

EPIDEMIOLOGY OF HUMAN AND ANIMAL TRICHINELLOSIS IN ITALY SINCE ITS DISCOVERY IN 1887

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Summary :

The epidemiology of trichinellosis in Italy is characterised by a sylvatic cycle present only on the mainland. The domestic cycle probably never existed, though a domestic focus occurred on the island of Sicily between 1933 and 1946. The red fox is the main reservoir, with the prevalence of infection ranging from 0.0 % in lowlands to 60 % in the Alps. The main etiological agent is *Trichinella britovi*. *Trichinella pseudospiralis* has been detected in two birds. From 1948 to March 2000, trichinellosis was diagnosed in 1,347 persons, who acquired the infection in 21 outbreaks.

KEY WORDS : humans, animals, trichinellosis, epidemiology, Italy.

TRICHINELLOSIS IN HUMANS

In Italy, the history of human trichinellosis can basically be divided into three major periods: 1) the period in which the first reports were published; 2) the period of outbreaks in Sicily; and 3) the period of outbreaks on mainland Italy (i.e., after World War II to the present) (Pozio, 1991). Specifically, the first reports of individual cases and the first outbreak date back to the end of the 19th century and the beginning of the 20th century (Table I). The first human *Trichinella* infection was detected in 1887 during an autopsy on a woman who had died for other reasons. The first trichinellosis outbreak occurred during World War I for the consumption of pork; two persons died, and to date, no other deaths from trichinellosis have been reported on mainland Italy. Epidemiological investigations conducted at that time suggested that the infected pig was bred with infected pork remnants brought to Italy by Austrian soldiers after Italy's defeat at Caporetto.

Between 1933 and 1946, four severe outbreaks occurred in Sicily for the consumption of pork (Table II). Epidemiological investigations carried out at that time showed that the source of the infection was sausages

from pigs bred on family farms in Montemaggiore Belsito, a village near Palermo, Sicily's capital city. This epidemic focus came to an end only in 1961, when the last infected pig was found at slaughtering. Thirty-six years later, the parasite isolated from tissue samples of the last infected pig was identified as *Trichinella spiralis* by polymerase chain reaction (Pozio & La Rosa, 1998). Since then, no other focus of domestic trichinellosis has been documented in Italy. The most reasonable explanation for the presence of *T. spiralis* in Sicily, which is free of trichinellosis in wildlife, is that pork or pork products (e.g., sausage and salami) infected with *T. spiralis* were brought to Sicily from persons who had emigrated to the United States and then returned home. It is well known that in the 1930s, hundreds of thousands of persons emigrated from Sicily to the United States, where domestic trichinellosis was a common infection in pigs. Leftovers of this infected food could have been ingested by domestic pigs, establishing a domestic focus on this island.

Year	Region (town)	No. of infected persons/deaths	Source of infection
1887	Marche (Camerino)	1/0	?
1900	Piedmont (Ozegna)	1/0	pig
1912	Venetian (Padova)	1/0	pig
1917	Lombardy (Bergamo)	20/2	pig
1930	Piedmont (Novara)	1/0	?

Table I. – First single human infections and the first outbreak of trichinellosis in Italy.

Year	Region (town)	No. of infected persons/deaths	Source of infection
1933	Sicily (Casteltermini)	80/5	pig
1942	Sicily (Villafrati)	30/4	pig
1945	Sicily (Montemaggiore Belsito)	84/13	pig
1946	Sicily (Caccamo)	15/0	pig

Table II. – Human infections with *Trichinella spiralis* for the consumption of pork from domestic pigs from the focus of Montemaggiore Belsito (Palermo).

