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Parasitic contamination of environmental objects with nematode eggs of *Trichuris* genus in the city of Poltava

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The spreading of dog digestive tract helminthoses, including trichurosis, still remains a topical problem, where one of the factors of significant infestations' spreading is the contamination of the environment with parasites' eggs, which can be preserved in the environment for a long time and cause infestation of susceptible animals. Therefore, one of the important factors in maintaining veterinary well-being in relation to dog trichurosis is establishing the contamination level of environmental objects by propagative stages of nematode development. The purpose of the research was to determine contamination indicators of sand and soil in the city of Poltava with nematode eggs of *Trichuris* genus. The studies were conducted on the basis of the laboratory of parasitology of Poltava State Agrarian University. Sand samples from sandboxes located on the territory of the city of Poltava, as well as soil from the territories adjacent to them were studied. The main contamination indicators were the extensive contamination index and intensive contamination index. It was revealed by the conducted research that 61 out of 90 sandboxes in the city of Poltava were contaminated with nematode eggs of *Trichuris* genus, where the extensive contamination index made 67.78 %, and the intensive contamination index made 195.79±18.41 eggs/kg. The territory of Kyiv district was the most contaminated with nematode eggs, where 25 out of 30 sandboxes were contaminated with propagative stages of trichurises development, and the level of parasites' contamination was 83.33 % and 218.91±17.27 eggs/kg. It was found that the most infected sand was taken from the surface at the edges of the sandbox, near its walls, where the extensive and intensive contamination indices made 41.11 % and 320.27±35.43 eggs/kg, respectively. Also, high rates of parasitic infestation were found during studying the soil, taken from the surface at a distance of 1 m from the sandbox, where, on the average, the extensive contamination index was 46.67 %, and the intensive contamination index was 263.90±28.87 eggs/kg. With an increase in the sampling depth, the indicators of contamination with trichurises' eggs decreased and amounted to: on the surface – 36.67–46.67 % and 120.37–320.7 eggs/kg, at a depth of 5 cm – 14.44–30.00 % and 80.77–274.07 eggs/kg, and at a depth of 10 cm – 8.89–20.00 % and 62.50–125.00 eggs/kg. The obtained results of parasitological studies prove that the territory of sandboxes is a real factor in the transmission of invasive agents, which must be taken into account in assessing the risks of infecting dogs with trichurosis causative agent.

Keywords: parasitology, trichurosis, dogs, nematode eggs, contamination level

Паразитарне забруднення об'єктів довкілля яйцями нематод роду *Trichuris* у місті Полтава

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Поширення гельмінтозів травного тракту собак, у тому числі й трихурозу, досі залишається актуальною проблемою, де одним з факторів значного розповсюдження інвазій є контамінація навколишнього середовища яйцями паразитів, які тривалий час можуть зберігатися у довкіллі та спричинювати зараження сприйнятливих тварин. Тому, одним із важливих факторів підтримання ветеринарного благополуччя щодо трихурозу собак є встановлення рівня забрудненості об'єктів довкілля пропагативними стадіями розвитку нематод. Метою досліджень було визначення показників контамінації піску та ґрунту в м. Полтава яйцями нематод роду *Trichuris*. Дослідження проводили на базі лабораторії паразитології Полтавського державного аграрного університету. Досліджували проби піску з пісочниць, що розташовані на території міста Полтави, а також ґрунт з прилеглих до них територій. Основними показниками контамінації були екстенсивний індекс контамінації та інтенсивний індекс контамінації. Проведеними дослідженнями виявлено, що 61 з 90 пісочниць м. Полтава виявилася забрудненою яйцями нематод роду *Trichuris*, де екстенсивний індекс контамінації становив 67,78 %, а інтенсивний індекс контамінації – 195,79±18,41 яєць/кг. Найбільш забрудненою яйцями нематод виявилася територія Київського району, де 25 з 30 пісочниць були контаміновані пропагативними стадіями розвитку трихурисів, а рівень забрудненості паразитами становив 83,33 % та 218,91±17,27 яєць/кг. Виявлено, що найбільш забрудненим виявився пісок, відібраний з поверхні по краях пісочниці, біля її стінок, де екстенсивний та інтенсивний індекс контамінації становили 41,11 % та 320,27±35,43 яєць/кг відповідно. Також високі показники паразитарного забруднення виявлено при дослідженні ґрунту, відібраного з поверхні на відстані 1 м від пісочниці, де у середньому екстенсивний індекс контамінації становив 46,67 %, а інтенсивний індекс контамінації –263,90±28,87 яєць/кг. Зі збільшенням глибини відбору проб показники контамінації яйцями трихурисів зменшувалися і становили: на поверхні – 36,67–46,67 % та 120,37–320,7 яєць/кг, на глибині 5 см – 14,44–30,00 % та 80,77–274,07 яєць/кг, на глибині 10 см – 8,89–20,00 % та 62,50–125,00 яєць/кг. Отримані результати паразитологічних досліджень доводять, що територія пісочниць є реальним фактором передачі інвазійних агентів, який необхідно враховувати в оцінці ризиків зараження собак збудником трихурозу.

