

***Toxocara cati* EGGS IN THE SOIL PASSED BY CATS AFFECTED THE OCCURRENCE OF ZOONOSES IN HUMANS**

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ABSTRACT

Background: *Toxocara cati* belong to STH (Soil Trasmitted Helminth) worm, soil media is needed for the development of eggs to be an infective form. When a cat is infected with *Toxocara cati*, the disease is called *Toxocariasis*. Year 2018 in the world, the prevalence of *Toxocara spp.* eggs on beaches, parks, and playgrounds were 21%, while the prevalence of cats infected with *Toxocariasis* in Surabaya is 60.9%. *Toxocariasis* caused by *Toxocara cati* requires more attention because the high environmental contamination and infected cats. If humans accidentally ingest infective eggs *Toxocara cati*, human will suffer zoonosis. *Toxocara cati* eggs cannot become adults but remain in the larval stage, attached in human organs causing *Visceral Larva Migrans* (VLM), *Ocular Larva Migrans* (OLM), and *Neurotoxocariasis* (NT).

Objective: To determine *Toxocara cati* eggs in the soil that frequently passed by cats can cause zoonoses in humans.

Methods: Literature review by taking libraries 30 journals and 4 textbooks national journals accredited sinta and good published international journals more than year 2015.

Results: The results of literature review showed that *Toxocara cati* eggs on the soil that frequently passed by cats cause zoonoses in humans.

Conclusion: *Toxocara cati* in the soil that frequently passed by cats can cause zoonoses in humans.

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1. INTRODUCTION

Soil Transmitted Helminths (STH) is an intestinal nematode worm that can infect humans via the faecal-oral route by accidentally ingesting eggs from the worm. Worms that include STH are *Ascaris lumbricoides*, *Toxocara spp.*, *Trichuris trichiura*, Hookworm, and *Strongyloides stercoralis*. [1] STH requires soil media for embryonic development, moist soil conditions, sandy soil, dust, and clay are the right habitats to live and reproduce. [2] *Toxocara cati* worms are intestinal nematodes belonging to the STH group and are Ascaris in cats.

The public health concern hazards associated with the increasing population of feral/pet cats is currently very high. Given that cats are the definitive hosts of *Toxocara spp.*, control of animals in public areas and parks is an important public health measure to reduce the associated hazards. In 2018, the worldwide prevalence of *Toxocara* eggs in beaches, parks and playgrounds was 21%. [3] The ideal environmental condition of *Toxocara cati* is soil that has a temperature of $\pm 30^{\circ}\text{C}$ and 80% humidity, under these conditions *Toxocara cati* eggs can grow into an infective form. [4]

The world prevalence of *Toxocara* infection in cats is 17%, the highest in Africa (43.3%) and the lowest in South America (12.6%). [5] In Indonesia, a study conducted in Bogor City found a prevalence of 35% and in Denpasar, a prevalence of 32.5% was found. [4] (The prevalence in the city of Surabaya is 60.9%. *Toxocariasis* caused by *Toxocara cati* needs more attention, because humans are closely related to cats and many are their pets. [6]

A zoonotic disease caused by *Toxocara spp.* is a public health problem, because this disease is common in children in developing and developed countries. [7] Based on the high prevalence, chronic, and strongly associated with poverty, this parasitic infection is considered as one of the important parasitic diseases. [8] Transmission occurs by accidentally ingesting *Toxocara cati* eggs that were previously in cat feces. In humans, the larvae can migrate to different tissues and cause clinical symptoms after ingestion. The third stage larvae that hatch from *Toxocara cati* eggs are larvae that develop into adults when the last host swallows the infective or parathenic eggs of the host and can survive for a long time in the host's body. [9] Humans infected by *Toxocara cati* can experience clinical manifestations ranging from asymptomatic symptoms to systemic infections, for example VLM and OLM. [3]

2. METHOD

This paper uses the literature review method by conducting a literature review of 30 journals and 4 textbooks. The journals that have been obtained are selected according to the criteria of national journals accredited by SINTA and international journals of good repute and have been indexed by scopus and non scopus.

