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Parasites of stray and client-owned domestic cats in urban areas in Russia during 2000-2015 years

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Abstract. Cats are commonly infected by many species of parasites that includes helminths, protozoan parasites, mites and fleas. Parasites affect the health of cats and cause morbidity and mortality, especially in young and old animals. Some species such as *Ancylostoma* spp., *Opisthorchis felineus* and *Echinococcus* spp. are well-known zoonotic parasites worldwide, that high public health risks. Currently of available data on prevalence of feline parasites in Russia, and published studies provide incomplete information regarding the period of parasitological study, number of cats examined, origin, gender and life condition of examined animals. There are no official veterinary guidelines on parasitological examination available. Moreover low quality of veterinary monitoring and inadequate preventive measures has lead to the high rates of environmental contamination by infested cats' feces containing helminths eggs and protozoan cysts. This paper reviews the knowledge on feline parasites fauna and the prevalence in Russia. Practical aspects related to diagnosis, treatment, and controls of parasitic diseases of cats in Russia are discussed.

INTRODUCTION

Cats and dogs are the most popular domestic animals worldwide. Pet population is rapidly increasing every year and reached critical indices. Statistical data shows that in the last decade, cat and dog population has increased 1.4 times whereas human population increased by 1.2 times. Currently, there are no clear statistical representation of cat population in Russia. However, every third family keeps a cat, therefore, the total number of cat population is estimated to be at least 37.5 million. According to statistical data, Russia occupies the fifth country in the world (after USA, Brazil, China and Japan) and leading country in Europe to have the most number of cats (Davtyan, 2016). So cats are one of the most popular animals, which live in close contact with humans. Due to this fact, cats are of major economic, social, medical and veterinary importance. Cats can be infected by a large number of parasites; some of which have zoonotic potential. Parasites such as *Ancylostoma* spp., *Echinococcus* sp., *Opisthorchis felineus*, *Ancylostoma* spp. are common parasites of cats that can also affect humans worldwide, these helminths are of major medical importance and can cause morbidity and mortality in human populations (Setasuban *et al.*, 1976; Ribertson & Tompson, 2002; Bowman *et al.*, 2010; Deplazes *et al.*, 2011; Petney *et al.*, 2013). The growing number of owned cats has also been accompanied by a substantial increase in free-roaming cat population. Free-roaming animals do not receive veterinary attention and anti-parasitic treatments. The prevalence rates of parasites are significantly higher in free-roaming cats, than in household cats, and as a result, the free-roaming cat population are the major source of parasites infection especially in urban ecosystems

(Dabritz *et al.*, 2006; Gerhold & Gessup, 2013; Hoopes *et al.*, 2015). Free-roaming cat populations are also increasing in Russia (Davtyan, 2016). Knowledge on the prevalence of cat parasite fauna and distribution, methods of diagnosis and treatment are essential for control and prevention of parasites infections in pet and human populations.

This review summarizes data on the endoparasites and ectoparasites in domestic cats in Russia, with a focus on zoonotic parasites.

Cats parasites in Russian Federation

There is a lack of data on the fauna of parasites of domestic cats in Russia. In present review data were summarized from published studies conducted between the years 2000 to 2015.A Total of 5 long-term studies are provided (Tables 2-4), and most of the study were conducted during one year. The total number of animals examined was significantly different in published reports; it fluctuates between 18 to 4280 numbers of examined cats (Tables 2, 3, 4). There is also a of lack data on the origin of the cats examined in the published study, however reports frequently included both stray and client owned animals. There is absence of clear data on number of client-owned and stray animals; parasites prevalence in stray and client-owned animals is also not distinguished (Tables 2-4). Most of the studies were conducted in Central Federal District (Aleksandrova & Safiullin, 2010; Puzenko & Malysheva, 2010; Kurnosova & Uspensky, 2011; Romasheva & Romashev, 2015; Saprykina, 2016) follow to Volga Federal district (Sidorkin *et al.*, 2013; Suleymaniva, 2014; Sivkova & Sogrina, 2015; Timerbaeva & Ilyashenko, 2014) and Siberian federal district (Bortsova, 2013; Domazcii, 2013; Luneva & Ponamarev, 2014; Rubin *et al.*, 2015). Sporadically reports were published from Northwestern (Gavrilova, 2013), North Caucasian (Zaychenko, 2012), Ural, South (Maslova *et al.*, 2015; Stolbova *et al.*, 2015) (Table 1).

The literature data on the parasites fauna of domestic cats include 25 ectoparasites species (Table 1, 3), 6 ectoparasites species; and 1 species of *Demodex* mites. Ectoparasites fauna includes mites *Notoedres cati*, *Sarcoptes scabiei*, *Otodectes cynotis*, *Cheyletiela yasguri*, fleas *Ctenocephalides felis;* lices *Felicola subrostratus* (Table 1, 4). Feline endoparasites fauna includes protozoan, roundworms, tapeworms and flatworms. Protozoan fauna includes 5 species. There are 6 species of tapeworms, 4 species of flatworms and and 10 species of roundworms (Table 1, 2, 3).

Species such as *Toxocara cati*, *Toxascaris leonina* and *Dipylidium caninum* are frequently found in cats from different districts. Helminths such as *Capillaria putorii*, *C. feliscati*, *Pseudamphistomum truncatum* and *Dirofilaria* spp. have been sporadically reported in cats from Russia. There is also a lack of data on the prevalence and distribution of *E. granulosus* and *Trichinella* spp. in cats as both the species are of major medical importance (Kodym *et al.*, 2007; Pavlova *et al.*, 2016).

Through analysis of the results obtained according to geographical districts, it was found that most of the endoparasites species were found in cats from Central Federal District, follow North Caucasian District (Table 1).

There are no information on the prevalence of ectoparasite and distribution in cats of different ages groups and gender, clinical signs and pathogenicity of ectoparasites infestations. Cats in Russia are frequently found infested with mites (*N. cati*, *O. cynotis*) fleas (*C. felis felis*), and less frequently infested with ticks and lice (Table 4). Fauna of ticks in Russia are large; and the information is lacking regarding wildlife species wildlife species such as *Amblioma* on cats.

