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Original Article

Epidemiology Study of *Trichinella Spiralis* Infection in Tyumen Region

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Abstract

Trichinosis is a parasitic infection with worldwide distribution, which is caused by consuming pork or other meats containing cystic larvae of the parasitic nematode *Trichinella Spiralis*. This study aimed to investigate the status of infection *Trichinella Spiralis* in domestic and wild animals. To study the spread of trichinelles in animals, a retrospective analysis was conducted based on the study of research journals and conducted their research methods of compressor trichinelloscopy (microscopic) and digestion of samples in artificial gastric juice (biochemical). A total of 17 positive samples were detected for trichinellosis during the observation period, of which 58.8% belonged to a badger (*Meles Meles*), and 35.3% to the brown bear (*Ursusarctos*), and only 5.9% of wild boar (*Susscrofa*). The mean long-term extent of infection belonged to badgers (18.2%), bears (7.9%), and wild boars (0.05%). The study found that between 2015 and 2020, seventeen *Trichinella* cases were recorded among wildlife in the Tyumen region and the Khanty-Mansi Autonomous Region. The number of annual *Trichinella* detection cases was declining, indicating the effectiveness of veterinary services. This study determined that the primary source of infection was bears, badgers, and wild boars. Among the 17 positive samples, 58.8% belonged to the badger, 35.3% to the bear, and only 5.9% to the wild boar.

Keywords: Tyumen region, trichinellosis, *Trichinella spiralis, Trichinella pseudospiralis*

1. Introduction

Trichinellosis is a parasitic infection with a worldwide spread, which is caused by consuming raw or half-cooked pork or other meats containing cystic larvae of the parasitic nematode *Trichinella*. In addition to humans, a wide range of carnivorous and omnivorous animals are infected with this parasite which causes its cycle to be maintained in nature (1, 2). Recent studies have identified eight species of this parasite, including *T. spiralis* (3), *T. natisova* (4), *T. brittovi* (5), *T. peseudospiralis* (6), *T. Murrelli* (7, 8), *T. nelsoni* (9), *T. papuae* (10), and *T. zimbabwensis* (10). Three strains, T_6 (11), T_8 (9), and T_9 (12), have also been isolated from wild carnivores in the United States, Africa, and Japan. Except for *T. spiralis* and *T.peseudospiralis*, widespread worldwide, the other species are regionally important (13).

Human infection with this parasite begins with the consumption of meat-containing cysts (14). After the cysts are digested, the released parasite larvae penetrate the intestinal mucosa and, within a short time, about 30 to 40 hours, become mature worms that mate immediately after puberty (15). The larvae hatch within three days of fertilization and enter the lymphatic vessels (16). Nowadays, Trichinosis has been identified in badger, nutria, raccoon-strip, forest cat, common fox, wolf, brown bear, raccoon dog, domestic dog, cat, pig, rat, mouse-like rodents, wild boar, Himalayan bear,

jackal, forest marten, hedgehog, stone marten, as well as fur-cell animals (1, 17-20).

Symptoms are divided into three stages: gastrointestinal, larval migration, and their establishment in muscles (encystation) (21). The invasive stage occurs in the gut, and symptoms usually last 2 to 3 days, including nausea, fever, abdominal pain, diarrhea, headache, and dysentery. Then there is the migration phase, which usually occurs in the blood. Symptoms last 1-2 weeks, including edema, conjunctivitis, fever, chills, sweating, photophobia, muscle aches, and severe eosinophilia. Diagnosis can be based on clinical signs and medical history but must be confirmed by laboratory tests or serological tests. Human infection with *Trichinella* is accompanied by the defeat of all body systems, including the central nervous system (22). Other symptoms of encystation include cachexia, swelling of the hands and feet, low blood pressure, and heart muscle involvement that can lead to chest pain, tachycardia, or increased heart rate and intravascular clots (21). Basic preventive measures are used to prevent the spread of the disease from animals to humans, such as strict observance of veterinary and health examination rules, especially for wild commercial animals. Paying attention to the symptoms of the disease helps in diagnosis. Asking the patient about the history of eating raw pork is also helpful. The patient suffers from spot bleeding under the nail and lethargy (23). Severe eosinophilia is an excellent key to diagnosing *Trichinella* (90-50% eosinophilia) (21). A definitive diagnosis is made by biopsying the muscles and observing spring larvae such as twisted (24). Serological tests such as ELISA and Immunoelectrophoresis can also be used, showing antibodies against *Trichinella spiralis* antigens (25, 26). Due to the high pork consumption in the Tyumen region and the presence of *Trichinella* infestation, this study was conducted to investigate the current situation scientifically.