3. RESULTS AND DISCUSSION

Based on data collected from 143 articles (51 countries), the worldwide prevalence of *Toxocara* infection in cats is 17%. The highest figure was found in Africa, namely 43.3% and the lowest was in South America at 12.6%. Based on other data from WHO, the prevalence of *Toxocariasis* in the Eastern Mediterranean (21.6%), North America (17.3%), and Southeast Asia (14.9%). *Toxocara* prevalence was higher in low-income tropical countries and also in feral cats (28.6%) and young cats (12 months of age) (27.7%) compared to domesticated cats (11.6%) and older cats. (age >12 months) (23.8%). These results indicate that low-income countries generally have a higher prevalence rate of *Toxocara cati* infection in cats than high-income countries, because generally high-income countries are more developed, have veterinary care, precautions for wild animals, maintained environmental hygiene, organized, accessible, and more aware of zoonotic diseases. Feral cats, unlike pets, live outdoors, are often neglected and not cared for so they have more infectious agents and can contaminate the environment with *Toxocara* eggs which pose a higher health risk. The higher prevalence of infected young cats is due to an underdeveloped immune system in younger cats and the risk of transmammary transmission of *Toxocara cati* from mother to kitten. [10] In Brazil, out of 5600 cats, 16.7% were infected with *Toxocara*. [11] The prevalence of cats infected with *Toxocara* in Germany (4.7%), the Netherlands (4.5%), Australia (1.2-3.2%), and Portugal, Nigeria, and China (3.2-91%). [10] According to Bakhshani (2019), *Toxocara* eggs can be in a cat's fur. Of the 167 cats studied, 18 (10.8%) had *Toxocara cati* eggs on their fur, 7 adult cats, 1 young cat, and 10 kittens (10 females and 8 males). The age of the cat is an important risk factor associated with parasitic infections because based on Bakhshani's research (2019), kittens are more likely to have eggs in their fur than adult cats (>1 year). The high prevalence of *Toxocara cati* in kittens is due to the parasite's life cycle involving transcolostral transmission, while adult cats already have a system to prevent parasites from developing. In this study also revealed that there was no significant difference between the sex of infected cats and the presence of *Toxocara* eggs in the fur of female and male cats.

In Bogor City, from 243 samples of cat feces, the prevalence was 35%. In Denpasar, the prevalence was 32.5%. [4] In Lumajang, from 120 samples of cat feces, a prevalence of 40% was found to be positive for *Toxocara cati* eggs. [12] The prevalence in the city of Surabaya in cats is 60.9% of the 69 samples. *Toxocariasis* caused by *Toxocara cati* needs more attention because in Indonesia, humans are closely related to cats and many are their pets. [6] Male cats have 1.5 times the risk of being infected with *Toxocara cati* than female cats, male cats have a higher chance of getting out than female cats because of their need to mate. Another factor is cat maintenance management. Cats who were not provided with sand had a 1.5 times risk of infection with *Toxocara cati* compared to cats that were provided with sand. It is suspected that cats who are not provided

with sand will defecate in any place, so that it is difficult to control contamination from cat feces infected with *Toxocara cati*. Cat feces as a source of transmission of Toxocariasis in cats and humans, especially cat owners, so that the sand for defecation must be kept clean. [4]

