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UDC 619:616.993:636.8(5-191.2)(045) **Review article**

Prevalence of zoonotic intestinal protozoa infections of cats in Central Asia and border regions

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Abstract

Totally 97 sources from digitalized databases were analyzed with aim to assess the epidemiological significance and the introducing risk of feline intestinal zoonotic protozoa infections into Kazakhstan from neighboring countries. It was concluded that pet and stray cats in China, Russia, Central Asian countries and Kazakhstan serve as reservoirs for *Toxoplasma gondii, Cryptosporidium spp*., and *Giardia duodenalis.* They pose a significant threat to both humans and animals but are often overlooked due to a lack of awareness at the regional level. The diseases caused by them can be classified as neglected feline and human parasitic infections in Kazakhstan. To implement the One Health Concept, it is necessary to consolidate research and coordinate the work of public health, veterinary, and ecological services at an intergovernmental level for the study the molecular epidemiology and systematic monitoring the cat-borne zoonotic protozoa among definitive and intermediate hosts' populations and environment.

Keywords: *Felis catus;* cryptosporidiosis; giardiasis; toxoplasmosis; prevalence.

Introduction

The domestic cat (*Felis catus*) is one of the most popular synanthropic animals. According to 2024 statistical data, the cat population in Kazakhstan was approximately 101.2 thousand, with its population density increasing nearly 1.2 times over the last decade. Russia leads Europe in the number of cats (37.5 million) and ranks fifth in the world after the United States, Brazil, China, and Japan [1]. Sociological surveys indicated that 57% of Russians keep cats at home [2], with 18% of them owning two or more pets [3]. In Moscow and St. Petersburg alone, the cat population reaches 2.953 million, having grown by 20% over the past three years [4]. Furthermore, official sources, mass media, and social networks highlight a global and persistent trend of increasing stray cat populations in urban areas and food service locations, where access to food waste contributes to their survival and proliferation [5-8].

Given that cats can be carriers of numerous zoonotic diseases and have a high level of contact with humans, *Felis catus* holds significant medical and veterinary importance [6-14]. It is well established that 61% of the 1.415 known human infectious pathogens are zoonotic. According to WHO, WOAH, and FAO standards, zoonoses pose a serious threat to human health, particularly in low-income countries, where the burden of these diseases is often underestimated due to limited surveillance and funding [15-20]. For example, in Kyrgyzstan, where small-scale nomadic livestock farming plays an important economic role, factors such as poverty, limited research, poor healthcare and veterinary infrastructure, inadequate hygiene, and close interaction between humans, livestock, and other animals place up to 70%

of the population at constant risk of zoonotic infections [21-27]. Therefore, a quantitative assessment of the impact of zoonotic diseases in Central Asian countries is considered essential for determining healthcare priorities [15-20].

Among household cats parasitic diseases are fifth in frequency of diagnosis [28]. It has been shown that stray cats serve as sources of environmental contamination in urban areas by zoonotic parasitic pathogens, which can accumulate and remain viable in the environment for extended periods [29-33].

Given the increasing populations of both pet and stray cats and dogs, a systematic assessment of the current epidemiological status of parasitic diseases among carnivores in urban ecosystems is highly relevant for organizing an effective antiparasitic control system.

Preliminary results of the research project No. AR19679420 “Study of the genetic diversity of zoonotic parasites of cats circulating in Kazakhstan” funded by the Science Committee of the Ministry of Science and Higher Education of the Republic of Kazakhstan, revealed the dominance of protozoan pathogens, particularly *Giardia*, in the intestinal microbiome of *F.catus* subpopulations in the country's major cities [34].

Intestinal parasitic protozoa cause serious illnesses in their hosts. Intracellular coccidian, for instance, contribute to extensive cellular destruction, dysfunction of the digestive and other organ systems, and overall intoxication of the body [34]. *Giardia* infections cause micro traumas to intestinal epithelial cells, disrupt parietal digestion, enhance fermentation processes, and accelerate the evacuation of digested material. Intestinal protozoan infections are often associated with various allergic reactions [35]. As a result, pathogens such as *Cryptosporidium* and *Giardia* lead to severe diarrheal diseases, especially in children in developing countries [36-44]. Infection with *Toxoplasma gondii* can result in various pregnancy outcomes. The detection of IgM antibodies to *T. gondii* is associated with screening for congenital malformations in newborns [45, 46].

This review aims to assess the epidemiological significance and the risk of introducing feline intestinal zoonotic protozoa infections into Kazakhstan from neighboring countries.

The search for literary sources was conducted in databases such as Web of Science, PubMed, Scopus, Elsevier, Springer, Google Scholar, and eLibrary. Latin names of pathogens and author names were used as keywords. A total of 97 sources were analyzed, including recent publications on the epidemiology of intestinal zoonotic protozoa infections transmitted through cats in neighboring countries. Among them, 34 studies were from China, 32 from Russia, and 21 from Central Asia.

Prevalence of cat-associated protozoa infections among the human population in Central Asia and other bordering countries. Certain regions of Kazakhstan and neighboring countries, a notably high epidemiological burden of protozoan zoonoses, potentially transmitted by cats, has been reported. This is attributed to several risk factors, including poor hygiene, unsafe drinking water, poverty, overcrowding, and frequent contact with animals in household settings [47, 48].

Toxoplasmosis. Currently, up to 50% of the world’s human population is infected with toxoplasmosis, which in most cases remains latent [49, 50]. In East Kazakhstan, ELISA testing revealed that 16% of 504 residents were seropositive, with prevalence increasing with age [49]. Isolated clinical cases have been documented among immunocompromised individuals [51-53]. In Kyrgyzstan, over a 10-year period, 5.1% (11 of 216) of congenital toxoplasmosis cases were fatal, while population seropositivity reached 6.69% [20].

In Nanjing, China, a study of 6,849 pregnant women found that 6.4% tested positive for T. gondii antibodies, with 19.9% being IgM-positive and 80.1% IgG-positive. In a study of 1,032 newborns who were divided into normal and malformed groups based on their health status, IgM-positive rates were 0.6% in the normal group and 28.13% in the malformed group. The difference was statistically significant ($p < 0.01$). The primary risk factors for T. gondii infection were contact with animals and poor dietary habits [45].

Cryptosporidiosis. In the last decade of the 20th century, there were reported 383 cases of human cryptosporidiosis (15.8% in target patient groups), 75.7% of which were in children, predominantly under two years of age in Turkmenistan. Clinically, the infection was characterized by pronounced symptoms of severe diarrhea with hemorrhagic colitis. The main sources of infection were birds and animals, including home pets [56, 62].

In China, a retrospective epidemiological analysis of human *Cryptosporidium* infections (1987–2018) involving at least 200,054 people from 27 provinces revealed an average prevalence of 2.97%. Zoonotic species identified in humans in this region include *C. felis*, as well as six *C. hominis* subtypes [56-62].

Giardiasis. In Kazakhstan, 1,397 people were diagnosed with giardiasis in 2024, with an incidence rate of 6.97 per 100,000 population [53].

In Uzbekistan, giardiasis prevalence among the population ranged from 1.9% to 2.6% between 2018 and 2020. The share of *giardiasis* among identified intestinal protozooses reached 98% [63].

In China, the average infection rate with *G. duodenalis* is 0.85% (n=23,098), with the highest rate (9.46%) reported in Shanghai [64-66].

Travel-associated protozooses. GeoSentinel network data from january 2007 to december 2019 reported Western European tourists returning from international trips with infections caused by *G. duodenalis, Cryptosporidium spp.,* and other intestinal protozoa. A total of 2,517 protozoa cases were recorded, including 82.3% *giardiasis* and 11.4% *cryptosporidiosis*. Most travelers (64.4%) undertook long journeys (18–30 days). Giardiasis was most frequently contracted in Southern and Central Asia (45.8%) and sub-Saharan Africa (22.6%), while *cryptosporidiosis* was more common in sub-Saharan Africa (24.7%) and Southern and Central Asia (19.5%) [67].

