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Parasitic infections of domestic cats, *Felis catus*, in western Hungary

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ABSTRACT

During 2011, faeces from 235 owned domestic cats from a rural area in western Hungary were examined using standard coproscopical techniques. The overall prevalence of cats with endoparasites was 39.6% (95% CI 33.3–46.1). The most frequently identified faecal forms were those of ascarids (*Toxocara*, 17.4%; *Toxascaris* 7.2%), followed by those of *Aelurostrongylus* lungworms (14.5%), hookworms (11.1%), taeniid cestodes (4.7%), *Cystoisospora* coccidians (4.3%), and capillarids (3.8%). Single and multiple infections with up to five parasites concurrently were founded in 24.7% and 14.9% of the cats, respectively. Mixed endoparasite infections were recorded more frequently ($p = 0.0245$) in cats greater than one year old compared to younger cats. Young cats (≤1 year) were parasitized more frequently ($p < 0.05$) with ascarids and *Cystoisospora* spp. but demonstrated infections of hookworms, lungworms and taeniid cestodes less often than the older cats. Cats with taeniid infection were more likely ($p < 0.05$) to harbour *Toxocara*, hookworm, *Aelurostrongylus*, and capillarid infections than cats without taeniid cestodes. Cats of owners who claimed the use of wormers were less frequently helminth-positive compared to cats whose owners did not use anthelmintics (21.2% vs. 44.4%; $p = 0.001$).

A subset of 115 faecal samples screened by a coproantigen ELISA revealed *Giardia*-specific antigen in 37.4% samples. *Giardia* cysts were found by immunofluorescent staining in 30 of the 43 samples tested positive for *Giardia* by ELISA.

In addition, ectoparasites collected from 82 cats by body search and combing were identified. Fleas (1–30 per cat), biting lice (*Felicola subrostratus*), and ticks (1–5 per cat) were isolated from 58, 1 and 43 cats, respectively. *Ctenocephalides felis* was identified on all flea infested cats while single specimens of *C. canis* and *Pulex irritans* were recovered from three and two cats, respectively. All but one tick collected were adult *Ixodes ricinus*; the single other tick was a nymph of *I. canisuga*.

By providing basic data on the epidemiology of parasitic infections, the results of this survey should emphasize the need of attending to parasites of cats from the veterinary point of view with respect to both appropriate diagnostics and control.

1. Introduction

In Hungary, the endoparasite spectrum infecting cats has been established through necropsy (Rátz, 1896, 1897, 1898; Cs. Tóth, 1926; Prettenhoffer, 1930; Murai and Sugár, 1976; Kávai, 1977; Dobos-Kovács, 1981; Takács and Takács, 2002), examination of faecal samples (Fok et al., 1988), blood tests (Fok et al., 2007; Fok and Jacsó, 2009), and serosurvey (Hornok et al., 2008). Ectoparasites of cats have received attention in more recently published works, including case descriptions and evaluation of a product against otocarosis (Farkas et al., 1994, 2007; Farkas and

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Table 1
Basic demographics of the cats ($n = 235$) from western Hungary whose faeces were examined.

Breed	187 European Short Hair cats; 48 pedigree cats or pedigree cat crosses (1 Abessin, 14 Bengal, 1 British Short Hair, 1 Egypt Mau, 1 Norwegian Forest cat, 15 Persian, 10 PersianXBengal, 3 PersianX European Short Hair, 1 Scottish fold, 1 Siamese)
Age	Approximately 0.3–16 years (68 ≤ 1 year, considered as young cats; 167 > 1 year, considered as adult cats)
Gender/neutering status	76 male, 27 male castrate, 93 female, 39 female spay
Use of anthelmintics (if any)	YES: 66 cats; NO: 169 cats

Földvári, 2001). Three species of flea have been identified parasitizing cats in Hungary (Szabó, 1964, 1965; Sréter-Lancz et al., 2006; Farkas et al., 2009), and epidemiology of flea infestation was studied in a recently conducted countrywide survey (Farkas et al., 2009). Data on infestation with ticks are limited to the identification of ticks collected from nine cats (Farkas and Földvári, 2001).