Prevalence of parasites

Prevalence rates vary broadly in different regions; the total prevalence of endoparasites varies from 13.3% to 42.8% (Table 2). Whereas real prevalence rates of endoparasites are underestimated, mainly because most studies carried out in this country are based on the detection and identification of eggs and oocysts in fecal samples using ordinary

Table 1. Helminth fauna of domestic cat in Russia

Phyllum	Class	Order	Family	Species	Method	Region
Plathyhelminthes	Trematoda	Plagiorchiida	Opisthorchiidae	*Methorchis bilis*	AU	North Caucasian Federal District
				Opisthorchis felineus	AU,CE	Central Federal District, Siberian Federal Distric
				Pseudamphistomum truncatum	AU	Central Federal District
			Dicrocoeliidae	*Dicrocoelium lanceatum*	CE	Central Federal District
	Cestoda	Cyclophillidea	Dipylidiidae	*Dipylidium caninum*	CE	Central Federal District, Siberian Federal District, Volga Federal District
				Echinococcus granulosus	AU	
			Mesocestoididae	*Mesocestoides lineatus*	AU	North Caucasian F.D
				Hydatigera taeniaformis	AU; CE	North Caucasian F.D., Central F.D., Siberian F.D., Kazakhstan; Volga F.D.
				Taenia spp.	CE	North Caucasian F.D.
		Pseudophyllidea	Diphyllobothriidae	*Diphyllobothrium latum*	CE	Volga F.D.
Nematoda	Secernentea	Ascaridida	Ascarididae	*Toxocara mystax*	CE	Central F.D., North Caucasian F.D., North-West F.D., Volga F.D., Siberian F.D., Far East F., Urals F.D.
				Toxascaris leonina	CE	North Caucasian F.D., Central F.D., Siberian F.D., Volga F.D., Ural F.D., Far East F.D.
		Strongylida	Ancylostomatidae	*Ancylostoma* sp.	CE	Siberian F.D., North-Caucasian F.D.
				Uncinaria stenocephala		Volga F.D., North-Caucasian F.D., Central F.D., Siberian F.D.
		Trichurida	Trichurida	*Trichuris vulpis* (syn *Trychocephalus vulpis*)	CE	Central F.D.
				Capillaria feliscati	CE	North-Caucasian Federal District
				Aonchoteca putorii (Capillaria putorii)	CE	North-Caucasian Federal District
				Eucoleus aerophilus	AU	South Federal District
				Dirofilaria immitis	AU	South Federal District
				D. repens	AU	Central Federal District

Note: AU – postmortem examination; CE – coprological examination; n/a – not available.

coprological techniques. Only a few studies were presented using postmortem examination. This emphasizes the need for additional diagnostic methods (e.g. coproantigen tests, PCR tests) if we are to understand the actual diversity and prevalence of endoparasites of cats in Russia. Most published studies were focused particularly on helminths, so it is not difficult to estimate frequency of helminth infections in cats in Russia.

Prevalence rates of helminths vary in cats of different age groups. Kittens between up 1 month to 1 year of age are the most exposed to helminth infections, followed by young animals 3-5 years of age. Cats older than 5 years are less frequently infected by helminths. This is due to the immature immune system of young animals (Domazcii *et al.*, 2013; Sidorkin *et al.*, 2013). There is also lack of data on helminth prevalence in cats in relation to gender. According to Pohodina, there is no significant difference between the prevalence rates of males and females cats, which were 41.4%, and 38.1% respectively.

Toxocara cati (syn. *T. mystax*) is the most frequently found species in cats in Russia. Its prevalence rates varies, and it fluctuates from 4.8 to 65-100% (Table 2). The high prevalence of *T. cati* (100%) was found in kittens aged 1-12 months. This species is not transmitted by transmammary or transplacentary methods and is the opposite to *T. canis*, parasitizing in dogs. High infestation rates of *T. cati* in neonatal cats are reported as the immune system is unable to generate long-term immunity to the parasites (Deplazes *et al.*, 2011). *Toxascaris leonina* is also frequently founded in cats, with infection rates fluctuating between 4.8% and 46% respectively. *Capillaria feliscati* and *Aonchoteca putorii* (syn. *Capillaria putorii*) are rare in cats, *A. putorii* was found in North-Caucasian Federal District (Pyatigorsk) with prevalence rate of 5.6%, *C. feliscati* was found in Voronezh with a prevalence rate of 11.7% and one case was registered in Moscow (Zaychenko, 2012; Panova *et al.*, 2015; Davyolova & Shemyakov, 2015). Lungworm *Eucoleus aerophilus* was reported from Voronezh region with a prevalence rate of 5.8% (Kulesov & Romashov, 2016). There are no published reports for lungworms such as *Aelurostrongylus abstrusus*, *Oslerus rostratus* and *Troglostrongylus brevior* (Traversa *et al.*, 2013) infestation in cats from Russia. The most frequently reported cestodes were *D. caninum* and *Hydatigera taeniaeformis* (syn. *Taenia taeniaeformis*) with prevalence rates ranging between 1% and 50% and 1.1% and 15.4% respectively (Table 2). *Mesocestoides lineatus* and *Diphyllobothrium latum* are also rare in cats (Table 1). *Metorchis bilis* was reported from the North-Caucasian Federal District (Pyatigorsk) and Central Federal District (Voronezh) (Zaychenko, 2012; Romasheva & Romashev, 2014), with prevalence rates varying between 3.7% and 0.91%–33.3% respectively. That species was found in Volga Federal district (Perm) with prevalence of less than 1% (Sivkova & Sogrina, 2015). *Mesocestoides lineatus* was found in cats from Pyatigorsk (Nourth-caucasian Federal District) and Voronezh (central Federal District) with prevalence of 3.7% and 5.8% (Zaychenko, 2012; Romasheva & Romashev, 2014). The most frequently reported trematodes of cats were *O. felineus* (Table 2). The prevalence rates of *O. felineus* from Altay region and Kursk were 83% and 12.5% respectively (Puzenko & Malysheva, 2010; Luneva & Ponamarev, 2014). *Pseudamphistomum truncatum* was detected during postmortem examination in Voronezh region, with a prevalence rate of 66.7% (Romasheva & Romashev, 2014). *Trichuris vulpis* and *Dicrocoelium lanceatum* are reported in cats; but both species were reported from Voronezh with a prevalence of 0.98% (Panova *et al.*, 2015). Only few sporadic reports of feline *Dirofilaria* sp. infection have been published in the last several years. *Dirofilaria* spp. were found in cats in Krasnodar, Barnaul, Rostov-on-Don and Kirovskii Region with min and max prevalence of 0.15% and 20% respectively (Kravchenko & Gnenenko, 2007; Krivorotova, 2014; Krivorotova & Nagorny, 2015; Luneva & Ponomarev, 2014; Vinokurova, 2011). Recent data show (Krivorotova, 2014) that the infection rates in cats between one and three years old and

