voor deze kat aan?**

- Ik houd geen ontwormingschema aan
- 1 maal per jaar
- 2-3maalperjaar

- 4 maal per jaar
- > 4 maal per jaar, namelijk (aantal invullen): []

***10. Op basis van welke informatie(bron) heeft u het ontwormingsschema gebaseerd?**

- Op advies van de fokker
- Op advies van de dierenarts
- Op advies van de dierenspecialzaak
- Op advies verkregen via internet
- Op advies verkregen via mijn opleiding of werk
- Anders, namelijk

Informatiebron

***11. Welke website heeft u als informatiebron gebruikt?**

- Een site van een dierenartsenpraktijk
- Een kattenforum
- Een andere site, namelijk: []

12. Hoe lang denkt u dat een ontwormingsmiddel werkzaam is?

- Kort tot enkele dagen
- 1 maand
- 2-3 maanden
- 1 jaar
- Weet ik niet

Ontwormen

13. Wanneer is uw kat voor het laatst ontwormd?

- Minder dan 1 week geleden
- 1 - 2 weken geleden
- 2 weken - 1 maand geleden
- 1 - 2 maanden geleden
- 2 - 3 maanden geleden
- 3 - 4 maanden geleden
- 5 - 6 maanden geleden
- Langer dan 6 maanden geleden

***14. Met welk middel is uw kat voor het laatst ontwormd?**

Indien onbekend "onbekend" invullen.

Naam ontwormingsmiddel: []

***15. Gebruikt u dit ontwormingsmiddel doorgaans ook?**

- Ja
- Nee

***16. Met welk middel wordt uw kat doorgaans ontwormd?**

Indien onbekend "onbekend" invullen.

Naam ontwormingsmiddel: []

Ontwormen

***17. Waar koopt u uw ontwormingsmiddelen? (er zijn meerdere antwoorden mogelijk)**

- Dierenarts
- Dierenspeciaalzaak
- Supermarkt/warenhuis/tuincentrum
- Internet

***18. Wat is de toedieningsvorm van het ontwormingsmiddel? (er zijn meerdere antwoorden mogelijk)**

- Tablet
- Pasta/drankje
- Spot-on (druppels op de huid)
- Anders, namelijk

Ontwormingschema

***19. Vindt de ontworming samen met de jaarlijkse vaccinatie bij de dierenarts plaats?**

- Ja
- Nee

Ontwormen

***20. Waarom ontwormt u uw kat niet? (er zijn meerdere antwoorden mogelijk)**

- Ik vind het niet nodig
- Ik vind het te duur
- Ik vind het te veel moeite
- Ik heb hier nooit over nagedacht
- Mijn kat komt niet buiten
- Anders, namelijk []

Gegevens van uw kat

***21. Komt uw kat buiten?**

- Ja
- Nee

***22. Hoe omschrijft u de omgeving waarin de kat buiten loopt? (er zijn meerdere antwoorden mogelijk)**

- Woonwijk
- Bosrijk
- Zee-/duingebied
- Platteland
- Balkon
- Afgeschermdde tuin

***23. Kunnen andere katten dan die van uzelf hier ook komen?**

- Ja
- Nee

Schoeisel binnen

***24. Loopt u met uw buitenschoenen in huis?**

- Ja
- Nee

Samenstelling huishouden

***25. Heeft u naast uw kat(ten) nog andere huisdieren?**

- Nee
- Ja, een of meerdere honden
- Ja, anders []

***26. Zijn er in uw huishouden kinderen jonger dan 16 jaar?**

- Ja
- Nee

27. Wat is de leeftijd van uw jongste kind?

Leeftijd: []

28. Wordt uw hond ontwormd?

- Ja
- Nee

Voeding van de kat

***29. Mijn kat eet (wel eens).... (er zijn meerdere antwoorden mogelijk)**

- Rauw vlees
- Rauwe vis
- Voorverpakt droogvoer/blikvoer
- Prooidieren
- Met de pot mee
- Anders, namelijk []

***30. Welke prooidieren worden voornamelijk gegeten door uw kat? (er zijn meerdere antwoorden mogelijk)**

- Vogel
- Muis/Rat
- Kikker/Pad
- Konijn
- Vis
- Insecten (vlieg, libelle, ect.)
- Gevonden dode dieren
- Andere prooidieren
- Weet ik niet

***31. Wat voor soort rauw vlees eet uw kat voornamelijk? (er zijn meerdere antwoorden mogelijk)**

- Rund
- Varken
- Paard
- Schaap
- Konijn
- Kip
- Ander gevogelte

***32. Wat is de herkomst van het rauwe vlees? (er zijn meerdere antwoorden mogelijk)**

- Supermarkt
- Slagerij / poelier
- Eigen fok
- Slachthuis
- Via internet

Kennel- of pensionverblijf

***33. Heeft uw kat de afgelopen 6 maanden in een asiel of pension gezeten?**

- Ja
- Nee

Aanwijzingen verminderde gezondheid

***34. Zijn er bij uw kat aanwijzingen voor een verminderde gezondheid? Denk hierbij aan: diarree, jeuk, benauwdheid etc.**

- Ja
- Nee

Aanwijzingen verminderde gezondheid

***35. Welke aanwijzingen voor een verminderde gezondheid zijn er gevonden bij uw kat?**

[]

Medicijngebruik

***36. Krijgt uw kat op dit moment één of meerdere medicijnen toegediend?**

- Ja
- Nee

Medicijngebruik

***37. Welke medicijnen krijgt uw kat op dit moment toegediend?**

Bij voorkeur middel en merknaam. Indien onbekend: "onbekend" invullen

1: []

2: []

Medicijngebruik

***38. Heeft uw kat de afgelopen 3 maanden medicijnen toegediend gekregen?**

- Ja
- Nee

Medicijngebruik

***39. Heeft uw kat in de laatste 3 maanden nog ANDERE medicijnen toegediend gekregen?**

- Ja
- Nee

Medicijngebruik

***40. Welke medicijnen heeft uw kat in de afgelopen 3 maanden toegediend gekregen?**

Bij voorkeur middel en merknaam.