2. Materials and Methods

This study was conducted in the diagnosis and ichthyopathology department of "Tyumen Regional Veterinary Laboratory" between 2015 and 2020. To study the prevalence of Trichinella in animals, a retrospective analysis based on the study of research journals was used, along with intensive trichinoscopy research methods (microscopy) and digestion of samples in artificial gastric juice (biochemistry). A total of 1,985,731 pig carcasses, 2,036 boar carcasses, 55 badger carcasses, and 76 carcasses of bears were examined during the observation period.

After removing the viscera, their urinary system was examined, and the bladders of the animals were carefully separated and placed in a petri dish containing physiological serum. The bladders are cut separately under a microscope with a scalpel to make the worms and eggs visible if present. The inner bladder area was also examined for any cysts or stones. After counting the nematodes, they were identified according to the methods of diagnosing worm parasites, based on physical characteristics and using the keys of Soulsby's (1986) parasitological sources (27). The evacuated bladder tissue and samples of the lungs and the kidneys pelvis were prepared and placed in formaldehyde solution for histopathological examination. After the time required for fixation, the preparation of tissue sections of 5 μm from paraffin blocks was performed and stained with hematoxylin and eosin.

2.1. Statistical Analysis

The data on chemical composition were analyzed *using one-way analysis* of variance (*ANOVA*), and mean values were compared by Duncan's multiple range method using SAS 9.1 software through the below statistical model:

$$Y_{ij}=\mu+X_i+e_{ij}$$

Y_{ij}: The numerical value of each observation, μ: is the average of the total population, X_i: is the fixed effect, and e_{ij}: the experimental error.

The regression equations were estimated by MiniTab 17 software.

3. Results

It was established that 17 cases of trichinelles among wild animals were registered in the Tyumen region and

the Khanty-Mansi autonomous region. Bears, badgers, and wild boars were named for the new reservoirs of the *trichinelles*. A total of 17 positive samples were detected for trichinellosis during the observation period, of which 58.8% belonged to a badger (*Meles meles*), and 35.3% to the brown bear (*Ursus arctos*), and only 5.9% of wild boar (*Sus scrofa*). The mean long-term extent of infection belonged to burrowers (18.2%), bears (7.9%), and wild boars (0.05%). It has been established that the main source of *trichinelles* in animals in the Tyumen region was *Trichinella spiralis*, with an index of dominance (ID) of 94.1%. *T. peseudospiralis* only in badger carcass was 5.9% in 2017.

To study the epizootic situation of *Trichinella* among animals, a retrospective analysis was conducted by the method of studying and veterinary research in the GAU "Tyumen Regional Veterinary Laboratory" and conducted their studies on the detection of *Trichinella* infestation among domestic pigs, as well as wild and rum-speaking animals in the Tyumen region and the Khanty-Mansi Autonomous Region. From 2015 to 2020, a study of 1985,731 pigs showed no *trichinella* infection (Figure 1). While the average severity of infected animals was 0.35 in wild animals from 2015 to 2020.

Positive samples were obtained from the Jurgin and Nizhnytavdin districts and the Khanta-Mansi Autonomous Region, with approved *Trichinella* from the Nizhnetavdinsky, Yalutorovsky, Kazan, and Iset districts, and invasive samples from the Tyumen, Kazan, and Uvat districts. In 2019, two *trichinella* cases were reported, and in both cases, *trichinella* larvae were found in the carcasses of animals living in the Jurgin district.

As shown in figure 2, the invasive trend of contamination *trichinella* decreased from 2015 to 2020, so the percentage of invasiveness reached 5 in 2015 and zero in 2018, which indicates the effectiveness of the veterinary service. Based on the calculated regression diagram, the relationship between the number of *Trichinella* and different years was linear with a negative slope, which R^2 showed the validity of the equation.

The highest infection levels were recorded at Nizhne-Tavdinsky, Yurginsky, and Kazansky (Figure 3). During the research period in the Jurgin and Nizhnytavdin districts, four positive samples were registered, and in Kazan recorded, three samples. One case of trichinellosis infestation was reported in the Vagai., Tyumen, Uvat., Iset., Yalutorovsky districts and Khanty-Mansi AO.