Table 2. Prevalence of intestinal helminths founding in cats from Russia

Parasite / Region	Period	Origin	n	Method	*Toxacara mystax*	*Toxascaris leonina*	*Uncinaria stenocephala*	*Ancylostoma* sp.	*Dipylidium caninum*	*Hydatigera taeniaformis*	*Taenia* sp.	*Mesocestoides lineatus*	*Opisthorchis felineus*	*Metorchis bilis*
Saratov (Sidorkin *et al.*, 2013)	one year	n/a	530	Fulleborn	19.7	12.4	1.8	–	1	–	–	–	–	–
Kursk (Puzenko & Malysheva, 2010)	2006–2009	stray+ client owned	26	AU	42.3	–	–	–	–	15.4	–	–	3.8	–
Pyatigorsk (Zaychenko, 2012)			107	MacMaster	24.3	7.5	6.6	3.7	3.7	3.7	–	3.7	–	–
Altay (Luneva & Ponomarev, 2014)	one year	stray+ client owned	402	Kotelnikov-Chrenov, Kotelnikov-Varenichev	46	37.8	5.2	3.9	?	1.1	–	–	83	–
Kazan (Timerbaeva & Ilyashenko,2014)	n/a	n/a	–		4.8	5.7	–	–	5.4	–	–	–	–	–
Voronezh (Volgina & Gaponov, 2009)	one year	n/a	293		31.4	7.8	0.9	–	24.5	2.9	–	0.9	1.9	–
Novosibirsk (Bortsova, 2013)	n/a	shelters	18	Floatation	32	3.6	–	–	–	–	–	–	–	–
Perm (Sivkova & Sogrina, 2015)	n/a	client owned	637	Kotelnikov-Chrenov	–	–	–	–	>1	2	–	–	–	–
Bashkortostan (Suleymanova, 2014)	n/a	n/a	37*+ 49	Fulleborn +AU	29.2	–	–	–	29.7	–	–	–	–	–
Western Siberia (Domazcii *et al.*, 2013)	one year	client owned + shelters	400	CE	26.7–30.2	–	–	–	–	–	–	–	–	–
Voronezh (Romasheva & Romashev, 2014)	2000–2013	n/a	54	AU		–	–	–	–	–	–	–	33.3	33.3
Zelenograd (Aleksandrova & Safiullin, 2010)	2008–2009	client owned	–	Fulleborn	14.5	–	–	–	2.9	–	–	–	–	–
Saint-Petersburg (Gavrilova, 2013)	september 2012 – december 2012	stray	20	CE	65	–	–	–	–	–	–	–	–	–
Moscow (Panova *et al.*, 2015)	n/a	client owned + stray	44	Fulleborn+ Kotelnikov-Chrenov	31.6	–	–	–	50	–	25	–	–	–

Note: AU – postmortem examination; CE – coprological examination; n/a – not available.

older than nine years was lower than in cats between four and eight years of ages; showed a prevalence was 7.6–14.4% and 18.8–22.5%, respectively. Same prevalence was found among female and male cats – infestation rates were 14.4 and 15.4%, respectively. In another study (Luneva & Ponomarev, 2014) *D. immitis* was found in cats older than 3 years of age, female cats were less frequently infected with *D. immitis*.

There is lack data on protozoan infections in cats in Russia. The most frequently reported protozoan parasites were Coccidia, including *Cystoisospora rivolta* and *C. felis*; the prevalence rates varying between 4.9% and 1.24%. *Giardia* spp. was found in Kazan and Moscow with a prevalence rate of 0.56% and 5.39% respectively. *Sarcocystis* spp. is rarely found in cats, it was reported from Moscow and Perm with prevalence of 0.82% and 0.16%. There is also a lack of information on *Toxoplasma* sp. The following prevalence was reported from Moscow (33.8%) Voronezh with prevalence rate of 17.65% and Kazan with prevalence rate of 0.4% (Table 3).

In total, six reports on ectoparasites in cats were published in the last decade. The most frequently found ectoparasite was *O. cynotis* with maximum prevalence rate of 68.7%, followed by *N. cati* with 8.8%. *Demodex cati* was registered sporadically with low prevalence rates between 0.1 and 2.8%. There is no published data on other feline *Demodex* mites such as *D. gatoi* and third unnamed molecular distinguished species (Frank *et al.*, 2013). Mites *C. yasguri* and *Sarcoptes scabiei* were observed in Ob,Tymen (Table 4). There is also lack of data on fleas and lice's species and their prevalence in cats.