Als beide onbekend zijn: "onbekend" invullen

1: []

2: []

Ontlasting

***41. Waar doet uw kat doorgaans zijn/haar behoeften?**

- Op de kattenbak
- Buiten
- Zowel op de kattenbak als buiten
- Anders, namelijk []

Ontlasting

***42. Hoe vaak scheidt u vieze delen uit de kattenbak?**

- Meer dan 3 keer per week
- 2-3 keer per week
- 1 keer per week
- Minder dan 1 keer per week

***43. Hoe vaak verschoont u de gehele vulling van de kattenbak?**

- Meer dan 3 keer per week
- 2-3 keer per week
- 1 keer per week
- Minder dan 1 keer per week

Ontlasting

***44. Is u de laatste tijd nog iets opgevallen aan de ontlasting van uw kat? (er zijn meerdere antwoorden mogelijk)**

- Nee
- Ja, het is dunner
- Ja, ik heb wormen/eipakketjes gevonden **gfedc** Ja, het is donkerder
- Ja, het is lichter
- Ja, er zat bloed bij
- Ja, er zat slijm bij
- Anders, namelijk

***45. Welke worm/eipakketten denkt u te hebben gevonden?**

- Spoelworm

- Lintworm
- Haakworm
- Zweepworm
- Weet ik niet

***46. Zijn de worm/eipakketten door een dierenarts bevestigd?**

- Ja
- Nee

Giardia

***47. Is uw kat, voor zover u weet, ooit besmet geweest met Giardia?**

- Ja
- Nee

***48. Wanneer was de besmetting met Giardia?**

[]

***49. Had de kat toen klachten?**

- Nee
- Ja, diarree
- Ja, buikpijn
- Ja, braken
- Ja, doffe vacht
- Ja, anders, namelijk []

***50. Is er vervolgens een behandeling ingesteld?**

- Ja
- Nee
- Weet ik niet

***51. Welke behandeling is er ingesteld?**

- Voerwisseling
- Kat gewassen
- Omgeving gereinigd
- Medicijnen
- Anders, namelijk []

***52. Weet u welke medicijnen er zijn voorgeschreven?**

- Nee
- Ja, namelijk []

***53. Zijn de klachten verdwenen?**

- Ja
- Nee
- Weet ik niet

***54. Is de Giardia infectie verdwenen?**

- Ja
- Nee
- Niet gecontroleerd

Deelname meerdere katten

***55. Heeft u nog meer katten opgegeven voor deelname aan dit onderzoek?**

- Ja
- Nee

Gegevens van uw kat

***56. Vul hieronder de gegevens van uw tweede kat in.**

Als het ras en/of geslacht niet bekend zijn, vult u hier dan "onbekend" in. De naam is wel verplicht ter identificatie.

Als u met meerdere katten mee wilt doen aan dit onderzoek, komen deze later aan bod. De volgorde van de verschillende katten is niet van belang.

Naam van de tweede deelnemende kat: []

Ras: []

***57. Wat is het geslacht van deze kat?**

- Poes gesteriliseerd
- Poes niet gesteriliseerd
- Kater gecastreerd
- Kater niet gecastreerd
- Onbekend

Gegevens van uw kat

***58. Vul hieronder de leeftijd van uw kat in, het liefst met een geboortedatum.**

- Jonger dan 6 maanden
- 6 maanden tot 1 jaar
- 1 jaar
- 2 jaar
- 3 jaar
- 4 jaar
- 5 jaar
- 6 jaar
- 7 jaar
- 8 jaar
- 9 jaar
- 10 jaar
- 11 jaar
- 12 jaar
- 13 jaar
- 14 jaar
- Ouder dan 14 jaar

Geboortedatum (dd/mm/jjjj) (als niet bekend, vul dan "onbekend" in): []

Ontwormingschema

***59. Is uw kat wel eens ontwormd?**

- Ja
- Nee

***60. Wat is uw motivatie om deze kat te ontwormen? (er zijn meerdere antwoorden mogelijk)**

- Na een ontlastingsonderzoek
- Op advies van de dierenarts
- Op advies van de dierenspecialzaak
- Op advies van een kennis
- Door informatie van het internet
- Door informatie vanuit mijn opleiding of werk
- Ik heb wormen/eipakketjes gevonden in de kattenbak/mandje van de kat
- Anders, namelijk []

***61. Welk ontwormingschema zou u graag voor deze kat willen aanhouden?**

- Geen voorkeur
- 1 maal per jaar
- 2-3 maal per jaar
- 4 maal per jaar
- > 4 maal per jaar, namelijk (aantal invullen): []

***62. Welk ontwormingschema houdt u voor deze kat aan?**

- Ik houd geen ontwormingschema aan
- 1 maal per jaar
- 2-3maalperjaar
- 4 maal per jaar
- > 4 maal per jaar, namelijk (aantal invullen): []

***63. Op basis van welke informatie(bron) heeft u het ontwormingschema gebaseerd?**

- Op advies van de fokker
- Op advies van de dierenarts
- Op advies van de dierenspecialzaak
- Op advies verkregen via internet
- Op advies verkregen via mijn opleiding of werk
- Anders, namelijk

Informatiebron

***64. Welke website heeft u als informatiebron gebruikt?**

- Een site van een dierenartsenpraktijk
- Een kattenforum
- Een andere site, namelijk: []

Ontwormen

65. Wanneer is uw kat voor het laatst ontwormd?

- Minder dan 1 week geleden
- 1 - 2 weken geleden
- 2 weken - 1 maand geleden
- 1 - 2 maanden geleden
- 2 - 3 maanden geleden
- 3 - 4 maanden geleden
- 5 - 6 maanden geleden
- Langer dan 6 maanden geleden

***66. Met welk middel is uw kat voor het laatst ontwormd?**

Indien onbekend "onbekend" invullen.

Naam ontwormingsmiddel: []

***67. Gebruikt u dit ontwormingsmiddel doorgaans ook?**

- Ja
- Nee

***68. Met welk middel wordt uw kat doorgaans ontwormd?**

Indien onbekend "onbekend" invullen.