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Year	Region (town or city)	No. of infected persons	Source of infection	Etiological agent
1948	Latium (Rome)	109	pig	?
1953	Umbria (Vallo di Nera)	9	pig	?
1961	Trentino Alto Adige (Canale S. Bovo)	9	fox	?
1968	Apulia (Mattinata)	9	pig	<i>T. britovi</i>
1975	Emilia Romagna (Bagnolo in Piano)	90	horse*	<i>T. britovi</i>
1978	Basilicata (Oliveto Lucano)	6	wild boar	?
1980	Calabria (Sila)	3	pig	<i>T. britovi</i>
1984	Lombardy (Varese)	13	horse*	?
1985	Apulia (Gravina di Puglia)	80	wild boar	<i>T. britovi</i>
1985	Calabria (Cosenza)	2	fox	<i>T. britovi</i>
1986	Basilicata (Irsinia)	20	wild boar	<i>T. britovi</i>
1986	Emilia Romagna (Salsomaggiore)	300	horse*	<i>T. britovi</i>
1988	Umbria (Polino)	48	wild boar	<i>T. britovi</i>
1990	Piedmont (Ovada)	11	wild boar	<i>T. spiralis</i>
1990	Apulia (Barletta)	500	horse*	<i>T. spiralis</i>
1991	Basilicata (Grassano)	6	pig	<i>T. britovi</i>
1993	Tuscany (Montevarchi)	4	pig	<i>T. britovi</i>
1995	Abruzzo (Castel di Sangro)	23	wild boar	<i>T. britovi</i>
1996	Basilicata (Villa d'Agri)	3	pig	<i>T. britovi</i>
1996	Abruzzo (Popoli)	10	wild boar	<i>T. britovi</i>
1998	Emilia Romagna (Piacenza)	92	horse*	<i>T. spiralis</i>
2000	Apulia (Bitonto)	36	horse*	<i>T. spiralis</i>

*Imported animals

Table III. – Human outbreaks of trichinellosis occurring after World War II to the present (no deaths occurred).

In the period beginning after World War II and continuing to the present, all outbreaks and single cases have occurred on mainland Italy (Table III) (Pozio *et al.*, 2000). During this period, changes in the epidemiological picture of human trichinellosis in Italy have been brought about by improvements in pig-breeding practices, increases in wild boar populations, and the consumption of horse meat imported from countries with high endemicity for domestic trichinellosis. In fact, the source of human infections, which, until the 1970s, was mainly pork from domestic pigs, currently represents only a small percentage of total infections. Consumption of raw meat of horses imported from the former Yugoslavia, Poland and Serbia has accounted for approximately 75 % of infections, and consumption of pork of domestic pigs and domestic wild boars has accounted for 18.1 % of infections. All infected animals but one were autochthonous. These swine acquired *Trichinella* infection from the sylvatic cycle. In fact, all of these animals were bred with carcasses of foxes. Only 6.5 % and 0.8 % of human infections were related to the consumption of meat from wild boars and foxes hunted for sport, respectively. All infections due to the consumption of local animals (i.e., pigs and wildlife) were caused by *T. britovi*, whereas most infections due to the consumption of imported animals (i.e., horses and a wild boar) were caused by *T. spiralis*. In the same period (1948-2000), trichinellosis was diagnosed in 63 persons who acquired the infection abroad (Eastern Europe, South-East Asia, and South America) and in 11 persons for whom the source of infection was unknown.

TRICHINELLOSIS IN ANIMALS

WILDLIFE

In the past 15 years, all but three of the sylvatic animals infected with *Trichinella* have been found to harbour *T. britovi*; one fox (*Vulpes vulpes*) harboured *T. spiralis*, which was shot 100 m from the French border, and two sedentary night-birds of prey (a tawny owl, *Strix aluco*, and a little owl, *Athene noctua*) were infected with *T. pseudospiralis* (Pozio *et al.*, 1999). Of the 3,565 foxes examined for *Trichinella*, 155 have been found to be positive (prevalence ranging from 3 % to 35 %). The infected animals originated from natural habitats above 500 m asl or from mountainous areas or natural parks at lower altitudes (Pozio *et al.*, 1996) (Table IV). The prevalence of infection in wolves (*Canis lupus*) has been reported to be 30.9 %, though infected wolves have only been

Host	Positive/examined (%)		
	< 500 m asl	> 500 m asl	
Fox	4/1,627 (0.2)	151/1,938 (7.8)	p < 0.001
Wolf	0/24	25/57 (43.8)	p < 0.001
Beech marten	0/34	2/55 (3.6)	–
Badger	0/15	3/19 (15.7)	–
Stray dog	0/157	3/274 (1.0)	p < 0.01
Wild boar	0/24 × 10 ⁴	9/13 × 10 ⁴ (0.006)	p < 0.001

Table IV. – Relationships between trichinellosis in sylvatic animals and altitude (asl: above sea level).