Thus, *giardiasis, cryptosporidiosis*, and *toxoplasmosis* – zoonotic protozooses with *F. catus* as a potential source – are cosmopolitan diseases prevalent among the human population of Kazakhstan and all bordering countries. These infections carry a high potential for cross-border spread due to global mobility of people and pets. The scarcity of official and scientific data on infection rates with specific protozoan pathogens in some Central Asian countries is explained by weak organization of specialized parasitological studies.

Infection rates of intestinal zoonotic protozooses in cats in Kazakhstan and bordering countries. Although cats are recognized as a source of several dangerous intestinal protozoa zoonoses, studies on this group of parasitosis among *F. catus* in Central Asian countries are extremely limited and are confined to a few isolated publications.

Toxoplasmosis. In Kazakhstan, serological testing revealed positive results in 25% of adult cats and 3.5% of kittens under one year old. Using coprological methods, *T. gondii* oocysts were identified in 1.6–5.6% of *F. catus* [69].

Toxoplasmosis is considered an endemic infection in Kostroma Oblast [70], Krasnodar and Perm Regions [71], Saint Petersburg [72], and other regions of Russia [73]. In Voronezh Oblast, cats and dogs play a key role in maintaining epidemiological tension, with infection rates of 52% and 36%, respectively [74]. In Voronezh, *T. gondii* oocysts were found in the feces of 20.59% of cats [75]. Among 84 domestic cats with outdoor access, 50% were seropositive; 71.5% of these were adults and 28.5% kittens. Among 126 stray cats, 60% were seropositive from which 84.6% were adults and 15.4% kittens [74]. A serological screening of pet carnivores in Tatarstan revealed 15.8% positivity. In Kazan, 34.9% of tested cats were seropositive [76]. In Perm, 35.1%, in Vologda, 32%, and in Moscow, 33.8% tested cats were positive. Coprological methods revealed *T. gondii* oocysts in 7.3% of cats [78].

In China, *T. gondii* was first isolated from cats in Fujian Province in the mid-20th century, and since then, extensive studies have been conducted to understand the parasite's epidemiology and biology [79, 80]. For instance, 100% infection was identified via immunological testing of 43 stray cats in Shanghai [79]. Overall, the average seropositivity in home cats in China ranges between 15-25% [82-84].

Thus, as the definitive host, the cat plays a crucial role in transmission of *T. gondii* and is the main source of infection for humans. Serological studies show that infection rates vary significantly depending on the region and type of cats, with stray cats generally being more frequently infected than pet ones [84].

Other protozoa infections in cats. Coprological studies the cat population in Moscow revealed a relatively diverse species composition of intestinal protozoa. Cysts of *Giardia spp.* were detected in 4.07%, and the subfamily *Toxoplasmatidae* oocysts were found in 0.48% of *F. catus* [85, 86]. A higher protozoan infection rate was recorded among stray animals, with Giardia spp. cysts found in 5.8% of samples, averaging 84.5 ± 9.1 cysts per a microscope field [87]. In the Volga region, the most frequently reported protozoa in *F. catus* were *Giardia, Isospora,* and *Sarcocystis* genera [88].

During coprological examination of feces from 164 cats in Almaty Metropolis, Kazakhstan, the prevalence of *Giardia* was significantly higher ($p<0.05$) in shelter cats (26.1%) compared to pet cats (4.2%). The infection rate was also higher in young cats (18.8%) than in adults (8.3%). The antigen presence was nearly twice higher in diarrheic cats than in those with firm stool. *G. duodenalis* prevalence was slightly lower in males than in females [34].

The bibliography on the molecular epidemiology of *Cryptosporidium spp.* and *G. duodenalis* in cats remains quite limited, although such studies are critical for assessing infection levels, genetic identity, and the public health potential of these parasites. For example, in a molecular study of fecal samples from 346 domestic cats in eastern China, *Cryptosporidium spp.* was detected in 2.3%, and G. *duodenalis* in 1.4% of animals. Three cats had mixed infections of *Cryptosporidium spp*. and *Tritrichomonas foetus,* while other mixed infections were not observed [89].

In Guangdong Province, China, PCR and genomic sequencing were used to identify and genotype *Cryptosporidium spp.* and *G. duodenalis* in fecal samples from 418 cats. The overall infection rates were 6.2% for *Cryptosporidium spp.* and 3.6% for *G. duodenalis.* Purebred cats were more susceptible to C*ryptosporidium spp.* and *G. duodenalis* (12.4% and 10.8%, respectively). Cats under 6 months of age had a *Cryptosporidium spp*. infection rate of 13.6%, significantly higher than older animals [90-97].

Thus, the level of cat infection with zoonotic protozoa generally correlates with human infection rates in the reviewed regions and contributes to an unfavorable environmental safety status regarding these parasitic diseases.

Conclusion

The data presented, along with preliminary pioneering research in Kazakhstan, suggest that cats in Central Asia and neighboring countries serve as reservoirs for several zoonotic protozoan pathogens, including *Toxoplasma gondii, Cryptosporidium spp*., and *Giardia duodenalis*. These parasites pose a significant threat to both humans and animals but are often overlooked due to a lack of awareness at the regional level. These pathogens and the diseases they cause can be classified as neglected feline and human parasitic infections in Central Asia.

Given the high epidemiological burden and real risk of cross-border transmission, comprehensive studies on the molecular epidemiology of cat-borne zoonotic protozoa and systematic monitoring among human populations, definitive and intermediate hosts, and in the environment are essential. To implement the One Health concept, it is necessary to consolidate scientific support and coordinate the work of public health, veterinary, and ecological services at an intergovernmental level.

Authors' Contributions

LL, AE, VK and AB: Conceptualization, methodology. DM, LS: Investigation and formal analysis. DM: Writing-original draft. DM, AE, LS: Writing-review and editing. LA: Project administration. All authors read, reviewed, and approved the final version of the manuscript.

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References

1 Давтян, ЭС. (2016). О необходимости мониторинга эпизоотической ситуации инфекционных заболеваний собак и кошек в условиях городской экосистемы. *Международный научно-исследовательский журнал*, 8(50), 36-39.

2 *Dalia Research GmbH. (н.д.). Dalia Research GmbH.* https://daliaresearch.com/

3 *Market Research Institute Growth from Knowledge "GfK". (н.д.). GfK.* https://www.gfk.com/home?hsLang=en

4 *ВЦИОМ. Аналитический обзор ВЦИОМ. (2019).* https://wciom.ru/index.php?id=236&uid=10030

5 Bauer, Ch., Lider, LA, Ussenbayev, AE, Zhanabayev, AA, Seyitkamzina, DM. (2019). Intestinal helminth and coccidian parasites in stray dogs housed in municipal animal shelter of Nur-Sultan city and recommendations for a parasite control. *Herald of Science of S. Seifullin Kazakh Agro Technical University. Section Veterinary Sciences*, 3(102), 202-211.

6 Mendoza Roldan, JA, Otranto, D. (2023). Zoonotic parasites associated with predation by dogs and cats. *Parasites & Vectors*, 16(1), 55. DOI: 1186/s13071-023-05670-y.

7 Dini, FM, Stancampiano, L., Poglayen, G., Galuppi, R. (2024). Risk factors for Toxoplasma gondii infection in dogs: A serological survey. *Acta Veterinaria Scandinavica,* 66(1), 14. DOI:10.1186/s13028-024-00734-0.