Naam ontwormingsmiddel: []

Ontwormen

***69. Waar koopt u uw ontwormingsmiddelen? (er zijn meerdere antwoorden mogelijk)**

- Dierenarts
- Dierenspeciaalzaak
- Supermarkt/warenhuis/tuincentrum
- Internet

***70. Wat is de toedieningsvorm van het ontwormingsmiddel? (er zijn meerdere antwoorden mogelijk)**

- Tablet
- Pasta/drankje
- Spot-on (druppels op de huid)
- Anders, namelijk

Ontwormingsschema

***71. Vindt de ontworming samen met de jaarlijkse vaccinatie bij de dierenarts plaats?**

- Ja
- Nee

Ontwormen

***72. Waarom ontwormt u uw kat niet? (er zijn meerdere antwoorden mogelijk)**

- Ik vind het niet nodig
- Ik vind het te duur

- Ik vind het te veel moeite
- Ik heb hier nooit over nagedacht
- Mijn kat komt niet buiten
- Anders, namelijk []

Gegevens van uw kat

***73. Komt uw kat buiten?**

- Ja
- Nee

***74. Hoe omschrijft u de omgeving waarin de kat buiten loopt? (er zijn meerdere antwoorden mogelijk)**

- Woonwijk
- Bosrijk
- Zee-/duingebied
- Platteland
- Balkon
- Afgeschermdde tuin

***75. Kunnen andere katten dan die van uzelf hier ook komen?**

- Ja
- Nee

Schoeisel binnen

***76. Loopt u met uw buitenschoenen in huis?**

- Ja
- Nee

Voeding van de kat

***77. Mijn kat eet (wel eens).... (er zijn meerdere antwoorden mogelijk)**

- Rauw vlees
- Rauwe vis
- Voorverpakt droogvoer/blikvoer
- Prooidieren
- Met de pot mee
- Anders, namelijk []

***78. Welke prooidieren worden voornamelijk gegeten door uw kat? (er zijn meerdere antwoorden mogelijk)**

- Vogel
- Muis/Rat
- Kikker/Pad
- Konijn
- Vis
- Insecten (vlieg, libelle, ect.)
- Gevonden dode dieren

- Andere prooidieren
- Weet ik niet

***79. Wat voor soort rauw vlees eet uw kat voornamelijk? (er zijn meerdere antwoorden mogelijk)**

- Rund
- Varken
- Paard
- Schaap
- Konijn
- Kip
- Ander gevogelte

***80. Wat is de herkomst van het rauwe vlees? (er zijn meerdere antwoorden mogelijk)**

- Supermarkt
- Slagerij / poelier
- Eigen fok
- Slachthuis
- Via internet

Kennel- of pensionverblijf

***81. Heeft uw kat de afgelopen 6 maanden in een asiel of pension gezeten?**

- Ja
- Nee

Aanwijzingen verminderde gezondheid

***82. Zijn er bij uw kat aanwijzingen voor een verminderde gezondheid? Denk hierbij aan: diarree, jeuk, benauwdheid etc.**

- Ja
- Nee

Aanwijzingen verminderde gezondheid

***83. Welke aanwijzingen voor een verminderde gezondheid zijn er gevonden bij uw kat?**

[]

Medicijngebruik

***84. Krijgt uw kat op dit moment één of meerdere medicijnen toegediend?**

- Ja
- Nee

Medicijngebruik

***85. Welke medicijnen krijgt uw kat op dit moment toegediend?**

Bij voorkeur middel en merknaam. Indien onbekend: "onbekend" invullen

1: []

2: []

Medicijngebruik

***86. Heeft uw kat de afgelopen 3 maanden medicijnen toegediend gekregen?**

- Ja
- Nee

Medicijngebruik

***87. Heeft uw kat in de laatste 3 maanden nog ANDERE medicijnen toegediend gekregen?**

- Ja
- Nee

Medicijngebruik

***88. Welke medicijnen heeft uw kat in de afgelopen 3 maanden toegediend gekregen?**

Bij voorkeur middel en merknaam.

Als beide onbekend zijn: "onbekend" invullen

1: []

2: []

Ontlasting

***89. Waar doet uw kat doorgaans zijn/haar behoeften?**

- Op de kattenbak
- Buiten
- Zowel op de kattenbak als buiten
- Anders, namelijk []

Ontlasting

***90. Hoe vaak schept u vieze delen uit de kattenbak?**

- Meer dan 3 keer per week
- 2-3 keer per week
- 1 keer per week
- Minder dan 1 keer per week

***91. Hoe vaak verschoont u de gehele vulling van de kattenbak?**

- Meer dan 3 keer per week
- 2-3 keer per week
- 1 keer per week
- Minder dan 1 keer per week

Ontlasting

***92. Is u de laatste tijd nog iets opgevallen aan de ontlasting van uw kat? (er zijn meerdere antwoorden mogelijk)**

- Nee
- Ja, het is dunner
- Ja, ik heb wormen/eipakketjes gevonden **gedc** Ja, het is donkerder
- Ja, het is lichter
- Ja, er zat bloed bij

- Ja, er zat slijm bij
- Anders, namelijk

***93. Welke worm/eipakketten denkt u te hebben gevonden?**

- Spoelworm
- Lintworm
- Haakworm
- Zweepworm
- Weet ik niet

***94. Zijn de worm/eipakketten door een dierenarts bevestigd?**

- Ja
- Nee

Giardia

***95. Is uw kat, voor zover u weet, ooit besmet geweest met Giardia?**

- Ja
- Nee

***96. Wanneer was de besmetting met Giardia?**

[]

***97. Had de kat toen klachten?**

- Nee
- Ja, diarree
- Ja, buikpijn
- Ja, braken
- Ja, doffe vacht
- Ja, anders, namelijk []

***98. Is er vervolgens een behandeling ingesteld?**

- Ja
- Nee
- Weet ik niet

***99. Welke behandeling is er ingesteld?**

- Voerwisseling
- Kat gewassen
- Omgeving gereinigd
- Medicijnen
- Anders, namelijk []

***100. Weet u welke medicijnen er zijn voorgeschreven?**

- Nee
- Ja, namelijk []

***101. Zijn de klachten verdwenen?**

- Ja
- Nee
- Weet ik niet

***102. Is de Giardia infectie verdwenen?**

- Ja
- Nee
- Niet gecontroleerd

Deelname meerdere katten

***103. Heeft u nog meer katten opgegeven voor deelname aan dit onderzoek?**

- Ja
- Nee

Gegevens van uw kat

***104. Vul hieronder de gegevens van uw derde kat in.**

Als het ras en/of geslacht niet bekend zijn, vult u hier dan "onbekend" in. De naam is wel verplicht ter identificatie.

Als u met meerdere katten mee wilt doen aan dit onderzoek, komen deze later aan bod.

De volgorde van de verschillende katten is niet van belang.

Naam van de derde deelnemende kat: []

Ras: []

Etcetera...

The same questions were asked again for the last three cats (total of five cats).