Table 3. Prevalence of Protozoa in cats from Russia

Region	Period	Origin	n	Method	*Toxoplasma gondii*	Coccidia	*Cystoisospora felis*	*Cystoisospora rivolta*	*Sarcocystis* spp.	Giardia spp.
Voronezh (Volgina & Gaponov, 2009)	one year	client-owned	293	Flotation	17.6	4.9	1.96	1.96	0.15	
Perm (Sivkova & Sogrina, 2015)	n/a	client-owned	637	Kotelnikov-Chrenov	–	–	4.71	–	–	–
Kazan (Timerbaeva & Ilyashenko, 2014)	n/a	n/a	–	–	0.4	–	–	–	–	0.5
Moscow (Kurnosova & Uspensky, 2011)			241	Fulleborn+ Kotelnikov-Chrenov	0.4		2.5	–	0.8	5.4

Table 4. Prevalence of ectoparasites and *Demodex cati* in cats from Russia

Region	Period	Origin	n	*Otodectes cynotis*	*Sarcoptes scabiei*	*Notoedres cati*	*Cheyletiella yasguri*	*Ctenocephalides felis*	*Demodex cati*	Aphalinidae
Ob (Rubin *et al.*, 2015)	2006–2013	client-owned	n= 263	68.7	20.4	8.8	0.4	–	2.8	–
Tyumen (Stolbova *et al.* 2015)	2010–2015	n/a	n= 1452	14.8	0.55	5.4	1.2	–	0.1	14.3
Saint-Petersburg (n=20) (Gavrilova, 2013)	september-december 2012	n/a	n= 20	–	–	–	–	70	–	–
Kazan (Timerbaeva & Ilyashenko, 2014)	n/a	n/a	–	10.2	–	1.2	–	–	–	16.6
Zelenograd (Aleksandrova & Safiullin, 2010)	2008–2009	client-owned	–	59.4	–	5.8	–	–	–	17.4

n/a – not available

MATERIALS AND METHODS

Fecal Sample collection

Fresh fecal samples that were collected were placed in individual tubes or jars with a label containing information regarding the cat's age, gender and data of sample collection. All samples were examined one day after collection. Skin scrapings and cerumen samples were investigated one day after collection.

Laboratory diagnostic procedures

The diagnosis of parasitic diseases affecting cats in Russia is still predominantly made by traditional methods. For instance, gastrointestinal parasites are usually detected by ordinary coprological techniques such as Fulleborn (flotation in saturated sodium chloride solution); this method has low sensitivity for Cestoda and Trematoda eggs (*Polowski et al.*, 2006; Becker *et al.*, 2016). Other original floatation sedimentation techniques such Kotelnikov-Ñhrenov($ZnCl_2$ SG 1.82), Kotelnikov-Varenich (NH_4NO_3 SG 1.28) methods using saturated solutions have high sensitivity for most intestinal parasites due to high gravity of the solutions (Lutfiullin *et al.*, 2010; Dolbin *et al.*, 2011; Timerbaeva *et al.*, 2014). However, direct morphological identification of helminths eggs such as *Taenia* spp., *Ancylostoma* spp. and protozoan cysts cannot normally be differentiated by light microscopy. The multiple polimerase chain reaction (PCR) is high sensitive method, using for detection indistinguishable *Tenia* spp. and *Ancylostoma* spp. eggs and protozoan cysts (Orlandi & Lampel, 2000; Traub *et al.*, 2004; Trachsel *et al.*, 2007). Unfortunately this method is not used by veterinarian's practitioners in Russia. Different methods are used for *Toxoplasma* identification – such as direct microscopy of fecal samples, and different serological tests. Serological analyses include IFA, CFT and immune chromatography (Kodym *et al.*, 2007; Bazhibina, 2011; Bespalova & Katkov, 2015).

TREATMENT

Efficacy of anthelminthic therapy presents major significance for prevention and control of helminths infections among companion animals (Dryden & Payne, 2004). Praziquantel, pyrantel, ivermectine and albendazol are frequently used in anthelminthic in Russia (Arkhipov & Smirnov, 2006; Prohorova, 2010; Smirnova & Arisov, 2015). These compounds are highly effective against most parasites of animals are toxic and have heavy side effects (Epe & Kaminsky, 2013). New synthetic drugs combined with praziquantel is commercially available; that have high efficacy and low toxicity compared with praziquantel (Epe & Kaminsky, 2013). Among the new anthelminthic compounds, only emodepside (Profender) is available in Russia (Arkhipov *et al.*, 2007). Ivermectin is often used against ectoparasites suc as *N. cati*, *O.cynotis*, fleas and lice (Prohorova, 2010). There are only a few known published reports on feline demodicosis treatment. In a report published by Yastreb, 2016 cat's demodicosis was successfully treated using Bravecto – insectoacaricide a new class of izoxasolines used against ectoparasites (Avdienko, 2008; Yastreb, 2016). In other report combined scheme for localized and generalized demodicosis acompanied with Staphylococcosiss treatment was presented, and it includes anatoxin, antibiotics, vitamin B12, immunoparasitan, gipchlofos.

PREVENTION

Veterinarian practitioners, cat owners do not have a native source of information for parasite epidemiology, life cycles or control measures in Russia (Makarov, 2004). Currently, prevention include regular deworming of infected cats, control of food quality and pet diets also help to prevent parasite infections. For example, to prevent *O. felineus* infestation it is recommend to avoid the feeding of fresh cyprinid fishes (Aunpromma *et al.*, 2016)

Many cat owners cannot afford preventive measures and act only when there is a life-threatening problem affecting their animals. Furthermore, there are a large number of free-roaming cats in the Russian cities. Government is not able to manage these animals due to the lack of adequate infrastructure and trained personnel to

conduct an effective long-term population control program. As a result, pet dogs and cats are endangered by a wide range of parasites that may cause disease to them and eventually to their human owners.

PARASITES WITH ZOONOTIC POTENTIAL

O. felineus, *M. bilis*, *D. lanceolatum* are major zoonotic parasites (Azizova, 1987; Ilynskikh *et al.*, 2006; Petney *et al.*, 2013). *D. caninum* and *T. mystax* can affect humans (Molina *et al.*, 2003; Fisher, 2003; Szwaja *et al.*, 2011). Larvae *Toxocara cati* and *T. canis* can cause larval migrans syndrome, including ocular larval migrans and visceral larval migrans (Fisher, 2003). Adult *T. cati* can also parasitize human intestine. However, in opposition *to T. canis*, *T. cati* is an underestimated zoonotic agent (Fisher, 2003). Incidence of *T. canis* was high in humans with a total 3310 cases of toxocariasis registered in 2011 and 3325 cases registered in 2012 in Russia (Maksimova & Maniya, 2014). The main source of *T. cati* infection is environment contaminated by helminths eggs passed by infected cats. Studies on the contamination of geohelminths eggs in soil shows a high contamination levels of *Toxocara* spp. eggs, the prevalence of *Toxocara* spp. eggs in soil varies between 1–3% and 50–60% with a mean intensity of 1–10 eggs per 100 gr (Malysheva *et al.*, 2013). However in single report, *Toxocara* eggs were identified as *T. cati* – in Vitebsk with prevalence rate of 30.2% (Bekish, 2006). Seasonal prevalence of *T. cati* in cats are high during the year, with peak of infection rates in autumn period. Free-roaming cats are also frequently infected with *T. cati* than cats without free access to outdoors.

