Ankara Üniversitesi Veteriner Fakültesi Dergisi/Ankara Univ Vet Fak Derg; 2026:73(3): 341-346
DOI: 10.33988/auvfd.1912074
Research Article

Epizootic and epidemiological trends of trichinellosis in Poland from 2015 to 2024

Hubert JAWORSKI[a], Marian FLIS[b,✉]

Life Sciences in Lublin University, Faculty of Animal Sciences and Bioeconomy, Department of Animal Ethology and Wildlife Management, Lublin, Poland.

[a]ORCID: 0009-0002-9563-4112; [b]ORCID: 0000-0001-7429-3158

ABSTRACT

The aim of this study was to evaluate the occurrence and trends of trichinellosis in wild boars, pigs, and humans in Poland between 2015 and 2024 based on official veterinary and public health data. This article presents an analysis of trichinellosis data in wild boars, pigs, and humans in Poland from 2015 to 2024. The presented values were obtained from the annual RRW-6 reports of the Veterinary Inspectorate and supplemented with data from the National Institute of Public Health. In recent years, the number of examined wild boar and pig carcasses has declined. Nevertheless, the occurrence of trichinellosis during the analysed period showed considerable fluctuations, with an overall downward trend in the number of positive findings in both species. However, throughout the study period, *Trichinella* was detected more than 30 times more frequently in wild boars than in pigs, confirming that wild boars remain the main reservoir of the parasite. The number of human trichinellosis cases also fluctuated markedly, although a clear decline has been observed since 2020. Despite this decrease, the presented data indicate that trichinellosis continues to persist in the natural environment and on pig farms. Therefore, this issue should not be underestimated, considering the potential for expansion of the epizootic threat and the associated increased risk to public health.

Keywords: Epidemiology, Pigs, Public health, Trichinellosis, Wild boars.

✉**Corresponding author:** marian.flis@up.edu.pl

Received: 18.03.2026, **Accepted:** 15.05.2026, **Publication Date:** 01.07.2026

How to cite this article: Jaworski H, Flis M (2026): Epizootic and epidemiological trends of trichinellosis in Poland from 2015 to 2024. Ankara Univ Vet Fak Derg, 73 (3), 341-346. DOI: 10.33988/auvfd.1912074.

Introduction

Game meat, i.e., the edible meat of game animals, is considered a natural meat. In addition to its excellent flavor, it is also a source of easily digestible protein and iron. Game carcasses, that are legally stored, processed, and transported, are exceptionally valuable for both culinary and health benefits. Game meat is characterized by a higher mineral content than meat from intensive farming (13, 14, 21, 38, 40). Furthermore, because game meat is part of diverse ecosystems does not negatively impact the environment, unlike with industrial livestock farming (2, 25). Despite growing interest in game meat in our country, its share remains small compared to other meat types. This is primarily due to availability and price. The negative image of hunting, which has been created for many years, and the issue of the safety of raw game meat, primarily the epidemiological threat of the possible transmission of various zoonoses to humans, have not improved the situation (14, 24, 36).

In the case of wild boars, one of the main threats to humans is the risk of *Trichinella* infection, mainly *Trichinella spiralis* (4, 5, 10, 12). In addition to wild boars and pigs, this parasite is also found in cattle, horses, sheep, nutria, and predatory mammals, however, its primary reservoir is carnivores and omnivores (9, 16, 17, 34, 37). The presence of *Trichinella* in nature is the main factor in the occurrence of the disease in domestic and farm animals and humans. Therefore, carcasses of wild boars, pigs, nutria, and horses are subject to official testing for trichinellosis (39). In recent years, trichinellosis has also been detected in beavers among wild animals. This fact is significant due to the increase in the species' population.

A consequence of this trend is the conduct of reduction shootings in our country, as well as the management of the beaver population as part of the hunting economy in other European countries, and thus the increasingly frequent use of carcasses for consumption (15, 32, 35, 41). The study aimed to present the epizootic situation of trichinellosis in pigs and wild boars and the epidemiological situation in Poland for the years 2015-2024.