Ключові слова: паразитологія, трихуроз, собаки, яйця нематод, рівень контамінації

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Introduction

Many parasitic diseases of carnivores are zoonoses and are dangerous not only to the animals themselves, but also to humans. In modern cities, nematodoses are among such diseases, including dog trichurosis, are of the greatest epidemiological importance [1–4]. This is explained by the fact that, firstly, trichurises' causative agents have a direct cycle of development, connected mainly with the soil. Secondly, the resistance of nematode eggs to the effects of adverse factors allows them to be stored in the external environment for a long time. As a result, a high probability of infecting susceptible animals is created. Thirdly, it should be taken into account that urban conditions are characterized by the accumulation in the immediate vicinity of the residential area of a large number of domestic and stray dogs, which are a source of soil contamination with nematode eggs [5–12].

The studies conducted in different countries showed a high level of soil and grass contamination with parasitic elements in recreation places, public and urban areas, parks, green zones, bicycle tracks, playgrounds, sandboxes, and beaches. When using these areas, people often bring pets with them, which may defecate in public places, thus contaminating the environment with parasites and contributing to zoonotic transmitting and infecting other animals. Also, researches by scientists have shown that soil and sand are the most epidemiologically significant substrates for geo-helminthiases, in which, under favorable climatic conditions, geohelminthes' eggs are preserved for a long time; they develop and reach the invasive stage, contributing to the spreading of parasitic diseases [13–15].

For example, the authors conducted the study of feces collected from the territory of 190 urban parks in Australia. On the whole, 44.2 % of the parks were infected with parasites' eggs, where *Trichuris* spp. accounted for 1.3 % [16]. On the territory of Poland, the study of 200 feces samples obtained from city and dog parks located in the districts of Warsaw was conducted. The eggs of gastro-intestinal nematodes, including *T. vulpis*, were found in 23 (11.5 %) of the examined fecal samples. The presence of parasites was confirmed in 14 out of 20 investigated places (70 %), including eight city parks (72.7 %) and six dog-walking parks (66.7 %) [17]. In the East Slovakian Lowland, the region near the EU border with Ukraine, during the study of 148 soil samples from public places, the presence of *Trichuris* spp. eggs made 29.05 % [18]. In three different Italian municipalities, studies were conducted on dog feces collected in public green areas (children's playgrounds, parks, etc.). Out of the total number of 677 collected samples, 38 (5.6 %) gave the positive result for helminthes' eggs parasitizing in dogs. Moreover, *T. vulpis* was the most common (4.4%); the eggs of *T. canis* (1.9%) and *A. caninum* (0.4 %) were found less often. The values of spreading *T. vulpis* and *T. canis* nematode eggs showed the similar tendency in each municipality (7.7 and 1.9 % in Rome, 5.1 and 3.6 % in Teramo, 1.5 and 0.7 % in Padua, respectively) [19].

The purpose of the study

The purpose of the studies was to determine sand and soil contamination indicators in the city of Poltava with nematode eggs of *Trichuris* genus.

Materials and methods

The work was conducted during 2023–2024 at the laboratory of the Department of Parasitology and Veterinary-Sanitary Expert Examination of Poltava State Agrarian University.