Appendix 8: Descriptive statistics

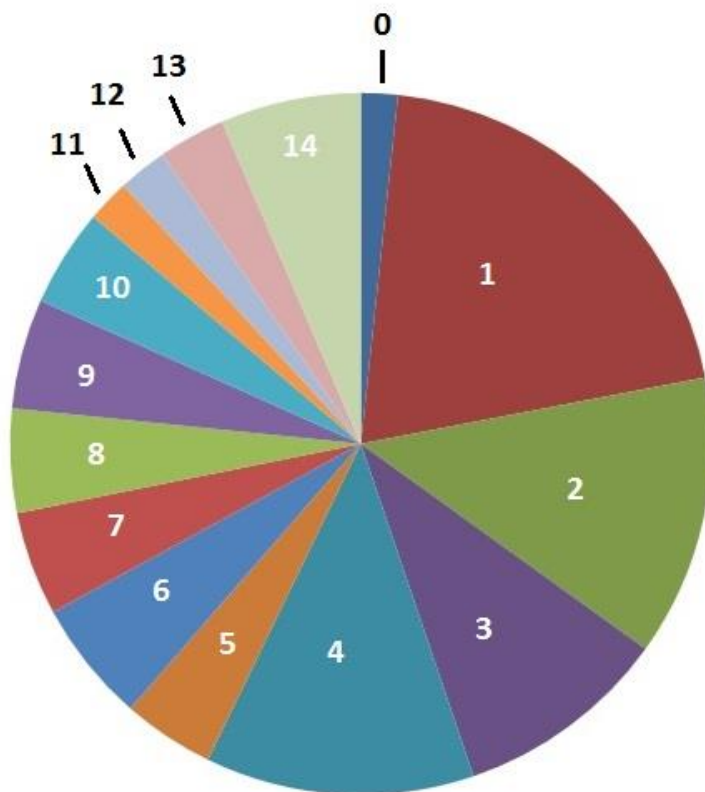
Appendix 8A: Distribution by age

Age	Number	%
0*	6	1,7
1*	72	20,3
2	46	13,0
3	35	9,9
4	44	12,4
5	15	4,2
6	20	5,6
7	17	4,8
8	17	4,8
9	18	5,1
10	16	4,5
11	7	2,0
12	8	2,3
13	11	3,1
14*	23	6,5
	355	

*0: Younger than 6 months old

1: Between 6 months and 1 year old

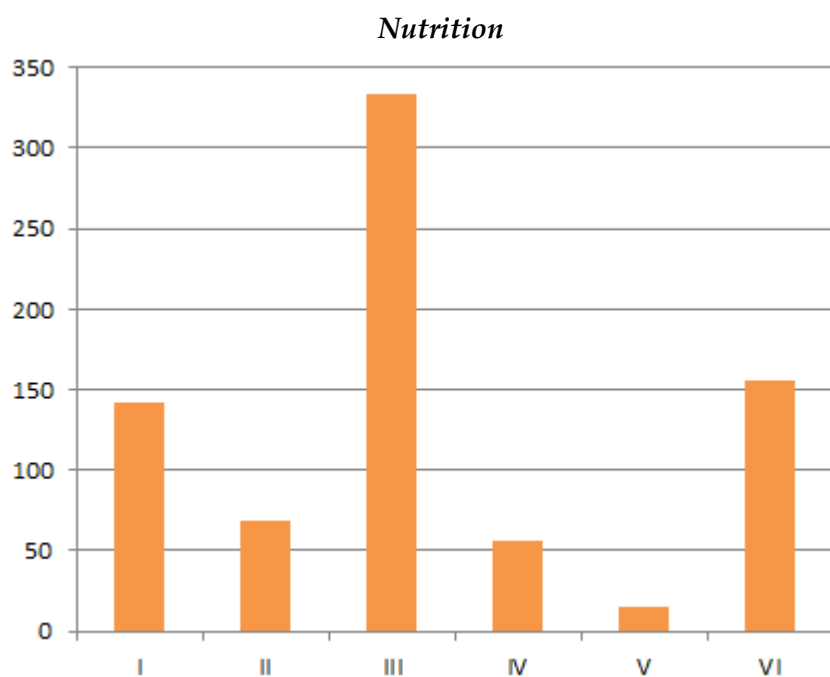
14: Older than 14 years old



Appendix 8B: Nutrition

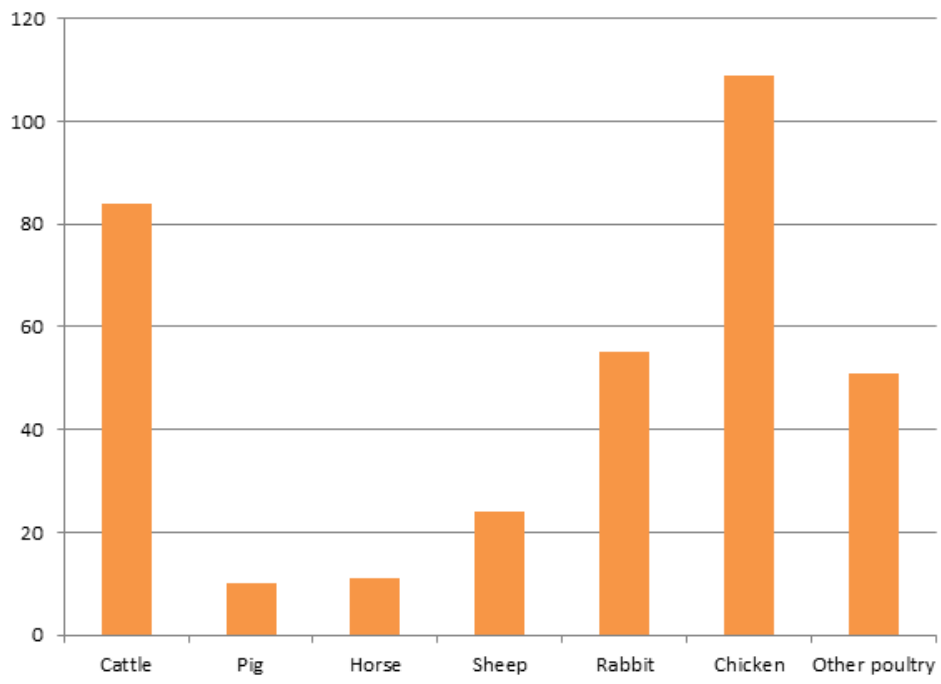
	Nutrition	Number	%*
I	Raw meat	142	40,0
II	Raw fish	69	19,4
III	Prepacked dry food/tin food	333	93,8
IV	Prey	56	15,8
V	Same food as owner	15	4,2
VI	Both raw meat and raw fish	156	43,9

* Percentage of the cats that participated (n = 355)



Raw meat	Number	%
Cattle	84	24,4
Pig	10	2,9
Horse	11	3,2
Sheep	24	7,0
Rabbit	55	16,0
Chicken	109	31,7
Other poultry	51	14,8
Total	344	

Correlation between deworming history and the patent infections with enteric helminths in cats.