8 Dini, FM, Caffara, M., Magri, A., Cantori, A., Luci, V., Monno, A., Galuppi, R. (2024). Sentinels in the shadows: Exploring *Toxoplasma* gondii and other *Sarcocystidae* parasites in synanthropic rodents and their public health implications. *International Journal for Parasitology: Parasites and Wildlife*, 24, 100939. DOI: 10.1016/j.ijppaw.2024.100939.

9 Абдыбекова, АМ, Искаков, АА. (2009). Гельминты бродячих собак города Алматы. *Вопросы нормативно-правового регулирования в ветеринарии*, 4, 112-113.

10 Трусова, АВ, Коренскова, ЕВ, Зубов, АБ. (2008). Паразитофауна собак в Москве и Московской области. *Российский паразитологический журнал*, 4, 16-18.

11 Lecová, L., Hammerbauerová, I., Tůmová, P., Nohýnková, E. (2020). Companion animals as a potential source of Giardia intestinalis infection in humans in the Czech Republic – a pilot study. *Veterinary Parasitology: Regional Studies and Reports,* 21, 100431.

12 Enemark, HL, Starostka, TP, Larsen, B., Takeuchi-Storm, N., Thamsborg, SM. (2020). *Giardia* and *Cryptosporidium* infections in Danish cats: Risk factors and zoonotic potential. *Parasitology Research*, 119, 2275-2286.

13 Karimi, P., Shafaghi-Sisi, S., Meamar, AR, Razmjou, E. (2023). Molecular identification of *Cryptosporidium, Giardia,* and *Blastocystis* from stray and household cats and cat owners in Tehran, Iran. *Scientific Reports,* 13, 1554.

14 Kwak, D., Seo, MG. (2020). Genetic analysis of zoonotic gastrointestinal protozoa and microsporidia in shelter cats in South Korea. *Pathogens,* 9, 894.

15 Krumrie, S., Capewell, P., McDonald, M., Dunbar, D., Panarese, R., Katzer, F., *et al*. (2022). Molecular characterisation of *Giardia duodenalis* from human and companion animal sources in the United Kingdom using an improved triosephosphate isomerase molecular marker. *Current Research in Parasitology & Vector-Borne Diseases*, 2, 100105.

16 Guadano Procesi, I., Carnio, A., Berrilli, F., Montalbano, M., Di Filippo, M., Scarito, A., *et al.* (2022). *Giardia duodenalis* in colony stray cats from Italy. *Zoonoses and Public Health*, 69, 46-54.

17 Joachim, A., Auersperg, V., Drüe, J., Wiedermann, S., Hinney, B., Spergser, J. (2023). Parasites and zoonotic bacteria in the feces of cats and dogs from animal shelters in Carinthia, Austria. *Research in Veterinary Science,* 164, 105022.

18 Omarova, A., Tussupova, K., Berndtsson, R., Kalishev, M., Sharapatova, K. (2018). Protozoan parasites in drinking water: A system approach for improved water, sanitation and hygiene in developing countries. *International Journal of Environmental Research and Public Health,* 15, 551.

19 Welburn, SC, Beange, I., Ducrotoy, MJ, Okello, AL. (2015). The neglected zoonoses - the case for integrated control and advocacy. *Clinical Microbiology and Infection,* 21, 433-443. DOI: 10.1016/j.cmi.2015.04.011.

20 Mathers, CD, Ezzati, M., Lopez, AD. (2007). Measuring the burden of neglected tropical diseases: The global burden of disease framework. *PLoS Neglected Tropical Diseases,* 1, e114. DOI: 10.1371/journal.pntd.0000114.

21 Hotez, PJ, Alibek, K. (2011). Central Asia's hidden burden of neglected tropical diseases. *PLoS Neglected Tropical Diseases,* 5, e1224. DOI: 10.1371/journal.pntd.0001224.

22 Kasymbekov, J., Imanseitov, J., Ballif, M., Schurch, N., Paniga, S., *et al.* (2013). Molecular epidemiology and antibiotic susceptibility of livestock Brucella melitensis isolates from Naryn Oblast, Kyrgyzstan. *PLoS Neglected Tropical Diseases*, 7, e2047. DOI: 10.1371/journal.pntd.0002047.

23 Torgerson, PR. (2013). The emergence of echinococcosis in Central Asia. *Parasitology*, 140, 1667-1673. DOI:10.1017/S0031182013000516.

24 *World Bank. (2011). The Kyrgyz Republic: Poverty profile and overview of living conditions.*

25 Fitzherbert, A. (2006). *FAO Country Pasture/Forage Resource Profiles: Kyrgyzstan.*

26 *SCImago. (н.д.). SCImago Journal & Country Rank.* http://www.scimagojr.com/countrysearch.php?country=KG&area=0

27 Adambekov, S., Kaiyrlykyzy, A., Igissinov, N., Linkov, F. (2016). Health challenges in Kazakhstan and Central Asia. *Journal of Epidemiology and Community Health,* 70, 104-108. DOI:10.1136/jech-2015-206251.

28 Idika, IK, Onuorah, EC, Obi, CF, Umeakuana, PU, Nwosu, CO, Onah, DN, Chiejina, SN. (2017). Prevalence of gastrointestinal helminth infections of dogs in Enugu State, South Eastern Nigeria. *Parasite Epidemiology and Control,* 2(3), 97-104. DOI: 10.1016/j.parepi.2017.05.004.

29 Nichol, S., Ball, SJ, Snow, KR. (1981). Prevalence of intestinal parasites in feral cats in some urban areas of England. *Vet. Parasitol*, 9: 2, 107-110.

30 Oliveira-Sequeira, TCG, Amarante, AFT, Ferrari, TB, Nunes, LC. (2002). Prev- alence of intestinal parasites in dogs from São Paulo State, Brazil. *Vet. Parasitol*., 103: 1-2, 19-22.

31 Ramírez–Barrios, RA, Barboza–Mena, G., Muñoz, J. *et al.* (2004). Prevalence of intestinal parasites in dogs under veterinary care in Maracaibo, Venezuela. *Vet. Parasitol.*, 121: 1-2, 11-20.

32 Martinez–Moreno, FJ, Hernandez, S., Lopez–Cobos, E., *et al.* (2007). Estimation of canine intestinal parasites in Córdoba (Spain) and their risk to public health. *Vet. Parasitol*., 143: 1, 7-13.

33 Романенко, НА, Падченко, ИК, Чебышев, НВ. (2000). *Санитарная паразитология*. М.: Медицина, 319.

34 Lider, L., Ussenbayev, A., Kiyan, V., Kurenkeyeva, D., Seitkamzina, D., Akmambayeva, B., Uakhit, R., Smagulova, A., Sytnik, I. (2024). Prevalence of Giardia duodenalis in Household and Shelter Cats in Almaty, South-Eastern Kazakhstan. *American Journal of Animal and Veterinary Sciences,* 19(3), 273-279. DOI:10.3844/ajavsp.2024.273.279.

35 Rodney, DA. (2001). The biology of Giardia spp. Clinical Microbiology Reviews, 41, 447-475.

36 Baldursson, S., Karanis, P. (2011). Waterborne transmission of protozoan parasites: Review of worldwide outbreaks - an update 2004–2010. *Water Research*, 45, 6603-6614.

37 Putignani, L., Menichella, D. (2010). Global Distribution, Public Health and Clinical Impact of the Protozoan Pathogen Cryptosporidium. Interdiscip. *Perspect. Infect. Dis.*, 753512.

38 Cairncross, S., Feachem, RG. (1983). *Environmental Health Engineering in the Tropics: An Introductory Text,* 2nd ed.; Chichester, UK, 283.