The study of the level of contaminating environmental objects with trichurises' eggs was carried out by examining samples of sand from sandboxes and soil from the territories adjacent to them in the city of Poltava (Podil, Shevchenko, and Kyiv districts). The selection of sand samples was conducted in sandboxes' central part, along the edges, and near the walls. Soil samples were taken directly outside the sandboxes near their walls, at a distance of 1 and 3 m from them. All samples were taken from different depths (0.5 and 10 cm). The samples were prepared according to the method of G. A. Kotelnikov (1984) [20], and the study on nematode egg contamination was carried out according to the method of V. V. Melnychuk and I. D. Yuskiv (2019) [21].

The main indicators of contamination were extensive contamination index (ECI, %) and intensive contamination index (ICI, eggs/kg).

A total of 1.350 samples and 90 sandboxes were examined.

Mathematical analysis of the obtained data was performed using the Microsoft "EXCEL" applied program package by determining the arithmetic mean (M) and standard error (m).

Results and discussion

It was revealed by the conducted research that 61 out of 90 sandboxes in the city of Poltava were contaminated with nematode eggs of *Trichuris* genus, where the extensive contamination index made 67.78 %, and the intensive contamination index was 195.79±18.41 eggs/kg. The territory of Kyiv district was the most contaminated with nematode eggs, where 25 out of 30 sandboxes were infected with propagative stages of trichurises' development, and the level of parasites' contamination was 83.33% and 218.91±17.27 eggs/kg (***Fig. 1***).

The territory of Podil district was less contaminated with nematode eggs, where 22 out of 30 sandboxes were contaminated with trichurises eggs, and the level of contamination with parasites was 73.33 % and189.95±17.27 eggs/kg. The least contaminated was the territory of Shevchenko district, where 14 out of 30 sandboxes were infested with trichurises' eggs, and the level of infestation with parasites was 46.67 % and163.70±21.04 eggs/kg.

It was found that the sand taken from the surface at the edges of the sandbox, near its walls turned out to be the most polluted, where the extensive and intensive

contamination indices were 41.11 % and 320.27±35.43 eggs/kg, respectively. Also, high rates of parasitic infestation were found at examining the soil, taken from the surface at a distance of 1 m from the sandbox, where, on the average, the extensive contamination index made 46.67 %, and the intensive contamination index was 263.90±28.87 eggs/kg.