Research in Osaka City, Japan revealed that 75% of parks and sand have been contaminated. Soil contamination by eggs of *Toxocara canis* and *Toxocara cati* is also often found in grass and forest areas, many dogs and cats tend to defecate in green spaces in urban situations, so green spaces have high levels of contamination of *Toxocara canis* and *Toxocara cati* eggs in soil. The prevalence of contaminated soil in Europe (64% in Ancona, Italy and 67% in Murcia City, Spain), Latin America (62% in universities in Brazil). [13] Gao (2017) also revealed that soil contaminated by *Toxocara spp.* mostly found in residential areas, grass and tree areas, this is supported by research conducted by Kroten (2016), Giacometti (1999), and Habluetzel (2003). The reason is because the residential areas have food supplies for cats and the grass and tree areas are places where cats defecate. Kleine (2016) revealed that children's playgrounds also have a high risk of contamination with *Toxocara spp.* eggs. because cats also defecate in that area. According to Raissi (2021), the prevalence of *Toxocara cati* eggs in beaches, parks and playgrounds in the world is 21%. This is also supported by data from WHO, which ranges from 13-35%. In Saveh City, Iran, the prevalence of soil contamination by eggs of *Toxocara spp.* is 18.25%, land around the hospital (15%), green areas and roads (15%), and fruit and vegetable shops (33.34%). Cats infected with *Toxocara cati* *Toxocara* eggs will come out with feces, then pollute the environment. When conditions of temperature and humidity are favorable, eggs can survive for weeks to months and can remain infective in the environment for months to years. [10] The environment that supports the development of *Toxocara* eggs has a temperature condition of 28-33°C. [11] According to French research (2020) *Toxocara cati* was also found in kiwi (*Apteryx mantleli*) causing cases of visceral and neural LM in these animals, this case occurred in New Zealand. This allows the transmission of Toxocariasis to humans is not only caused by the definitive host (cats), but can also be caused by infected paratenic hosts such as kiwi (*Apteryx mantleli*).

Recent epidemiological studies estimate that 1.4 billion people worldwide, mainly in subtropical and tropical areas are infected or exposed to *Toxocara spp.* [12] This is similar to Fiorentini's (2020) study which also revealed that parasitic infections in humans affect >1.5 billion people worldwide and are generally associated with poverty and poor sanitation. Very high prevalence (>80%) of humans infected or exposed to *Toxocara spp.* in several subtropical and tropical countries/regions (such as: Indonesia, Kashmir, Marshall Islands, Nepal, and Nigeria). [12] Prevalence in New Zealand (0.7%), Japan (1.6%), Denmark (2.4%), Austria (6.3%), Sweden (7%), America (14%), Ireland (31 %), Iran (22%), Nepal (81%), schools in Manado, Indonesia (85%), and Marshall Island (87%). [5] According to Chen (2018), 823 cases of OT have been reported, 282 cases in Europe, 317 cases in Asia, 5 cases in Australia, 218 cases in Latin America, and 1 case in Tunisia. NT case data in the world is 99 cases, 46 cases in Europe, 32 cases in Asia, 20 cases in America, and 1 in South Africa. Data on VLM cases in the world were 247 cases, the most cases were reported in Spain (61 cases; 63% of 97 cases in Europe), India (14; 29% of 49 cases in Asia), Argentina and Brazil (16; 16% and 76; 75% of 101 cases in South America). [16] Data on cases of Toxocariasis which causes blindness in America is approximately 70 people every year. [17] In Indonesia, a high seroprevalence rate of 63.2% was found in children and adolescents in the Bali area, in Sidoarjo, East Java by 63% of the 224 population, junior high school students from 2 districts near Manado, North Sulawesi at 84.6 %. [18] In Europe, the prevalence of *Toxocara spp.* on soil samples in the cities of Ancona, Italy and Murcia, Spain by 64% and 67%, respectively. In Latin America, the soil contamination rate is 62% on university campuses in Brazil (Gao, et al., 2017). Toxocariasis is a very important disease as a public health problem, because this disease is very common among socio-economically disadvantaged children in developing and developed countries. [7]

Potential risk factors associated with seropositivity to *Toxocara* include male gender, living in rural areas, young age, close contact with dogs, cats or soil, consumption of raw meat, and drinking untreated water. According to research conducted by Stensvold, et al. and Poepl, et al., gender was not the main factor associated with *Toxocara* seropositivity in humans. On the other hand, there was a significant difference between antibody seroprevalence in women in Rome (51.5%) and men in Rome (29.4%). Results from several community studies in Iran and Venezuela show that boys are more exposed than girls based on differences in activities and interests. On the other hand, Uhlíková and Hübner reported that women are at higher risk of infection due to their higher interest in gardening activities. The higher seroprevalence of anti-*Toxocara* antibodies in children reflects inadequate hygiene habits and more frequent contact with contaminated environments due to activities such as playing on the ground. [8]