Material and Methods

The material for the analyses was obtained from the annual RRW-6 reports of the Veterinary Inspection of the Chief Veterinary Inspectorate. Data contained in the individual sections of the document include the total number of pig and wild boar carcasses examined. They also cover the total number of pigs slaughtered and examined, both in meat processing plants and in samples collected during on-farm slaughter. Data regarding wild boar are divided into carcasses intended for personal consumption and those placed on the market by game processing plants. The reports include the total number of trichinellosis cases in the species analysed. Information on the hunting of wild boars through planned culling based on game management assumptions and mandated culling as part of African swine fever (ASF) control was obtained from hunting reports published by the Central Statistical Office. In turn, information on the number of human disease cases was obtained from analyses of data from for the years 2015-2024, the National Institute of Public Health, ultimately from the Department of Epidemiology of Infectious Diseases and Surveillance and the Laboratory of Monitoring and Analysis of the Epidemiological Situation.

Statistical Analysis: The research data comprised information from 2015–2024 on the results of monitoring for the presence of *Trichinella* (*Trichinella* spp.) in wild boar and pigs. Due to the significant disparity in the size of the study groups (2.7 million wild boars compared to 212.5 million pigs), the raw data were aggregated in the form of 2×2 contingency tables, taking into account the number of infected and healthy individuals. The analysis employed a procedure of weighting cases relative to the size of the individual groups.

The relationship between animal species and epidemiological status (infected/healthy) was verified using Pearson's χ^2 independence test. The odds ratio (OR) and 95% confidence intervals (95% CI) were calculated. The choice of this parameter allowed for a comparison of the probability of infection in both species, regardless of the size of the populations studied. Results were considered statistically significant where the test probability level was $P<0.05$.

Results

During the period under review, the incidence of trichinellosis in Polish pigs fluctuated significantly. Over the past 10 years, the highest numbers of infections were recorded in 2018 and 2020 (Figure 1). The incidence varies annually, with a sharp downward trend observed over the past 5 years. This is confirmed by the value of the trend line equation $y = -1.3091x + 22.6$. Over the past decade, a downward trend in the number of *Trichinella* samples tested from pigs has also been observed.

Over the past decade, the occurrence of ASF has led to a significant increase in hunting wild boars. The peak harvest occurred in the 2019/2020 hunting season, when slightly over 350.000 of these animals were hunted (28). In subsequent years, a rather sharp downward trend in hunted was observed, which was associated with numerous deaths due to disease and depopulation caused by hunters in previous hunting seasons. This led to a decline in the population and local densities of this species, limiting the possibility of harvesting these animals by shooting (Figure 2). This is confirmed by the trend line equation $y = -9021.4x + 333676$.

This factor significantly contributed to the decline in the number of *Trichinella* tests conducted. During the period under review, the highest number of trichinellosis cases among wild boars was recorded in 2020, which coincided with a record harvest that year (Figure 3). Overall, a significant decline in the number of infected wild boars was observed, as confirmed by the trend line equation $y = -47.794x + 819.07$.

The data presented indicate that wild boars remain the primary reservoir of *Trichinella* in Poland, posing a threat to humans. This is confirmed by the positive, significant correlation coefficient between tested and infected individuals ($r_{xy}=0.857$). The calculated prevalence rate of *Trichinella* in pigs during the evaluation period averaged 0.00007%. Among wild boars, the prevalence rate among tested individuals averaged 0.20% during the same period.

Statistical analysis revealed a highly significant association between species and *Trichinella* prevalence ($\chi^2 = 425{,}384.7$; $df = 1$; $P<0.0001$). The likelihood of infection with the parasite is, on average, 2,846.6 times higher in wild boars than in pigs (95% CI: 2425.4 – 3341.1) (Table 1).

Analysis of human trichinellosis cases revealed that infections with this parasite fluctuated significantly over the past decade (Figure 4). During the first five years of the assessment period, there was a significant decline in cases since the base year of 2015. The first year of analysis saw the highest number of human cases, 27. In 2020, the next peak in infections occurred, with 20 cases reported nationwide. In the remaining years, the number of cases did not exceed 10 per year.

