

Occurrence and geographical distribution of scrapie in the Italian sheep population in the context of the effectiveness of the breeding national scrapie plan.

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Introduction. Scrapie is a contagious, fatal neurodegenerative disease of sheep and goats caused by prions. Various polymorphisms in the gene encoding the prion protein influence susceptibility.

Aims. To assess the effectiveness of selective interventions in Italy by describing temporal trends and the geographic distribution of (a) classical scrapie (CS) prevalence and (b) the implementation and effectiveness of the Genetic Selection Plan (PNSG).

Material & methods

TSE surveillance data (2002–2022): 570,097 sheep, 61,351 flocks, 871 positives; two streams: SHC (n=376,627) and NSHC (n=193,470).

CS prevalence: cases per 10,000 tested; adjusted for stream (SHC/NSHC) and age (< / ≥48 months).

Prevalence ratios were estimated using a Poisson regression model (model 1): cases as outcome, tested as offset, year as continuous variable.

National Genetic Selection Plan data (2005–2022): 494,519 rams (<2 years).

Periods: 2005–2014 (high genetic merit flocks only); 2015–2022 (all flocks).

Proportion of susceptible animals: temporal trend estimated using a Poisson regression model (model 2): number of susceptible animals as outcome, number genotyped as offset, year as a continuous variable.

CS prevalence and genotyping: Poisson mixed regression model (model 3) → number of positives (y) / number of tested animals (offset); proportion of susceptible animals categorized as dichotomous variable (first quartile, 0–22% vs others, >22%) as fixed-effect; province as random effect.

Results

National CS prevalence decreased overall in 2002–2022 (PR=0.98; 95% CI: 0.97–1.00), with an increase in 2005–2014 (PR=1.07; 95% CI: 1.03–1.11) (fig. 1) followed by a marked decline in 2015–2022 (PR=0.87; 95% CI: 0.81–0.92) (fig. 2). The proportion of susceptible rams declined over time (2005–2022: PR=0.97; 95% CI: 0.96–0.98), consistently across both subperiods (2005–2014: PR=0.92; 95% CI: 0.89–0.96; 2015–2022: PR=0.94; 95% CI: 0.89–0.98) (fig. 3 and 4). Mixed-effects model: risk increased 2.16-fold (95% CI: 1.47–3.18) when susceptibility exceeded the first quartile (fig. 5).

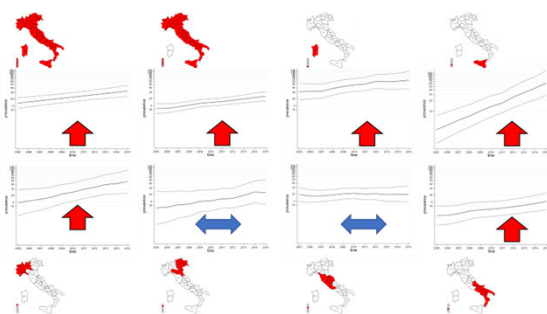


Fig 1. Stream- and age class-adjusted annual prevalence rates by macro-region through Poisson regression models: linear trends calculated by macro-region and period (2005–2015).

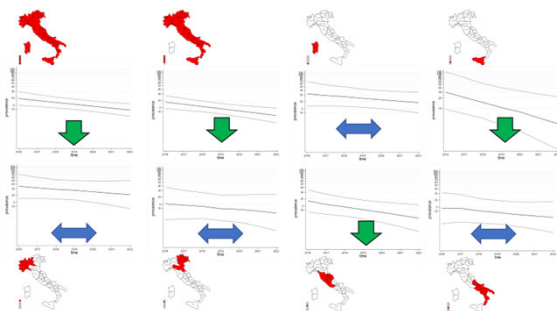


Fig 2. Stream and age class-adjusted annual prevalence rates by macro-region through Poisson regression models: linear trends calculated by macro-region and period (2016–2022).

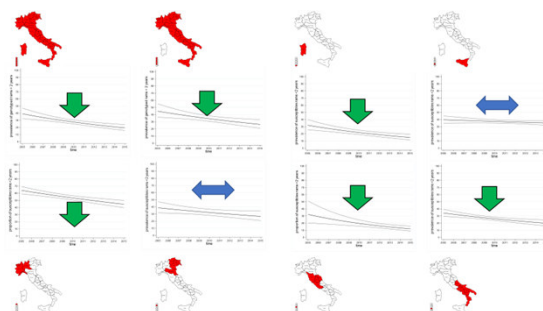


Fig 3. Temporal trend of the proportion of susceptible rams among the youngest breeding rams (<2 years) in the first period (2005–2015). Line shows linear time trend, outer lines show 95% confidence interval.

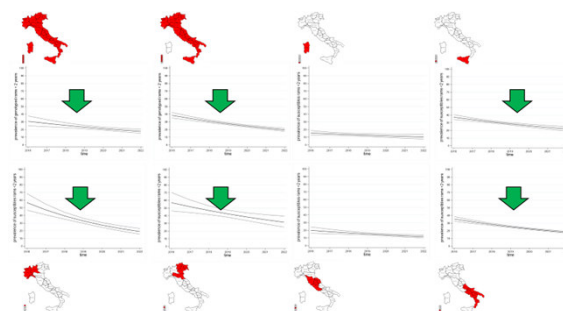


Fig 4. Temporal trend of the proportion of susceptible rams among the youngest breeding rams (<2 years) in the second period (2016–2022). Line shows linear time trend, outer lines show 95% confidence interval.

Model 3		
STATA®		
Poisson mixed regression model		
Based on modelling of standardized prevalence ratio		
Effects	PR	95%CI
Categorization of the proportion of susceptible animals (0–22% as referent; > 22%) (fixed)	2.16	1.47–3.18
Province (random)	0.80	0.48–1.32

Fig 5. Mixed-effects model to detect the association between the proportion of susceptible rams and scrapie prevalence accounting for province random effect.

Conclusions

The enforcement of NGSP resulted successfully in a decreasing trend in the prevalence of the disease.

The decreasing trend of the disease shows differences at national and macro-regional level.

Heterogeneity of the prevalence of the disease: temporal and geographic patterns can be linked to the scrapie control strategy implemented over time.