Appendix 9: Deworming statistics

Appendix 9A: Deworming

Deworming	Number	%
Yes	340	95,8
No	15	4,2
	355	

Reason no deworming	Number	%
<i>Not needed</i>	2	13,3
<i>Too expensive</i>	0	0,0
<i>Too much effort</i>	1	6,7
<i>Never thought of deworming</i>	1	6,7
<i>Indoor kat</i>	8	53,3
<i>Other reasons</i>	3	20,0
	15	

Appendix 9B: Motivation and reason to deworm

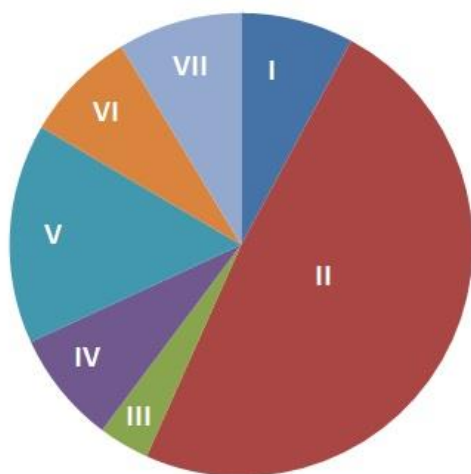
Motivation	Number	%
I <i>After faecal examination</i>	31	7,2
II <i>Advice veterinarian</i>	158	36,8
III <i>Advice pet shop</i>	6	1,4
IV <i>Advice friend</i>	13	3,0
V <i>Information on the internet</i>	33	7,7
VI <i>Information from school/work</i>	76	17,7
VII <i>Found (oö)cysts/worm eggs</i>	28	6,5
VIII <i>Advice of a breeder/cattery</i>	26	6,1
IX <i>Health reasons</i>	16	3,7
X <i>Because it is needed</i>	22	5,1
XI <i>Other</i>	20	4,7
	429	

Reason	Number	%
<i>Health cat</i>	147	84,0
<i>Public health</i>	21	12,0
<i>Because it is needed</i>	7	4,0
	175	

Appendix 9C: Deworming schedule

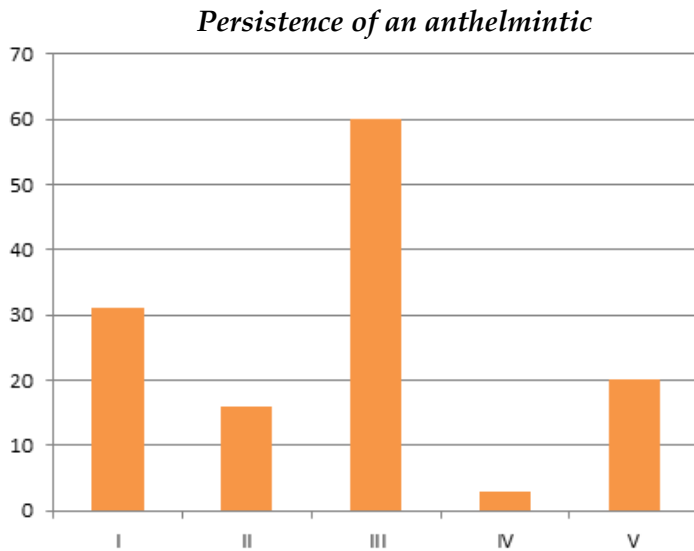
Schedule	Number	%
No schedule	92	27,0
Once a year	42	12,3
Two or three times a year	120	35,2
Four times a year	79	23,2
More than four times a year	8	2,3
	341	

Information deworming schedule	Number	%
I Advice breeder	20	7,9
II Advice veterinarian	124	48,8
III Advice pet shop	9	3,5
IV Information on internet	20	7,9
V Information from school/work	39	15,4
VI My own opinion	22	8,7
VII Others	20	7,9
	254	



Appendix 9D: Persistence of an anthelmintic

	Persistence	Number	%
I	<i>Short, a couple of days</i>	31	23,9
II	<i>1 month</i>	16	12,3
III	<i>2-3 months</i>	60	46,2
IV	<i>1 year</i>	3	2,3
V	<i>I don't know</i>	20	15,4
		130	