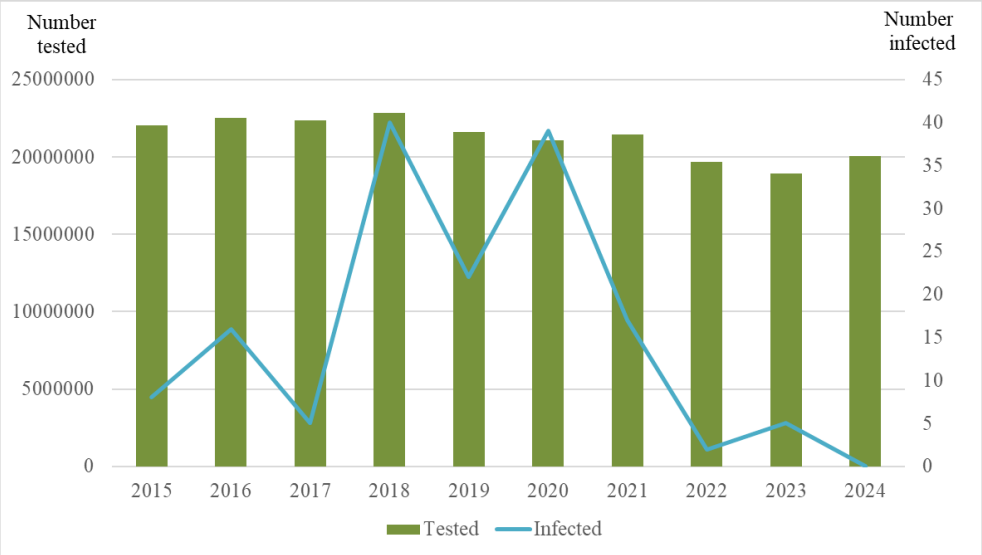

Figure 1. Number of pigs tested and infected with *Trichinella* over the last decade.

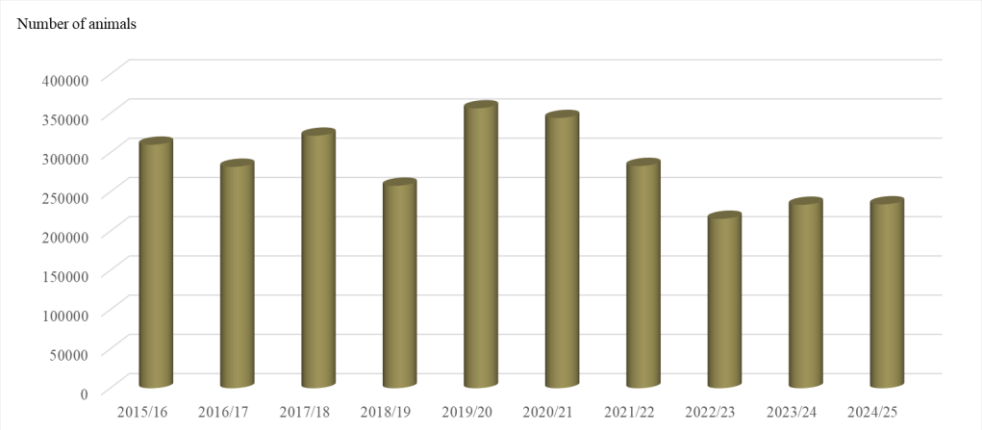

Figure 2. Wild boar shooting (thousands of individuals) during the last 10 hunting seasons.