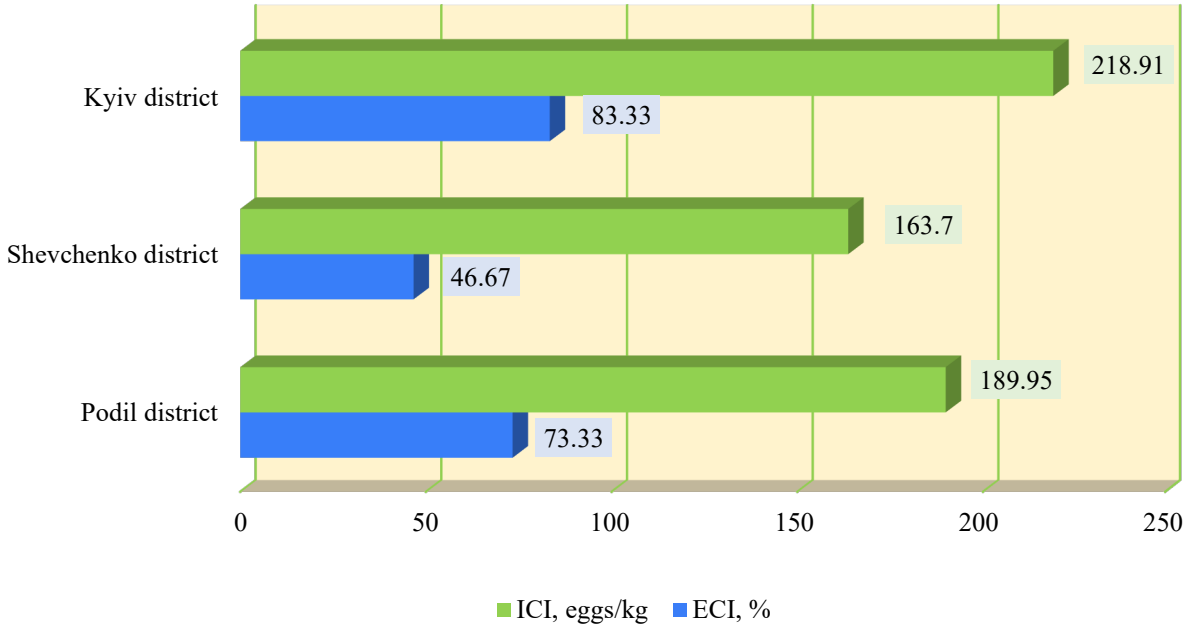

Fig. 1. Indicators of contaminating environmental objects in different districts of Poltava with nematode eggs of *Trichuris* genus

As the depth of sampling increased, the indicators of contamination with trichurises' eggs decreased. In particular, the samples taken from the surface of environmental objects had the highest levels of contamination, namely: the sand from the central part of the sandbox – 34.44 % and 214.52±26.05 eggs/kg, the sand from the sandbox edges, near its walls – 41.11 % and 320.27±35.43 eggs/kg, the soil outside the sandbox, near its walls – 26.67 % and 266.67±41.78 eggs/kg, the soil at a distance of 1 m from the sandbox – 46.67 % and 263.90±28.87 eggs/kg, soil at a distance of 3 m from the sandbox – 30.00 % and 120.37±17.75 eggs/kg (***Fig. 2***).

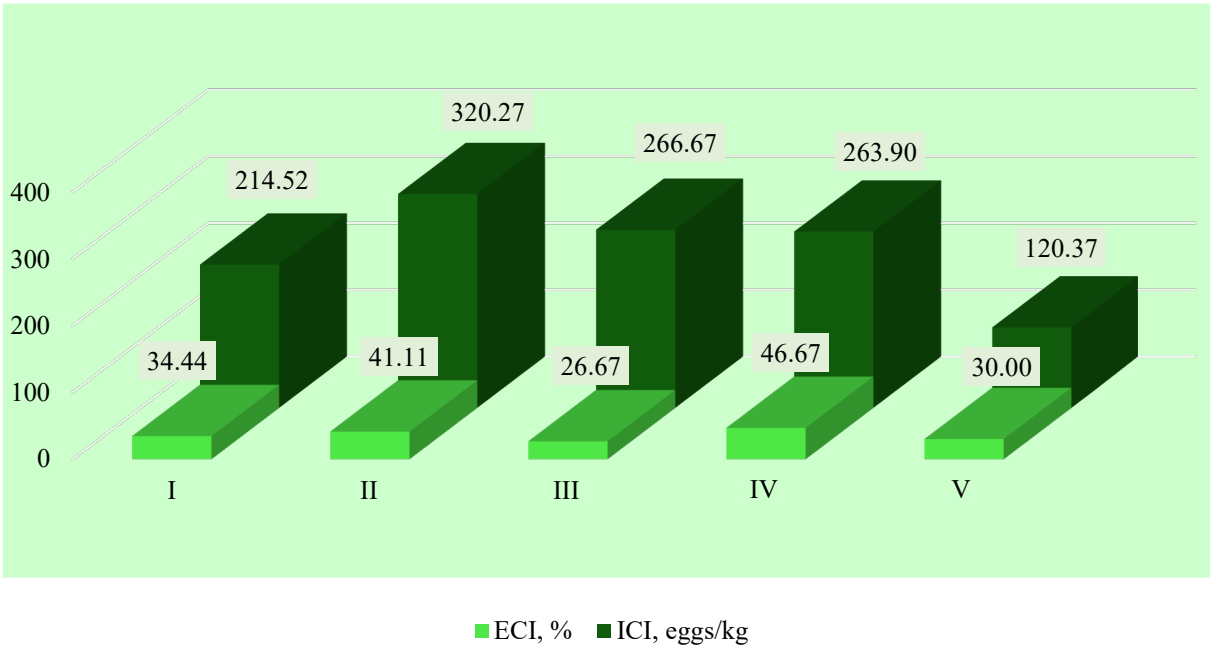

Fig. 2. Indicators of samples' contamination with trichurises' eggs, taken from the surface:
I – sand from the central part of the sandbox; II – sand from the edges of the sandbox, near its walls; III – soil outside the sandbox, near its walls; IV– soil at a distance of 1 m from the sandbox; V– soil at a distance of 3 m from the sandbox