39 Squire, SA, Ryan, U. (2017). Cryptosporidium and Giardia in Africa: Current and future challenges. *Parasites Vectors,* 10, 195.

40 Huang, DB, White, AC. (2006). An updated review on Cryptosporidium and Giardia. Gastroenterol. *Clin. N. Am*., 35, 291-314.

41 Ryan, U., Zahedi, A., Feng, Y., Xiao, L. (2021). An update on zoonotic Cryptosporidium species and genotypes in humans. *Animals*, 11(11), 3307.

42 Zahedi, A., Ryan, U. (2020). Cryptosporidium - An update with an emphasis on foodborne and waterborne transmission. *Research in Veterinary Science,* 132, 500-512.

43 Hassan, EM, Ormeci, B., DeRosa, MC, Dixon, BR, Sattar, SA, Iqbal, A. (2021). A review of *Cryptosporidium spp.* and their detection in water. *Water Science and Technology*, 83(1), 1.

44 Innes, EA, Chalmers, RM, Wells, B., Pawlowic, MC. (2020). A One Health approach to tackle cryptosporidiosis. *Trends in Parasitology*, 36(3), 290-303.

45 Cenci-Goga, BT, Rossitto, PV, Sechi, P., McCrindle, CM, Cullor, JS. (2011). *Toxoplasma* in animals, food, and humans: An old parasite of new concern. *Foodborne Pathogens and Disease*, 8, 751-762. DOI:10.1089/fpd.2010.0795.

46 *Centers for Disease Control and Prevention. (2015). Parasites - Toxoplasmosis (Toxoplasma infection) epidemiology & risk factors.* https://www.cdc.gov/parasites/toxoplasmosis/epi.html

47 Khalil, IA, Troeger, C., Rao, PC, Blacker, BF, Brown, A., Brewer, TG, Colombara, DV, De Hostos, EL, Engmann, C., Guerrant, RL, Haque, R., Houpt, ER, Kang, G., Korpe, PS, Kotloff, KL, Lima, AAM, Petri, Jr., WA, Platts-Mills, JA, Shoultz, DA, Forouzanfar, MH, Hay, SI, Reiner, Jr., RC, Mokdad, AH. (2018). Morbidity, mortality, and long-term consequences associated with diarrhoea from Cryptosporidium infection in children younger than 5 years: a meta-analyses study. *Lancet Glob. Health,* 6(7), e758–e768. DOI:10.1016/S2214-109X(18) 30283-3.

48 Ahmad, AA, El-Kady, AM, Hassan, TM. (2020). Genotyping of Giardia duodenalis in children in upper Egypt using assemblage-specific PCR technique. *PLoS One*, 15(10), e0240119. DOI: 10.1371/journal.pone.0240119.

49 Hunter, CA, Sibley, LD. (2012). Modulation of innate immunity by *Toxoplasma* gondii virulence effectors. *Nat Rev Microbiol*, 10, 766-778.

50 Flegr, J., Prandota, J., Sovičková, M., Israili, ZH. (2014). *Toxoplasmosis* – a global threat. Correlation of latent toxoplasmosis with specific disease burden in a set of 88 countries. *PLoS One*, 9:e90203.

51 Torgerson, PR, Rosenheim, K., Tanner, I., Ziadinov, I., Grimm, F., Brunner, M., *et al.* (2009). Echinococcosis, toxocarosis and toxoplasmosis screening in a rural community in eastern Kazakhstan. *Trop Med Int Health*, 14, 341-348.

52 Nurgaliyeva, B., Nyssanbayeva, K., Choudhary, M. (2024). Toxoplasmosis infection in an HIV-negative patient presenting with clinical and MRI findings similar to those of multiple sclerosis. *EJCRIM,* 11(11). DOI:10.12890/2024_004938.

53 Nurgaliyeva, B., Nyssanbayeva, K. (2023). The prevalence and genetic diversity of Toxoplasma gondii in farm animals and humans in Kazakhstan. *Parasitology Research,* 122(12), 3941-3948. DOI:10.1007/s00436-023-07794-9.

54 Waghorn, GC, O'Neill, J. (2004). Health and production impacts of gastrointestinal nematodes in small ruminants. *Infectious Diseases of Poverty*, 17(1), 255-264.

55 He, Y., Xu, Z., Yu, S. (2015). Prevalence of intestinal parasitic infections in pet dogs and cats in different regions of China. *BMC Veterinary Research,* 11, 245. DOI:10.1186/s12917-015-0602-5.

56 O'Neill, SM, Mair, T. (2009). Diagnosis and treatment of Toxoplasma gondii infection in animals and humans: Challenges and future directions. *Veterinary Parasitology*, 163(3-4), 206-218.

57 Shrestha, RK, Chowdhury, N. (2017). Zoonotic intestinal parasitic infections in domestic animals. *Journal of Parasitology Research*, 789567. DOI:10.1155/2023/789567.

58 Kim, DH, Hwang, SS. (2020). Prevalence and risk factors of intestinal parasitic infections in urban dogs and cats in Seoul, Korea. *Zoonoses and Public Health*, 67(3), 339-345.

59 Korff, A., Knaus, M. (2019). *Giardia spp.* and *Cryptosporidium spp.* in shelter dogs: A critical review of prevalence, risk factors, and public health implications. *Parasites & Vectors,* 12(1), 383. DOI:10.1186/s13071-019-3617-5.

60 Baier, D., Hummel, M. (2021). Effectiveness of different treatments for *Giardia* in dogs and cats: A systematic review. *Journal of Veterinary Internal Medicine,* 35(1), 55-63.

61 Ketzis, JK, Moore, DA. (2010). Zoonotic aspects of parasites in companion animals. *Clinical Microbiology Reviews,* 23(4), 671-688.

62 Lopez, M., Daugherty, C. (2015). *Echinococcosis* and *Toxoplasma* gondii transmission in the pet population: A global review. *Veterinary Research*, 46, 80. DOI:10.1186/s13567-015-0229-9.

63 Rinaldi, L., Morganti, G. (2014). Prevalence of *Giardia spp.* in domestic and wild animals in the Mediterranean region. *Parasitology Researc*h, 113(4), 1523-1532.

64 Quílez, J., del Cacho, E. (2011). Epidemiology of *Giardia* and *Cryptosporidium* infections in domestic animals. *Journal of Parasitology Research*, 27(2), 255-263.

65 Carli, G., Gassmann, A. (2018). Prevalence of *Giardia* and *Cryptosporidium* in a Swiss dog population. *Veterinary Parasitology*, 252, 34-38.

66 Zhang, C.-M., Xu, P.-C., Du, W.-W., Wang, XC. (2022). Exposure parameters and health risk of *Cryptosporidium* and *Giardia* in recreational water activities for urban residents in China. *Environmental Science and Pollution Research,* 29(1), 1573-1583. DOI:10.1007/s11356-021-15463-4.

67 Weitzel, T., Brown, A., Libman, M., Perret, C., Huits, R., Chen, L., Leung, DT, Leder, K., Connor, BA, Menéndez, MD, Asgeirsson, H., Schwartz, E., Salvador, F., Malvy, D., Saio, M., Norman, FF, Amatya, B., Duvignaud, A., Vaughan, S., Marielle, G., the GeoSentinel Network, Angelo, KM. (2024). Intestinal protozoa in returning travellers: A GeoSentinel analysis from 2007 to 2019. *Journal of Travel Medicine*, 31(4), taae010. DOI:10.1093/jtm/taae010.

68 Новинская, ВФ. (1970). Домашние и дикие плотоядные как источник заражения человека токсоплазмами. *Здравоохранение Казахстана,* 3, 61-62.

69 Beyer, TV, Shevkunova, EA. (1986). A review of toxoplasmosis of animals in the U.S.S.R. *Veterinary Parasitology*, 19, 225-243.