Toxoplasmosis is an important zoonotic parasitic disease in humans and many species of birds and mammals, which is caused by the opportunistic protozoan *Toxoplasma gondii* (Dubey, 2010). As the definitive hosts for *T. gondii*, infested cats pass oocysts in their feces leading to contamination with *T. gondii* oocysts in soil (Elmore *et al.*, 2010). Serological assays show that seroprevalence of *Toxoplasm*a in kittens was lower than in adult cats; female cats are frequently infected with *Toxoplasma* than males with a prevalence 27.1% and 12.2% respectively (Berezina *et al.*, 2011). A total of 10090 cases of toxoplasmosis in human population were registered from the year 2000–2011 in Russia. The regions with the highest incident rate were Arkhangelsk Oblast (714 cases per 100 000) and Yakutia (306 cases per 100 000) (Dubarev *et al.*, 2013).

Liver flukes *O. felineus* and *M. bilis* are the main humans' parasites in Russia (Mordvinov *et al.*, 2012). Life cycle of both species includes two intermediate hosts: fist intermediate hosts are freshwater snails; second intermediate hosts are Cyprinidae fishes. The final hosts of both species can be variuos species of fish-eating mammals the largest parasite-endemic area is in western Siberia, namely the Ob and Irtysh River valleys and their tributaries (Skarednov *et al.*, 1986; Filatov *et al.*, 1989; Zelia *et al.*, 1990). In the central part of this area, the Tyumen and Tomsk Districts, the mean prevalence of human infection is 40%–95%. The prevalence of 65% were reported in the Komi-Permiak national district. Other districts and territories where opisthorchiasis is endemic include Voronezh District (Chubirko *et al.*, 1997), Yekaterinburg District (Tsybina, 1994) Altai territory (Chubirko *et al.*, 1997), Volga River valley ((Kazadaeva & Kastranova, 2015) and Archangelsk District (Zelia & Gerasimov, 1992). *M. bilis* is also found in Western Siberia. Seroprevalence of this species is 4.9–8.4% (Ilyinskikh *et al.*, 2006; Mordvinov *et al.*, 2012).

CONCLUSIONS

The close contact between domestic cats and humans may unintentionally represent hazard for humans. Therefore, to avoid the potential risks associated with owning a pet, it is fundamental to maintain pets in good health and protect them from zoonotic pathogens.

Therefore, veterinary practitioners and medical physicians should work together towards improving the well-being and general health of both animals and humans.

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REFERENCES

Aleksandrova, A.S. & Safiullin, R.T. (2010). Parasitic fauna of small domestic animals in conditions of the Zelenograd city. *Teorija i praktika parazitarnyh boleznej zhivotnyh* **11**: 15-17. (In Russian)

Arkhipov, A.A. & Smirnov, A.A. (2006). Efficacy of drug Prazicide for treatment of carnivorous helminth infestations. *Veterinary Pathology* **3**: 155-159. (In Russian)

Arkhipov, A.A., Zubov, A.V., Abramov, V.E. & Tihanova, N.V. (2007) Cats helminthiasis in Russia and their therapy by anthelmintic drug Profender (Bayer). *Rossijskij veterinarnyj zhurnal. Melkie domashnie i dikie zhivotnye* **1**: 45-47.

Aunpromma, S., Kanjampa, P., Papirom, P., Tangkawattana, S., Tangkawattana, P., Tesana, S. & Sripa, B. (2016). Prevalence and risk factors for Opisthorchis viverrini infection among cats and dogs in six districts surrounding the ubolratana dam, an endemic area for human opisthorchiasis in Northeastern Thailand. *Southeast Asian Journal* of *Tropical Medicine* and *Public Health* **47**: 1153-1159.

Avdienko, V.A. (2008). Treatment of animals at demodecosis complicated by staphylococcosis. *Russian Journal of Parasitology* **1**: 1-4. (In Russian)

Azizova, O.M., Sagieva, A.T., Israilova, S., Sadykov, V.M. & Shirinova, N. (1987). *Dicrocoelium lanceatum* infestation in humans (based on autopsy data). *Meditsinskaia parazitologiia i parazitarnye bolezni* 2: 26-28. (In Russian)

Bazhibina, E.B. (2011). Algorhitms of the infections and invasive diseases diagnostics in cats. *Rossijskij veterinarnyj zhurnal. Melkie domashnie i dikie zhivotnye* **2**: 4-12. (In Russian)

Becker, A.C., Kraemer, A., Epe, C. & Strube, C. (2016). Sensitivity and efficiency of selected coproscopical methods-sedimentation, combined zinc sulfate sedimentation-flotation, and McMaster method. *Parasitology Research* **113**: 2401-2406.

Bekish, L.E. (2006). Soil cantamination of Toxocara eggs in Vitebsk. *Teorija i praktika parazitarnyh boleznej zhivotnyh* **5**: 1-9. (In Russian)

Berezina, E.S., Lobkis, D.V. & Starostina, O.Yu. (2011). Spreading of toxoplasmosis in domestic and farm animals' populations and humans. *Veterinary Pathology* **3**: 107-112. (In Russian)

Bespalova, N.S. & Katkov, S.S. (2015). Use of immunocomb biogal system for research house carnivorous on toxoplasmosis. *Uchenye zapiski kazanskoj gosudarstvennoj akademii veterinarnoj mediciny im. N.Je. Baumana* **2**: 24-27. (In Russian)

Bortsova, N.S. (2013). Nematodes of dogs and cats in Novosibirsk shelters for stray animals. *Teorija i praktika parazitarnyh boleznej zhivotnyh* **14**: 1-3. (In Russian)

Bowman, D.D., Montgomery, S.P., Zajac, A.M., Eberhard, M.L. & Kazacos, K.R. (2010). Hookworms of dogs and cats as agents of cutaneous larva migrans. *Trends In Parasitology* **26**: 162-167.