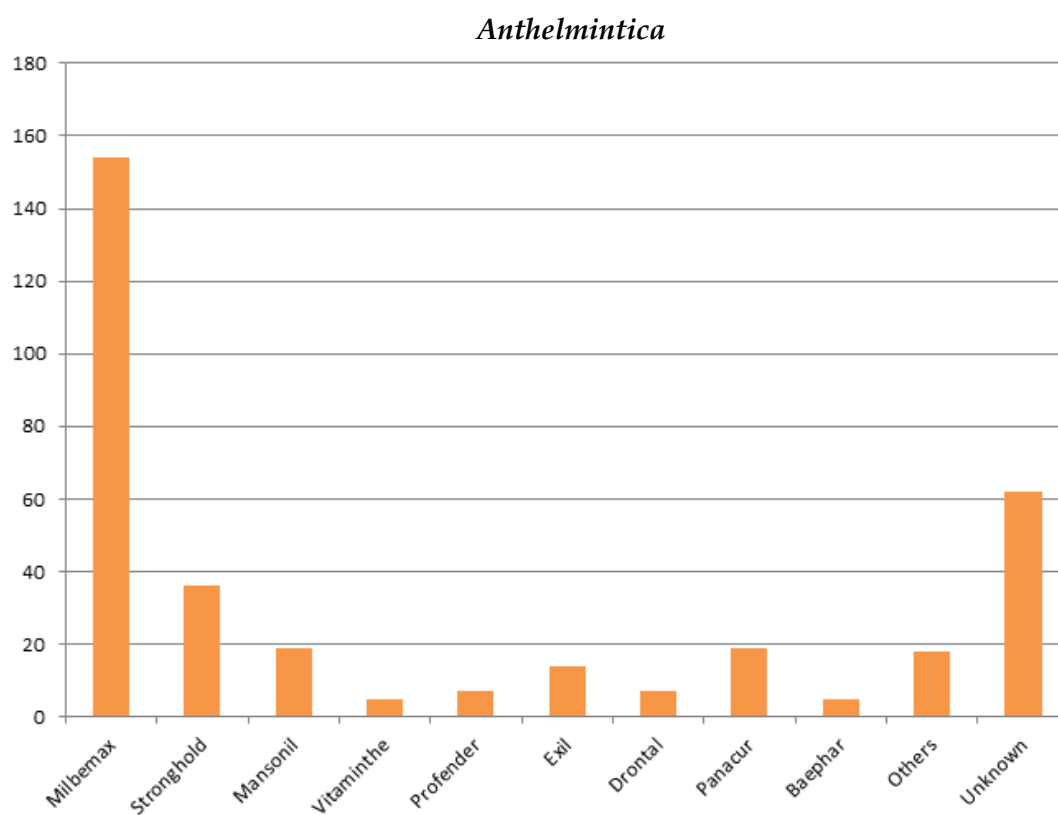


Appendix 9E: Anthelmintics

Anthelminticum	Number	%	Indication**
Milbemax®	154	44,5	<i>T. cati</i> , <i>A. tubaeforme</i> , <i>D. caninum</i> , <i>Taenia</i> spp., <i>E. multilocularis</i> (42)
Stronghold®	36	10,4	<i>T. cati</i> , <i>A. tubaeforme</i> (45)
Mansonil®	19	5,5	<i>T. cati</i> , <i>A. tubaeforme</i> , <i>T. leonina</i> (46)
Vitaminthe®	5	1,5	<i>T. cati</i> , <i>A. tubaeforme</i> , <i>T. leonina</i> , <i>D. caninum</i> , <i>Taenia</i> spp. (47)
Profender®	7	2,0	<i>T. cati</i> , <i>A. tubaeforme</i> , <i>T. leonina</i> , <i>D. caninum</i> , <i>Taenia</i> spp., <i>E. multilocularis</i> (44)
Exil®	14	4,1	<i>T. cati</i> , <i>A. tubaeforme</i> , <i>T. leonine</i> , <i>Taenia</i> spp. (41)
Drontal®	7	2,0	<i>T. cati</i> , <i>A. tubaeforme</i> , <i>T. leonina</i> , <i>D. caninum</i> , <i>Taenia</i> spp., <i>E. multilocularis</i> (40)
Panacur®	19	5,5	<i>T. cati</i> , <i>A. tubaeforme</i> (43)
Baephar®	5	1,5	<i>T. cati</i> , <i>T. leonina</i> , <i>D. caninum</i> , <i>Taenia</i> spp. (39)
Others*	18	5,2	-
Unknown	62	17,9	-
	346		

*Others, like Celestum, Vita care and Bayer.

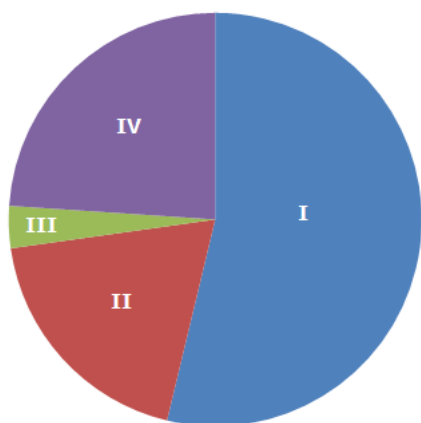
** Only endoparasites are shown.



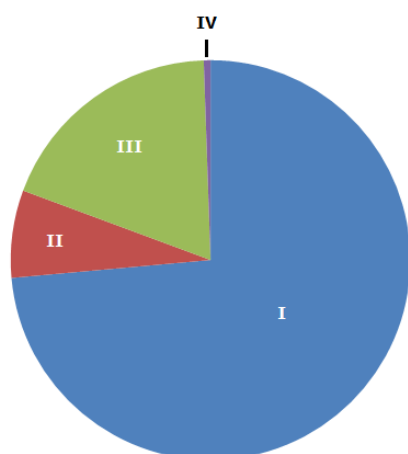
Correlation between deworming history and the patent infections with enteric helminths in cats.

Unknown anthelmintics bought	Number	%
<i>Veterinarian</i>	48	63,2
<i>Pet shop</i>	18	23,7
<i>Supermarket/warehouse/garden centre</i>	5	6,6
<i>Internet</i>	5	6,6
	76	

	All anthelmintics bought	Number	%
I	<i>Veterinarian</i>	229	53,8
II	<i>Pet shop</i>	81	19,0
III	<i>Supermarket/warehouse/garden centre</i>	14	3,3
IV	<i>Internet</i>	102	23,9
		426	



	Administration	Number	%
I	<i>Tablet</i>	270	73,6
II	<i>Paste/potion</i>	26	7,1
III	<i>Spot-on (skin drops)</i>	69	18,8
IV	<i>Other</i>	2	0,5
		367	



Correlation between deworming history and the patent infections with enteric helminths in cats.

Cross table and Chi-square test: Infection x Anthelmintic

Infection * Anthelmintic Crosstabulation

		Anthelmintic											Total
		Unknown	Milbemax	Stronghold	Mansonil	Vitaminthe	Exil	Drontal	Panacur	Beaphar	Profender	Other	
Infection -	Count	59	141	31	15	5	13	6	18	4	7	16	315
	% within Anthelmintic	95,2%	91,6%	93,9%	88,2%	100,0%	92,9%	85,7%	94,7%	80,0%	100,0%	94,1%	92,6%
+	Count	3	13	2	2	0	1	1	1	1	0	1	25
	% within Anthelmintic	4,8%	8,4%	6,1%	11,8%	0,0%	7,1%	14,3%	5,3%	20,0%	0,0%	5,9%	7,4%
Total	Count	62	154	33	17	5	14	7	19	5	7	17	340
	% within Anthelmintic	100,0%	100,0%	100,0%	100,0%	100,0%	100,0%	100,0%	100,0%	100,0%	100,0%	100,0%	100,0%

Chi-Square Tests

	Value	df	Asymp. Sig. (2-sided)
Pearson Chi-Square	4,207 ^a	10	,938
Likelihood Ratio	4,655	10	,913
Linear-by-Linear Association	,001	1	,972
N of Valid Cases	340		

a. 12 cells (54,5%) have expected count less than 5. The minimum expected count is ,37.