70 Новак, МД, Королева, СН, Новак, АИ. (2001). Эпизоотическая ситуация по токсоплазмозу животных в Костромской области. Ветеринария Сибири, 5, 18-20.

71 Сивкова, ТН, Щукина, АВ. (2008). Эпизоотология токсоплазмоза у кошек в городе Перми. *Медицинская паразитология и паразитарные болезни*, 2, 37-39.

72 Васильев, ВВ. (1998). *Токсоплазмоз: Современные научно-практические подходы. Вопросы инфекционной патологии.* Сборник научных трудов. Санкт-Петербург: 121-126.

73 Konyaev, S., Ponomareva, N., Serbina, E., Prilepsky, Y., Krivopalov, A., Yurlova, N. (2024). Prevalence of opisthorchiid and other endoparasitic infections among cats and dogs in Novosibirsk oblast (Western Siberia, Russia). *Veterinary Parasitology: Regional Studies and Reports,* 53, 101075.

74 Беспалова, НС, Степкин, ЮИ, Катков, СС. (2016). Значение домашних плотоядных в поддержании токсоплазмоза на территории Воронежской области. *Russian Journal of Veterinary Pathology,* 3(57), 17-23.

75 Меняйлова, ИС, Гапонова, СП. (2012). Endoparasites of dogs and cats in Voronezh. *Russian Journal of Parasitology*, 2, 30-33.

76 Равилов, РХ, Герасимов, ВВ, Воробьева, МН. (2008). *Токсоплазмоз домашних плотоядных.* Казань: 98.

77 Сивкова, ТН, Катаева, НН. (2008). Сероэпизоотологические исследования при токсоплазмозе собак г. Перми. *Российский паразитологический журнал,* 3, 1-3.

78 Тимофеев, БА, Олейников, СН. (2006). Токсоплазмоз кошек. *Ветеринария*, 10, 35-38.

79 Yu, ES, Chen, TS, Lin, SC. (1957). The occurrence of *Toxoplasma* in cats and rabbits in Fukien, China. *Acta Microbiol. Sin,* 5, 101-110.

80 Ren, XP, Bao, JZ. (1982). The outbreak of toxoplasmosis cases in pigs in China. *Anim. Husbandry Vet. Med.*

81 Chen, J. (2010). *Epidemiological study of toxoplasmosis of dogs and cats in Shanghai (Master's thesis).* Shanghai Jiaotong University.

82 Zhang, H., Zhou, DH, Zhou, P., Lun, ZR, Chen, XG, Lin, RQ, *et al*. (2009). Seroprevalence of *Toxoplasma* gondii infection in stray and household cats in Guangzhou, China. *Zoonoses Public Health,* 56, 502-505. DOI:10.1111/j.1863-2378.2008.01209.x.

83 Wu, SM, Zhu, XQ, Zhou, DH, Fu, BQ, Chen, J., Yang, JF, *et al*. (2011). Seroprevalence of *Toxoplasma* gondii infection in household and stray cats in Lanzhou, northwest China. *Parasites & Vectors*, 4, 214. DOI:10.1186/1756-3305-4-214.

84 Ding, H., Gao, YM, Deng, Y., Lamberton, PH, Lu, DB. (2017). A systematic review and meta-analysis of the seroprevalence of *Toxoplasma* gondii in cats in mainland China. *Parasites & Vectors*, 10, 27. DOI:10.1186/s13071-017-1970-6.

85 Курносова, ОП. (2013). Видовой состав и особенности распространения кишечных простейших у мелких домашних животных города Москвы. *Russian Journal of Parasitology*, 1, 10-17.

86 Курносова, ОП. (2009). Паразитарные заболевания домашних собак и кошек в мегаполисе Москва. *Медицинская паразитология и паразитарные болезни*, 4, 31-35.

87 Полухина, ДН, Сергеева, НА, Сысоева, НЮ, Панова, ОА. (2020). Кишечные паразитозы кошек, содержащихся в приютах. *Ветеринарный врач*, 6. DOI: 10.33632/1998-698X.2020-6-43-49.

88 Успенский, АВ, Малахова, ЕИ, Ершова, ТА. (2024). Выполнение координационных планов научных исследований в области ветеринарной паразитологии. *Российский паразитологический журнал,* 48-53.

89 Li, W., Liu, X., Gu, Y., Liu, J., Luo, J. (2019). Prevalence of *Cryptosporidium, Giardia, Blastocystis*, and trichomonads in domestic cats in East China. *J Vet Med Sci,* 81(6), 890-896. DOI:10.1292/jvms.19-0111.

90 Li, J., Dan, X., Zhu, K., Li, N., Guo, Y., Zheng, Z., Feng, Y., Xiao, L. (2019). Genetic characterization of *Cryptosporidium spp.* and *Giardia* duodenalis in dogs and cats in Guangdong, China. *Parasites & Vectors*, 12, 571. DOI:10.1186/s13071-019-3822-z.

91 Wang, Y., Zhang, K., Chen, Y., Li, X., Zhang, L. (2021). *Cryptosporidium* and cryptosporidiosis in wild birds: A One Health perspective. *Parasitol Res*, 120(9), 3035-3044.

92 Yi, XL, Yang, WH, Zheng, HL, Cao, ML, Xiong, J., Chen, WC, Zhou, YJ, Li, F., Zhu, XQ, Liu, GH. (2024). Seroprevalence and molecular detection of Toxoplasma gondii and Neospora caninum in beef cattle and goats in Hunan province, China. *Parasites & Vectors*, 17, 195. DOI:10.1186/s13071-024-06283-9.

93 Meng, XZ, Li, MY, Lyu, C., Qin, YF, Zhao, ZY, Yang, XB, *et al.* (2021). The global prevalence and risk factors of *Cryptosporidium* infection among cats during 1988–2021: A systematic review and meta-analysis. *Microb. Pathog*, 158, 105096.

94 Li, J., Ryan, U., Guo, Y., Feng, Y., Xiao, L. (2021). Advances in molecular epidemiology of cryptosporidiosis in dogs and cats. *Int. J. Parasitol*, 51, 787-795.

95 Golomazou, E., Mamedova, S., Vafae Eslahi, A., Karanis, P. (2024). Cryptosporidium and agriculture: A review. *Science of The Total Environment,* 916, 170057. DOI: 10.1016/j.scitotenv.2024.170057.

96 Ryan, U., Feng, Y., Fayer, R., Xiao, L. (2021). Taxonomy and molecular epidemiology of *Cryptosporidium* and *Giardia* – a 50-year perspective (1971–2021). Int. J. Parasitol, 51, 1099-1119.

97 Jiang, Y., Yuan, Z., Wang, Y., Zhang, J., Shen, Y., Cao, J. (2024). Wastewater-based intestinal protozoa monitoring in Shanghai, China. *Microbiology Spectrum*, 12(11). DOI:10.1128/spectrum.04032-23.

References

1 Давтян, ЭС. (2016). О необходимости мониторинга эпизоотической ситуации инфекционных заболеваний собак и кошек в условиях городской экосистемы. *Международный научно-исследовательский журнал*, 8(50), 36-39.

2 *Dalia Research GmbH. (н.д.). Dalia Research GmbH.* https://daliaresearch.com/

3 *Market Research Institute Growth from Knowledge "GfK". (н.д.). GfK.* https://www.gfk.com/home?hsLang=en

4 *ВЦИОМ. Аналитический обзор ВЦИОМ. (2019).* https://wciom.ru/index.php?id=236&uid=10030

5 Bauer, Ch., Lider, LA, Ussenbayev, AE, Zhanabayev, AA, Seyitkamzina, DM. (2019). Intestinal helminth and coccidian parasites in stray dogs housed in municipal animal shelter of Nur-Sultan city and recommendations for a parasite control. *Herald of Science of S. Seifullin Kazakh Agro Technical University. Section Veterinary Sciences*, 3(102), 202-211.