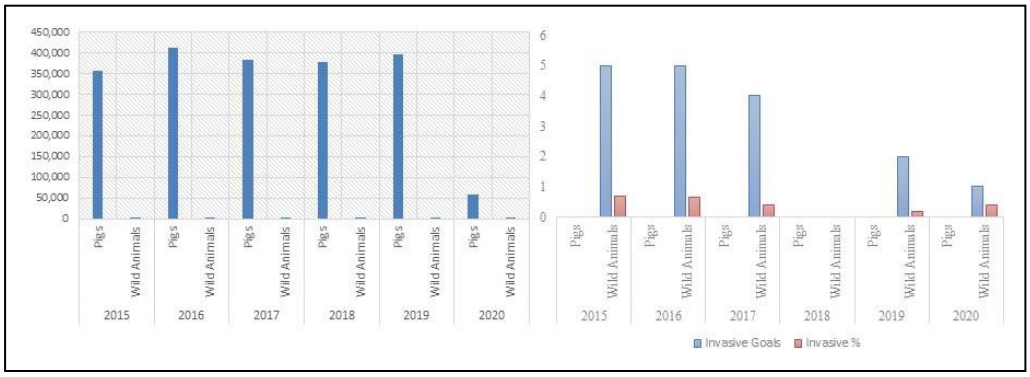

Figure 1. Distribution of Trichinelles among pigs and wild animals

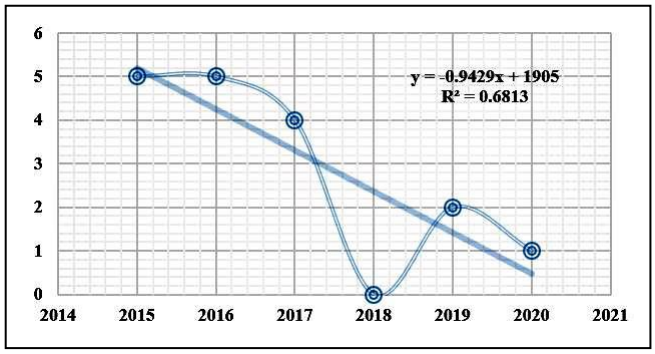

Figure 2. Retrospective analysis of the Trichinellesic invasion in the Tyumen region and the Khanty-Mansi Autonomous regions

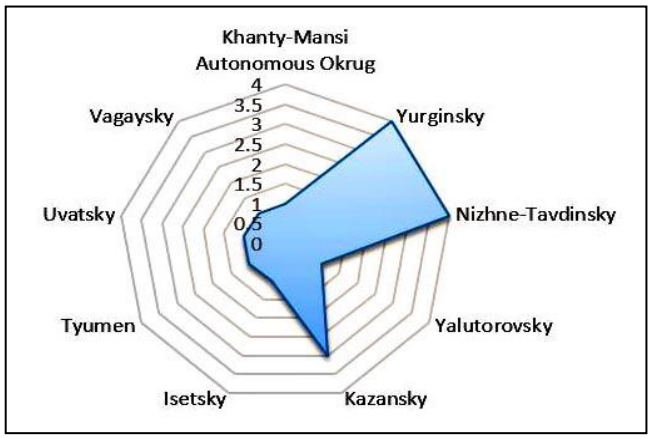

Figure 3. Geographical distribution of recorded cases of Trichinelles infestation in different regions

Laboratory tests were carried out to determine the circle of the owners of the trichinelles, which were taken to the regional veterinary laboratory. The results of the study are presented in table 1.

The primary source of Trichinella was determined in bears, badgers, and wild boars. The highest severity of Badger infestation (42.9%) was recorded in 2017, and 100% for bears with only one infected animal. Overall, the Badger invasion rates for 2015, 2016, 2017, and 2019 were 16.7, 21, 42.90, and 12.50%, respectively. The mean invasive percentages of badger, bears, and wild boars were 18.2, 7.90, and 0.05 percent, respectively.

The distribution of *Trichinella* between species is shown in table 2.

Table 1 Distribution of *Trichinelles* among wild animals in the Tyumen region

year	Animal species	Samples investigated		
		Number	Positive	%
2015	Boar	304	0	0.00
	Badger	12	2	16.70
	Bear	19	3	15.80
	Other animals	385	0	0.00
2016	Boar	325	1	0.30
	Badger	19	4	21.00
	Bear	17	0	0.00
	Other animals	420	0	0.00
2017	Boar	397	0	0.00
	Badger	7	3	42.90
	Bear	19	1	5.30
	Other animals	555	0	0.00
2018	Boar	399	0	0.00
	Badger	9	0	0.00
	Bear	12	0	0.00
	Other animals	736	0	0.00
2019	Boar	455	0	0.00
	Badger	8	1	12.50
	Bear	8	1	12.50
	Other animals	542	0	0.00
2020	Boar	156	0	0.00
	Badger	0	0	0.00
	Bear	1	1	100.00
	Other animals	94	0	0.00

Table 2. Speciescomposition of *Trichinelles* in Tyumen

Year	Animal	Number	Species of *Trichinella*
2015	Bear	3	*Trichinella spiralis*
	Badger	2	*Trichinella spiralis*
2016	Boar	1	*Trichinella spiralis*
	Badger	4	*Trichinella spiralis*
2017	Badger	2	*Trichinella spiralis*
	Badger	1	*Trichinellapeseudospiralis*
	Bear	1	*Trichinella spiralis*
2019	Bear	1	*Trichinella spiralis*
	Badger	1	*Trichinella spiralis*
2020	Bear	1	*Trichinella spiralis*

According to table 2, only in 2017 was *Trichinella peseudospiralis* recorded in badgers, and in other animals between 2015 and 2020, the species *Trichinella spiralis* was identified.