Cross table and Chi-square test: Helminth x Anthelmintic

Crosstab

		Anthelmintic											Total
		Unknown	Milbemax	Stronghold	Mansonil	Vitaminthe	Exil	Drontal	Panacur	Beaphar	Profender	Other	
Helminth -	Count	60	151	32	16	5	14	6	18	4	7	16	329
	% within Anthelmintic	96,8%	98,1%	97,0%	94,1%	100,0%	100,0%	85,7%	94,7%	80,0%	100,0%	94,1%	96,8%
+	Count	2	3	1	1	0	0	1	1	1	0	1	11
	% within Anthelmintic	3,2%	1,9%	3,0%	5,9%	0,0%	0,0%	14,3%	5,3%	20,0%	0,0%	5,9%	3,2%
Total	Count	62	154	33	17	5	14	7	19	5	7	17	340
	% within Anthelmintic	100,0%	100,0%	100,0%	100,0%	100,0%	100,0%	100,0%	100,0%	100,0%	100,0%	100,0%	100,0%

Chi-Square Tests

	Value	df	Asymp. Sig. (2-sided)
Pearson Chi-Square	9,919 ^a	10	,448
Likelihood Ratio	7,125	10	,714
Linear-by-Linear Association	1,931	1	,165
N of Valid Cases	340		

a. 13 cells (59,1%) have expected count less than 5. The minimum expected count is ,16.

Cross table and Chi-square test: Protozo x Anthelmintic

Crosstab

		Anthelmintic											Total
		Unknown	Milbemax	Stronghold	Mansonil	Vitaminthe	Exil	Drontal	Panacur	Beaphar	Profender	Other	
Protozo -	Count	61	143	32	16	5	13	7	18	5	7	17	324
	% within Anthelmintic	98,4%	92,9%	97,0%	94,1%	100,0%	92,9%	100,0%	94,7%	100,0%	100,0%	100,0%	95,3%
+	Count	1	11	1	1	0	1	0	1	0	0	0	16
	% within Anthelmintic	1,6%	7,1%	3,0%	5,9%	0,0%	7,1%	0,0%	5,3%	0,0%	0,0%	0,0%	4,7%
Total	Count	62	154	33	17	5	14	7	19	5	7	17	340
	% within Anthelmintic	100,0%	100,0%	100,0%	100,0%	100,0%	100,0%	100,0%	100,0%	100,0%	100,0%	100,0%	100,0%

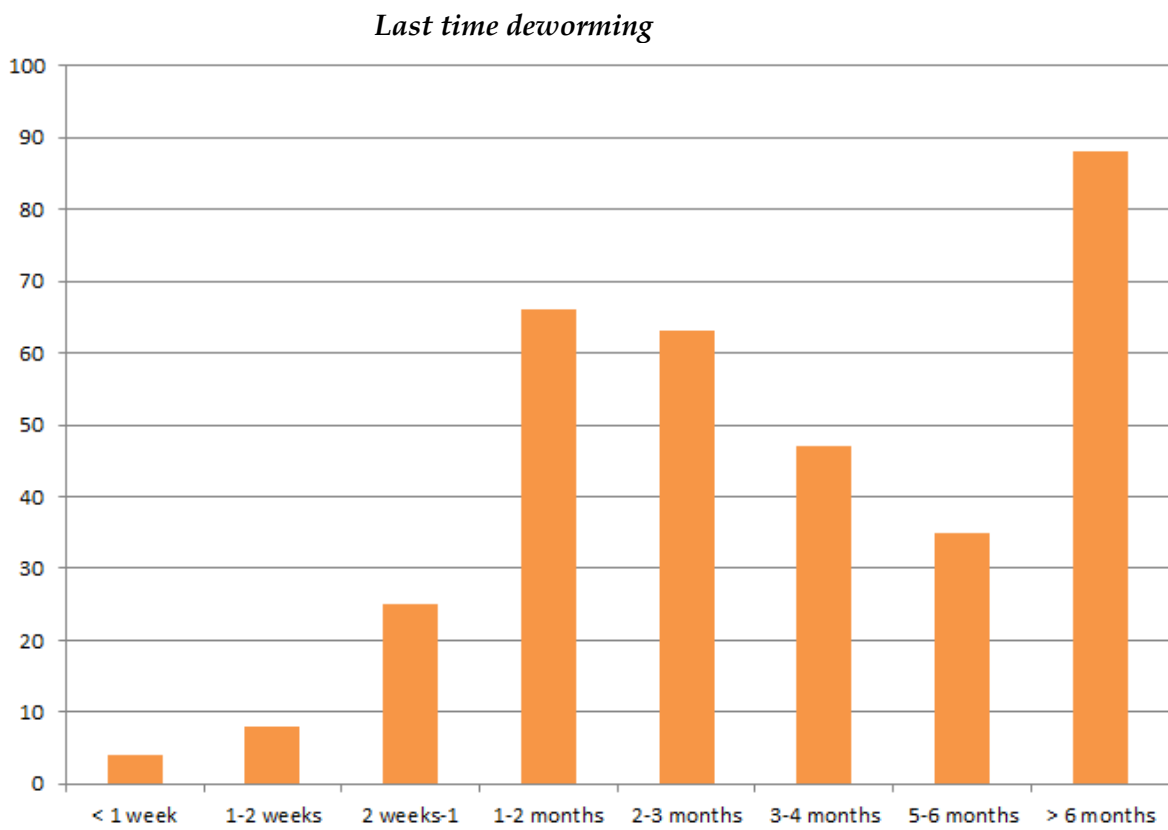
Chi-Square Tests

	Value	df	Asymp. Sig. (2-sided)
Pearson Chi-Square	5,844 ^a	10	,828
Likelihood Ratio	7,937	10	,635
Linear-by-Linear Association	,831	1	,362
N of Valid Cases	340		

a. 12 cells (54,5%) have expected count less than 5. The minimum expected count is ,24.

Appendix 9F: Last time of deworming

Last time deworming	Number	%
< 1 week	4	1,2
1-2 weeks	8	2,4
2 weeks-1 month	25	7,4
1-2 months	66	19,6
2-3 months	63	18,8
3-4 months	47	14,0
5-6 months	35	10,4
> 6 months	88	26,2
	336	



Correlation between deworming history and the patent infections with enteric helminths in cats.