Chubirko, M.I., Sharinova, L.F., Popova, T.I., Morozova, N.N. & Starostina, L.S. (1997). The spread of Opisthorchis invasion in Voronezh Province *Meditsinskaia parazitologiia i parazitarnye bolezni* **3**: 16-9. (In Russian)

Dabritz, H.A., Atwill, E.R., Gardner, I.A., Miller, M.A. & Conrad, P.A. (2006). Outdoor fecal deposition by free-roaming cats and attitudes of cat owners and nonowners toward stray pets, wildlife, and water pollution. *Journal of the American Veterinary Medical Association* **229**: 74-81.

Davydova, O.E. & Shemyakov, D.N. (2015). Two Clinical Cases of Capillaries Bladder in a Dog and a Cat. Rossijskij veterinarnyj zhurnal. Melkie domashnie i dikie zhivotnye, **1**: 24-25. (In Russian)

Davtyan, E.S. (2016). About the need to monitor the epidemic situation of infectious diseases dogs and cats in the urban ecosystem. *International Research Journal* DOI: 10.18454/IRJ.2227-6017 (In Russian)

Deplazes, P., van Knapen, F., Schweiger, A. & Overgaauw, P.A. (2011). Role of pet dogs and cats in the transmission of helminthic zoonoses in Europe, with a focus on echinococcosis and toxocarosis. *Veterinary Parasitology* **182**: 41-53.

Dolbin, D.A., Lutfullin, M.H. & Hayrullin, R.M. (2011). Universal coproscopy diagnosis of intestinal parasites. *Uchenye Zapiski Kazanskoj Gosudarstvennoj Akad. Vet. Med. N. Je. Baumana* **2**: 207, 190-195. (In Russian)

Domazcii, V.N., Fadeev, O.V., Aubakirov, M.J. & Chernyshova, E.N. (2013). Dogs and cats toxocariasis in urban foci of West Siberia. *Kazahskij Nacional''nyj Agrarnyj Universitet Issledovanija, Rezul"taty* **3**: 28-35. (In Russian)

Dubey, J.P. (2010). Toxoplasmosis of Animals and Humans. CRC Press Inc, Boca Raton, New York, 1-313.

Dryden, M.W. & Payne, P.A. (2004). Preventing parasites in cats. *Veterinary Therapeutics* **6**: 260-267.

Dudarev, A.A., Dorofeyey, V.M., Dushkina, E.V., Alloyarov, P.R., Chupakhin, V.S., Sladkova, Y.N. & Evengård, B. (2013). Food and water security issues in Russia III: food-and waterborne diseases in the Russian Arctic, Siberia and the Far East, 2000-2011. *International Journal of Circumpolar Health* **72**.

Engasheva, E.S., Salnikova, O.G. & Birukova, N.P. (2015). Insectoacaricide activity of drops Bars forte for cats. *Teorija i praktika parazitarnyh boleznej zhivotnyh* **16**: 140-143. (In Russian)

Elmore, S.A., Jones, J.L., Conrad, P.A., Patton, S., Lindsay, D.S. & Dubey, J.P. (2010). *Toxoplasma gondii*: epidemiology, feline clinical aspects, and prevention. *Trends in Parasitology* **26**: 190-196.

Epe, C. & Kaminsky, R. (2013). New advancement in anthelmintic drugs in veterinary medicine. *Trends in Parasitology* **29**: 129-134.

Fisher, M. (2003). *Toxocara cati*: an underestimated zoonotic agent. *Trends in Parasitology* **19**: 167-170.

Filatov, V.G., Pustovalova, V.I., Ushakov, A.V. & Maier, V.A. (1989). The role of various intermediate and definitive host species in the dissemination of Opisthorchis felineus from the Ob-Irtysh focus of opisthorchiasis [in Russian]. *Meditsinskaia parazitologiia i parazitarnye bolezni* **3**: 39-41. (In Russian)

Frank, L.A., Kania, S.A., Chung, K. & Brahmbhatt, R. (2013). A molecular technique for the detection and differentiation of Demodex mites on cats. *Veterinary Dermatology* **24**: 367.

Gavrilova, N.A. (2013). Using of drug Inspector total for treatment of carnivorous mix infestation. *Vet Pharma* **1**: 54-56.

Gerhold, R.W. & Jessup, D.A. (2013). Zoonotic Diseases Associated with Free-Roaming Cats. *Zoonoses and Public Health* **3**: 189-195.

Hoopes, J., Hill, J.E., Polley, L., Fernando, C., Wagner, B., Schurer, J. & Jenkins, E. (2015). Enteric parasites of free-roaming, owned, and rural cats in prairie regions of Canada. *Canadian Veterinary Journal* **56**: 495-501.

Ilyinskikh, Ye.N., Novitsky, V.V., Ilyinskikh, N.N. & Lepyokhin, A.V. (2006). Assessment of the incidence of *Opisthorchis felineus* (Rivolta, 1884) and *Metorchis bilis* (Braun, 1890) infections in population of several regions of the West Siberia. *Bulletin Siberian Medicine* **4**: 18-24. (In Russian)

Kazadaeva, M.G. & Kastranova, E.S. (2015). Helminthoses of carnivores of the Novorossisk city. *Teorija i praktika parazitarnyh boleznej zhivotnyh* **16**: 168-170. (In Russian)

Khamidullin, R.I., Fomina, O.A., Sultanaeva, E.G. & Khamidullin, I.R. (1995). Opisthorchiasis and pseudamphistomiasis on the territory of the middle Volga valley. *Meditsinskaia parazitologiia i parazitarnye bolezni* **1**: 40-142. (In Russian)

Kravchenko, I.A. & Gnenenko, A.A. (2007). Dinamika rasprostraneniya dirofilarioza sobak i koshek v g. Barnaul. *Vestnik Altaiskogo gosudarstvennogo agrarnogo universiteta* **6**: 42-45. (In Russian.)