The indicators of the extensive and intensive contamination index of the samples taken from a depth of 5 cm turned out to be somewhat lower than those taken from the surface, namely: the sand from the central part of the sandbox –30.00 % and 274.07±33.80 eggs/kg, the sand from the edges of the sandbox, near its walls – 17.78 % and 146.88±38.32 eggs/kg, the soil outside the sandbox, near its walls – 18.89 % and 191.18±41.49 eggs/kg, the soil at a distance of 1 m from the sandbox – 21.11 % and 150.0±20.94 eggs/kg, the soil at a distance of 3 m from the sandbox – 14.44 % and 80.77±9.02 eggs/kg (***Fig. 3***).

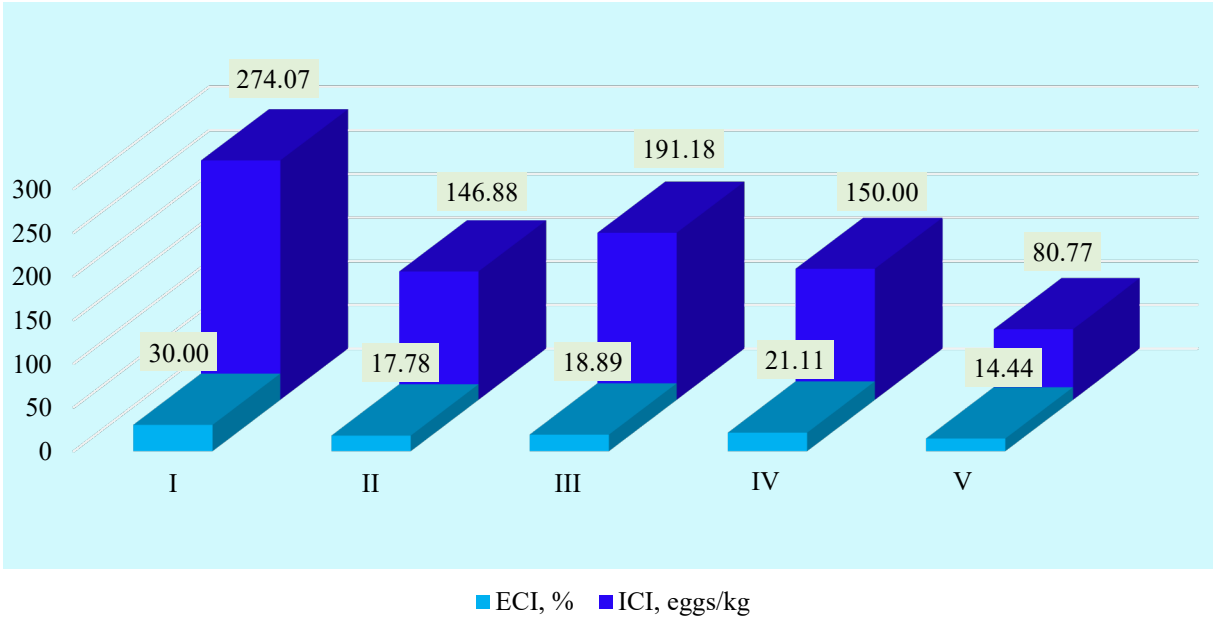

Fig. 3. Indicators of sample contamination with trichurises' eggs, taken from a depth of 5 cm:
I – sand from the central part of the sandbox; II - sand from the edges of the sandbox, near its walls; III – soil outside the sandbox, near its walls; IV–of soil at a distance of 1 m from the sandbox; V–soil at a distance of 3 m from the sandbox

The lowest indicators of the extensive and intensive contamination index were found when examining the samples taken from a depth of 10 cm, namely: sand from the central part of the sandbox – 20.00 % and 125.00±22.96 eggs/kg, sand from the edges of the sandbox, near its walls – 14.44 % and119.23±20.83 eggs/kg, soil outside the sandbox, near its walls – 11.11 % and 95.00±13.84 eggs/kg, soil at a distance of 1 m from the sandbox – 14.44 % and 88.46±10.05 eggs/kg, soil at a distance of 3 m from the sandbox 8.89 % and 62.50±8.18 eggs/kg (***Fig. 4***).