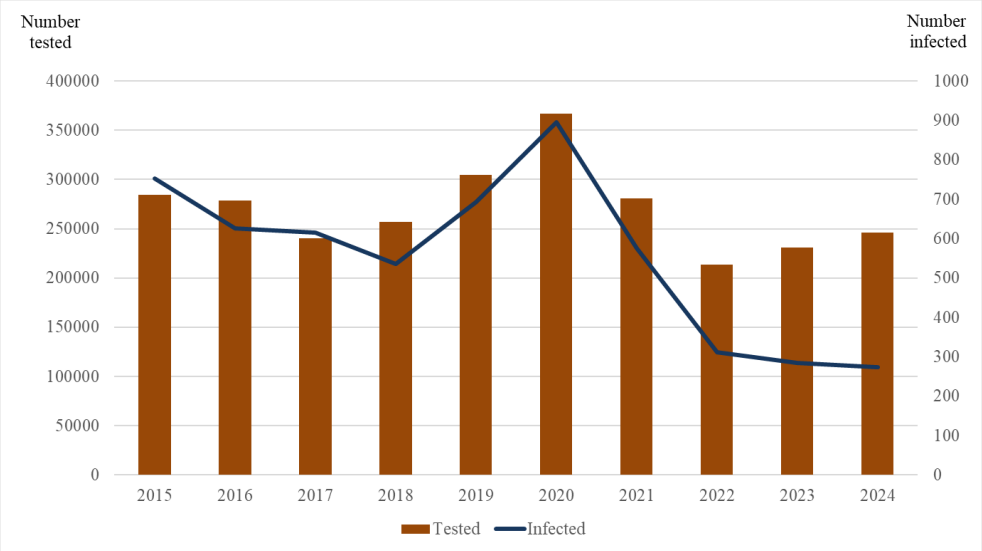

Figure 3. Number of wild boars tested and infected with *Trichinella* in the last decade.

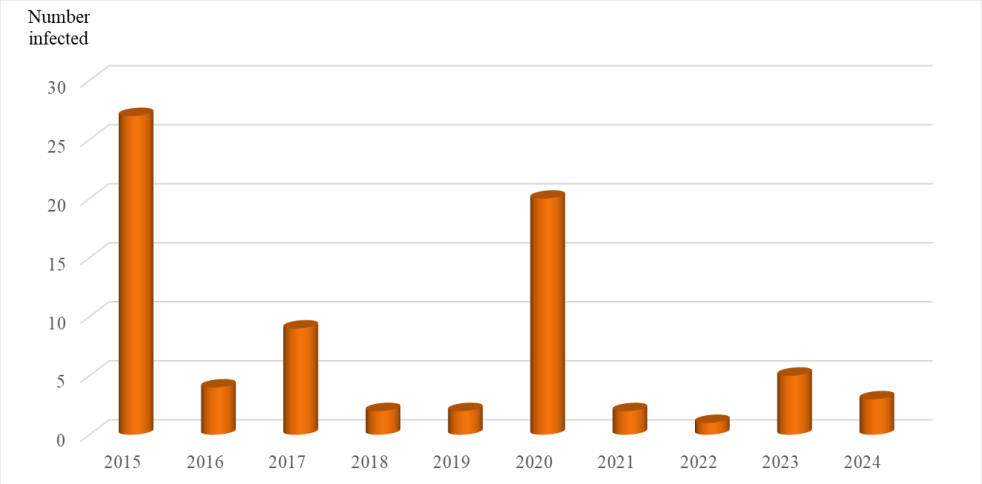

Figure 4. The number of human trichinellosis cases over the last decade

Table 1. Comparison of the prevalence of trichinellosis in pigs and wild boar between 2015–2024.

Parameters	Pigs	Wild boars
Infected individuals	154	5562
Healthy individuals	212575735	2697199
Total number of individuals examined in the study	212575889	2702761
Infection rate (%)	0.00%	0.21%
Odds ratio (OR)	1.00 (ref.)	2846.6
95% Confidence interval (CI)	—	2425.4 – 3341.1
P	—	<0.0001

Discussion and Conclusion

Trichinellosis occurs on all continents except Antarctica, but the incidence of human cases varies greatly between countries. In Europe, a common cause of infection is the consumption of wild boar meat, while in countries where pork and game meat consumption are very low, the incidence is marginal (7, 9, 19). Trichinellosis was discovered and monitored as a dangerous zoonosis at the end of the 19th century. Despite its control and statistical monitoring, it is still reported in farm animals, wild animals, and trichinellosis in humans (11, 18, 23, 27).