Krivorotova, E.Yu. (2014). Biologicheskie aspekty dirofiljarioza v rjade subyektov Rossijskoj Federacii [Biological aspects of dirofilariasis on Russian Federation territory]. PhD thesis, Rostov-on-Don (In Russian)

Krivorotova, E.Yu. & Nagorny, S.A. (2015). Role of cats in transmission of *Dirofilaria* spp. in the Rostov-on-Don city. *Òeorija i praktika parazitarnyh boleznej zhivotnyh* **16**: 185-187. (In Russian)

Kodym, P., Machala, L., Roháèová, H., Širocká, B. & Malý, M. (2007). Evaluation of a commercial IgE ELISA in comparison with IgA and IgM ELISAs, IgG avidity assay and complement fixation for the diagnosis of acute toxoplasmosis. *Clinical Microbiology and Infection* **13**: 40-47.

Konyaev, S.V., Yanagida, T., Ivanov, M.V., Ruppel, V.V., Sako, Y., Nakao, M., *et al.* (2012). The first report on cystic echinococcosis in a cat caused by Echinococcus granulosus sensu stricto (G1). *Journal of Helminthology* **86**: 391-4.

Kuleshov, A.A. & Romashov, B.V. Zoonotic nematodes circulating with wild and domestic carnivores in the conditions of the Voronezh region. *Metarials of Scientists Proceedings "Modern Problems of Parasitology and Epizootology"* Voronezh 2016, 79-84.

Kurnosova, O.P. & Uspensky, A.V. (2011). Distribution of intestinal protozoosis at dogs and cats in Moscow. *Russian Journal of Parasitology* **3**: 14-16.

Luneva, N.A. & Ponamarev, N.M. (2014). The description of species composition of feline helminths in the Altai region. *Vestnik Altajskogo gosudarstvennogo agrarnogo universiteta* **12**: 105-107. (In Russian)

Lutfullin, M.H., Latypov, D.G. & Nikiforov, P.G. (2010). Gel'mintoovoskopicheskaja diagnostika trematodozov i puti uluchshenija ee jeffektivnosti, (Gelmintoovoskopicheskaya trematodozov diagnosis and ways of improving its efficiency). *Uchenye Zapiski Kazanskoj Gosudarstvennoj Akad. Vet. Med. N. Je. Baumana* **201**: 75-80. (In Russian)

Maksimova, M.S. & Maniya, T.R. (2014). Comparative analysis of the incidence of toxocariasis in 2011-2012. *Gigiena i sanitarija* **6**: 61-62. (In Russian)

Makarov, V.V. Zoonozes. *Veterinarnaja Patologia* **3**: 7-9. (In Russian)

Malysheva, N.S., Samofalova, N.A., Grigor'ev, D.G., Vagin, N.A., Elizarov, A.S., Gladkih, K.A. & Shuykina, A.E. (2013). The current problem of toxocarosis and improvement of the preventive measures against it. *Uchenye zapiski. Jelektronnyj nauchnyj zhurnal Kurskogo gosudarstvennogo universiteta* **1**: 1-7. (In Russian)

Ìaslova, E.N., Sidorova, K.A., Dragiæ, O.A. & Borisova, S.K. (2015). The otitis and dermatitis of the external ear canal in small animals. *Sovremennye Problemy Nauki I Obrazovanija* **6**: 1-7. (In Russian)

Molina, C.P., Ogburn, J. & Adegboyega, P. (2003). Infection by *Dipylidium caninum* in an infant. Archives of Pathology & Laboratory Medicine **127**: e157-e159.

Mezentsev, S.V. & Razumovskaya, V.V. (2014). Trichinella distribution in the Altai region. *Vestnik Altajskogo gosudarstvennogo agrarnogo universiteta* **3**: 69-73. (In Russian)

Mordvinov, V.A., Yurlova, N.I., Ogorodova, L.M. & Katokhin, A.V. (2012). *Opisthorchis felineus* and *Metorchis bilis* are the main agents of liver fluke infection of humans in Russia. *Parasitology International* **61**: 25-31. (In Russian)

Nikulin, P.I. & Romashev, B.V. (2011). Helminths of domestic carnivores in Voronezh region. *Russian Journal of Parasitology* **1**: 32-39. (In Russian)

Orlandi, P.A. & Lampel, K.A. (2000). Extraction-free, filter-based template preparation for rapid and sensitive PCR detection of pathogenic parasitic protozoa. *Journal of Clinical Microbiology* **38**: 2271-2277.

Panova, O.A., Napisanova, L.A. & Glamazdin, I.G. (2015). Examination of cats on intestinal and migrative forms of helminthoses in the Moscow city. *Teorija i praktika parazitarnyh boleznej zhivotnyh* **16**: 320-322. (In Russian)

Pavlova, E.V., Kirilyuk, E.V. & Naidenko, S.V. (2016). Occurrence pattern of influenza A virus, *Coxiella burnetii*, *Toxoplasma gondii*, and *Trichinella* sp. in the pallas cat and domestic cat and their potential prey under arid climate conditions. *Arid Ecosystems* **6**: 277-283.

Petney, T.N., Andrews, R.H., Saijuntha, W., Wenz-Mücke, A. & Sithithaworn, P. (2013). The zoonotic, fish-borne liver flukes *Clonorchis sinensis*, *Opisthorchis felineus* and *Opisthorchis viverrini*. *International Journal for Parasitology* **43**: 1031-1046.

Pohodina, N.S. Study of helminth fauna of cats in Saratov. Veterinarnaja medicina. Sovremennye problemy i perspektivy razvitija: *Materials of International Scientist Proceedings* 2010, 220-332. (In Russian)

Połozowski, A., Zawadzki, W. & Nowak, M. (2006). Comparison of two fecal flotation techniques for diagnostic of internal parasites infections in swine and dogs. *Electronic Journal of Polish Agricultural Universities* **9**: 39.

Prohorova, I.A. (2010). Development of new drugs for prophylactic and treatment of parasitic diseases of carnivorous. *Russian Journal of Parasitology* **2**: 119-123. (In Russian)

Puzenko, S.V. & Malisheva, N.S. (2010). Influence of animal age on helminth infection rates. *Teorija i praktika parazitarnyh boleznej zhivotnyh* **11**: 375-377. (In Russian)

Romashova, E.N. & Romashev, B.V. (2014). Prevalence of Opisthorchidae infection in cats in the conditions of the Voronezh Region. *Teorija i praktika parazitarnyh boleznej zhivotnyh* **15**: 253-257. (In Russian)

Robertson, I.D. & Thompson, R.C. (2002). Enteric parasitic zoonoses of domesticated dogs and cats. *Microbes and Infection* **4**: 867-873.