Apart from the necropsy study on stray cats by Takács and Takács (2002), contemporary surveys for the presence of gastrointestinal, hepatic and pulmonary parasites in cats from Hungary are lacking. It was therefore considered useful to assess the current situation of parasitic infections of owned cats in the country as domestic cats represent a potential reservoir of several diseases, including zoonotic parasitic infections and/or infections which may impact the health of cats. This study presents data on the prevalence of feline gastrointestinal and pulmonary helminth and intestinal protozoan parasites detected by examination of faecal samples and reports the results of the speciation of ectoparasites collected from cats from a rural area in western Hungary (counties Veszprem and Zala) during 2011. In addition, risk factors for endoparasite infection are identified.

2. Materials and methods

Faecal samples of 235 clinically normal house cats from 95 private owners, one privately owned cattery with indoor cat housing (36 pedigree or pedigree cross cats + one common European Shorthair [ESH] cat) and one animal shelter with 15 ESH cats were obtained through a veterinary practice in western Hungary. Cat owners were invited to provide faecal samples for examination. Basic demographic data obtained on each animal are summarized in Table 1. In addition, ectoparasites recovered by body search and combing using a fine-toothed comb from 82 EHS cats presented in the veterinary practice were determined to species.

Fresh faecal samples were examined initially grossly for the presence of nematodes and cestode proglottids. Thereafter, all samples were tested for helminth eggs and protozoan oocysts by a modified McMaster technique (Wetzel, 1951) using a slide with three chambers (Marienfeld GmbH & Co., KG, Lauda-Königshofen, Germany) and a zinc sulphate solution with a specific gravity adjusted to 1.3. Two slides per sample were examined under 100× magnification in order to achieve a sensitivity level of 25 eggs/oocysts per gram (EPG/OPG). In addition, each faecal sample was subjected to the Baermann technique for the detection of lungworm larvae (Wetzel, 1930). Parasites were identified based on morphology of the faecal forms alone; thus, identification in most instances was not down to species. Samples with capillarid eggs were also processed using a combined sedimentation/centrifugal floatation procedure to allow for a detailed examination of the morphology of those eggs at 400× magnification.

For testing for *Giardia* infection, an aliquot of a subset of 115 faecal samples was stored frozen at approximately −20 °C until analysis. Samples were screened with a commercially available ELISA kit for the presence of the *Giardia* specific antigen GSA65 (PROSPECT® *Giardia* MicroPlate Assay; Oxoid Ltd., Basingstoke Hants, UK) according to manufacturer's instructions. Evaluation was performed with a spectrophotometer (LEDETECT 96; Deelux GmbH, Gödenstorf, Germany) at 450 nm and the MIKROWIN 2010 software package (Mikrotek Laborsysteme GmbH, Overath, Germany). Faecal samples that tested positive by the ELISA were analysed additionally for the presence of *Giardia* cysts by immunofluorescence staining using FITC-conjugated *Giardia* specific monoclonal antibodies (MERIFLUOR® *Cryptosporidium*/*Giardia* Test Kit; Meridian Bioscience, Inc., Cincinnati, USA) following dilution with sodium acetate–acetic acid formalin (1:1, v/v). The presence of FITC-stained *Giardia* cysts was diagnosed at 200× magnification using a fluorescent microscope (AxioLab.A1; Carl Zeiss MicroImaging GmbH, Göttingen, Germany) at 490 nm.

Ectoparasites were identified using existing descriptions and/or keys (Jancke, 1938; Peus, 1938; Babos, 1964; Pérez-Eid, 2007).

The 95% Clopper–Pearson confidence intervals for the prevalences were computed with software R version 2.13.1 with package PropCi version 0.1-5 (R Development Core Team, 2011. R: A language and Environment for Statistical Computing. R Foundation for Statistical Computing, Vienna, Austria. ISBN 3-900051-07-0, URL http://www.R-project.org/). Associations between parasitism and host and management factors and between parasites were analysed using contingency tables and Fisher's exact test by using GRAPHPAD PRISM® 5 software (GraphPad Software, Inc., La Jolla, CA, USA). Significance was set at $p < 0.05$.

3. Results

Total prevalence and count of faecal forms of endoparasites detected by coproscopical examination are given in Table 2. A 39.6% (95% CI 33.3–46.1) overall rate of infection of cats with endoparasites (helminths and/or *Cystoisospora* spp.) was established. Eighty cats (34.0%, 95% CI 28.0–40.5), 34 cats (14.5%, 95% CI 10.2–19.6) and 10 cats (4.3%, 95% CI 2.1–7.7) had evidence of gastrointestinal helminth, lungworm, and *Cystoisospora* infections, respectively. Identification of the faecal forms revealed eggs of nematodes (*Toxocara*, *Toxascaris*, hookworm and capillarid species)