Cross table and Chi-square test: Correlation last time of deworming and infection

Infection * Last deworming Crosstabulation

		Last deworming							Total	
		< 1 week	1 - 2 weeks	2 weeks - 1 month	1 - 2 months	2 - 3 months	3 - 4 months	5 - 6 months		> 6 months
Infection -	Count	3	8	23	61	60	44	33	81	313
	% within Last deworming	75,0%	80,0%	92,0%	92,4%	95,2%	93,6%	94,3%	92,0%	92,6%
+	Count	1	2	2	5	3	3	2	7	25
	% within Last deworming	25,0%	20,0%	8,0%	7,6%	4,8%	6,4%	5,7%	8,0%	7,4%
Total	Count	4	10	25	66	63	47	35	88	338
	% within Last deworming	100,0%	100,0%	100,0%	100,0%	100,0%	100,0%	100,0%	100,0%	100,0%

Chi-Square Tests

	Value	df	Asymp. Sig. (2-sided)
Pearson Chi-Square	5,039 ^a	7	,655
Likelihood Ratio	3,818	7	,800
Linear-by-Linear Association	,652	1	,419
N of Valid Cases	338		

a. 8 cells (50,0%) have expected count less than 5. The minimum expected count is ,30.

Appendix 10: Correlation deworming schedule and infection

Appendix 10A: Cross table and Chi-square tests (no) deworming schedule

Infection * Schedule Crosstabulation

		Schedule		Total
		No schedule	Schedule	
Infection -	Count	80	236	316
	% within Schedule	93,0%	92,5%	92,7%
+	Count	6	19	25
	% within Schedule	7,0%	7,5%	7,3%
Total	Count	86	255	341
	% within Schedule	100,0%	100,0%	100,0%

Chi-square test: Infection x Schedule

Chi-Square Tests

	Value	df	Asymp. Sig. (2-sided)	Exact Sig. (2-sided)	Exact Sig. (1-sided)
Pearson Chi-Square	,021 ^a	1	,884		
Continuity Correction ^b	,000	1	1,000		
Likelihood Ratio	,022	1	,883		
Fisher's Exact Test				1,000	,551
Linear-by-Linear Association	,021	1	,884		
N of Valid Cases	341				

a. 0 cells (0,0%) have expected count less than 5. The minimum expected count is 6,30.

b. Computed only for a 2x2 table

Chi-square test: Infection x No schedule

Chi-Square Tests

	Value	df	Asymp. Sig. (2-sided)	Exact Sig. (2-sided)	Exact Sig. (1-sided)
Pearson Chi-Square	1,114 ^a	1	,291		
Continuity Correction ^b	,675	1	,411		
Likelihood Ratio	1,055	1	,304		
Fisher's Exact Test				,348	,203
Linear-by-Linear Association	1,111	1	,292		
N of Valid Cases	341				

a. 0 cells (0,0%) have expected count less than 5. The minimum expected count is 6,74.

b. Computed only for a 2x2 table

Appendix 10B: Cross tables and Chi-square tests per deworming schedule

Once a year

Infection * Once Crosstabulation

		Once		Total
		Other	Once a year	
Infection -	Count	274	42	316
	% within Once	91,6%	100,0%	92,7%
+	Count	25	0	25
	% within Once	8,4%	0,0%	7,3%
Total	Count	299	42	341
	% within Once	100,0%	100,0%	100,0%

Chi-Square Tests

	Value	df	Asymp. Sig. (2-sided)	Exact Sig. (2-sided)	Exact Sig. (1-sided)
Pearson Chi-Square	3,790 ^a	1	,052		
Continuity Correction ^b	2,659	1	,103		
Likelihood Ratio	6,844	1	,009		
Fisher's Exact Test				,056	,033
Linear-by-Linear Association	3,778	1	,052		
N of Valid Cases	341				

a. 1 cells (25,0%) have expected count less than 5. The minimum expected count is 3,08.

b. Computed only for a 2x2 table

Two or three times a year

Infection * TwoOrThree Crosstabulation

		TwoOrThree		Total
		Other	Two or three times a year	
Infection -	Count	206	110	316
	% within TwoOrThree	93,2%	91,7%	92,7%
+	Count	15	10	25
	% within TwoOrThree	6,8%	8,3%	7,3%
Total	Count	221	120	341
	% within TwoOrThree	100,0%	100,0%	100,0%

Chi-Square Tests

	Value	df	Asymp. Sig. (2-sided)	Exact Sig. (2-sided)	Exact Sig. (1-sided)
Pearson Chi-Square	,274 ^a	1	,601		
Continuity Correction ^b	,093	1	,760		
Likelihood Ratio	,269	1	,604		
Fisher's Exact Test				,665	,374
Linear-by-Linear Association	,273	1	,601		
N of Valid Cases	341				

a. 0 cells (0,0%) have expected count less than 5. The minimum expected count is 8,80.

b. Computed only for a 2x2 table

Four times a year

Infection * Four Crosstabulation

			Four		Total
			Other	Four times a year	
Infection -	Count	240	76	316	
	% within Four	91,6%	96,2%	92,7%	
+	Count	22	3	25	
	% within Four	8,4%	3,8%	7,3%	
Total	Count	262	79	341	
	% within Four	100,0%	100,0%	100,0%	

Chi-Square Tests

	Value	df	Asymp. Sig. (2-sided)	Exact Sig. (2-sided)	Exact Sig. (1-sided)
Pearson Chi-Square	1,890 ^a	1	,169		
Continuity Correction ^b	1,274	1	,259		
Likelihood Ratio	2,161	1	,142		
Fisher's Exact Test				,221	,127
Linear-by-Linear Association	1,885	1	,170		
N of Valid Cases	341				

a. 0 cells (0,0%) have expected count less than 5. The minimum expected count is 5,79.

b. Computed only for a 2x2 table

More than four times a year

Infection * MoreOften Crosstabulation

			MoreOften		Total
			Other	More than four times a year	
Infection -	Count	311	5	316	
	% within MoreOften	93,4%	62,5%	92,7%	
+	Count	22	3	25	
	% within MoreOften	6,6%	37,5%	7,3%	
Total	Count	333	8	341	
	% within MoreOften	100,0%	100,0%	100,0%	

Chi-Square Tests

	Value	df	Asymp. Sig. (2-sided)	Exact Sig. (2-sided)	Exact Sig. (1-sided)
Pearson Chi-Square	10,975 ^a	1	,001		
Continuity Correction ^b	6,898	1	,009		
Likelihood Ratio	6,120	1	,013		
Fisher's Exact Test				,015	,015
Linear-by-Linear Association	10,943	1	,001		
N of Valid Cases	341				

a. 1 cells (25,0%) have expected count less than 5. The minimum expected count is ,59.

b. Computed only for a 2x2 table