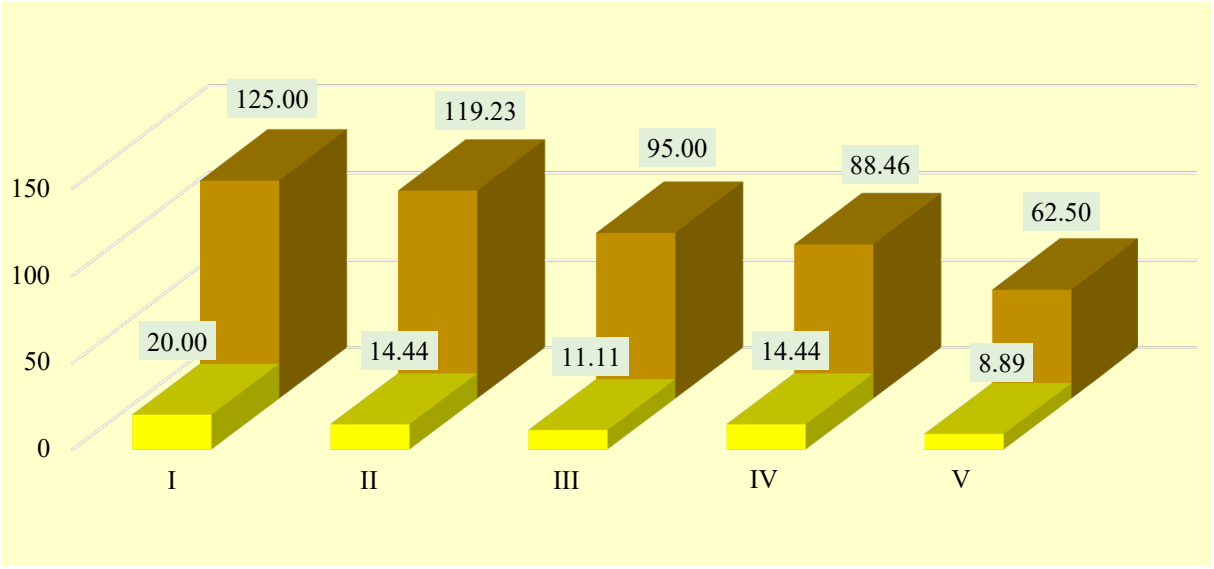

Fig. 4. Indicators of sample contamination with trichurises' eggs, taken from a depth of 10 cm:
I – sand from the central part of the sandbox; II - sand from the edges of the sandbox, near its walls; III – soil outside the sandbox, near its walls; IV– soil at a distance of 1 m from the sandbox; V–soil at a distance of 3 m from the sandbox

Thus, the papers of many scientists from different countries of the world are the evidence of the relevance of establishing the level of contaminating environmental objects by the propagative stages of carnivores' gastrointestinal tract nematodes' development, especially in the conditions of cities [5–12]. Therefore, the purpose of our research was to determine sand and soil contamination indicators in the city of Poltava with nematode eggs of *Trichuris* genus. The conducted research revealed that 61 out of 90 sandboxes in the city of Poltava were contaminated with nematode eggs of *Trichuris* genus, where the extensive contamination index made 67.78 %, and the intensive contamination index was 195.79±18.41 eggs/kg. It was found that the most polluted sand was taken from the surface at the edges of the sandbox, near its walls, where the extensive and intensive contamination indices made 41.11 % and 320.27±35.43 eggs/kg, respectively. Also, high indicators of parasitic infestation were found while studying soil, taken from the surface at a distance of 1 m from the sandbox, where, on the average, the extensive contamination index made 46.67 % and the intensive contamination index was 263.90±28.87 eggs/kg. With an increase in the distance from the sandboxes and increase in the sampling depth, the indicators of contamination by trichurises' eggs gradually decreased and amounted to: on the surface – up to 36.67 % and 120.37±17.75 eggs/kg; at a depth of 5 cm – up to 14.44 % and 80.77±9.02 eggs/kg; at a depth of 10 cm – up to 8.89% and 62.50±8.18 eggs/kg.