The type of *Trichinella* larvae was determined based on their morphological characteristics (Figures 4 and

5). After various studies, it was found that the main *Trichinella* in the Tyumen region was *Trichinella spiralis* (94.10%), and the calculated ID showed that *T. Pseudospiralis* was 5.9% in the badger carcass.

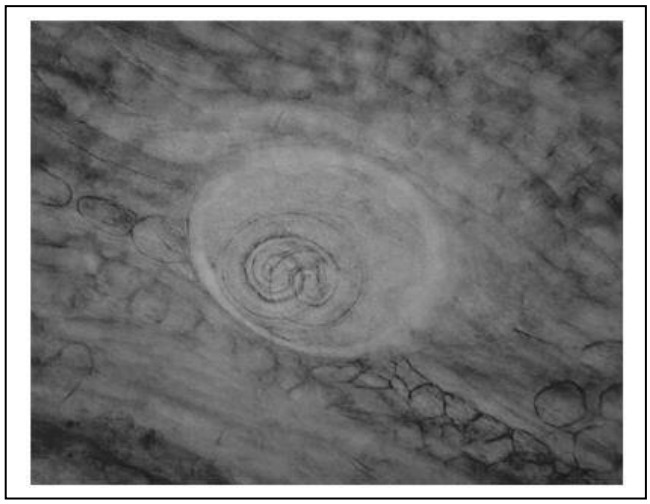

Figure 4. The encapsulated larva Trichinellaspiralis in the bear's muscles

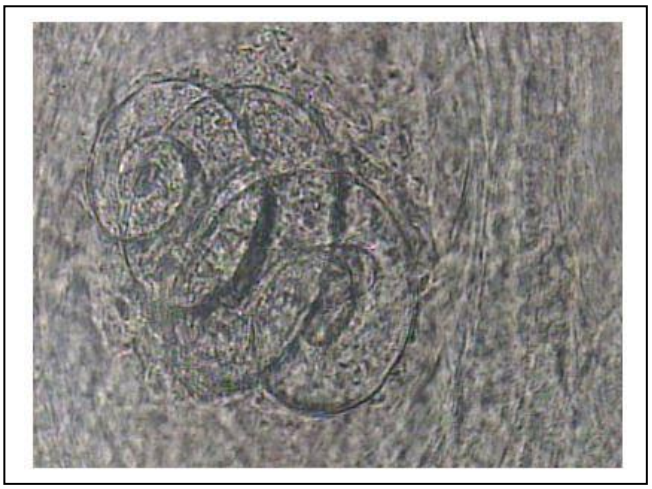

Figure 5. Unanacapsulated *Trichinellaspiralis* larva in boar's muscles

4. Discussion

The study found that between 2015 and 2020, 17 *Trichinella* cases were recorded among wildlife in the Tyumen region and the Khanty-Mansi Autonomous Region. The number of annual *Trichinella* detection cases was declining, indicating the effectiveness of veterinary services. This study determined that the main source of infection was bears, badgers, and wild boars. Among the 17 positive samples, 58.8% belonged to the badger, 35.3% to the bear, and only 5.9% to the wild boar.

It has been established that the number of cases of *trichinelles* detected annually declines, which demonstrates the effectiveness of the veterinary service. When explaining the spread of the circle of *trichinelles*, it found that bears, badgers, and wild boars were the main reservoir. Due to the increasing tendency to consume game meat, especially among young people, the lack of inspection of these meats, and the presence of contamination in wild animals, there is a possibility of similar cases and small epidemics, so special attention should be paid to health professionals and physicians. This disease controls and reduces the epidemic. The invasive trend of contamination *Trichinella* decreased from 2015 to 2020, so the percentage of invasiveness reached 5 in 2015 and zero in 2018, which indicated the effectiveness of the veterinary service. This decrease was due to the use of veterinary and health services. For prevention, treatment of pigs can be put on the agenda because treatment of pigs eliminates the source of infection (28). It is also recommended to cook and freeze pork, which eliminates the parasite in the meat and prevents its transmission to humans (29).

Authors' Contribution

Study concept and design: Y. V. G.
Acquisition of data: Y. A. V.
Analysis and interpretation of data: Y. V. G.
Drafting of the manuscript: Y. V. G.
Critical revision of the manuscript for important intellectual content: Y. A. V.
Statistical analysis: Y. A. V.
Administrative, technical, and material support: Y. A. V.

Conflict of Interest

The authors declare that they have no conflict of interest.

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