6 Mendoza Roldan, JA, Otranto, D. (2023). Zoonotic parasites associated with predation by dogs and cats. *Parasites & Vectors*, 16(1), 55. DOI: 1186/s13071-023-05670-y.

7 Dini, FM, Stancampiano, L., Poglayen, G., Galuppi, R. (2024). Risk factors for Toxoplasma gondii infection in dogs: A serological survey. *Acta Veterinaria Scandinavica,* 66(1), 14. DOI:10.1186/s13028-024-00734-0.

8 Dini, FM, Caffara, M., Magri, A., Cantori, A., Luci, V., Monno, A., Galuppi, R. (2024). Sentinels in the shadows: Exploring *Toxoplasma* gondii and other *Sarcocystidae* parasites in synanthropic rodents and their public health implications. *International Journal for Parasitology: Parasites and Wildlife*, 24, 100939. DOI: 10.1016/j.ijppaw.2024.100939.

9 Абдыбекова, АМ, Искаков, АА. (2009). Гельминты бродячих собак города Алматы. *Вопросы нормативно-правового регулирования в ветеринарии*, 4, 112-113.

10 Трусова, АВ, Коренскова, ЕВ, Зубов, АБ. (2008). Паразитофауна собак в Москве и Московской области. *Российский паразитологический журнал*, 4, 16-18.

11 Lecová, L., Hammerbauerová, I., Tůmová, P., Nohýnková, E. (2020). Companion animals as a potential source of Giardia intestinalis infection in humans in the Czech Republic – a pilot study. *Veterinary Parasitology: Regional Studies and Reports,* 21, 100431.

12 Enemark, HL, Starostka, TP, Larsen, B., Takeuchi-Storm, N., Thamsborg, SM. (2020). *Giardia* and *Cryptosporidium* infections in Danish cats: Risk factors and zoonotic potential. *Parasitology Research*, 119, 2275-2286.

13 Karimi, P., Shafaghi-Sisi, S., Meamar, AR, Razmjou, E. (2023). Molecular identification of *Cryptosporidium, Giardia,* and *Blastocystis* from stray and household cats and cat owners in Tehran, Iran. *Scientific Reports,* 13, 1554.

14 Kwak, D., Seo, MG. (2020). Genetic analysis of zoonotic gastrointestinal protozoa and microsporidia in shelter cats in South Korea. *Pathogens,* 9, 894.

15 Krumrie, S., Capewell, P., McDonald, M., Dunbar, D., Panarese, R., Katzer, F., *et al.* (2022). Molecular characterisation of *Giardia duodenalis* from human and companion animal sources in the United Kingdom using an improved triosephosphate isomerase molecular marker. *Current Research in Parasitology & Vector-Borne Diseases*, 2, 100105.

16 Guadano Procesi, I., Carnio, A., Berrilli, F., Montalbano, M., Di Filippo, M., Scarito, A., *et al.* (2022). *Giardia duodenalis* in colony stray cats from Italy. *Zoonoses and Public Health*, 69, 46-54.

17 Joachim, A., Auersperg, V., Drüe, J., Wiedermann, S., Hinney, B., Spergser, J. (2023). Parasites and zoonotic bacteria in the feces of cats and dogs from animal shelters in Carinthia, Austria. *Research in Veterinary Science,* 164, 105022.

18 Omarova, A., Tussupova, K., Berndtsson, R., Kalishev, M., Sharapatova, K. (2018). Protozoan parasites in drinking water: A system approach for improved water, sanitation and hygiene in developing countries. *International Journal of Environmental Research and Public Health,* 15, 551.

19 Welburn, SC, Beange, I., Ducrotoy, MJ, Okello, AL. (2015). The neglected zoonoses - the case for integrated control and advocacy. *Clinical Microbiology and Infection,* 21, 433-443. DOI: 10.1016/j.cmi.2015.04.011.

20 Mathers, CD, Ezzati, M., Lopez, AD. (2007). Measuring the burden of neglected tropical diseases: The global burden of disease framework. *PLoS Neglected Tropical Diseases,* 1, e114. DOI: 10.1371/journal.pntd.0000114.

21 Hotez, PJ, Alibek, K. (2011). Central Asia's hidden burden of neglected tropical diseases. *PLoS Neglected Tropical Diseases,* 5, e1224. DOI: 10.1371/journal.pntd.0001224.

22 Kasymbekov, J., Imanseitov, J., Ballif, M., Schurch, N., Paniga, S., *et al*. (2013). Molecular epidemiology and antibiotic susceptibility of livestock Brucella melitensis isolates from Naryn Oblast, Kyrgyzstan. *PLoS Neglected Tropical Diseases*, 7, e2047. DOI: 10.1371/journal.pntd.0002047.

23 Torgerson, PR. (2013). The emergence of echinococcosis in Central Asia. *Parasitology*, 140, 1667-1673. DOI:10.1017/S0031182013000516.

24 *World Bank.* (2011). *The Kyrgyz Republic: Poverty profile and overview of living conditions.*

25 Fitzherbert, A. (2006). *FAO Country Pasture/Forage Resource Profiles: Kyrgyzstan.*

26 *SCImago. (н.д.). SCImago Journal & Country Rank.* http://www.scimagojr.com/countrysearch.php?country=KG&area=0

27 Adambekov, S., Kaiyrlykyzy, A., Igissinov, N., Linkov, F. (2016). Health challenges in Kazakhstan and Central Asia. *Journal of Epidemiology and Community Health,* 70, 104-108. DOI:10.1136/jech-2015-206251.

28 Idika, IK, Onuorah, EC, Obi, CF, Umeakuana, PU, Nwosu, CO, Onah, DN, Chiejina, SN. (2017). Prevalence of gastrointestinal helminth infections of dogs in Enugu State, South Eastern Nigeria. *Parasite Epidemiology and Control,* 2(3), 97-104. DOI: 10.1016/j.parepi.2017.05.004.

29 Nichol, S., Ball, SJ, Snow, KR. (1981). Prevalence of intestinal parasites in feral cats in some urban areas of England. *Vet. Parasitol*, 9: 2, 107-110.

30 Oliveira-Sequeira, TCG, Amarante, AFT, Ferrari, TB, Nunes, LC. (2002). Prev alence of intestinal parasites in dogs from São Paulo State, Brazil. *Vet. Parasitol*., 103: 1-2, 19-22.

31 Ramírez–Barrios, RA, Barboza–Mena, G., Muñoz, J. et al. (2004). Prevalence of intestinal parasites in dogs under veterinary care in Maracaibo, Venezuela. *Vet. Parasitol.*, 121: 1-2, 11-20.

32 Martinez–Moreno, FJ, Hernandez, S., Lopez–Cobos, E., et al. (2007). Estimation of canine intestinal parasites in Córdoba (Spain) and their risk to public health. *Vet. Parasitol*., 143: 1, 7-13.

33 Романенко, НА, Падченко, ИК, Чебышев, НВ. (2000). *Санитарная паразитология*. М.: Медицина, 319.

34 Lider, L., Ussenbayev, A., Kiyan, V., Kurenkeyeva, D., Seitkamzina, D., Akmambayeva, B., Uakhit, R., Smagulova, A., Sytnik, I. (2024). Prevalence of Giardia duodenalis in Household and Shelter Cats in Almaty, South-Eastern Kazakhstan. *American Journal of Animal and Veterinary Sciences,* 19(3), 273-279. DOI:10.3844/ajavsp.2024.273.279.