Such high indicators of public places' contamination with trichurises' eggs are also confirmed by the papers of many scientists, where *Trichuris* spp. eggs were found in parks in Australia, Warsaw, Italy, and the level of contamination ranged from 1.3 to 70 % [16, 17, 19].

The obtained results of parasitological studies prove that the territory of sandboxes is a real factor in the transmission of invasive agents, which must be taken into account in assessing the risks of infecting dogs with trichurosis causative agent.

Conclusions

A high level of contaminating sandboxes and their adjacent territories in the city of Poltava with nematode eggs of *Trichuris* genus was established. Depending on the sampling places, the indicators of extensive contamination index ranged from 46.67 to 83.33 %, and intensive contamination index ranged from 163.70 to 218.91 eggs/kg. The contamination of sand and soil with trichurises' eggs depended on the depth and location of sampling. The sand taken from the surface at the edges of the sandbox, near its walls, turned out to be the most infested as well as the soil, taken from the surface at a distance of 1 m from the sandbox, where the extensive and intensive contamination indices were 41.11 and 46.67 % and 320.27 and 263.90 eggs/kg, respectively.

Conflict of interest

The author declare no conflict of interest.

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References

1. Di Cesare, A., Castagna, G., Meloni, S., Otranto, D., & Traversa, D. (2012). Mixed trichuroid infestation in a dog from Italy. *Parasites & Vectors*, 5 (1). https://doi.org/10.1186/1756-3305-5-128
2. Redman, W. K., Bryant, J. E., & Ahmad, G. (2016). Gastrointestinal helminths of Coyotes (*Canis latrans*) from Southeast Nebraska and Shenandoah area of Iowa. *Veterinary World*, 9 (9), 970–975. https://doi.org/10.14202/vetworld.2016.970-975
3. Varodi, E. I., Malega, A. M., Kuzmin, Y. I., & Kornyushin, V. V. (2017). Helminths of wild predatory mammals of Ukraine. Nematodes. *Vestnik Zoologii*, 51 (3), 187–202. https://doi.org/10.1515/vzoo-2017-0026
4. Karamon, J., Dąbrowska, J., Kochanowski, M., Samorek-Pieróg, M., Sroka, J., Różycki, M., Bilska-Zając, E., Zdybel, J., & Cencek, T. (2018). Prevalence of intestinal helminths of red foxes (*Vulpes vulpes*) in central Europe (Poland): a significant zoonotic threat. *Parasites & Vectors*, 11, 436. https://doi.org/10.1186/s13071-018-3021-3
5. Raza, A., Rand, J., Qamar, A. G., Jabbar, A., & Kopp, S. (2018). Gastrointestinal parasites in shelter dogs: occurrence, pathology, treatment and risk to shelter workers. *Animals*, 8, 108. https://doi.org/10.3390/ani8070108
6. Fahmy, M. A. M. (1954). An investigation on the life cycle of *Trichuris muris*. *Parasitology*, 44 (1-2), 50–57. https://doi.org/10.1017/S003118200001876X
7. Yevstafieva, V. A., Yuskiv, I. D., & Melnychuk, V. V. (2015). An investigation of embryo and eggshell development in *Trichuris suis* (Nematoda, Trichuridae) under Laboratory Conditions. *Vestnik Zoologii*, 50 (2), 173–178. https://doi.org/10.1515/vzoo-2016-0020
8. Stroehlein, A. J., Young, N. D., Korhonen, P. K., Chang, B. C. H., Nejsum, P., Pozio, E., La Rosa, G., Sternberg, P. W., & Gasser, R. B. (2017). Whipworm kinomes reflect a unique biology and adaptation to the host animal. *International Journal for Parasitology*, 47 (13), 857–866. https://doi.org/10.1016/j.ijpara.2017.04.005
9. Maikai, B. V., Umoh, J. U., Ajanusi, O. J., & Ajogi, I. (2008). Public health implications of soil contaminated with helminth eggs in the metropolis of Kaduna, Nigeria. *Journal of Helminthology*, 82 (2), 113–118. https://doi.org/10.1017/S0022149X07874220
10. Bojar, H., & Kłapeć, T. (2012). Contamination of soil with eggs of geohelminths in recreational areas in the Lublin region of Poland. *Annals of Agricultural and Environmental Medicine*, 19 (2), 267–270.
11. Simonato, G., Cassini, R., Morelli, S., Di Cesare, A., La Torre, F., Marcer, F., Traversa, D., Pietrobelli, M., & Frangipane di Regalbono, A. (2019). Contamination of Italian parks with canine helminth eggs and health risk perception of the public. *Preventive Veterinary Medicine*, 172, 104788. https://doi.org/10.1016/j.prevetmed.2019.104788
12. Cociancic, P., Deferrari, G., Zonta, M. L., & Navone, G. T. (2020). Intestinal parasites in canine feces contaminating urban and recreational areas in Ushuaia (Argentina). *Veterinary Parasitology, Regional Studies and Reports*, 21, 100424. https://doi.org/10.1016/j.vprsr.2020.100424
13. Morgan, E. R., Azam, D., & Pegler, K. (2013). Quantifying sources of environmental contamination with *Toxocara* spp. eggs. *Veterinary Parasitology*, 193 (4), 390–397. https://doi.org/10.1016/j.vetpar.2012.12.034
14. Cassenote, A. J. F., Pinto Neto, J. M., Lima-Catelani, A. R. de A., & Ferreira, A. W. (2011). Contaminação do solo por ovos de geo-helmintos com potencial zoonótico na municipalidade de Fernandópolis, Estado de São Paulo, entre 2007 e 2008. *Revista Da Sociedade Brasileira de Medicina Tropical*, 44 (3), 371–374. https://doi.org/10.1590/s0037-86822011005000026
15. Rubel, D., & Wisnivesky, C. (2010). Contaminación fecal canina en plazas y veredas de Buenos Aires, 1991-2006 [Dog fouling and helminth contamination in parks and sidewalks of Buenos Aires City, 1991-2006]. *Medicina*, 70 (4), 355–363.