In Poland, trichinellosis infections in humans occur primarily through the consumption of illegally obtained wild boar meat and pork that has not been subjected to mandatory testing. For this reason, it is extremely important to conduct educational activities for the public, both consumers and people responsible for obtaining, processing, and marketing raw meat, including game (1, 3, 22).

There are many noticeable fluctuations in the number of trichinellosis cases in pigs from year to year. The downward trend observed over recent decades is most likely related to the intensification of pig farming, changes in the quality and safety of feed, and the adaptation of pig farms to professional breeding (6, 8, 20). This is confirmed by the fact that trichinellosis was most often recorded on small farms with small pig herds (6). The outbreak of ASF and the introduction of several sanitary restrictions changed the breeding profile of many thousands of farms, forcing them to specialise in existing pig housing conditions (29, 30). A potential threat to *Trichinella* transmission may continue to be the development of organic pig farming, which involves keeping animals on pastures and outdoor runs (26, 31). Analyses of the prevalence of *Trichinella* in pigs reveal a general decline in the number of cases in examined pig carcasses. In the period from 1996 to 2004, it was 0.0054% (8). In the years 2007-2011, it oscillated between 0.00004% and 0.00034% (15). Between 2012 and 2022, it amounted to 0.000088% (6).

The analyses presented here of trichinellosis incidence data show that it occurs much less frequently in pigs than in wild boars, which are currently the main vector of *Trichinella* transmission and therefore of human disease. This situation has been observed in our country since the beginning of the 21st century; in previous years, pork consumption was the main cause of disease (10, 15, 33). The prevalence of *Trichinella* in wild boars in 2003-2009 ranged from 0.28% to 1.09%, while in 2010, 2011, and 2012 it was 0.34%, 0.32%, and 0.30%, respectively

(15). Apart from the general downward trend, these data also reveal random fluctuations, which have been frequently observed in the current decade.

The fluctuations in the number of reported human trichinellosis cases observed over the past decade also occurred in earlier years, but nationwide, the number of cases has increased significantly. In 2003, there were 40 cases, while a year later, there were over 170 (8).

The occurrence of trichinellosis is associated with many factors, the main one being the presence of parasites in the natural environment. Despite numerous fluctuations and an increase in reported cases of trichinellosis in wild boars between 2015 and 2020, a downward trend in the number of cases of *Trichinella* in examined carcasses of both pigs and wild boars was observed over the last five years. There was also a downward trend in the number of human cases. Despite numerous random fluctuations, there is a clear correlation between the volume of wild boar harvested and the number of trichinellosis findings in examined animal carcasses. Data analysis indicates an increase in awareness, which involves avoiding the purchase and consumption of raw meat obtained illegally or of unknown origin. Monitoring and increased public awareness are reducing the incidence of the disease.

However, one should remember the potential threat posed by the presence of *Trichinella*, especially the spiral form (*Trichinella spiralis*), in the natural environment when consuming meat from wild boars, especially from an unknown source.

Financial Support

This research did not receive any specific grant from funding agencies in the public, commercial, or not-for-profit sectors.

Ethical Statement

No live animals were used to experimental procedures in this study. Therefore, ethical approval was not required.

Conflict of Interest

The authors declare that there is no conflict of interest.

Author Contributions

HJ and MF conceived the study and planned the manuscript. HJ and MF contributed to sample preparation. HJ and MF also provided significant scientific support and contributed to the interpretation of the results. All authors made substantial contributions by providing feedback and helping to shape the manuscript.

Data Availability Statement

The data supporting the findings of this study are available from the corresponding author upon reasonable request.

Declaration of Generative Artificial Intelligence (AI)

The authors declare that generative artificial intelligence (AI) and AI-assisted technologies were not used in the writing of this manuscript or in the preparation of figures.

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