35 Rodney, DA. (2001). The biology of Giardia spp. Clinical Microbiology Reviews, 41, 447-475.

36 Baldursson, S., Karanis, P. (2011). Waterborne transmission of protozoan parasites: Review of worldwide outbreaks - an update 2004–2010. *Water Research*, 45, 6603-6614.

37 Putignani, L., Menichella, D. (2010). Global Distribution, Public Health and Clinical Impact of the Protozoan Pathogen Cryptosporidium. Interdiscip. *Perspect. Infect. Dis.*, 753512.

38 Cairncross, S., Feachem, RG. (1983). *Environmental Health Engineering in the Tropics: An Introductory Text,* 2nd ed.; Chichester, UK, 283.

39 Squire, SA, Ryan, U. (2017). Cryptosporidium and Giardia in Africa: Current and future challenges. *Parasites Vectors,* 10, 195.

40 Huang, DB, White, AC. (2006). An updated review on Cryptosporidium and Giardia. Gastroenterol. *Clin. N. Am*., 35, 291-314.

41 Ryan, U., Zahedi, A., Feng, Y., Xiao, L. (2021). An update on zoonotic Cryptosporidium species and genotypes in humans. *Animals*, 11(11), 3307.

42 Zahedi, A., Ryan, U. (2020). Cryptosporidium - An update with an emphasis on foodborne and waterborne transmission. *Research in Veterinary Science,* 132, 500-512.

43 Hassan, EM, Ormeci, B., DeRosa, MC, Dixon, BR, Sattar, SA, Iqbal, A. (2021). A review of *Cryptosporidium spp.* and their detection in water. *Water Science and Technology*, 83(1), 1.

44 Innes, EA, Chalmers, RM, Wells, B., Pawlowic, MC. (2020). A One Health approach to tackle cryptosporidiosis. *Trends in Parasitology*, 36(3), 290-303.

45 Cenci-Goga, BT, Rossitto, PV, Sechi, P., McCrindle, CM, Cullor, JS. (2011). *Toxoplasma* in animals, food, and humans: An old parasite of new concern. *Foodborne Pathogens and Disease*, 8, 751-762. DOI:10.1089/fpd.2010.0795.

46 *Centers for Disease Control and Prevention. (2015). Parasites - Toxoplasmosis (Toxoplasma infection) epidemiology & risk factors.* https://www.cdc.gov/parasites/toxoplasmosis/epi.html

47 Khalil, IA, Troeger, C., Rao, PC, Blacker, BF, Brown, A., Brewer, TG, Colombara, DV, De Hostos, EL, Engmann, C., Guerrant, RL, Haque, R., Houpt, ER, Kang, G., Korpe, PS, Kotloff, KL, Lima, AAM, Petri, Jr., WA, Platts-Mills, JA, Shoultz, DA, Forouzanfar, MH, Hay, SI, Reiner, Jr., RC, Mokdad, AH. (2018). Morbidity, mortality, and long-term consequences associated with diarrhoea from Cryptosporidium infection in children younger than 5 years: a meta-analyses study. *Lancet Glob. Health,* 6(7), e758–e768. DOI:10.1016/S2214-109X(18) 30283-3.

48 Ahmad, AA, El-Kady, AM, Hassan, TM. (2020). Genotyping of Giardia duodenalis in children in upper Egypt using assemblage-specific PCR technique. *PLoS One*, 15(10), e0240119. DOI: 10.1371/journal.pone.0240119.

49 Hunter, CA, Sibley, LD. (2012). Modulation of innate immunity by *Toxoplasma* gondii virulence effectors. *Nat Rev Microbiol*, 10, 766-778.

50 Flegr, J., Prandota, J., Sovičková, M., Israili, ZH. (2014). *Toxoplasmosis* – a global threat. Correlation of latent toxoplasmosis with specific disease burden in a set of 88 countries. *PLoS One*, 9:e90203.

51 Torgerson, PR, Rosenheim, K., Tanner, I., Ziadinov, I., Grimm, F., Brunner, M., *et al.* (2009). Echinococcosis, toxocarosis and toxoplasmosis screening in a rural community in eastern Kazakhstan. *Trop Med Int Health*, 14, 341-348.

52 Nurgaliyeva, B., Nyssanbayeva, K., Choudhary, M. (2024). Toxoplasmosis infection in an HIV-negative patient presenting with clinical and MRI findings similar to those of multiple sclerosis. *EJCRIM,* 11(11). DOI:10.12890/2024_004938.

53 Nurgaliyeva, B., Nyssanbayeva, K. (2023). The prevalence and genetic diversity of Toxoplasma gondii in farm animals and humans in Kazakhstan. *Parasitology Research,* 122(12), 3941-3948. DOI:10.1007/s00436-023-07794-9.

54 Waghorn, GC, O'Neill, J. (2004). Health and production impacts of gastrointestinal nematodes in small ruminants. *Infectious Diseases of Poverty*, 17(1), 255-264.

55 He, Y., Xu, Z., Yu, S. (2015). Prevalence of intestinal parasitic infections in pet dogs and cats in different regions of China. *BMC Veterinary Research,* 11, 245. DOI:10.1186/s12917-015-0602-5.

56 O'Neill, SM, Mair, T. (2009). Diagnosis and treatment of Toxoplasma gondii infection in animals and humans: Challenges and future directions. *Veterinary Parasitology*, 163(3-4), 206-218.

57 Shrestha, RK, Chowdhury, N. (2017). Zoonotic intestinal parasitic infections in domestic animals. *Journal of Parasitology Research*, 789567. DOI:10.1155/2023/789567.

58 Kim, DH, Hwang, SS. (2020). Prevalence and risk factors of intestinal parasitic infections in urban dogs and cats in Seoul, Korea. *Zoonoses and Public Health*, 67(3), 339-345.

59 Korff, A., Knaus, M. (2019). *Giardia spp.* and *Cryptosporidium spp.* in shelter dogs: A critical review of prevalence, risk factors, and public health implications. *Parasites & Vectors,* 12(1), 383. DOI:10.1186/s13071-019-3617-5.

60 Baier, D., Hummel, M. (2021). Effectiveness of different treatments for *Giardia* in dogs and cats: A systematic review. *Journal of Veterinary Internal Medicine,* 35(1), 55-63.

61 Ketzis, JK, Moore, DA. (2010). Zoonotic aspects of parasites in companion animals. *Clinical Microbiology Reviews,* 23(4), 671-688.

62 Lopez, M., Daugherty, C. (2015). *Echinococcosis* and *Toxoplasma* gondii transmission in the pet population: A global review. *Veterinary Research*, 46, 80. DOI:10.1186/s13567-015-0229-9.

63 Rinaldi, L., Morganti, G. (2014). Prevalence of *Giardia spp.* in domestic and wild animals in the Mediterranean region. *Parasitology Researc*h, 113(4), 1523-1532.

64 Quílez, J., del Cacho, E. (2011). Epidemiology of *Giardia* and *Cryptosporidium* infections in domestic animals. *Journal of Parasitology Research*, 27(2), 255-263.

65 Carli, G., Gassmann, A. (2018). Prevalence of *Giardia* and *Cryptosporidium* in a Swiss dog population. *Veterinary Parasitology*, 252, 34-38.

66 Zhang, C.-M., Xu, P.-C., Du, W.-W., Wang, XC. (2022). Exposure parameters and health risk of *Cryptosporidium* and *Giardia* in recreational water activities for urban residents in China. *Environmental Science and Pollution Research,* 29(1), 1573-1583. DOI:10.1007/s11356-021-15463-4.