Zoonotic infectious diseases caused by bacteria, viruses, and parasites that are transmitted from animals to humans are still a major public health problem. Tick fever, scabies, leishmaniasis, and ascariasis are diseases that often attack pets, such as cats and dogs, and have the potential to spread to humans. [19] *Toxocara spp.* is the etiologic agent of Toxocariasis in humans, caused by accidentally ingesting eggs containing larvae and is one of the most common types of zoonotic infections in the world. [20] *Toxocara spp.* is a class of intestinal

nematodes Soil Transmitted Helminths (STH) that infect humans who accidentally ingest their eggs via the faecal-oral route. [21] STH is an intestinal nematode that requires soil media for egg development. [2] Toxocariasis infection in humans is usually caused by soil contaminated with cat feces, from unwashed fruit and vegetables, eating raw or undercooked meat containing *Toxocara spp* eggs. or from animal hair, this is supported by research conducted by Kollipara (2016), Hombu (2017), Padhi (2017), Ma (2018), Vega (2019) and Raissi (2021).

A significant risk factor for transmission of *Toxocara spp*. These include keeping cats, onychophagia (nail-biting), geophagia, living in a contaminated environment and poor socioeconomic status and also locations such as parks that are frequented by animals that have a high probability of contamination. [22] It can also be caused by poor eating and hygiene habits. [18] In Indonesia, diseases caused by worms are still common, especially in conditions of environmental sanitation and poor hygiene. According to the Ministry of Health (2006), the prevalence of helminthiasis in Indonesia is 40%-60%. [2] Humans become infected by accidentally ingesting embryonic eggs/larvae in soil, contaminated food, and improperly cooked beef, lamb and chicken. After ingestion of the embryonated egg, the larva hatches in the small intestine, penetrates the intestinal wall, gains access to the circulation, migrates throughout the body, causing an inflammatory response and various clinical symptoms, depending on the organ involved. In general, human toxocariasis is categorized into 3 clinical forms: VLM, OLM, and NT. [5, 14, 16] Migration of larvae to tissues causes symptoms such as vomiting, nausea, fever, recurrent abdominal pain, myalgia, skin manifestations (pruritus, rash, eczema, panniculitis, and vasculitis) and lung problems, whereas OT causes symptoms such as endophthalmitis, retinitis, granulomas, leukocoria, and blindness in some cases. According to Wang (2016), delayed diagnosis of OT can lead to inadequate treatment or even enucleation of the eye. NT cases have symptoms such as paralysis, epilepsy, meningitis, encephalitis, myelitis, and death. [13, 15, 22]

Domestic cats (*Felis silvestris catus*) are animals that can carry various kinds of microorganisms, namely ectoparasites and endoparasites. [23] Domestic cats can be found in every human-inhabited area except Antarctica, most likely from African wildcats or Asian desert cats. [24] The presence of cats in natural areas can cause several environmental problems, such as competition with other species, transmission, and the spread of disease. [25] Cats can be infected with *Toxocara* caused by ingesting eggs from other animals and transmammary in kittens, the prevalence ranges from 10%-75%. [26] The close relationship between humans and cats has a great impact on zoonotic diseases, so that parasitic diseases in cats (*Toxocara spp*) are very important and cannot be ignored. [12] According to Shifa (2020) that the high prevalence of parasites in cats should be considered by health workers as an effort and early prevention of vector-borne diseases. Serological and molecular tests for pathogens in cats need to be carried out for early detection of zoonotic diseases transmitted from mechanical vectors.