found in natural habitats above 500 m asl. Of 156 mustelids tested, three badgers (*Meles meles*) and two beech martens (*Martes foina*) were found to be positive for *Trichinella*, and all of them originated from mountainous areas above 600 m asl. An isolate was obtained from a brown bear (*Ursus arctos marsicanus*) originating from the National Park of Abruzzo at 1,100 m asl. *Trichinella britovi* larvae were isolated from stray dogs killed in the mountains of the Basilicata region at 600-750 m asl. In the past fifteen years, approximately 560,000 wild boars (*Sus scrofa*) have been killed by hunters, but only eleven animals were found to be positive for *Trichinella*. Of the 1,547 rodents trapped in mountain areas, five brown rats (*Rattus norvegicus*) were found to be infected with *Trichinella* larvae, and all five were found in two garbage dumps located at 450 m asl in a mountainous area of Abruzzo; an infected black rat (*Rattus rattus*) was found in a farm where a *Trichinella*-infected wild boar had been bred. *Trichinella* larvae were not found in 132 insectivores trapped in mountain areas, where the prevalence of trichinellosis in the vulpine population was higher than 10%. *Trichinella*-positive animals were collected from mountainous areas with an average population density of 73 inhabitants/km², whereas *Trichinella*-negative animals were collected from lowland areas with 238 inhabitants/km².

DOMESTIC ANIMALS

Of the approximately 12 million domestic pigs slaughtered each year in Italy, since 1958, when the examination of all slaughtered pigs become compulsory, only nine animals raised in open pastures in mountainous areas have been found to be infected with *T. britovi*. The sporadic detection of *Trichinella* infection in domestic cats and dogs was found to coincide with human outbreaks (Pozio, 1998).

CONCLUSIONS

Only the sylvatic cycle is currently present in mountainous areas and natural parks of mainland Italy, whereas lowlands and all Mediterranean islands are *Trichinella*-free. The prevalence of infection in wild boars is very low (0.006%) as in domestic pigs bred in contact with wildlife in mountain areas. Domestic pigs bred on modern industrialised farms have never been found to be infected with *Trichinella*. Although the prevalence of infection in swine bred on organic or ecological farms is very low (0.001%), most of these animals are not routinely examined for *Trichinella* at the slaughterhouse. *Trichinella pseudospiralis* has only been detected in two

birds, but its presence in Italian mammals is strongly suspected. Most human infections (75%) are caused by the consumption of horse meat imported from Eastern Europe, whereas human infections for the consumption of domestic and sylvatic animals account for only 25%. The finding that most infections for the consumption of pig and wild boar meat occur in the winter, during which other viral infections are most common, may have resulted in trichinellosis often being misdiagnosed, especially in the past, when serodiagnosis did not exist and when the incidence of the infection is assumed to have been higher, given that pig-rearing was practised by many families. Since 1983, when a passive surveillance of human trichinellosis cases and a free-of-charge serological service were established at the Istituto Superiore di Sanità, the number of documented outbreaks has increased considerably. However, we cannot exclude that in recent decades the transmission pattern has changed due to increases in the wild boar population, the breeding of wild boars and pigs on organic farms and an increase in infected horses imported from abroad.

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REFERENCES

- POZIO E. La trichinellosi in Italia. *Notiziario dell'Istituto Superiore di Sanità*, 1991, 4, 2-3.
- POZIO E. Trichinellosis in the European Union: epidemiology, ecology and economic impact. *Parasitology Today*, 1998, 14, 35-38.
- POZIO E., GOFFREDO M., FICO R. & LA ROSA G. *Trichinella pseudospiralis* in sedentary night-birds of prey from Central Italy. *Journal of Parasitology*, 1999, 85, 759-761.
- POZIO E. & LA ROSA G. Identification of the likely etiological agent of human trichinellosis in Sicily (Italy) between 1933 and 1946. *American Journal of Tropical Medicine and Hygiene*, 1998, 59, 906-907.
- POZIO E., LA ROSA G., D'ANCONA F., AMATI M., MANCINI BERBIERI F. & DE GIACOMO M. International *Trichinella* Reference Center. *Notiziario dell'Istituto Superiore di Sanità*, 2000, 13, 1-4.
- POZIO E., LA ROSA G., SERRANO F.J., BARRAT J. & ROSSI L. Environmental and human influence on the ecology of *Trichinella spiralis* and *Trichinella britovi* in Western Europe. *Parasitology*, 1996, 113, 527-533.