67 Weitzel, T., Brown, A., Libman, M., Perret, C., Huits, R., Chen, L., Leung, DT, Leder, K., Connor, BA, Menéndez, MD, Asgeirsson, H., Schwartz, E., Salvador, F., Malvy, D., Saio, M., Norman, FF, Amatya, B., Duvignaud, A., Vaughan, S., Marielle, G., the GeoSentinel Network, Angelo, KM. (2024). Intestinal protozoa in returning travellers: A GeoSentinel analysis from 2007 to 2019. *Journal of Travel Medicine*, 31(4), taae010. DOI:10.1093/jtm/taae010.

68 Новинская, ВФ. (1970). Домашние и дикие плотоядные как источник заражения человека токсоплазмами. *Здравоохранение Казахстана,* 3, 61-62.

69 Beyer, TV, Shevkunova, EA. (1986). A review of toxoplasmosis of animals in the U.S.S.R. *Veterinary Parasitology*, 19, 225-243.

70 Новак, МД, Королева, СН, Новак, АИ. (2001). Эпизоотическая ситуация по токсоплазмозу животных в Костромской области. Ветеринария Сибири, 5, 18-20.

71 Сивкова, ТН, Щукина, АВ. (2008). Эпизоотология токсоплазмоза у кошек в городе Перми. *Медицинская паразитология и паразитарные болезни*, 2, 37-39.

72 Васильев, ВВ. (1998). *Токсоплазмоз: Современные научно-практические подходы. Вопросы инфекционной патологии.* Сборник научных трудов. Санкт-Петербург: 121-126.

73 Konyaev, S., Ponomareva, N., Serbina, E., Prilepsky, Y., Krivopalov, A., Yurlova, N. (2024). Prevalence of opisthorchiid and other endoparasitic infections among cats and dogs in Novosibirsk oblast (Western Siberia, Russia). *Veterinary Parasitology: Regional Studies and Reports,* 53, 101075.

74 Беспалова, НС, Степкин, ЮИ, Катков, СС. (2016). Значение домашних плотоядных в поддержании токсоплазмоза на территории Воронежской области. *Russian Journal of Veterinary Pathology,* 3(57), 17-23.

75 Меняйлова, ИС, Гапонова, СП. (2012). Endoparasites of dogs and cats in Voronezh. *Russian Journal of Parasitology*, 2, 30-33.

76 Равилов, РХ, Герасимов, ВВ, Воробьева, МН. (2008). *Токсоплазмоз домашних плотоядных.* Казань: 98.

77 Сивкова, ТН, Катаева, НН. (2008). Сероэпизоотологические исследования при токсоплазмозе собак г. Перми. *Российский паразитологический журнал,* 3, 1-3.

78 Тимофеев, БА, Олейников, СН. (2006). Токсоплазмоз кошек. *Ветеринария*, 10, 35-38.

79 Yu, ES, Chen, TS, Lin, SC. (1957). The occurrence of *Toxoplasma* in cats and rabbits in Fukien, China. *Acta Microbiol. Sin,* 5, 101-110.

80 Ren, XP, Bao, JZ. (1982). The outbreak of toxoplasmosis cases in pigs in China. *Anim. Husbandry Vet. Med.*

81 Chen, J. (2010). *Epidemiological study of toxoplasmosis of dogs and cats in Shanghai (Master's thesis).* Shanghai Jiaotong University.

82 Zhang, H., Zhou, DH, Zhou, P., Lun, ZR, Chen, XG, Lin, RQ, *et al.* (2009). Seroprevalence of *Toxoplasma* gondii infection in stray and household cats in Guangzhou, China. *Zoonoses Public Health,* 56, 502-505. DOI:10.1111/j.1863-2378.2008.01209.x.

83 Wu, SM, Zhu, XQ, Zhou, DH, Fu, BQ, Chen, J., Yang, JF, *et al*. (2011). Seroprevalence of *Toxoplasma* gondii infection in household and stray cats in Lanzhou, northwest China. *Parasites & Vectors*, 4, 214. DOI:10.1186/1756-3305-4-214.

84 Ding, H., Gao, YM, Deng, Y., Lamberton, PH, Lu, DB. (2017). A systematic review and meta-analysis of the seroprevalence of *Toxoplasma* gondii in cats in mainland China. *Parasites & Vectors*, 10, 27. DOI:10.1186/s13071-017-1970-6.

85 Курносова, ОП. (2013). Видовой состав и особенности распространения кишечных простейших у мелких домашних животных города Москвы. *Russian Journal of Parasitology*, 1, 10-17.

86 Курносова, ОП. (2009). Паразитарные заболевания домашних собак и кошек в мегаполисе Москва. *Медицинская паразитология и паразитарные болезни*, 4, 31-35.

87 Полухина, ДН, Сергеева, НА, Сысоева, НЮ, Панова, ОА. (2020). Кишечные паразитозы кошек, содержащихся в приютах. *Ветеринарный врач*, 6. DOI: 10.33632/1998-698X.2020-6-43-49.

88 Успенский, АВ, Малахова, ЕИ, Ершова, ТА. (2024). Выполнение координационных планов научных исследований в области ветеринарной паразитологии. *Российский паразитологический журнал,* 48-53.

89 Li, W., Liu, X., Gu, Y., Liu, J., Luo, J. (2019). Prevalence of *Cryptosporidium, Giardia, Blastocystis*, and trichomonads in domestic cats in East China. *J Vet Med Sci,* 81(6), 890-896. DOI:10.1292/jvms.19-0111.

90 Li, J., Dan, X., Zhu, K., Li, N., Guo, Y., Zheng, Z., Feng, Y., Xiao, L. (2019). Genetic characterization of *Cryptosporidium spp.* and *Giardia d*uodenalis in dogs and cats in Guangdong, China. *Parasites & Vectors*, 12, 571. DOI:10.1186/s13071-019-3822-z.

91 Wang, Y., Zhang, K., Chen, Y., Li, X., Zhang, L. (2021). *Cryptosporidium* and cryptosporidiosis in wild birds: A One Health perspective. *Parasitol Res*, 120(9), 3035-3044.

92 Yi, XL, Yang, WH, Zheng, HL, Cao, ML, Xiong, J., Chen, WC, Zhou, YJ, Li, F., Zhu, XQ, Liu, GH. (2024). Seroprevalence and molecular detection of Toxoplasma gondii and Neospora caninum in beef cattle and goats in Hunan province, China. *Parasites & Vectors*, 17, 195. DOI:10.1186/s13071-024-06283-9.

93 Meng, XZ, Li, MY, Lyu, C., Qin, YF, Zhao, ZY, Yang, XB, et al. (2021). The global prevalence and risk factors of *Cryptosporidium* infection among cats during 1988–2021: A systematic review and meta-analysis. *Microb. Pathog*, 158, 105096.

94 Li, J., Ryan, U., Guo, Y., Feng, Y., Xiao, L. (2021). Advances in molecular epidemiology of cryptosporidiosis in dogs and cats. *Int. J. Parasitol*, 51, 787-795.

95 Golomazou, E., Mamedova, S., Vafae Eslahi, A., Karanis, P. (2024). Cryptosporidium and agriculture: A review. *Science of The Total Environment,* 916, 170057. DOI: 10.1016/j.scitotenv.2024.170057.

96 Ryan, U., Feng, Y., Fayer, R., Xiao, L. (2021). Taxonomy and molecular epidemiology of *Cryptosporidium* and *Giardia* – a 50-year perspective (1971–2021). Int. J. Parasitol, 51, 1099-1119.

97 Jiang, Y., Yuan, Z., Wang, Y., Zhang, J., Shen, Y., Cao, J. (2024). Wastewater-based intestinal protozoa monitoring in Shanghai, China. *Microbiology Spectrum*, 12(11). DOI:10.1128/spectrum.04032-23.