16. Massetti, L., Wiethoelter, A., McDonagh, P., Rae, L., Marwedel, L., Beugnet, F., Colella, V., & Traub, R. J. (2022). Faecal prevalence, distribution and risk factors associated with canine soil-transmitted helminths contaminating urban parks across Australia. *International Journal for Parasitology*, 52(10), 637–646. https://doi.org/10.1016/j.ijpara.2022.08.001
17. Tylkowska, A., Mocha, N., Kołnierzak, M. M., & Szenejko, M. (2024). Risk factors associated with soil-transmitted helminths in dog feces that contaminate public areas of Warsaw, Poland. *Animals*, 14 (3), 450. https://doi.org/10.3390/ani14030450
18. Ihnacik, L., Šmigová, J., Šoltys, J., Blišťan, P., Kovanič, L., Blišťanová, M., Schusterová, I., & Papajová, I. (2023). Risk factors associated with dog endoparasites infection spread in East Slovak Lowland. *Helminthologia*, 60 (2), 152–160. https://doi.org/10.2478/helm-2023-0014
19. Traversa, D., Frangipane di Regalbono, A., Di Cesare, A., La Torre, F., Drake, J., & Pietrobelli, M. (2014). Environmental contamination by canine geohelminths. *Parasites & Vectors*, 7 (1), 67. https://doi.org/10.1186/1756-3305-7-67
20. Kotelnikov, G. A. (1984). *Helminthological studiesof animals and environment*. Moskva: Kolos.
21. Melnychuk V. V., & Yuskiv I. D. (2019). Patent na korysnu model № 135972. Ukraina. Sposib vyiavlennia yaiets nematod u probakh gruntu. Retrieved from: https://sis.nipo.gov.ua/uk/search/detail/1371877/ [in Ukrainian]

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