Rubin, N.V., Zubareva, I.M. & Erova, L.M. (2015). Peculiarities of epizootic situation on domestic animals' acariases in Ob (Novosibirsk Region). *Vestnik Novosibirskogo Gosudarstvennogo Agrarnogo Universiteta* **1**: 115-120. (In Russian)

Saprykina, R.S. (2016). Season dynamic of otodectosis and demodicosis of carnivorous. *Setevoj nauchnyj zhurnal* **2**: 85-88. (In Russian)

Setasuban, P., Vajrasthira, S. & Muennoo, C. (1976). Prevalence and zoonotic potential of *Ancylostoma ceylanicum* in cats in Thailand. *Southeast Asian Journal of Tropical Medicine and Public Health* **7**: 534-539. (In Russian)

Sidorkin, W.A., Nefedova, N.S. & Panfilova, M.N. (2013). Experience of application of alvet-suspension for treatment of helminthosis of cats. *Russian Journal of Parasitology* **1**: 92-94. (In Russian)

Sivkova, T.N. & Sogrina, A.V. (2015). Parasitoses of domestic carnivores in the Perm city in 2014. *Teorija i praktika parazitarnyh boleznej zhivotnyh* **16**: 405-407. (In Russian)

Skarednov, N.I., Ozhirel'ev, V.V., Maier, V.A., Serednitskii, S.I. & Satin, V.A. (1986). Ecologo-epidemiologic reasons for the prevalence of opisthorchiasis in the Kurgan region *Meditsinskaia parazitologiia i parazitarnye bolezni* **6**: 11-4. (in Russian)

Smirnova, E.S. & Arisov, M.V. (2015). Efficacy of new complex anthelmintic drug Helmintal against roundworm and tapeworms in cats. Innovation technology and technological instruments for APC. *Materials of International Scientist Proceedings of Young Scientists and Specialists. Part III*, 158-164. (In Russian)

Stepanchuk, N.A. (2009). Helminthoses of cats in the Volgograd Region having the epidemiological importance. *Teorija i praktika parazitarnyh boleznej zhivotnyh* **10**: 382-385. (In Russian)

Stolbova, O.A., Skosyrskikh, L.N. & Tkacheva, Yu.A. (2015). Diseases of the skin in dogs and cats in the Tyumen region. *Modern Problems of Science and Education* **4**: https://www.science-education.ru/ru/article/view?id=20744 (In Russian)

Suleymanova, G.F. (2014). Parazitofauna of dogs and cats in Bashkortostan. *Sovremennye Dostizhenija Veterinarnoj Mediciny I Biologii – V Sel"skohozjajstvennoe Proizvodstvo: materials of II Russian scientistic proceedings* 120-121.

Szwaja, B., Romañski, L. & Zabczyk, M. (2011). A case of *Dipylidium caninum* infection in a child from the southeastern Poland. *Wiadomosci parazytologiczne* **57**: 175-178. (In Russian)

Timerbaeva, R.R., Idrisov, A.A. & Lutfullin, M.H. (2014). Comparative efficacy of helminthovoscopic methods of diagnosis of swine helminthoses. *Teorija i praktika parazitarnyh boleznej zhivotnyh* **15**: 314-317. (In Russian)

Timerbaeva, R.R. & Ilyashenko, N.E. (2014). Distribution of the main invasive diseases carnivorous Kazan. *Sovremennye Dostizhenija Veterinarnoj Mediciny I Biologii – V Sel"skohozjajstvennoe Proizvodstvo: materials of II Russian Scientistic Proceedings* 127-129. (In Russian)

Trachsel, D., Deplazes, P. & Mathis, A. (2007). Identification of taeniid eggs in the faeces from carnivores based on multiplex PCR using targets in mitochondrial DNA. *Parasitology* **134**: 911-920.

Traub, R.J., Robertson, I.D., Irwin, P., Mencke, N. & Thompson, R.A. (2004). Application of a species-specific PCR-RFLP to identify Ancylostoma eggs directly from canine faeces. *Veterinary Parasitology* **123**: 245-255.

Traversa, D. & Di Cesare, A. (2013). Feline lungworms: what a dilemma.Trends in Parasitology **29**: 423-430.

Tsybina, T.N. (1994). The ecological-epidemiological characteristics of opisthorchiasis in Sverdlovsk Province. *Meditsinskaia parazitologiia i parazitarnye bolezni* **3**: 45-50. (In Russian)

Vinokurova, D.P. (2011). Spreading and prevalence of *Dirofilaria* spp. among digs and cats in Krasnodar region; and *Dirofilaria* spp. morphology. PhD thesis. Stavropol. (In Russian.)

Volgina, I.S. & Gaponov, S.P. (2009). Parasitoses of domestic carnivores in conditions of the city of Voronezh. *Teorija i praktika parazitarnyh boleznej zhivotnyh* **10**: 93-95. (In Russian)

Yastreb, V.B. (2016). Case of ear *Demodex* infection in cat with immunodeficiency virus (HIV). *Teorija i praktika parazitarnyh boleznej zhivotnyh* **17**: 542-543.

Zaychenko, I.V. (2012). Helminthiasis of urban population of carnivorous (distribution, diagnostic, treatment). Abstract of PhD thesis, Stavropol. (In Russian)

Zelia, O.P., Zavoikin, V.D. & Sergeeva, M.N. (1990). The characteristics of the circulation of the causative agent of opisthorchiasis in the tributaries of the Ob. *Meditsinskaia parazitologiia i parazitarnye bolezni* **4**: 22-25. (In Russian)

Zelia, O.P. & Gerasimov, I.V. (1992). The possibility of the formation of an opisthorchiasis focus in the lower reaches of the Angara. *Meditsinskaia parazitologiia i parazitarnye bolezni* 1: 59. (In Russian)