The diagnosis of Toxocariasis relies on clinical, radiographic, and laboratory evidence of disease. In general, the diagnosis of Toxocariasis is based on history (eg individuals who eat raw or undercooked meat), clinical examination, direct microscopic examination of tissue, and blood analysis (leukocytosis and eosinophilia). Serological and molecular methods can also be performed and can be used to confirm the diagnosis. [16, 27] This is also supported by French (2020) who revealed that the diagnosis needs to be based on a combination of history, clinical presentation, hematology, fluid analysis, imaging, and serological testing. According to Fiorentini (2020), Kollipara (2016), and Kroten (2018) the diagnosis of Toxocariasis is generally based on clinical manifestations, peripheral eosinophilia, and ELISA, while for a definite diagnosis according to Wang (2016), histological examination or identification of *Toxocara* larvae bodies in biopsy specimens can be used, but obtaining such a specimen is so difficult and poses a high risk that this technique is rarely used in clinical practice. Radiographs generally have less specific results because some cases are very similar to tuberculosis and neoplasms. The radiological features of pulmonary toxocariasis are cloudy, and/or solid components (84%), multiple solid nodules (29%), and uneven consolidation (21%). The diagnosis of Toxocariasis in animals is most often used by histological examination, while morphological examination has limitations because nematode larvae have a small size and lack of distinguishing features between larvae. [15, 28] According to Kleine (2016), to distinguish the different characteristics between *Toxocara* species and ascertain whether the soil/cat feces contain *Toxocara* eggs, floatation checks can be carried out. Meanwhile, according to Wang (2018), to find out if there are *Toxocara* larvae in meat, you can use nested multiplex PCR, in this study using this method to detect approximately 2 DNA *Toxocara cati* larvae found in chicken liver tissue.

Education to the public about the potential for zoonotic diseases caused by *Toxocara cati*, prevention of environmental contamination from cat feces, reduction of stray cat populations, and the use of anthelmintics and animal hygiene also need to be carried out because they can help prevent the occurrence of Toxocariasis in humans. [29] Toxocariasis in humans can be cured with appropriate therapy or management. Treatment with albendazole is usually very effective, but daily contact with cats and poor hygiene habits can reduce the success

of treatment for this disease. [22] Prevention of infection in humans is by washing hands after touching or playing with pets or after exposure to a potentially contaminated environment. Parents should also educate their children about hygiene. [15] The habit of cats defecating on the ground can prolong the survival of worm eggs in the soil, so Toxocariasis caused by *Toxocara cati* needs more attention because of the high cat population in Indonesia and the close relationship between these pets and humans. [6]

The main therapy for zoonotic diseases caused by *Toxocara spp.* In humans, treatment with anthelmintics (eg, albendazole, mebendazole, and thiabendazole) and anti-inflammatory drugs is indicated. This drug serves to heal and reduce inflammation caused by the migration of larvae to various organs, especially the brain and eyes. The first choice of VLM treatment is albendazole 400 mg twice daily for 5 days, the second option is mebendazole. As for the treatment of OT is to perform surgery or administration of antihelmintic drugs. NT can be treated with a combination of corticosteroids, diethylcarbamazine, mebendazole, and orthiabendazole for approximately 3 weeks. [16] Hombu (2017) also said the same thing, the first choice of LMS treatment is albendazole, the recommendation in Europe and America is oral albendazole 400 mg 2 times a day for 5 days for adult and pediatric patients, while the recommendation in Japan is 10-15 mg /kg/day orally.

Treatment that can be given to cats is a topical solution of salamectin (Revolution®, Zoetis), this type of drug has been used for 20 years in the United States for the treatment and control of *Toxocara cati*. Currently, there is a new formulation in the combination of sarolaner for broad spectrum treatment namely Revolution® Plus/Stronghold® Plus, Zoetis. From a study conducted by Vatta (2019), it was found that the result of administering lambectin/sarolaner was to reduce 100% of the number of eggs in the cats studied. Monthly topical administration of the new formulation of malumectin plus sarolaner (Revolution® Plus/Stronghold® Plus) is safe and highly effective in treating and controlling *Toxocara cati* infection in cats when administered in the intended commercial dose range of 6–12 mg/kg salamectin plus 1–2 mg/kg sarolaner. [30,31]

4. CONCLUSION

Based on the analytical studies that have been carried out, it can be concluded that an estimated 1.4 billion (>80%) people worldwide are exposed to or infected with zoonotic diseases caused by *Toxocara spp.* This disease causes VLM, OLM, and NT; Humans are infected with *Toxocara cati* because they accidentally ingest *Toxocara cati* eggs on the ground where the stray cat (*Felis silvestris catus*) passed; and The soil environment that is commonly contaminated with *Toxocara cati* is green space (grass and trees), and residential areas.

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